Technical Reference Catalog

Indication

Timers | Counters | Temperature Controls
Intelligent Panel Meters | Signal Conditioners
Tachometers | Sensors

USD $25

A Message from the President

As we bring Red Lion, N-Tron and Sixnet together, our promise to you is that we shall become a better company, and not just a bigger one."

Mike Granby
President, Red Lion Controls

Please allow me to start by saying thank you to the thousands of customers all over the world who place their trust in the products and reputation of Red Lion, N Tron and Sixnet: We appreciate your business and look forward to serving you at even higher levels in the future.

We are currently in the middle of exciting changes, as we take the steps towards bringing N-Tron and Sixnet together as part of a bigger, better Red Lion. Each company has its own legacy and its own strengths, and together we offer an industry-leading portfolio of products and solutions. The long and trusted history of Red Lion and Sixnet in the automation market is a perfect complement to N-Tron's mastery of industrial networking, and to Sixnet's recent developments in the fields of cellular and machine-to-machine communications.

As we bring Red Lion, N-Tron and Sixnet together, our promise to you is that we shall become a better company, and not just a bigger one. We recognize that you, the customer, is what matters, and that our merger only makes sense if it is able to put better solutions and better products in your hands. We are dedicated to becoming the global experts in communication, monitoring and control for industrial automation and networking—and to doing so with the exceptional levels of service for which Red Lion is well known.

In addition to the panel meters, HMIs and other industrial automation products that Red Lion customers have always trusted, we now have a broad selection of communication technologies for industrial networks, ranging from industrial Ethernet, through WiFi to complete cellular M2M solutions.

And the end result? A comprehensive set of products that enable you to connect, monitor and control anything. From one device to a thousand devices. Connecting serially, via Ethernet, or over high-speed wireless networks. Speaking one protocol, or hundreds of protocols. On a single machine, across your factory, or spanning multiple sites all over the globe.

Thank you again, and join us on our journey as Red Lion, N-Tron and Sixnet become better, together.

red lion®
better. together.
N-TRON better.redlion.net Sixnet

Mike

Red Lion Panel Meters Win *Control Design* Readers' Choice Award for 13 Consecutive Years

For over forty years, customers around the world have trusted Red Lion Controls. Our award-winning products provide critical information and controls to improve productivity, working with numerous devices and diverse protocols to access data.

We know that you rely on our products, and while they might only comprise one part of your overall system, they play a vital role in keeping your operation running.

Red Lion's legacy is strong, and so is our future.

We are a company that you can trust.

- Our company has been around 40 years.
- Our company has global reach and financial stability of Spectris.
- Our company invests in product research and development.
- Our company manufactures reliable, high-quality products.
- Our company stocks product that can ship today.
- Our employees care. We will go out of our way to serve you.

Our products solve problems.

- Our products are high performance and dependable.
- Our products work together to create systems.
- Our products interoperate with other products.
- Our products provide insight into your business.
- Our products improve productivity to increase your bottom line.

Red Lion *panel meter overview*

Red Lion has more high quality solutions for your digital panel meter requirements than any other supplier. A wider range of models, sizes, and capabilities from our basic CUB indicators to the versatile PAX process meters that let you add or change capabilities with plug-and-play, field installable cards. When the world thinks of panel meters, they think of Red Lion.

PAX2C:

The PAX2C meter is like no other PID meter in the controls market today. It offers plug-n-play option cards for setpoint, retransmitted analog output, a second Analog Input, Heater Current Monitor, and a Motorized Valve Positioner.

PAX Series:

A versatile 1/8 DIN meter. Add up to 3 field-upgradeable option cards for dual and quad setpoint, retransmitted analog output, RS232, RS485, Modbus, Profibus and DeviceNet™ communications; also dual count, dual rate, and dual process meters available; NEMA 4X/IP65.

PAX2:

All the features of the PAX Series with a dual line display and increased update rates. The main display can be programmed for red, orange, or green; while the bottom display is green.

C48 Series:

1/16 DIN dual line display for counting or timing. Multiple setpoints; RS485 communications; NEMA 4X/IP65.

CUB5 Series:

Flexible functionality in a miniature 38 mm x 75 mm package. Field-installable option cards for setpoint and communications. 10 to 28 VDC powered with backlit 0.46" high LCD; NEMA 4X/IP65.

CUB7 Series:

Dedicated function 8-digit miniature displays with large 0.35" high backlit LCD. Low voltage and high voltage models. Standard wire connections or optional plug-in terminal blocks. Internal lithium battery. Remote reset; NEMA 4X/IP65.

Red Lion's Technical Reference Catalog offers several tools to help you find the exact control solution you need, whether it's instrumentation, indication, panel meters, or communications.

Products are grouped by section. Preceding each section, you'll find a summary of general specifications for the product group. Product listings offer a detailed look at specifications including description, applications and features, along with specific technical data such as voltages, input and output, physical dimensions, wiring diagrams, tutorials and ordering information.

More ways to find the right solutions.

There are also several alternative methods of determining the best product for your application:

- **Product Selection Guide** (Starting on page 11)
  Helps you determine the appropriate product model based on your application parameters.
- **Quick Spec Comparison Grid** (Beginning of each section)
  Offers a side-by-side comparison of models within a given product group.
- **Product Replacement Guide** (Following "Quick Specs" in each section)
  A cross reference to the current Red Lion models to provide a functional replacement for obsolete products. Always refer to replacement product literature as differences may exist.
- **Product Lookup** (Starting on page 1041)
  An historical reference of current and past Red Lion products.

Industry and application experts at your disposal.
Because Red Lion's selection of control solutions is so vast and growing every day, you might find the best way to get what you need is by asking your local Red Lion distributor. We choose nothing but the best and most experienced industry professionals to represent our products and give them the support and resources to help our customers deploy the best solutions, quickly.

In some cases, you may want more advice. That's where Red Lion's dedicated customer support and technical assistance teams can help. We respect your time by providing real answers from real people. Not automated phone menus and stock answers. Red Lion also has an extensive Virtual Help Desk with Knowledge Base, technical notes, tutorials and FAQs easily accessible 24/7 on our web site, plus convenient email technical assistance. So you have several options to get the answers, and solutions you need:

- Personal service from your **Local Red Lion Distributor**
- **Live customer service, application and technical assistance** at +1 (717) 767-6511
- **Online Virtual Help Desk** available 24/7 at www.redlion.net
- **Email tech support** for a prompt, personal response at techsupport@redlion.net
- **Tutorials and Training** available pre- and post-sale

Table of Contents

Section D - Timers

Section E - Digital Panel Meters

Section F - Temperature Indicators and Controllers

Section I - Sensors Cont'd

Section J - Accessories

Section J - Accessories Cont'd

Section K - Enclosures & Panels

This page intentionally left blank.

SELECTION GUIDE: Counter

TOTALIZER (NO PRESETS)

LCD – WITHOUT SCALING

CUB7 [pg. 23]
DIN: 24mm (H) x 48mm (W)
8-digit, 0.35"
Battery powered

CUB7W [*]
DIN: 24mm (H) x 48mm (W)
8-digit, 0.35"
Voltage input
Battery powered

CUB4L [pg. 29]
33mm (H) x 68mm (W)
6-digit, 0.48"
Battery powered

CUB4L8 [pg. 29]
33mm (H) x 68mm (W)
8-digit, 0.46"
Battery powered

CUB4L8W [pg. 32]
33mm (H) x 68mm (W)
8-digit, 0.46"
Voltage input
Battery powered

LCD – WITH SCALING

CUB7P [*]
DIN: 24mm (H) x 48mm (W)
8-digit, 0.35"
Electronic and
voltage inputs
Battery powered

CUB5 [pg. 35]
33mm (H) x 68mm (W)
8-digit, 0.46"
Counter/Rate
Optional setpoint
and comms cards

LED – WITH SCALING

PAXLC6/8 [pg. 50]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
8-digit, 0.4"

PAXLCR [pg. 57]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.4"
Counter/Rate
Dual Setpoint Capability

PAXC [pg. 68]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional setpoint
output cards

PAXI [pg. 97]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Counter/Rate
Optional plug-in
output cards

PAX2D [pg. 98]
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Count/Dual Count w/Math
Optional plug-in
output modules

LD [pg. 657]
2.25 or 4",
4-digit Counter
2.25 or 4",
6-digit Counter/Rate

LPAX/MPAXI [pg. 729]
120mm (H) x 254mm (W)
6-digit, 1.5"
Counter/Rate
Optional plug-in
output modules

EPAX/MPAXI [pg. 743]
183mm (H) x 629mm (W)
6-digit, 4"
Counter/Rate
Optional plug-in
output modules

PRESETS (OUTPUTS)

LCD

CUB5 [pg. 35]
33mm (H) x 68mm (W)
8-digit, 0.46"
Counter/Rate
Optional setpoint
and comms cards

C48C [pg. 136]
DIN: 48mm (H) x 48mm (W)
6-digit, 2 line
Main display 0.3"
Secondary 0.2"
1 or 2 Presets

LEGEND [*]
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
1 , 2 or 6 Presets

LEGEND PLUS [*]
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
6 Presets
Message capability
Foot/Inch counting

LIBRA [*]
68mm (H) x 68mm (W)
4-digit, 0.5"
1 or 2 Presets

LED

PAXC [pg. 68]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional setpoint cards

PAXLCR [pg. 57]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.4"
Counter/Rate
Dual Setpoint Capability

PAXI [pg. 97]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Counter/Rate
Optional plug-in cards

PAX2D [pg. 98]
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Count/Dual Count w/Math
Optional plug-in
output modules

LIBRA [*]
68mm (H) x 68mm (W)
4-digit, 0.4"
1 or 2 Presets

GEMINI [*]
68mm (H) x 133mm (W)
6-digit, 0.56"
1 or 2 Presets
Dual counter or
Counter/Rate versions

LD [pg. 657]
2.25 or 4",
4-digit Counter
2.25 or 4",
6-digit Counter/Rate

EPAX/LPAX/MPAXI
[pg. 743, 729]
EPAX: 183mm (H) x 629mm (W)
LPAX: 120mm (H) x 254mm (W)
6-digit, Large Display
Counter/Rate
Optional plug-in modules

BATCH

LCD

CUB5 [pg. 35]
33mm (H) x 68mm (W)
8-digit, 0.46"
Counter/Rate
Optional setpoint
and comms cards

C48CB [pg. 136]
DIN: 48mm (H) x 48mm (W)
6-digit, 2 line
Main display 0.3"
Secondary 0.2"
1 or 2 Presets

LEGEND [*]
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
4 Presets

LEGEND PLUS [*]
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
4 Presets
Message capability

LED

PAXLCR [pg. 57]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.4"
Counter/Rate
Dual Setpoint Capability

PAXI [pg. 97]
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Counter/Rate
Optional plug-in
output cards

GEM33 [*]
68mm (H) x 133mm (W)
6-digit, 0.56"
3 Presets; 2
process and
1 batch

LD (Batch) [pg. 657]
2.25 or 4",
6-digit Counter/Rate

LPAX/MPAXI [pg. 729]
120mm (H) x 254mm (W)
6-digit, 1.5"
Counter/Rate
Optional plug-in
output modules

EPAX/MPAXI [pg. 743]
183mm (H) x 629mm (W)
6-digit, 4"
Counter/Rate
Optional plug-in
output modules

* See website for product information.

SELECTION GUIDE: Rate

INDICATION

LCD

DT8 *[pg. 153]*
33mm (H) x 68mm (W)
5-digit, 0.6"
Rate Indicator

CUB5 *[pg. 157]*
33mm (H) x 68mm (W)
8-digit, 0.46"
Counter/Rate
Optional setpoint
and comms cards

LED

PAXLR *[pg. 158]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"

PAXLCR *[pg. 165]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.4"
Counter/Rate
Dual Setpoint Capability

PAXR *[pg. 166]*
DIN: 48mm (H) x 96mm (W)
8-digit, 0.4"
Optional setpoint
output cards

PAXI *[pg. 167]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Counter/Rate
Optional plug-in
output cards

PAX2D *[pg. 168]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Rate/Dual Rate w/Math
Slave Display
Optional plug-in
output modules

LD *[pg. 657]*
2.25 or 4",
6-digit Counter/Rate

LPAX/MPAXI *[pg. 729]*
120mm (H) x 254mm (W)
6-digit, 1.5"
Counter/Rate
Optional plug-in
output modules

EPAX/MPAXI *[pg. 743]*
183mm (H) x 629mm (W)
6-digit, 4"
Counter/Rate
Optional plug-in
output modules

PRESETS (OUTPUTS)

LCD

CUB5 *[pg. 157]*
33mm (H) x 68mm (W)
8-digit, 0.46"
Counter/Rate
Optional setpoint
and comms cards

LEGEND *[*]*
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
4 Presets

LEGEND PLUS *[*]*
75mm (H) x 75mm (W)
8-digit, 0.3"
2 line
4 Presets
Message capability

LED

PAXR *[pg. 166]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional setpoint
output cards

PAXI *[pg. 167]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Counter/Rate
Optional plug-in
output cards

PAX2D *[pg. 168]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Rate/Dual Rate w/Math
Slave Display
Optional plug-in
output modules

GEMINI *[*]*
68mm (H) x 133mm (W)
6-digit, 0.56"
1 or 2 Presets
Dual counter or
Counter/Rate
versions

LD *[pg. 657]*
2.25 or 4",
6-digit Counter/Rate

LPAX/MPAXI *[pg. 729]*
120mm (H) x 254mm (W)
6-digit, 1.5"
Counter/Rate
Optional plug-in
output modules

EPAX/MPAXI *[pg. 743]*
183mm (H) x 629mm (W)
6-digit, 4"
Counter/Rate
Optional plug-in
output modules

SPECIALTY

LCD

MDC *[*]*
Motor Drive
Controller
DIN: 48mm (H) x 48mm (W)
6-digit, 2 line
Main display 0.3"
Secondary 0.2"
1 or 2 Presets

LED

PAXLPT *[pg. 169]*
Process Time
Indication
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"

NO DISPLAY

IFMA *[pg. 755]*
Frequency to Analog
Converter
DIN rail mount
0-10 V, 4-20 mA
outputs

IFMR *[pg. 763]*
Speed Switch
DIN rail mount
Over or underspeed
outputs

* See website for product information.

SELECTION GUIDE: Timer

INDICATION

LCD

CUB7T ***[*]***
DIN: 24mm (H) x 48mm (W)
8-digit, 0.35"
Contact and
voltage versions

CUB5T ***[pg. 181]***
33mm (H) x 68mm (W)
7-digit, 0.46"
Optional setpoint and
comms cards

LED

PAXTM ***[pg. 199]***
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional plug-in
output cards

LDT ***[pg. 672]***
2.25 or 4",
6-digit
Setpoint and comms
capability

LPAXCK/MPAXTM ***[pg. 729]***
120mm (H) x 254mm (W)
6-digit, 1.5"
Optional plug-in
output modules

EPAX/MPAXTM ***[pg. 743]***
183mm (H) x 629mm (W)
6-digit, 4"
Optional plug-in
output modules

PRESETS (OUTPUTS)

LCD

C48T ***[pg. 194]***
DIN: 48mm (H) x 96mm (W)
6-digit, 2 line
Main display 0.3"
Secondary 0.2"
1 or 2 Presets

LIBRA ***[*]***
68mm (H) x 68mm (W)
4-digit, 0.5"
1 or 2 Presets

LED

PAXTM ***[pg. 199]***
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional plug-in
output cards

LIBRA ***[*]***
68mm (H) x 68mm (W)
4-digit, 0.4"
1 or 2 Presets

LDT ***[pg. 672]***
2.25 or 4",
6-digit
Setpoint and comms
capability

LPAXCK/MPAXTM ***[pg. 729]***
120mm (H) x 254mm (W)
6-digit, 1.5"
Optional plug-in
output modules

EPAX/MPAXTM ***[pg. 743]***
183mm (H) x 629mm (W)
6-digit, 4"
Optional plug-in
output modules

REAL-TIME CLOCK

LED

PAXCK ***[pg. 224]***
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
Optional plug-in
output cards

LPAXCK/MPAXCK ***[pg. 729]***
120mm (H) x 254mm (W)
6-digit, 1.5"
Optional plug-in
output modules

EPAX/MPAXCK ***[pg. 743]***
183mm (H) x 629mm (W)
6-digit, 4"
Optional plug-in
output modules

* See website for product information.

SELECTION GUIDE: Digital Panel Meter

DC

CURRENT

CUB 4I *[*]*
33mm (H) x 68mm (W)
3 1/2-digit, 0.6"
Counter/Rate
199.9 mA DC max

CUB5I *[pg. 244]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Optional setpoint
and comms cards

PAXLID *[pg. 255]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
1.999 Amp DC max

PAXLA *[pg. 273]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint Capability

PAXD *[pg. 283]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Current/Volt
2 Amp DC max
Optional plug-in
output cards

PAX2A *[pg. 332]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Current/Volt
2 Amp DC max
Optional plug-in
output modules

LDA *[pg. 685]*
5-digit, 2.25 or 4"
Setpoint and comms
capability

EPAX/LPAX/MPAXD *[pg. 725, 737]*
EPAX: 183mm (H) x 629mm (W)
LPAX: 120mm (H) x 254mm (W)
5-digit, Large Display
Current/Volt
2 Amp DC max
Optional plug-in
output modules

VOLTAGE

CUB 4V *[*]*
33mm (H) x 68mm (W)
3 1/2-digit, 0.6"
Counter/Rate
199.9 VDC max

CUB5V *[pg. 233]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Optional setpoint
and comms cards

PAXLVD *[pg. 255]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
300 VDC max

PAXLA *[pg. 273]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint Capability

PAXD *[pg. 283]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Current/Volt
300 VDC max
Optional plug-in
output cards

PAX2A *[pg. 332]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Current/Volt
200 VDC max
Optional plug-in
output modules

LDA *[pg. 685]*
5-digit, 2.25 or 4"
Setpoint and comms
capability

EPAX/LPAX/MPAXD *[pg. 725, 737]*
EPAX: 183mm (H) x 629mm (W)
LPAX: 120mm (H) x 254mm (W)
5-digit, Large Display
Current/Volt
300 VDC max
Optional plug-in
output modules

AC

CURRENT

PAXLIA *[pg. 255]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
1.999 Amp AC max

PAXLIT *[pg. 262]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
5 Amp AC max

PAXH *[pg. 362]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Current/Volt
5 Amp AC max
Optional plug-in
output cards

LPAX/MPAXH *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
Current/Volt
5 Amp AC max
Optional plug-in
output modules

EPAX/MPAXH *[pg. 737]*
183mm (H) x 629mm (W)
5-digit, 4"
Current/Volt
5 Amp AC max
Optional plug-in
output modules

VOLTAGE

PAXLVA *[pg. 255]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
300 VAC max

PAXLHV *[pg. 268]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
600 VAC max

PAXH *[pg. 362]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Current/Volt
300 VAC max
Optional plug-in
output cards

LPAX/MPAXH *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
Current/Volt
300 VAC max
Optional plug-in
output modules

EPAX/MPAXH *[pg. 737]*
183mm (H) x 629mm (W)
5-digit, 4"
Current/Volt
300 VAC max
Optional plug-in
output modules

PROCESS

CURRENT

CUB4CL/LP *[pg. 363]*
33mm (H) x 68mm (W)
3 1/2-digit, 0.6"
4-20 mA or 10-50 mA
Loop powered

CUB5P *[pg. 367]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Optional setpoint
and comms cards

PAXLCL *[pg. 378]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
4-20 mA or 10-50 mA

PAXLA *[pg. 273]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint Capability

PAXP (Single Loop) *[pg. 395]*
PAXDP (Dual Loop) *[pg. 396]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
4-20 mA or 10-50 mA
Dual inputs (PAXDP)
Optional plug-in cards

PAX2A *[pg. 332]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process Inputs
Optional plug-in
output modules

LDA *[pg. 685]*
5-digit, 2.25 or 4"
Setpoint and comms
capability

EPAX/LPAX/MPAXP *[pg. 725, 737]*
LPAXDA/MPAXDP *[pg. 733]*
120mm (H) x 254mm (W)
5-digit, Large Display
4-20 mA or 10-50 mA
Dual inputs (LPAXDA/MPAXDP)
Optional plug-in modules

VOLTAGE

CUB5P *[pg. 367]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Optional setpoint
and comms cards

PAXLPV *[pg. 386]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
1-5 VDC

PAXLA *[pg. 273]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint Capability

PAXP (Single Loop) *[pg. 395]*
PAXDP (Dual Loop) *[pg. 396]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
0-10 VDC
Dual inputs (PAXDP)
Optional plug-in
output cards

PAX2A *[pg. 332]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process Inputs
Optional plug-in
output modules

LDA *[pg. 685]*
5-digit, 2.25 or 4"
Setpoint and comms
capability

EPAX/LPAX/MPAXP *[pg. 725, 737]*
LPAXDA/MPAXDP *[pg. 733]*
120mm (H) x 254mm (W)
5-digit, Large Display
0-10 VDC
Dual inputs (LPAXDA/MPAXDP)
Optional plug-in
output modules

STRAIN GAGE (microvoltmeter)

PAXLSG *[pg. 424]*
DIN: 48mm (H) x 96mm (W)
3 1/2-digit, 0.56"
Single-ended or
differential 2 V max

PAXS *[pg. 432]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
24 or 240 mV DC
Optional plug-in
output cards

PAX2S *[pg. 433]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Load Cell, Strain Gage,
Pressure Sensor Input
Optional plug-in
output modules

LDSG *[pg. 699]*
5-digit, 2.25 or 4"
Setpoint and comms
capability

LPAX/MPAXS *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
240 mV DC max
Optional plug-in
output modules

EPAX/MPAXS *[pg. 737]*
183mm (H) x 629mm (W)
5-digit, 4"
240 mV DC max
Optional plug-in
output modules

* See website for product information.

SELECTION GUIDE: Temperature/Process

TEMPERATURE

INDICATORS

LCD

CUB4RT *[*]*
33mm (H) x 68mm (W)
5-digit, 0.48"
Pt392, Pt385,
Ni672, and Cu427

CUB5TC *[pg. 469]*
33mm (H) x 68mm (W)
5-digit, 0.46"
T, E, J, K, R, S, B,
N, and mV
Optional setpoint and
comms cards

CUB5RT *[pg. 480]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Pt392, Pt385,
Ni672, and Cu427
Optional setpoint and
comms cards

PAXLT *[pg. 506]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint
Capability

LED

PAXLTC *[pg. 491]*
DIN: 48mm (H) x 96mm (W)
4-digit, 0.56"
T, E, J, K, R, S, B,
N, and mV

PAXLRT *[pg. 499]*
DIN: 48mm (H) x 96mm (W)
4-digit, 0.56"
Pt392, Pt385

PAXLT *[pg. 506]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
Dual Setpoint Capability

PAX2A *[pg. 518]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
T, E, J, K, R, S, B, N,
C, mV, Pt392, Pt385,
Ni672, and Cu427
Optional plug-in
output modules

LPAX/MPAXT *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
T, E, J, K, R, S, B,
N, and mV
Optional plug-in
output modules

EPAX/MPAXT *[pg. 737]*
183mm (H) x 629mm (W)
6-digit, 4"
T, E, J, K, R, S, B,
N, and mV
Optional plug-in
output modules

ON/OFF CONTROL

CUB5TC/RT *[pg. 469/480]*
33mm (H) x 68mm (W)
5-digit, 0.46"
T, E, J, K, R, S, B,
N, and mV (CUB5TC)
Pt392, Pt385, Ni672,
and Cu427 (CUB5RT)
Optional setpoint and
comms cards

PAXT *[pg. 517]*
DIN: 48mm (H) x 96mm (W)
6-digit, 0.56"
T, E, J, K, R, S, B,
N, and mV
Optional plug-in
output cards

PAX2A *[pg. 518]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
T, E, J, K, R, S, B, N,
C, mV, Pt392, Pt385,
Ni672, and Cu427
Optional plug-in
output modules

PAX2C *[pg. 550]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process, Temperature,
Voltage, Current, and Resistance
Optional plug-in
output modules

LPAX/MPAXT *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
T, E, J, K, R, S, B,
N, and mV
Optional plug-in
output modules

EPAX/MPAXT *[pg. 737]*
183mm (H) x 629mm (W)
6-digit, 4"
T, E, J, K, R, S, B,
N, and mV
Optional plug-in
output modules

PID CONTROL

T16 *[pg. 519]*
DIN: 48mm (H) x 48mm (W)
4-digit, 0.3"
2 line

T48 *[pg. 542]*
DIN: 48mm (H) x 48mm (W)
4-digit, 0.3"
2 line

PAX2C *[pg. 550]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process, Temperature,
Voltage, Current, and Resistance
Optional plug-in
output modules

TCU *[pg. 602]*
DIN: 96mm (H) x 48mm (W)
4-digit, 2 line
Main display 0.4"
Secondary 0.3"

TSC *[pg. 611]*
DIN: 96mm (H) x 48mm (W)
4-digit, 2 line
Main display 0.4"
Secondary 0.3"
Ramp/Soak

PROCESS

ON/OFF CONTROL

CUB5P *[pg. 367]*
33mm (H) x 68mm (W)
5-digit, 0.46"
Optional setpoint
and comms cards

PAXP *[pg. 395]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
4-20 mA or 10-50 mA
Optional plug-in cards

PAXDP *[pg. 396]*
DIN: 48mm (H) x 96mm (W)
5-digit, 0.56"
4-20 mA or 10-50 mA
Dual inputs
Optional plug-in cards

PAX2C *[pg. 550]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process, Temperature,
Voltage, Current, and Resistance
Optional plug-in
output modules

LPAX/MPAXP *[pg. 725]*
120mm (H) x 254mm (W)
5-digit, 1.5"
4-20 mA or 10-50 mA
Optional plug-in modules

LPAXDA/MPAXDP *[pg. 733]*
120mm (H) x 254mm (W)
5-digit, 1.5"
4-20 mA or 10-50 mA
Dual inputs
Optional plug-in modules

EPAX/MPAXP *[pg. 737]*
183mm (H) x 629mm (W)
5-digit, 4"
4-20 mA or 10-50 mA
Optional plug-in modules

PID CONTROL

PAX2C *[pg. 550]*
DIN: 48mm (H) x 96mm (W)
6/9-digit, Dual Line/Tri-color
Universal Process, Temperature,
Voltage, Current, and Resistance
Optional plug-in
output modules

P16 *[pg. 618]*
DIN: 48mm (H) x 48mm (W)
4-digit, 0.3"
2 line

P48 *[pg. 619]*
DIN: 48mm (H) x 48mm (W)
4-digit, 0.3"
2 line

PCU *[pg. 624]*
DIN: 96mm (H) x 48mm (W)
4-digit, 2 line
Main display 0.4"
Secondary 0.3"

PSC *[pg. 632]*
DIN: 96mm (H) x 48mm (W)
4-digit, 2 line
Main display 0.4"
Secondary 0.3"
Ramp/Soak

* See website for product information.

SELECTION GUIDE: Signal Conditioning

DIN RAIL

PROCESS

IAMA ***[pg. 784]***
Universal Signal
Conditioning module
Inputs and Outputs are
Switch Selectable
9-32 VDC Powered

IAMS ***[pg. 774]***
Universal Signal
Conditioning Module
Programmable Inputs
and Outputs
Dual Setpoint Control
21.6-253 VAC or
19.2-300 VDC Powered
Removable Programming
Module

IAMA6 ***[pg. 792]***
Universal Signal
Conditioning module
Inputs and Outputs are
Switch Selectable
19.2-32 VDC Powered
6.2 mm Wide

AAMA ***[pg. 795]***
Universal Signal
Conditioning module
Inputs and Outputs are
Switch Selectable
18-32 VDC Powered
Negative Signal Inputs

AIMI ***[pg. 773]***
Loop Powered
0-20 or 4-20 mA
Input/Output Isolation

TEMPERATURE

IAMS ***[pg. 774]***
Universal Signal
Conditioning Module
Programmable Inputs
and Outputs
Dual Setpoint Control
21.6-253 VAC or
19.2-300 VDC Powered
Removable Programming
Module

ITMA ***[pg. 816]***
Accepts Thermocouple
Types J, K, T, & E or
Millivolt Input
12-42 VDC
Loop Powered
Adjustable Range Setting

ITMA DC ***[pg. 823]***
Accepts Thermocouple
Types J, K, T, & E or
Millivolt Input
9-32 VDC
Adjustable Range Setting

IRMA ***[pg. 804]***
Accepts RTD Inputs
12-42 VDC
Loop Powered
Adjustable Range Setting

IRMA DC ***[pg. 810]***
Accepts RTD Inputs
9-32 VDC
Adjustable Range Setting

FREQUENCY

AFCM ***[pg. 771]***
Analog to Frequency Converter
Universal Input to Output
3-Way Isolation
19-30 VDC Powered

IFMA ***[pg. 755]***
Frequency to Analog Converter
0-10 V, 4-20 mA Output
1 to 25 KHz Input
On-Line Range Setting

IFMR ***[pg. 763]***
Speed Switch
Settable Trip Frequency
Over Speed, Under Speed,
and Zero-Speed Detection
Form C Relay Output

COMMUNICATIONS

ICM4 ***[pg. 829]***
RS-232 to RS-485
RS-232 to RS-422
4800-19200 Baud
9-32 VDC Powered

ICM5 ***[pg. 833]***
RS-232 to RS-485
RS-232 to RS-422
4800-19200 Baud
9-32 VDC Powered
Three Way Isolation

ICM8 ***[pg. 837]***
Serial to Ethernet Converter
RS-232 or RS-485 from
Red Lion products only
24 VDC Powered

POWER SUPPLIES

PSDR1 ***[pg. 943]***
24 VDC @ 1 A
Input 85-264 VAC or
90-350 VDC
CE Approved
UL Listed

PSDR2 ***[pg. 943]***
24 VDC @ 2 A
Input 85-264 VAC or
90-350 VDC
CE Approved
UL Listed

PSDR4 ***[pg. 943]***
24 VDC @ 4 A
Input 85-264 VAC or
90-350 VDC
CE Approved
UL Listed

OTHER MODULES

APMR ***[pg. 800]***
3 Phase Fault Detector
230, 380, & 480 VAC
Modules
SPDT Relay Output

* See website for product information.

SELECTION GUIDE: Large Displays

COUNT	RATE	TIME/CLOCK	AC CURRENT AC VOLTAGE	DC CURRENT DC VOLTAGE	PROCESS	TEMPERATURE	STRAIN GAGE	SERIAL SLAVE
LD2 *[pg. 657]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD2** *[pg. 657]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD2T** *[pg. 672]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LPAX05/MPAXH** *[pg. 725]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LD2A** *[pg. 685]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD2A** *[pg. 685]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LPAX05/MPAXT** *[pg. 725]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LDSG** *[pg. 699]* 5-digit, 2.25 or 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD2SS** *[pg. 717]* 2.25" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability
LD4 *[pg. 657]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD4** *[pg. 657]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD4T** *[pg. 672]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**EPAX05/MPAXH** *[pg. 737]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**LD4A** *[pg. 685]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**LD4A** *[pg. 685]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability	**EPAX05/MPAXT** *[pg. 737]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX05/MPAXS** *[pg. 725]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LD4SS** *[pg. 717]* 4" LED Display AC or DC Powered NEMA 4X Case Setpoint and comms capability
LPAX06/MPAXC *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX06/MPAXR** *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX06/MPAXTM** *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules		**LPAX05/MPAXD** *[pg. 725]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX05/MPAXP** *[pg. 725]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules		**EPAX05/MPAXS** *[pg. 737]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	
EPAX06/MPAXC *[pg. 743]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**EPAX06/MPAXR** *[pg. 743]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**EPAX06/MPAXTM** *[pg. 743]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules		**EPAX05/MPAXD** *[pg. 737]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**EPAX05/MPAXP** *[pg. 737]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules			
LPAX06 /MPAXI *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX06/MPAXI** *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**LPAX06/MPAXCK** *[pg. 729]* 1.5" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules						
EPAX06/MPAXI *[pg. 743]* 4" LED Display AC or DC Powered Accepts various PAX input modules Optional plug-in output modules	**EPAX06/MPAXI** *[pg. 743]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules	**EPAX06/MPAXCK** *[pg. 743]* 4" LED Display AC Powered Accepts various PAX input modules Optional plug-in output modules						

* See website for product information.

This page intentionally left blank.

TOTALIZING COUNTERS

The Trusted Source for Innovative Control Solutions

QUICK Specs

Totalizers

COUNTERS

	CUB7	CUB4	PAXLC	CUB5
				
Description	1/32 DIN Miniature Counter	Counter	1/8 DIN Counter	Counter/Rate Meter With Output Option Card Capability
Dimensions (Height) x (Width)	28 mm (H) x 51mm (W)	39 mm (H) x 75mm (W)	50 mm (H) x 97mm (W)	39 mm (H) x 75mm (W)
Display	8 Digit, .35" (9mm) Reflective, Green and Red Backlight LCD	6 Digit, .46" (12mm), 8 Digit, .46" (12mm) Reflective, Green and Red Backlight LCD	6 Digit, .56" (14mm) 8 Digit, .4" (10mm) Red LED	8 Digit, .35" (9mm) Reflective, Green and Red Backlight LCD
Counting Capability	Uni-Directional	Uni-Directional	Uni-Directional Up/Down Inhibit Store	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch
Max. Input Frequency	10,000 Counts/Sec.	5000 Counts/Sec.	25,000 Counts/Sec	20,000 Counts/Sec. Program Dependent.
Input Scaling & Decimal Points	No	No	Yes	Yes
Reset Capability	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote
Sensor Power	No	No Yes, with Micro Line Power Supply	9 to 17.5 VDC @ 100 mA	No Yes, with Micro Line Power Supply
Setpoint Capability	No	No	No	Single Form C Relay Dual Sinking
Communications	No	No	No	RS485
Power Source	3 Volt Lithium Battery, Backlighting 9 - 28 VDC @ 35 mA	3 Volt Lithium Battery, Backlighting 9 - 28 VDC @ 35 mA	115/230 VAC 10 to 16 VDC	10 to 28 VDC
Page Number	Page 23	Page 29	Page 50	Page 35

QUICK Specs

Totalizing Counters

COUNTERS W/CONTROL

	PAXLCR	PAXC	PAXI	PAX2D
Description	1/8 DIN Counter/Rate Meter With Setpoint Capability	1/8 DIN Counter With Setpoint Card Capability	1/8 DIN Counter/Rate Meter With Output Option Card Capability	1/8 DIN Dual Line Counter/Dual Counter, Rate/Dual Rate Meter With Output Option Card Capability
Dimensions (Height)x(Width)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)
Display	6 Digit, .56" (14mm) Red LED	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .71" (18mm) Tri-color Backlight Bottom Line: 9 Digit, .35" (9mm) Green Backlight
Counting Capability	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch
Max. Input Frequency	20,000 Counts/Sec. Program Dependent	34,000 Counts/Sec. Program Dependent	34,000 Counts/Sec. Program Dependent	50,000 Counts/Sec. Program Dependent
Input Scaling & Decimal Points	Yes	Yes	Yes	Yes
Reset Capability	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote
Sensor Power	24 VDC @ 100 mA, over 50 V 24 VDC @ 50 mA, under 50 V	12 VDC @ 100 mA	12 VDC @ 100 mA	18 VDC @ 60 mA
Setpoint Capability	Dual Form C Relays	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing
Communications	No	No	RS232 or RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 or RS485 Modbus DeviceNet Profibus
Power Source	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 11 to 36 VDC 24 VAC	85 to 250 VAC 11 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC
Page Number	Page 57	Page 68	Page 97	Page 98

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **CUB1**	■ Display: .2" (5 mm) Reflective LCD ■ Power Source: 2 "N" Alkaline Batteries ■ Count Speed: 5 KHz Max.	 **CUB7**	■ Display: .35" (9 mm) Reflective LCD ■ Power Source: Internal Battery ■ Count Speed: 10 KHz Max.
 **CUB2**	■ Display: .35" (9 mm) Reflective LCD ■ Power Source: Battery Powered ■ Count Speed: 5 KHz Max.	 **CUB4 / CUB4L8**	■ Display: .48" (12 mm) Reflective LCD ■ Power Source: Internal Battery ■ Count Speed: 10 KHz Max.
 **CUB3**	■ Display: .2" (5 mm) Reflective LCD ■ Power Source: 2 "N" Alkaline Batteries ■ Count Speed: 100 Hz Max.	 **CUB7**	■ Display: .35" (9 mm) Reflective LCD ■ Power Source: Internal Battery ■ Count Speed: 10 KHz Max. **Panel Cut-Out Dimension Differences**
 **APLT**	■ Display: 6 Digit, .56" (14 mm) Red LED, 8 Digit, .36" (9 mm) Red LED ■ Power Source: 115/230 VAC, 11 to 14 VDC ■ Count Speed: 10 KHz Max.	 **PAXLC**	■ Display: 6 Digit, .56" (14 mm) Red LED, 8 Digit, .4" (10 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Count Speed: 25 KHz Max.
 **SCT**	■ Display: 6 Digit, .43" (11 mm) Red LED ■ Power Source: 115/230 VAC, 12 VDC ■ Count Speed: 10 KHz Max.	 **PAXLC**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Count Speed: 25 KHz Max.

Note: Refer to the current product literature, as some differences may exist.

MODEL CUB7 – MINIATURE ELECTRONIC 8 DIGIT COUNTER or TIMER

c UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

- 0.35" (8.9 mm) *HIGH LCD DIGITS, REFLECTIVE OR TRANSMISSIVE WITH YELLOW/GREEN OR RED BACKLIGHTING (6-26 VDC power supply required for version with LED backlighting)*
- *INTERNAL LITHIUM BATTERY PROVIDES UP TO 7 YEARS OF TYPICAL UNINTERRUPTED OPERATION*
- *COUNT SPEEDS UP TO 10KHZ*
- *9 PROGRAMMABLE TIME RANGES*
- *CONTACT, LOGIC, OPEN COLLECTOR, OR HIGH VOLTAGE INPUTS*
- *STANDARD WIRE CONNECTIONS OR OPTIONAL PLUG-IN TERMINAL BLOCK*
- *NEMA 4X/IP65 SEALED FRONT BEZEL THAT FITS 1/32 DIN CUT-OUT*

DESCRIPTION

The CUB7 series is an 8-digit lithium battery powered miniature counter or timer with large 0.35" (8.9 mm) high digits. It has an LCD read-out available in Positive Imagine Reflective, Negative Image Transmissive with yellow/green or red backlighting. The backlight versions require an external 6-26 VDC power supply. The CUB7 series is housed in a lightweight, high impact plastic case with a clear viewing window. The sealed front panel with silicon rubber keypad meets NEMA 4X/IP65 specification for wash-down and/or dusty environments, when properly installed with supplied panel gasket and mounting clip.

Both counter and timer CUB7 models are available with a low voltage input (28 VDC max) or an isolated high voltage input (50-250 VDC/VAC). The low voltage input has DIP switch selections for SINKING or SOURCING along with a HIGH/LOW FREQUENCY selection (low frequency for contact inputs). Both units have front panel keypads that can be used to reset the display. The keypad can be enabled/disabled via a single DIP switch. The standard unit uses 22 gauge wires for external connections, an optional plug-in terminal block is available.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

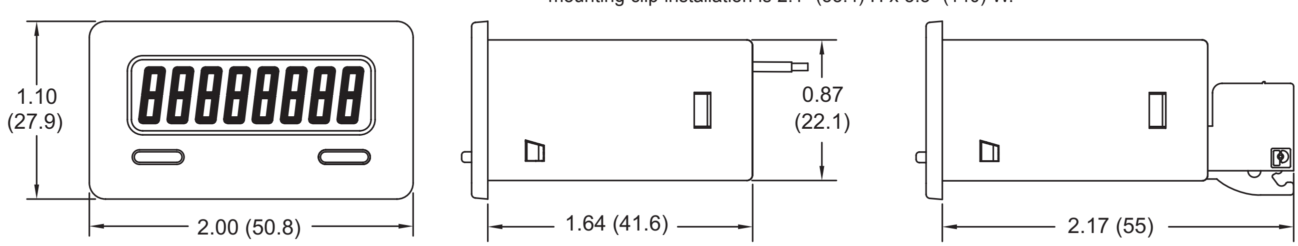
CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **DISPLAY**: 8-digit LCD, 0.35" (8.90 mm) high digits
2. **POWER**: Non-replaceable internal 3.6 VDC lithium battery provides 7 years of typical continuous operation (high count speeds in SNK mode & extreme ambient temperatures will decrease battery life, use of SRC mode can extend battery life)
   OPTIONAL LED BACKLIGHT POWER: 6-26 VDC @ 25 mA max.
   Must use an NEC Class 2 or Limited Power Source (LPS) rated power supply.
   Note: External power shall incorporate disconnecting device (switch or circuit breaker) and provide Double/Reinforced isolation from MAINS supply.
3. **LOW VOLTAGE INPUT**:
   COUNTERS: CUB7CCS0, CUB7CCR0, CUB7CCG0
   SNK mode (DIP switch 1 off, internal pull-up to battery)
   V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
   I_{IN} Max = 8 µA; V_{IN} Max = 3.6 VDC
   Count Speed: (count on negative edge)
   High freq mode (DIP switch 2 off): max 5 kHz @ 50% duty cycle
   Low freq mode (DIP switch 2 on): max 30 Hz @ 50% duty cycle
   Note: The three models listed above may be used for count inputs with 10-50 VAC signals when using a VCM10000 converter module. DIP switches must be set for SNK and Low frequency.
   SRC mode (DIP switch 1 on, internal 20 kΩ pull-down to common)
   V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
   I_{IN} Max = 5 mA; V_{IN} Max = 28 VDC
   Count Speed: (count on negative edge)
   High freq mode (DIP switch 2 off): max 10 kHz @ 50% duty cycle
   Low freq mode (DIP switch 2 on): max 50 Hz @ 50% duty cycle
   TIMERS:
   Models: CUB7TCS0, CUB7TCR0, CUB7TCG0 **For these models, the unit will time when the CUB7 input is low.**
   SNK mode (DIP switch 1 off, internal pull-up to battery)
   V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
   I_{IN} Max = 8 µA; V_{IN} Max = 3.6 VDC
   Note: The three models listed above may be used with 10-50 VAC

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.



With Wires

With Terminal Block

signals when using a VCM10000 converter module.
SRC mode (DIP switch 1 on, internal 20 kΩ pull-down to common)
V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
I_{IN} Max = 5 mA; V_{IN} Max = 28 VDC
Models: CUB7TCS1, CUB7TCR1, CUB7TCG1 **For these models, the unit will time when the CUB7 input is high.**
SNK mode (DIP switch 1 off - **DO NOT USE**)
SRC mode (DIP switch 1 on, internal 20 kΩ pull-down to common)
V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
I_{IN} Max = 5 mA; V_{IN} Max = 28 VDC

4. **HIGH VOLTAGE INPUT**:
COUNTERS: CUB7CVS0, CUB7CVR0, and CUB7CVG0
The unit adds one count with voltage present
V_{IN} Range = 50-250 VDC/VAC 50/60 Hz, 5 mA max
Isolation: 2500 VAC 1 min
TIMERS: CUB7TVS0, CUB7TVR0, and CUB7TVG0
Unit will time with voltage present
V_{IN} Range = 50-250 VDC/VAC 50/60 Hz, 5 mA max
Isolation: 2500 VAC 1 min
5. **RESET INPUT**:
V_{IN} Low Max = 1.5 VDC (internal pull-up to battery)
I_{IN} Max = 20 µA
5 msec min (active low)
Note: Reset input is active low to clear display to zero
6. **TIMER ACCURACY**:
CUB7TV: 0.03% +100 msec per RUN terminal activation
CUB7TC low freq/snk setup: 0.03% +1 msec per RUN terminal activation
CUB7TC high freq/snk setup: 0.03% -1 msec per RUN terminal activation
7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature: 0 to 50 °C
Storage Temperature: -30 to 80 °C
Vibration according to IEC 68-2-6: Operational 5 to 500 Hz, in X, Y, Z direction for 1.5 hours, 5 g.
Shock according to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
Operating and Storage Humidity: 85% max. (non-condensing)
8. **CONNECTIONS**: 22 gauge wire; wire length minimum 10"
OPTIONAL TERMINAL BLOCKS: Wire clamping terminals
Wire Strip Length: 0.275" (7 mm)
Wire Gage: 24-16 AWG copper wire
9. **CONSTRUCTION**: High impact plastic case with clear viewing window. The front panel meets NEMA 4X/IP65 requirements for outdoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and mounting clip are included.
10. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Listed, File # E179259, UL508
Type 4X Outdoor Enclosure rating (Face only), UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326:2006: Electrical Equipment for Measurement, Control and Laboratory use.

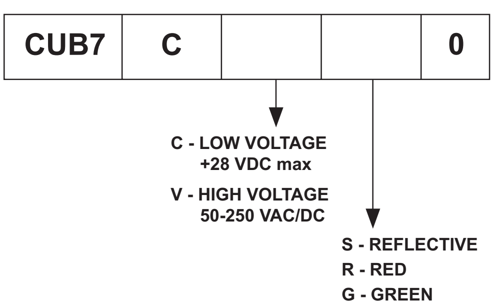
Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m (80 MHz to 1 GHz) 3 V/m (1.4 GHz to 2 GHz) 1 V/m (2 GHz to 2.7 GHz)
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV I/O signal
Surge	EN 61000-4-5	Criterion A power 1 kV L to L, 2 kV L to G
RF conducted interference	EN 61000-4-6	Criterion A 3 Vrms
Power freq magnetic fields	EN 61000-4-8	Criterion A 30 A/m
AC power	EN 61000-4-11	
Voltage dip		Criterion A 0% during 1 cycle 40% during 10/12 cycle 70% during 25/30 cycle
Short interruptions		Criterion B 0% during 250/300 cycles
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.
Refer to the EMC Installation Guidelines section of the bulletin for additional information.

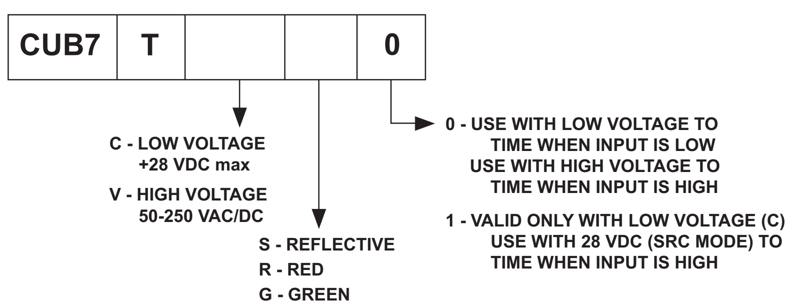
11. **WEIGHT**: 0.11 lbs. (0.05 Kg)

ORDERING INFORMATION

COUNTERS



TIMERS



Accessories Part Numbers

TYPE	DESCRIPTION	PART NUMBER	USED WITH
Plug-in Terminal Block	3 Position Terminal Block	TB100003	CUB7CCS0, CUB7TCS0, CUB7TCS1
	4 Position Terminal Block	TB100004	CUB7CCG0, CUB7TCG0, CUB7TCG1, CUB7CCR0, CUB7TCR0, CUB7TCR1, CUB7CVS0, CUB7TVS0
	5 Position Terminal Block	TB100005	CUB7CVG0, CUB7TVG0, CUB7CVR0, CUB7TVR0
Enclosure *	CUB7 Enclosure	ENC13000	
Base Mount *	CUB7 Base Mount	BMK80000	

See Wiring the Meter section to determine the terminal block needed.
** Enclosure and base mount will NOT function with plug-in terminal block option.*

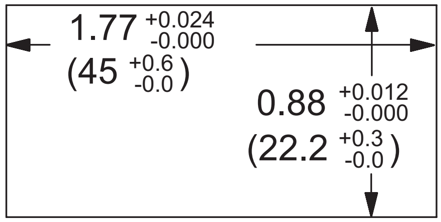
1.0 Installing the Meter

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the bezel. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



Installation

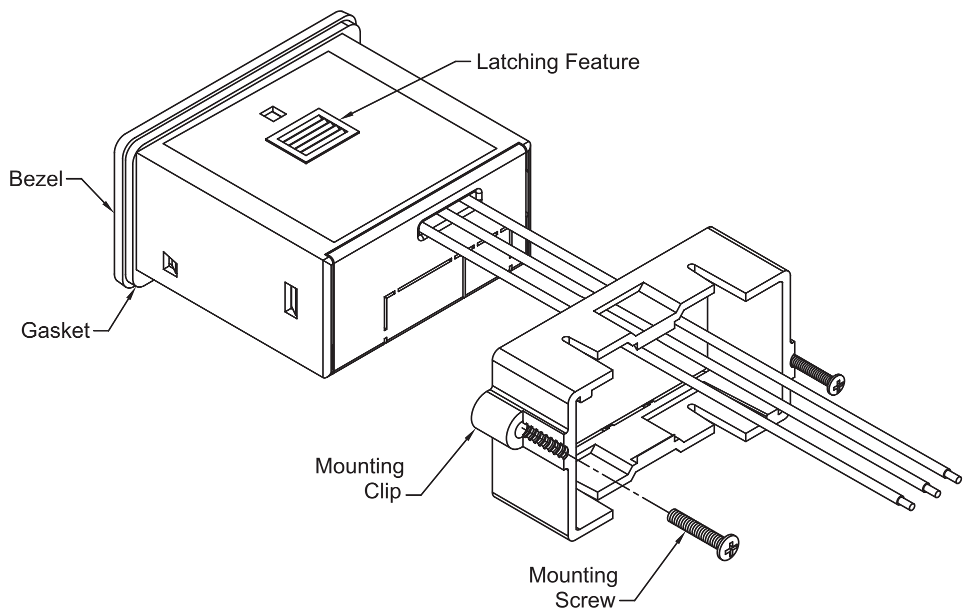
The CUB7 series of products meets NEMA 4X/IP65 requirements for outdoor use, when properly installed. The units are intended to be mounted into an enclosed panel. The viewing window and reset button are factory sealed for a washdown environment. A sponge rubber gasket and mounting clip are provided for installing the unit in the panel cut-out.

The following procedure assures proper installation:

1. Cut panel opening to specified dimensions. Remove burrs and clean around panel opening.
2. Carefully remove and discard the center section of the gasket. Slide the panel gasket over the rear of the unit to the back of the bezel. Insert the mounting screws onto both sides of mounting clip. The tip of the screw should **NOT** project from the hole in the mounting clip.
3. Install the CUB7 unit through the panel cut-out until the front bezel flange contacts the panel.
4. Slide the mounting clip over the rear of the unit until the clip is against the back of the panel. The mounting clip has latching features which engage into mating features on the CUB7 housing.

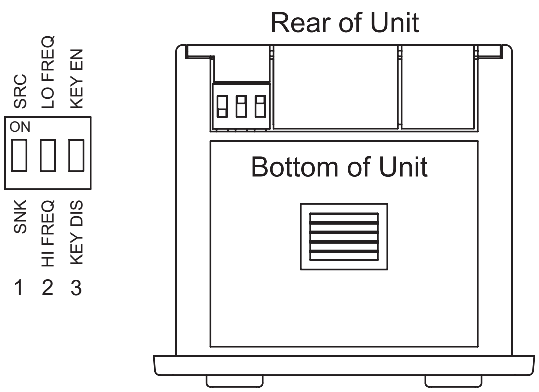
Note: It is necessary to hold the unit in place when sliding mounting clip into position.

5. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness. If not, gradually turn mounting screws to further compress gasket.
6. If gasket is not adequately compressed and the mounting screws can no longer be turned, loosen mounting screws, and check that mounting clip is latched as close as possible to the panel.
7. Repeat from step #5 for tightening mounting screws.

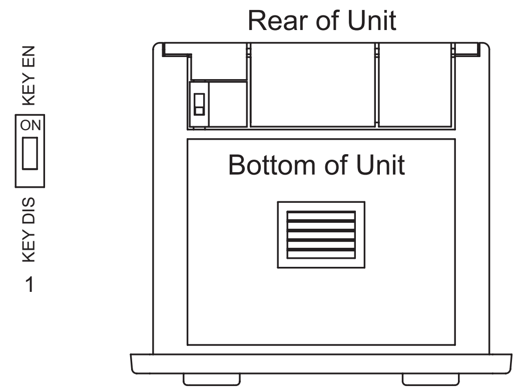


A

2.0 Setting the DIP Switches



Low Voltage Input Unit



High Voltage Input Unit

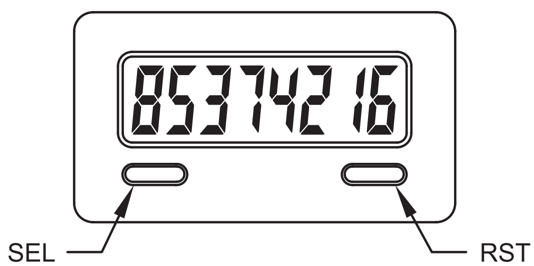
Low voltage input units have 3 DIP switches that must be positioned appropriately prior to wiring.

High voltage input units have 1 DIP switch to enable or disable the front bezel keypad.

Note: Placing the KEY DISABLE/ENABLE DIP switch in the OFF position, disables all front panel keys.

3.0 Programming The Time Range

The CUB7 Timer has 9 time ranges. To change ranges, enable the front keypad with the DIP switch and press the SEL key. The currently programmed time range will be displayed (example 2222222.2 = time range 2). To change the range, press the RST key. The ranges will cycle from 0-8 and back to 0. To enter your time range, press the SEL key and the unit will retain the current time range and return back to normal.



DISPLAY DURING PROGRAMMING	TIMER RANGE
00000.000	0.001 SEC
111111.11	0.01 SEC
2222222.2	0.1 SEC
333333333	1 SEC
4444444.4	0.1 MIN
555555555	1 MIN
666666.66	0.01 HR
7777777.7	0.1 HR
88888888	1 HR

4.0 Resetting The Display

The display may be reset to zero via the front RST key, the remote reset input or both.

The front RST key must be enabled for front panel reset. DIP switch # 3 on the low voltage input units or the single DIP switch on the high voltage input units. (See 2.0 Setting the DIP Switches for switch location)

The remote reset is activated via an external momentary contact closure between the reset input (blue wire) and the common (black wire). When the optional terminal blocks are used, see 5.0 Wiring The Meter, for the appropriate reset input terminal and the common terminal.

5.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made to the #22 AWG colored wires protruding from the rear of the unit. When using the optional terminal block, the #22 AWG colored wires are cut off and electrical connections are made via screwless type terminal block. All conductors should conform to the meter's voltage and current ratings. All cabling and wire terminations should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the backlight power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

USING THE COLOR CODED WIRES

The low voltage input units will contain three or four color coded wires depending on the backlight power requirements.

The high voltage input units will contain (2) orange wires and an additional two or three wires depending on the backlight power requirements.

The tables define the function of each colored wire.

LOW VOLTAGE INPUT
Wire Colors

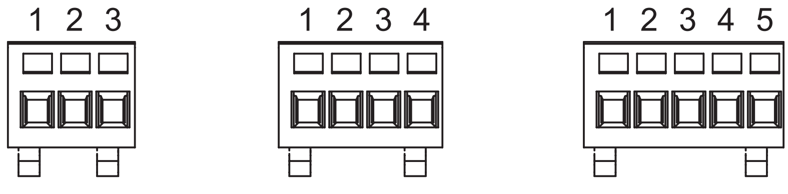
WHITE	BLUE	BLACK	RED
Low Voltage Input	Reset	Common	+Backlight Power

HIGH VOLTAGE INPUT
Wire Colors

ORANGE	ORANGE	BLUE	BLACK	RED
High Voltage Input	High Voltage Input	Reset	Common	+Backlight Power

TERMINAL BLOCK OPTION

CONNECTIONS: Wire clamping terminals
Wire Strip Length: 0.275" (7 mm)
Wire Gage: 24-16 AWG copper wire



USING THE OPTIONAL TERMINAL BLOCK

1. Remove the rear cover. Refer to Figure 1. A small slotted screwdriver is required to release the side latches. Insert the screwdriver tip between the rear cover and the side of the unit. Leverage the screwdriver away from the case to unlatch the side latch and slightly lift the rear cover. Pinch the corners to hold the rear cover in place. Remove the screwdriver and repeat the same procedure on the other side of the rear cover. When both side latches are released, slide the rear cover from the unit and the wires.
2. For safety concerns, the wires should be cut off completely flush with the PC board to prevent a short.
3. Break out the break away tab(s) as required. Remove the left tab only for 3 position terminal block or both tabs for 4 and 5 position terminal blocks.
4. Reinstall the rear cover into CUB7 unit.
5. Mount the CUB7 into the panel (refer to 1.0 Installing The Meter)
6. Push the keyed terminal block onto the exposed PC board. The left most terminal, next to the DIP switch(s) is terminal #1.

Note: Wire sizes 16-24 AWG may be used with 0.25" length exposed. The screwless type terminal block requires a small slotted screwdriver engaged in the upper slot to open the wire clamp in the lower larger slot. Removing the screwdriver will lock the wire clamp unto the wire.

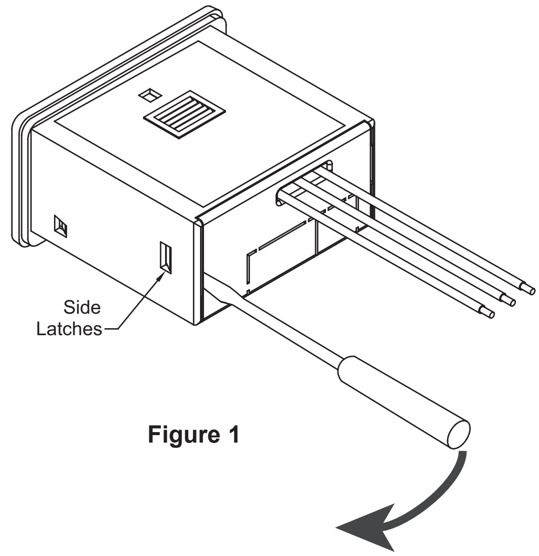
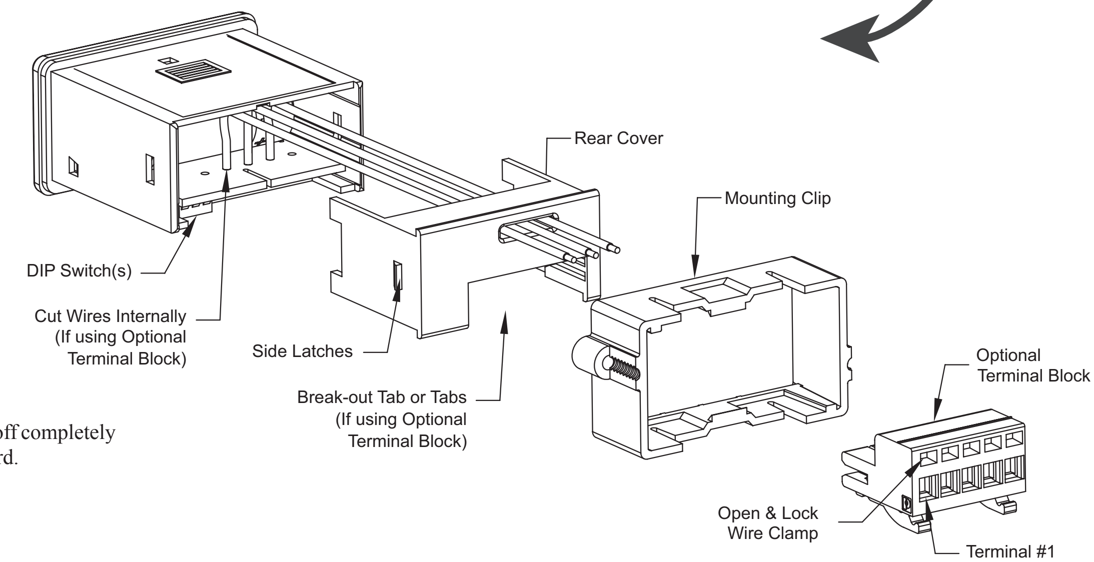
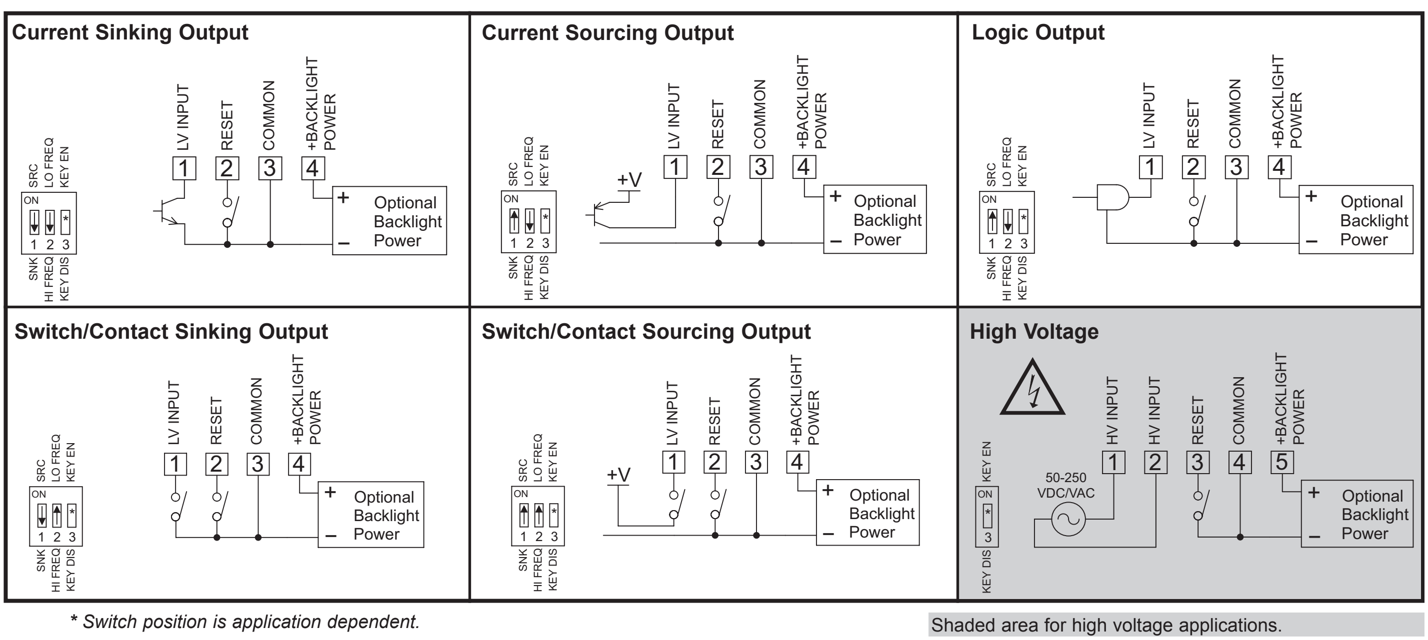


Figure 1



Wires must be cut off completely flush with PC board.



** Switch position is application dependent.*

Shaded area for high voltage applications.

MODEL CUB4L & CUB4L8 - MINIATURE ELECTRONIC COUNTERS

- *LCD, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE WITH YELLOW/GREEN OR RED LED BACKLIGHTING*
- *INTERNAL LITHIUM BATTERY PROVIDES UP TO 6 YEARS OF UNINTERRUPTED OPERATION*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *FRONT PANEL RESET, REMOTE RESET, OR BOTH*
- *COUNT SPEEDS UP TO 5 KHz*
- *WIRE CONNECTION MADE VIA SCREW CLAMP TYPE TERMINALS*

DESCRIPTION

The CUB4 offers a large display in a miniature package with a choice of three displays; reflective, red backlight or green backlight.

The backlight versions require power from an external 9–28 VDC supply. The optional power supply (MLPS) is designed to be attached directly to the rear of the CUB4 and is powered from an 85–250 VAC source.

The CUB4 series has a lightweight, high impact plastic case with a clear viewing window. The sealed front panel with the silicone rubber reset button meets NEMA 4X/IP65 specifications for wash-down and/or dusty environments, when properly installed.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CUB4L (6-digit)	Counter Positive Image Reflective	CUB4L000
	Counter w/Yel-Grn Backlighting	CUB4L010
	Counter w/Red Backlighting	CUB4L020
CUB4L8 (8-digit)	Counter Positive Image Reflective	CUB4L800
	Counter w/Yel-Grn Backlighting	CUB4L810
	Counter w/Red Backlighting	CUB4L820
MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
	+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

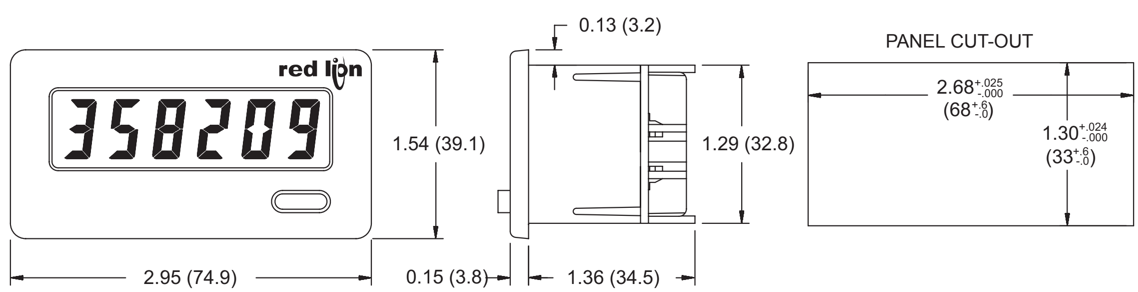
CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **DISPLAY**:
   CUB4L: 6-Digit, LCD, 0.48" *(12.2 mm)* high digits.
   CUB4L8: 8-Digit, LCD, 0.46" *(11.7 mm)* high digits.
2. **POWER SOURCE**: Internal 3.6 V lithium battery will provide up to 6 years of continuous operation (high speed counting and extreme temperatures will decrease battery life).
3. **BACKLIGHT POWER REQUIREMENTS**: 9 to 28 VDC, 30 mA typical, 50 mA max. Above 26 VDC, derate operating temperature to 50°C.
   Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.
4. **COUNT INPUT**:
   SNK mode (DIP switch 1 off, internal pull-up to battery)
   V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
   I_{IN} Max = 5 µA; V_{IN} Max = 3.6 VDC
   Count Speed: (count on negative edge)
   High freq mode (DIP switch 2 off): max 5 kHz @ 50% duty cycle
   Low freq mode (DIP switch 2 on): max 50 Hz @ 50% duty cycle
   SRC mode (DIP switch 1 on, internal 20 kΩ pull-down to common)
   V_{IN} High Min = 1.25 VDC; V_{IN} Low Max = 0.45 VDC
   I_{IN} Max = 5 mA; V_{IN} Max = 28 VDC
   Count Speed: (count on negative edge)
   High freq mode (DIP switch 2 off): max 5 kHz @ 50% duty cycle
   Low freq mode (DIP switch 2 on): max 50 Hz @ 50% duty cycle
5. **RESET INPUT**:
   V_{IN} Low Max = 1.5 VDC (internal pull-up to battery)
   I_{IN} Max = 20 µA
   5 msec min (active low for count reset to zero)
6. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0 to 60°C (above 50°C, derate backlight operating voltage to 26 VDC max.).
   Storage Temperature: -30 to 85°C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
   Vibration to IEC 68-2-6: 5 to 500 Hz, 5 g.
   Shock to IEC 68-2-27: Operational 30 g.
   Altitude: Up to 2000 meters

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



A

7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class B
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E179259
   Type 4X Indoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **CONSTRUCTION**:
   This unit is rated for NEMA 4X/IP65 indoor use. Installation Category I, Pollution Degree 2
9. **WEIGHT**: 3 oz. *(85 grams)*

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

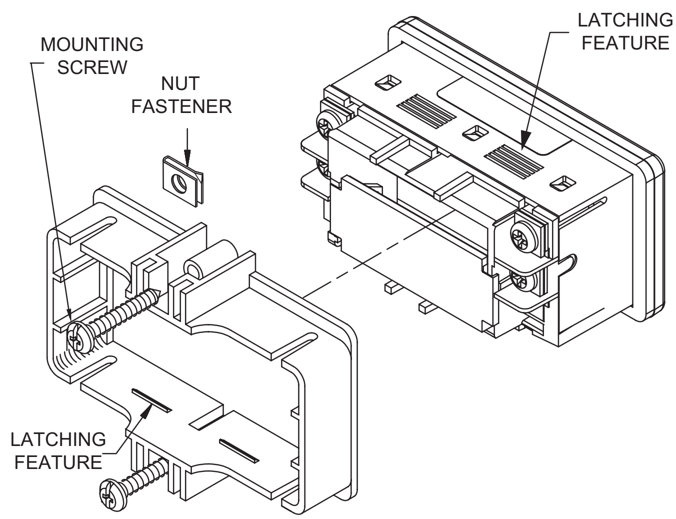
Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

Installation

The CUB4 series of products meet NEMA 4X/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel. The viewing window and reset button are factory sealed for a washdown environment. A sponge rubber gasket and mounting clip are provided for sealing the unit in the panel cut-out.

The following procedure assures proper installation:

1. Cut panel opening to specified dimensions. Remove burrs and clean around panel opening.
2. Carefully remove the center section of the panel gasket and discard. Slide gasket over rear of the unit to the back of the bezel.
3. Assemble nut fastener first and then mounting screw onto both sides of mounting clip. Tip of screw should not project from hole in mounting clip.
4. Install CUB4 unit through the panel cut-out until front bezel flange contacts the panel-mounted gasket.
5. Slide the mounting clip over the rear of the unit until the mounting clip is against the back of the panel. The mounting clip has latching features which engage into mating features on the CUB4 housing.
   Note: It is necessary to hold the unit in place when sliding mounting clip into position.



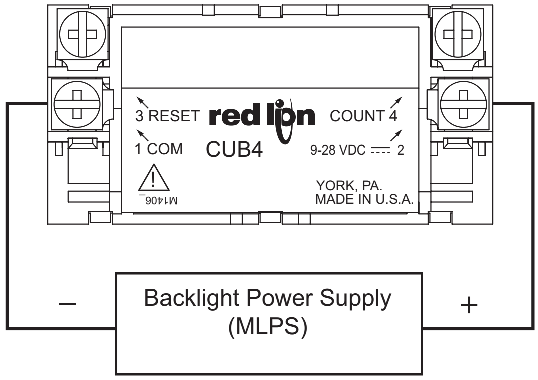
6. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed about 75 to 80% of its original thickness. (Recommended torque is 28 to 36 in-oz.) If not, gradually turn mounting screws to further compress gasket.
7. If gasket is not adequately compressed, and mounting screws can no longer be turned, loosen mounting screws and check that mounting clip is latched as close as possible to panel.
   Repeat procedure for tightening mounting screws.

WIRING CONNECTIONS

The electrical connections are made via rear screw-clamp terminals located on the back of the unit. When wiring the unit, use the label to identify the wire position with the proper function. All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" bare wire exposed *(stranded wires should be tinned with solder)*. Insert the wire into the screw-clamp terminal and tighten down the screw until the wire is clamped tightly. Each terminal can accept up to two #14 AWG wires.

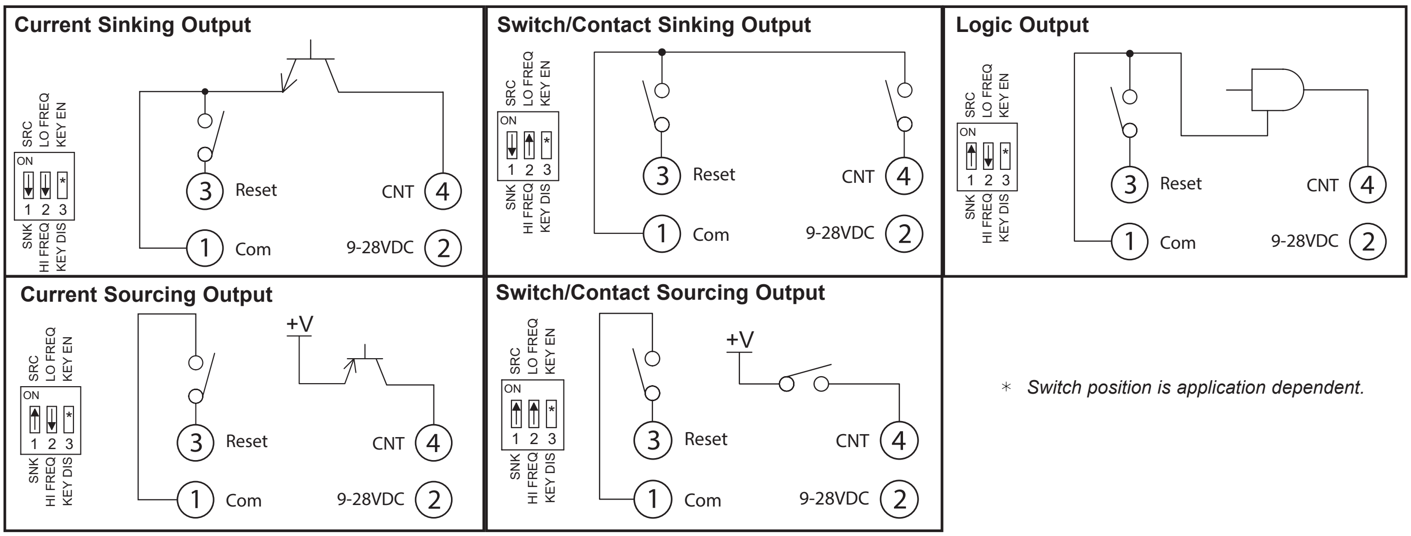
Backlight Wiring

Optional backlight versions of the CUB4 require an external 9-28 VDC power supply. The external supply is connected between the V+ and Common terminals.



Warning: *Lithium battery may explode if incinerated.*

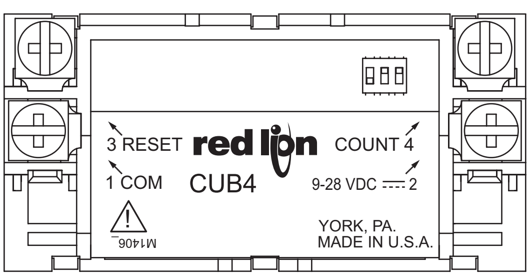
COUNT INPUT WIRING



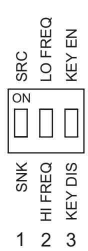
∗ *Switch position is application dependent.*

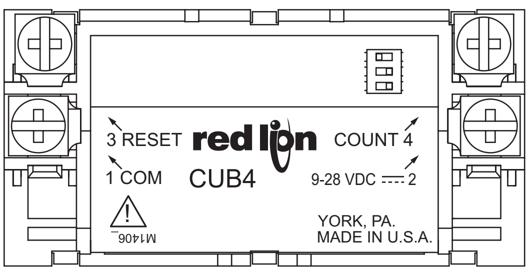
SETTING THE DIP SWITCHES

The switches must be positioned appropriately prior to wiring. Placing the key disable/enable DIP switch in the off position disables the front panel key.

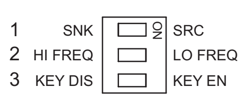


CUB4L





CUB4L8



RESETTING THE DISPLAY

The display may be reset to zero via the front RST key, the remote reset input or both. The front RST key must be enabled for front panel reset by setting DIP switch # 3 ON. The remote reset is activated via an external momentary contact closure between the reset input and the common.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL CUB4L8W - MINIATURE ELECTRONIC COUNTERS

- *LCD, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE WITH YELLOW/GREEN OR RED LED BACKLIGHTING*
- *INTERNAL LITHIUM BATTERY PROVIDES UP TO 6 YEARS OF UNINTERRUPTED OPERATION*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *FRONT PANEL RESET, REMOTE RESET, OR BOTH*
- *COUNT INPUT FROM 10 to 300 VAC/DC*
- *WIRE CONNECTION MADE VIA SCREW CLAMP TYPE TERMINALS*

DESCRIPTION

The CUB4L8W offers a large display in a miniature package. The CUB4L8W (8-digit counter with voltage input) has a choice of three displays; reflective, red backlight or green backlight.

The backlight versions require power from an external 9–28 VDC supply. The optional power supply (MLPS) is designed to be attached directly to the rear of the CUB4L8W and is powered from an 85–250 VAC source. The power supply provides 12 VDC @ 400 mA to power the backlight and sensor, if required.

The CUB4L8W has a lightweight, high impact plastic case with a clear viewing window. The sealed front panel with the silicone rubber reset button meets NEMA 4X/IP65 specifications for wash-down and/or dusty environments, when properly installed.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CUB4L8W (8-digit w/VCM)	Counter Positive Image Reflective	CUB4L8W0
	Counter w/Yel-Grn Backlighting	CUB4L8W1
	Counter w/Red Backlighting	CUB4L8W2
	Counter Positive Image Reflective w/V+ Terminal	CUB4L8WM
MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
	+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

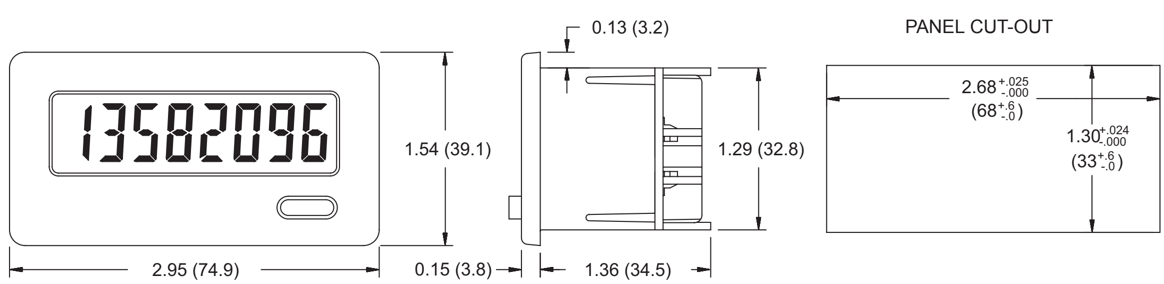
CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **DISPLAY**: 8-Digit, LCD, 0.46" *(11.7 mm)* high digits.
2. **POWER SOURCE**: Internal 3.0 V lithium battery to provide up to 6 years of continuous operation. Battery life is dependent upon usage. Count and reset contacts that remain closed for long periods of time will reduce battery life.
3. **BACKLIGHT POWER REQUIREMENTS**: 9 to 28 VDC, 35 mA typical, 50 mA max. Above 26 VDC, derate operating temperature to 50°C. Must use the MLPS or a Class 2 or SELV rated power supply. Note: External power shall incorporate disconnecting device (switch or circuit breaker) and provide double/reinforced isolation from MAINS supply.
4. **INPUTS**:
   Low Speed Input: 10 to 300 VAC/DC, 50/60 Hz, 30 cps max. V_{IL} = 0.5 VDC max. Unit counts on positive going edge. Will not operate with Triac outputs.
   Remote Reset: 15 msec min. pulse width *(active low)* from 3.0 V bipolar output or an open collector transistor or a switch contact to common.
   Resetting Input: V_{IL} *(low)* = 0.5 V max.
5. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0 to 60°C (above 50°C, derate backlight operating voltage to 26 VDC max.).
   Storage Temperature: -30 to 85°C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
   Vibration According to IEC 68-2-6: 5 to 500 Hz, in X, Y, Z direction for 1.5 hours, 5 g.
   Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
6. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only), IEC 529
7. **CONSTRUCTION**:
   This unit is rated for NEMA 4X/IP65 indoor use. Installation Category I, Pollution Degree 2
8. **WEIGHT**: 3 oz. *(85 grams)*

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:

   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0

   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3

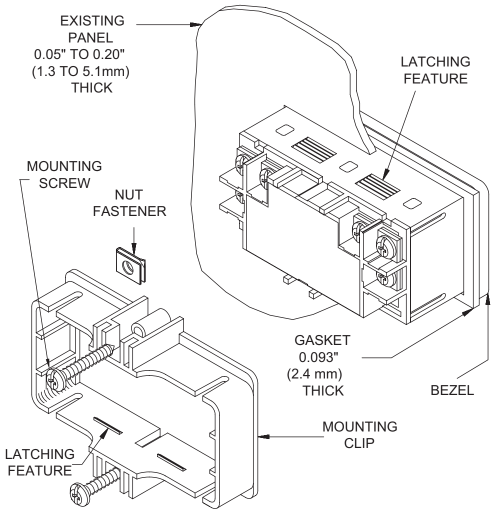
   Note: *Reference manufacturer's instructions when installing a line filter.*
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



Installation

The CUB4L8W meets NEMA 4X/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel. The viewing window and reset button are factory sealed for a washdown environment. A sponge rubber gasket and mounting clip are provided for sealing the unit in the panel cut-out.

The following procedure assures proper installation:

1. Cut panel opening to specified dimensions. Remove burrs and clean around panel opening.
2. Carefully remove the center section of the panel gasket and discard. Slide gasket over rear of the unit to the back of the bezel.
3. Assemble nut fastener first and then mounting screw onto both sides of mounting clip. Tip of screw should not project from hole in mounting clip.
4. Install the unit through the panel cut-out until front bezel flange contacts the panel-mounted gasket.
5. Slide the mounting clip over the rear of the unit until the mounting clip is against the back of the panel. The mounting clip has latching features which engage into mating features on the unit housing.
   Note: It is necessary to hold the unit in place when sliding mounting clip into position.
6. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed about 75 to 80% of its original thickness. (Recommended torque is 28 to 36 in-oz.) If not, gradually turn mounting screws to further compress gasket.
7. If gasket is not adequately compressed, and mounting screws can no longer be turned, loosen mounting screws and check that mounting clip is latched as close as possible to panel.
   Repeat procedure for tightening mounting screws.

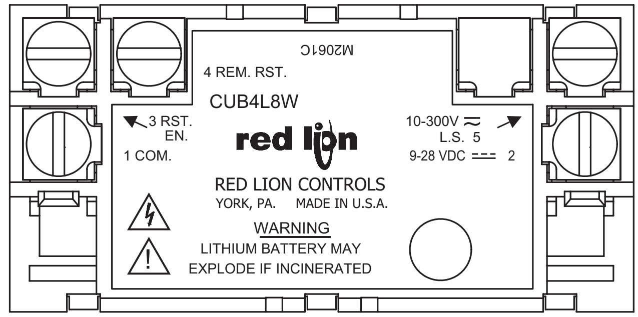
WIRING CONNECTIONS

The electrical connections are made via rear screw-clamp terminals located on the back of the unit. When wiring the unit, use the label to identify the wire position with the proper function. All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" bare wire exposed *(stranded wires should be tinned with solder)*. Insert the wire into the screw-clamp terminal and tighten down the screw until the wire is clamped tightly. Each terminal can accept up to two #14 AWG wires.

*Note: The Reflective CUB4 will **NOT** have a screw terminal installed at the V+ terminal, since it is **NOT** required for operation and is not internally connected. Refer to the Ordering Information for the part number of a reflective model that will accommodate the MLPS.*

Backlight Wiring

Optional backlight versions of the CUB4 require an external 9-28 VDC power supply. The external supply is connected between the V+ and Common terminals.

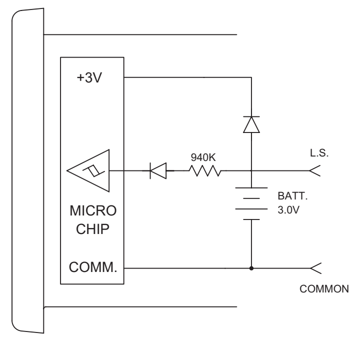


Warning: *Lithium battery may explode if incinerated.*
Caution: *All leads will be at the same line potential as the input leads.*

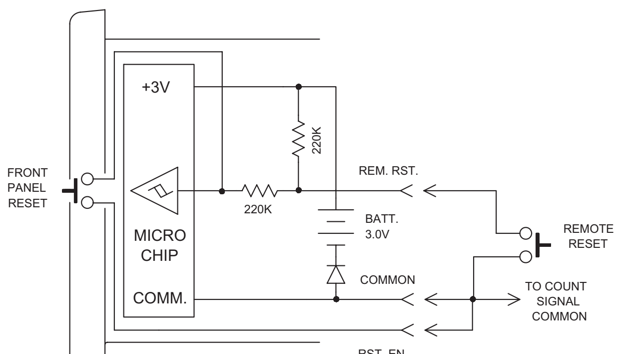
L.S. INPUT, 30 CPS MAX.

The CUB4L8W accepts most machine control voltage signals. The input accepts AC (50/60 Hz) or DC control voltages from 10 to 300 V at count speeds up to 30 cps. The unit counts on the positive going edge of the input signal.

WARNING: Any lead may be at hazardous live input potential. External wiring and devices connected to the unit must be rated the same as applied signal input voltage and be properly isolated from Class 2 or SELV circuitry.



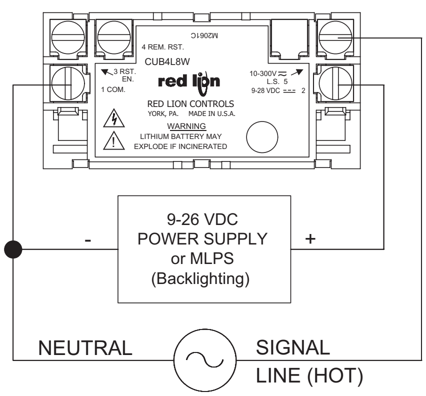
RESET OPTIONS



Connecting a wire from the *"RST. EN." (Reset Enable)* Input terminal to Common will enable the front panel Reset button. When Remote Reset is required, a wire is connected from the "*REM. RST."* input terminal to Common. Pulling this input low causes the counter to reset. The *"REM. RST."* can be pulled low by either a mechanical switch or solid-state transistor switch. Switch load and leakage are the same as for "*L.S. CNT."* Input above.

Note: The RC protection circuit on the "REM. RST." Input causes a delay of approximately 15 msec in Reset response.

BACKLIGHT OPTION



Optional backlight versions of the CUB4 require an external 9-28 VDC power supply. The external supply is connected between the V+ and Common terminals as shown in the drawing.

Red Lion Controls optional power supply (MLPS1000) is designed to be attached directly to the rear of a CUB4 and is powered from a 85 to 250 VAC source. The MLPS provides power for unit backlighting and a sensor.

WARNING: When connecting the wiring for a backlit CUB4L8W measuring an AC input voltage, the neutral of the single phase AC signal is connected to Terminal 1 (COM), and line (hot) is connected to Terminal 5 (LS). The DC supply for the backlighting is connected as shown in the drawing. Three phase AC applications require an isolation transformer.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL CUB5 - MINIATURE ELECTRONIC 8-DIGIT DUAL COUNTER AND RATE INDICATOR

C UL US LISTED
IND. CONT. EQ.
51EB

- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.46" (11.7 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATIONS CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *BUILT-IN BATCH COUNTING CAPABILITY*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The meter can be programmed as a single or dual counter with rate indication capability. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.46" (11.7 mm) high digits. The LCD is available in two versions, reflective (CUB5R000) and backlight (CUB5B000). The backlight version is user selectable for green or red backlighting with variable display intensity.

The counter is programmable for one of eight different count modes, including bi-directional and quadrature. When programmed as a dual counter, each counter has a separate scale factor and decimal points. In the counter/rate indicator mode, each have their own scaling and decimal point read-outs in different engineering units. The internal batch counter can be used to count setpoint output activations.

The meter has two separate inputs which provide different functions depending on which operating mode is selected. Input A accepts the signal for the Count and/or Rate displays, while Input B accepts the signal for the Count display or direction control. In the anti-coincidence mode, both inputs are monitored simultaneously so that no counts are lost. The resulting display can be chosen as the sum or difference of the two inputs. The Rate Indicator has programmable low (minimum) and high (maximum) update times to provide optimal display response at any input frequency. There is a programmable user input that can be programmed to perform a variety of functions.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the single setpoint relay output card or the dual setpoint solid state output card. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

COUNTER

The CUB5 receives incoming pulses and multiplies them by the Count Scale Factor to obtain the desired reading for the count display. Input A accepts the signal for the count and Input B is used for quadrature, dual counter, anti-coincidence counting, or up/down control counting.

RATE

The rate indicator utilizes the signal at Input A to calculate the rate value using a time interval method (1/tau). The unit counts on the negative edge of the input pulses. After the programmed minimum update time elapses and the next negative edge occurs, the unit calculates the input rate based on the number of edges that occurred during the elapsed time. The input rate is then multiplied by the rate scaling value to calculate the rate display.

At slower rates, averaging can be accomplished by programming the rate minimum update time for the desired response. Extensive scaling capabilities allow practically any desired reading at very slow count rates.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

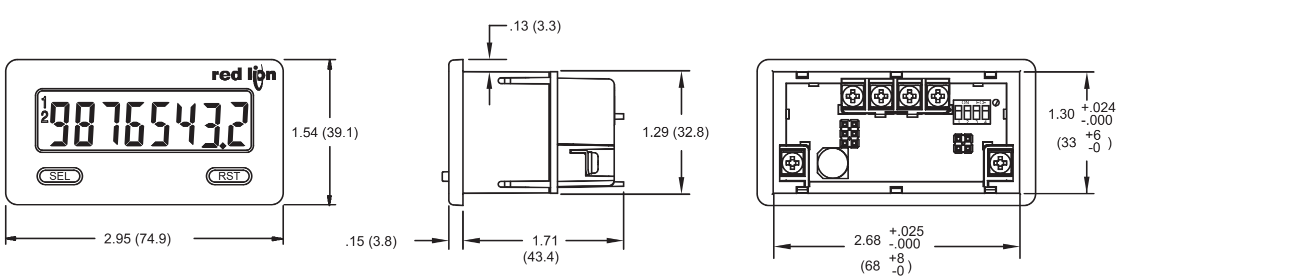
Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger. Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5R	Dual Counter & Rate Indicator with Reflective Display	CUB5R000
	CUB5B	Dual Counter & Rate Indicator with Backlight Display	CUB5B000
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPRO	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 8 digit LCD 0.46" (11.7 mm) high digits
   CUB5R000: Reflective LCD with full viewing angle
   CUB5B000: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5R000	---	10 mA	30 mA
CUB5B000	Red (max intensity)	85 mA	115 mA
CUB5B000	Green (max intensity)	95 mA	125 mA

3. **COUNTER DISPLAYS**:
   Counter A: 8-digits, enabled in all count modes
   Display Range: -9999999 to 99999999
   Overflow Indication: Display flashes "Cnt OUEr"
   Counter B: 7-digits, enabled in Dual Counter Mode or batch counting
   Display Designator: "b" to the left side of the display
   Display Range: 0 to 9999999 (positive count only)
   Overflow Indication: Display flashes "bCntOUEr"
   Maximum Count Rates: 50% duty cycle
   Without setpoint option card: 20 KHz (all count modes)
   With setpoint option card: 20 KHz for any count mode except Dual Counter (16 KHz), Quadrature x2 (14 KHz) and Quadrature x4 (13 KHz).
4. **RATE DISPLAY**: 6-digits, may be enabled or disabled in any count mode
   Display Designator: "R" to the left side of the display
   Display Range: 0 to 999999
   Over Range Display: "R OLOLOL"
   Maximum Frequency: 20 KHz
   Minimum Frequency: 0.01 Hz
   Accuracy: ±0.01%
5. **COUNT/RATE SIGNAL INPUTS (INP A and INP B):**
   Input A: DIP switch selectable to accept pulses from a variety of sources. See Section 2.0 Setting the DIP Switches for Input A specifications.
   Input B: Logic signals only
   Trigger levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Current sinking: Internal 10KΩ pull-up resistor to +9 to 28 VDC
   Filter (LO Freq.): Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec min.
6. **USER INPUT (USR):** Programmable input. Connect to input common (INP COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and count values when power is removed.
8. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
9. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5R000: -35 to 75 °C
    Operating Temperature Range for CUB5B000 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85 °C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 40 g
    Altitude: Up to 2000 meters
11. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    IEC/EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E179259
    UL Listed: File #E137808
    Type 4X Outdoor Enclosure rating (Face only)
    IP65 Enclosure rating (Face only)
    IP20 Enclosure rating (Rear of unit)
    Refer to EMC Installation Guidelines for additional information.
12. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

SINGLE RELAY OUTPUT CARD (One setpoint only)

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations
Response Time:
Turn On Time: 4 msec. max.
Turn Off Time: 4 msec. max.

DUAL SINKING OUTPUT CARD (One or two setpoints)

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable, 2 msec min. or 50 msec min.

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

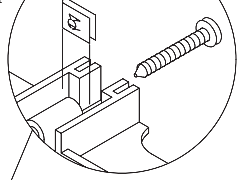
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

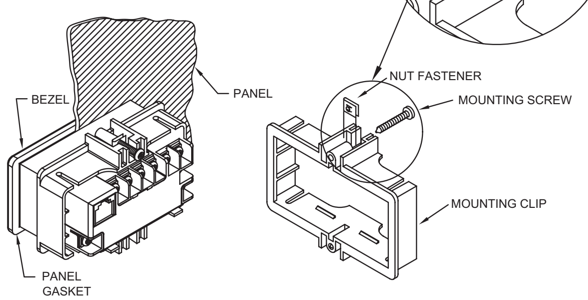
1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.



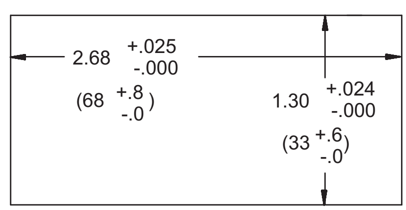


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 Setting the DIP Switches

To access the switches, remove the rear cover of the meter as described below. A bank of 4 switches is located in the upper right hand corner. After setting the switches, install any optional plug-in cards before replacing the rear cover (see next section).

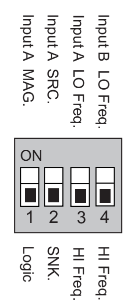
Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

SETTING THE INPUT DIP SWITCHES

The meter has four DIP switches for Input A and Input B that must be set before applying power.



■ Factory Setting

SWITCH 1

LOGIC: Input A trigger levels V_{IL} = 1.25 V max.; V_{IH} = 2.75 V min.; V_{MAX} = 28 VDC

MAG: 200 mV peak input sensitivity; 100 mV hysteresis; maximum input voltage: ±40 V peak (28 Vrms); Must also have SRC switch ON. (Not recommended with counting applications.)

SWITCH 2

SNK.: Adds internal 7.8 KΩ pull-up resistor to +9 to 28 VDC, I_{MAX} = 3.8 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

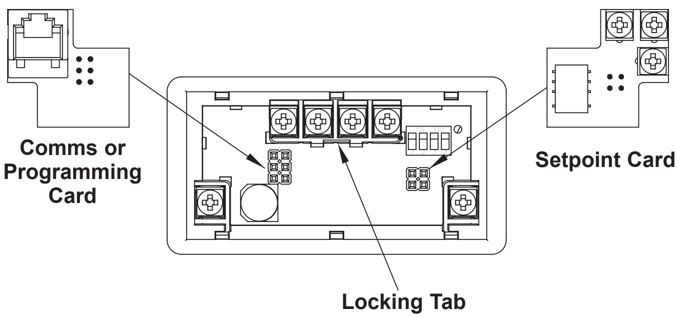
SWITCHES 3 and 4

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.

3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter. After installing the cards, replace the rear cover before wiring the meter.



CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REPLACING THE REAR COVER

To replace the rear cover, align the cover with the input terminals and press down until the cover snaps into place.

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter’s voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

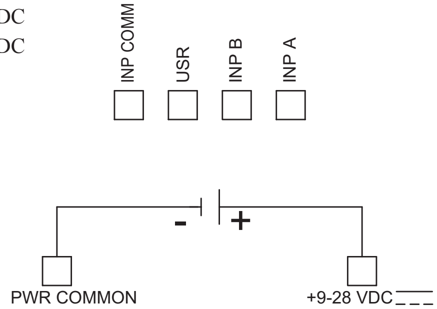
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer’s instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

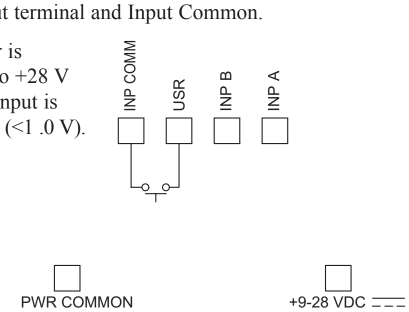


4.2 USER INPUT WIRING

Sinking Logic

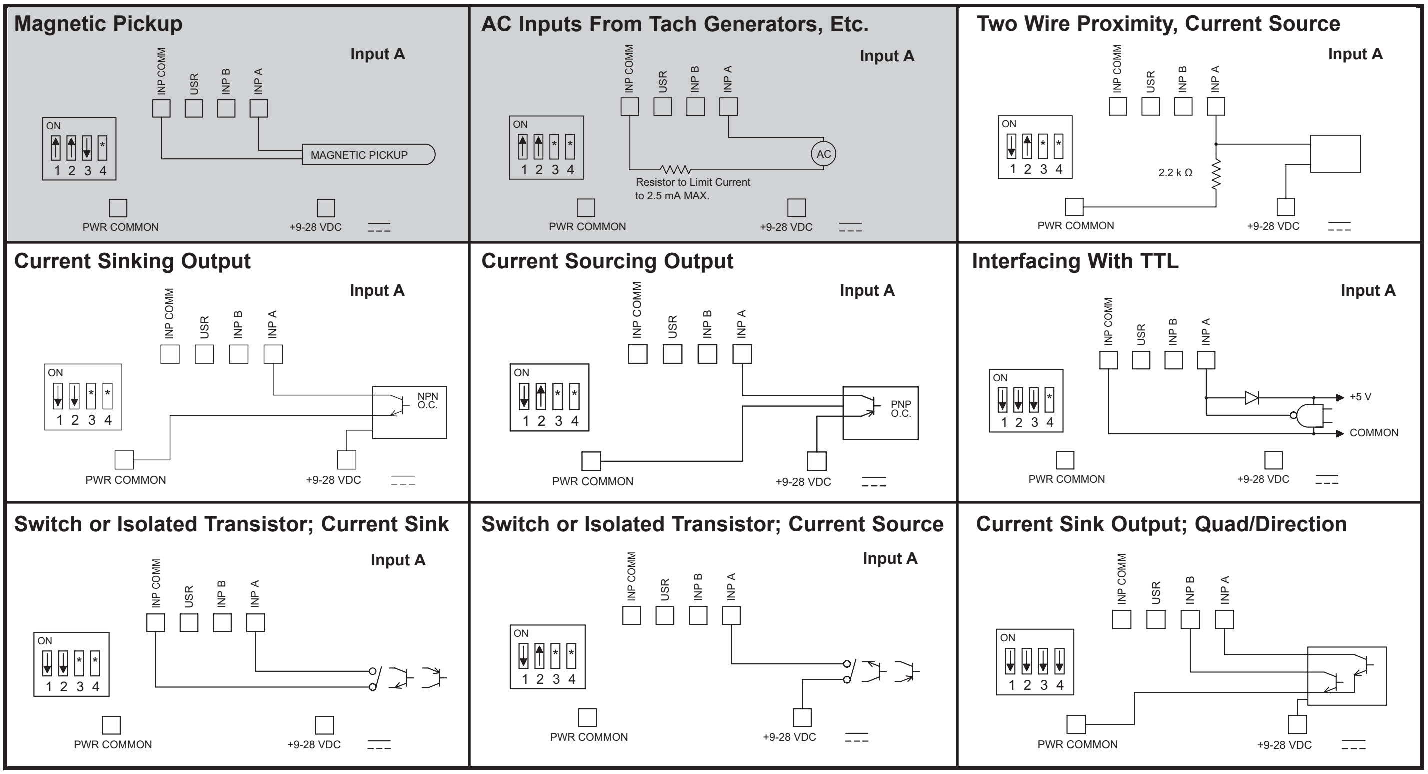
INP COMM } Connect external switching device between the
USR } User Input terminal and Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<1 .0 V).



4.3 INPUT WIRING

CAUTION: Power common (PWR COMMON) is NOT isolated from input common (INP COMM). In order to preserve the safety of the meter application, the power common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the Signal or User Inputs and input common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground; and the common of the plug-in cards with respect to input common.

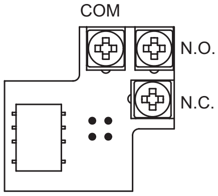


* Switch position is application dependent.

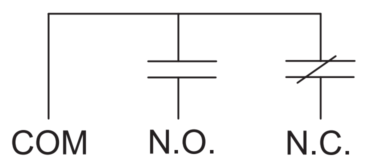
Shaded areas not recommended for counting applications.

4.4 SETPOINT (OUTPUT) WIRING

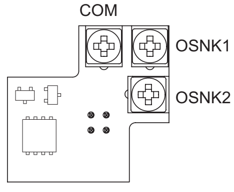
SINGLE SETPOINT RELAY PLUG-IN CARD



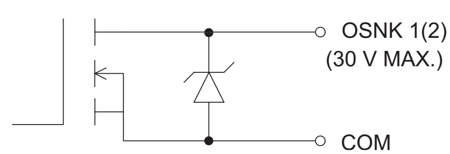
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



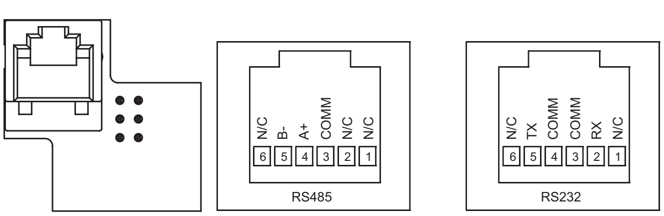
ELECTRICAL CONNECTIONS



Note: Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

4.5 SERIAL COMMUNICATION WIRING

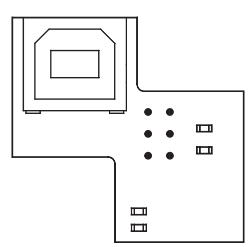
SERIAL COMMUNICATIONS PLUG-IN CARD



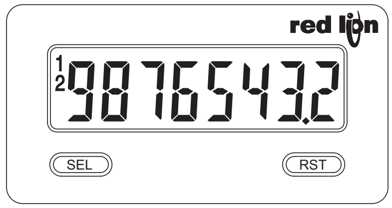
RJ11 CONNECTOR PIN OUTS

4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



5.0 Reviewing the Front Buttons and Display



KEY	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets count display(s) and/or outputs		Advances through the program menu/ Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

"R" - To the left of the display is the rate value.
- Counter A has no designator.

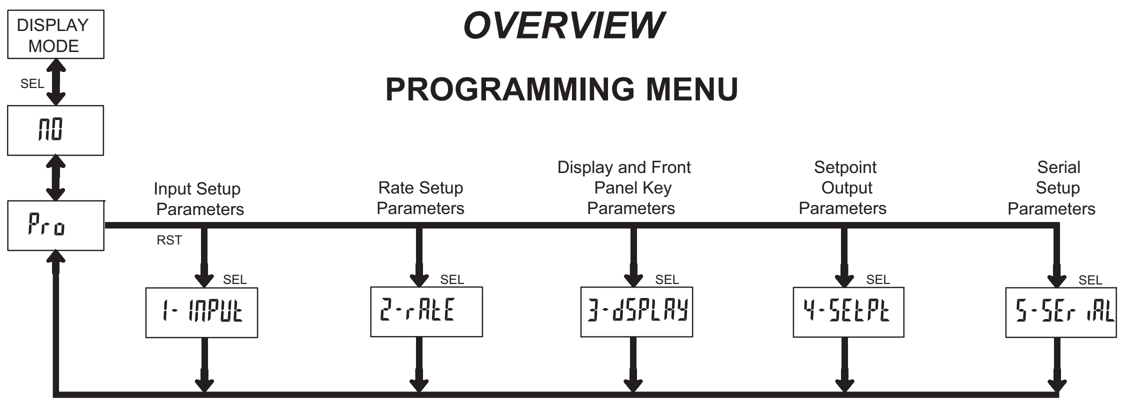
"b" - To the left of the display is the Counter B value (dual count or batch).
"1" and "2" - Indicates setpoint 1 and 2 output status.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the rate and count values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (SEL KEY)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** key. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST KEYS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** key is used to select the desired module. The displayed module is entered by pressing the **SEL** key.

MODULE MENU (SEL KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** key is used to move through the selections/values for that parameter. Pressing the **SEL** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** key to access the value. The right hand most digit will begin to flash. Pressing the **RST** key again increments the digit by one or the user can hold the **RST** key and the digit will automatically scroll. The **SEL** key will advance to the next digit. Pressing and holding the **SEL** key will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL KEY)

The Programming Mode is exited by pressing the **SEL** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

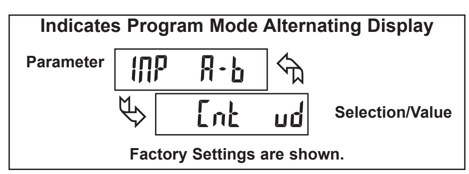
It is recommended to start with Module 1 for counting or Module 2 for rate. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory settings may be completely restored in Module 3. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's factory setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - INPUT SETUP PARAMETERS (1- INPUt)

A

PARAMETER MENU

1- INPUt

SEL

INP A-b	CntA dP	CntA ScF	CntA rSt	CntA dir	CntA Ld	Cntb bAt	Cntb dP	Cntb ScF	RSt P-UP	USEr INP	USEr ASN	Pro
Count Mode	Counter A Decimal Point	Counter A Scale Factor	Counter A Reset Action	Counter A Count Direction	Counter A Count Load Value	Counter B Batch Count Enable	Counter B Decimal Point	Counter B Scale Factor	Counter Reset at Power-up	User Input Function	User Input Assignment	

Dual Count or Batch Only (Counter B Decimal Point, Counter B Scale Factor)

Dual Count or Batch Only (User Input Assignment)

Shaded area selections only apply when Counter B is enabled (Dual Counter mode or batch counter).

COUNT MODE

INP A-b
Cnt ud

Cnt ud · RAtE Cnt · dUAL Cnt · QUAd 1 · QUAd 2 · QUAd 4 · Add Add · Add Sub

Select the count mode that corresponds with your application. The input actions are shown in the boxes below. For simple counting applications, it is recommended to use Count with Direction for the count mode. Simply leave the direction input unconnected.

DISPLAY	MODE	INPUT A ACTION	INPUT B ACTION
Cnt ud	Count with Direction	Counter A	Counter A Direction
RAtE Cnt	Rate/Counter	Rate only	Counter A Add
dUAL Cnt	Dual Counter	Counter A Add	Counter B Add
QUAd 1	Quadrature x1	Count A	Quad A
QUAd 2	Quadrature x2	Count A	Quad A
QUAd 4	Quadrature x4	Count A	Quad A
Add Add	2 Input Add/Add	Counter A Add	Counter A Add
Add Sub	2 Input Add/Subtract	Counter A Add	Counter A Subtract

Note: The Rate indicator signal is derived from Input A in all count modes.

COUNTER A DECIMAL POSITION

CntA dP
0

0 · 0.0 · 0.00 · 0.000 · 0.0000 · 0.00000

This selects the decimal point position for Counter A. The selection will also affect Counter A scale factor calculations.

COUNTER A SCALE FACTOR

CntA ScF
01.0000

00.0001 to 99.9999

The number of input counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER A RESET ACTION

CntA rSt
to ZEro

to ZEro · to CtLd

When Counter A is reset, it returns to Zero or Counter A Count Load value. This reset action applies to all Counter A resets, except a setpoint generated Counter Auto Reset programmed in Module 4.

COUNTER A COUNT DIRECTION

CntA dir
NOr

NOr · rEU

Reverse (rEU) switches the normal Counter A count direction shown in the Count Mode parameter chart.

COUNTER A COUNT LOAD VALUE

CntA Ld
00000500

-9999999 to 99999999

Counter A resets to this value if Reset to Count Load action is selected.

COUNTER B BATCH COUNT ENABLE

Cntb bAt
NO

NO · SP1 · SP2 · SP1-2

The Counter B batch count function internally counts the number of output activations of the selected setpoint(s). The count source for the batch counter can be SP1, SP2 or both. Batch counting is available in all count modes except Dual Counter, which uses an external input signal for Counter B. This parameter only appears if a Setpoint Output option card is installed.

COUNTER B DECIMAL POSITION

Cntb dP
0

0 · 0.0 · 0.00 · 0.000 · 0.0000 · 0.00000

This selects the decimal point position for Counter B. The selection will also affect Counter B scale factor calculations.

COUNTER B SCALE FACTOR

Cntb ScF
01.0000

00.0001 to 99.9999

The number of input or batch counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input or batch counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER RESET AT POWER-UP

RSt P-UP
NO

NO · YES · NO · Count A · Count b · both · A-b

The selected counter(s) will reset at each meter power-up.

* For value entry instructions, refer to selection/value entry in the Programming The Meter section.

A

SCALING FOR COUNT INDICATION

The CUB5's scale factor is factory set to 1, to provide one count on the display for each pulse that is input to the unit. In many applications, there will not be a one-to-one correspondence between input pulses and display units. Therefore, it is necessary for the CUB5 to scale or multiply the input pulses by a scale factor to achieve the desired display units (feet, meters, gallons, etc.)

The Count Scale Factor Value can range from 00.0001 to 99.9999. It is important to note that the precision of a counter application cannot be improved by using a scale factor greater than one. To accomplish greater precision, more pulse information must be generated per measuring unit. The following formula is used to calculate the scale factor.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

WHERE:

Desired Display Units: Count display units acquired after pulses that occurred.

Number of Pulses: Number of pulses required to achieve the desired display units.

Decimal Point Position:

0	=	1
0.0	=	10
0.00	=	100
0.000	=	1000
0.0000	=	10000
0.00000	=	100000

EXAMPLE: The counter display is used to indicate the total number of feet used in a process. It is necessary to know the number of pulses for the desired units to be displayed. The decimal point is selected to show the resolution in hundredths.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

Given that 128 pulses are equal to 1 foot, display total feet with a one-hundredth resolution.

$$\text{Scale Factor} = \frac{1.00}{128} \times 100$$

$$\text{Scale Factor} = 0.007812 \times 100$$

$$\text{Scale Factor} = 0.7812$$

USER INPUT FUNCTION

USEr INP
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
Pro Loc	Program Mode Lock-out	See Programming Mode Access chart. (Module 3)
Inhibit	Inhibit	Inhibit counting for the selected counter(s).
rESEt	Maintained Reset	Level active reset of the selected counter(s).
StorE	Store	Freeze display of selected counter(s) while allowing counts to accumulate internally.
Stor-rSt	Store and Reset	Edge triggered reset of the selected counter(s) after storing the count.
d-SELECt	Display Select *	Advance once for each activation
d-LEUEL	Display Intensity Level *	Increase intensity one level for each activation. (backlight version only)
d-COLOr	Backlight Color *	Change backlight color with each activation (backlight version only)
Print	Print Request	Serial transmit of the active parameters selected in the Print Options (Module 5)
Prnt-rSt	Print and Reset *	Same as Print Request followed by a momentary reset of the selected counter(s).
rESEt-1	Setpoint 1 Reset *	Reset Setpoint 1 output
rESEt-2	Setpoint 2 Reset *	Reset Setpoint 2 output
rESEt-12	Setpoint 1 and 2 Reset *	Reset Setpoint 1 and 2 outputs

*Note: * indicates Edge Triggered function. Other functions are Level Active (maintained)*

USER INPUT ASSIGNMENT

USEr ASN
Count A

Count A   Count b   both A-b

The User Input Assignment is only active when Counter B is enabled and the User Input performs a Reset, Inhibit or Store function on one or both counters.

6.2 MODULE 2 - RATE SETUP PARAMETERS (2-rAtE)

PARAMETER MENU

2-rAtE → SEL → RAtE Enb — RAtE dP — RAtE dSP — RAtE INP — LO-Udt — HI-Udt → Pro

RAtE Enb	RAtE dP	RAtE dSP	RAtE INP	LO-Udt	HI-Udt
Rate Enable	Rate Decimal Point	Rate Scaling Display Value	Rate Scaling Input Value	Rate Low Update Time	Rate High Update Time

Module 2 is the programming for the rate parameters. For maximum input frequency, Rate Enable should be set to NO when not in use. When set to NO, the remaining rate parameters are not accessible. The rate value is shown with an annunciator of "R" in the Display Mode.

RATE ENABLE

RAtE Enb
YES

NO   YES

RATE DECIMAL POINT

RAtE dP
0

0   0.00   0.0000
0.0   0.000   0.00000

This selects the decimal point position for the rate display and any setpoint value assigned to rate. This parameter does not affect rate scaling calculations.

RATE SCALING DISPLAY VALUE

RAtE dSP
001000

0 to 999999

Enter the desired Rate Display Value for the Scaling Point.*

RATE SCALING INPUT VALUE

RAtE INP
01000.0

0.1 to 99999.9

Enter the corresponding Rate Input Value for the Scaling Point.*

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

SCALING FOR RATE INDICATION

To scale the rate, enter a Scaling Display value with a corresponding Scaling Input value. These values are internally plotted to a display value of 0 and input value of 0.0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The meter is capable of showing a rate display value for any linear process.

SCALING CALCULATION

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (RAtE dSP) and Scaling Input (RAtE INP). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (RAtE dSP)	INPUT (RAtE INP)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

NOTES:

1. If # of pulse per unit is less than 10, then multiply both Input and Display values by 10.
2. If # of pulse per unit is less than 1, then multiply both Input and Display values by 100.
3. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
4. Both values must be greater than 0.0.

EXAMPLE:

1. With 15.1 pulses per foot, show feet per minute in tenths. Scaling Display = 60.0 Scaling Input = 15.1.
2. With 0.25 pulses per gallon, show whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.) Scaling Display = 36000 Scaling Input = 2.5.

RATE LOW UPDATE TIME

LO-Udt

01.0

0.1 to 99.9 seconds

The Low Update Time is the minimum amount of time between display updates for the rate display. Values of 0.1 and 0.2 seconds will update the display correctly but may cause the display to appear unsteady.

RATE HIGH UPDATE TIME

HI-Udt

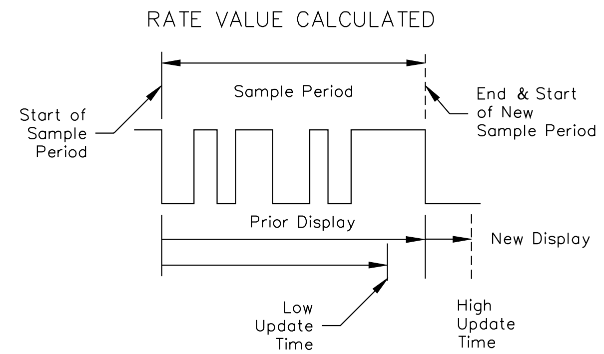
02.0

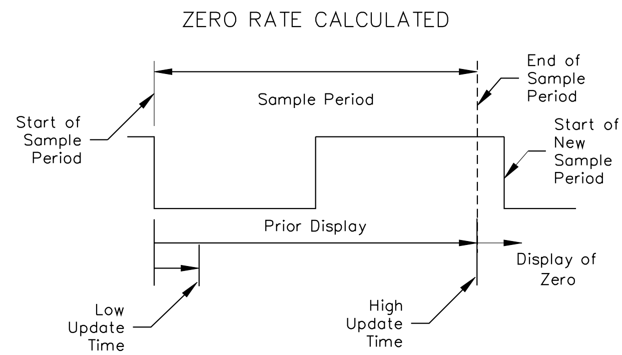
0.2 to 99.9 seconds

The High Update Time is the maximum amount of time before the rate display is forced to zero. (For more explanation, refer to Rate Value Calculation.) The High Update Time **must** be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.

INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by the scaling calculation.

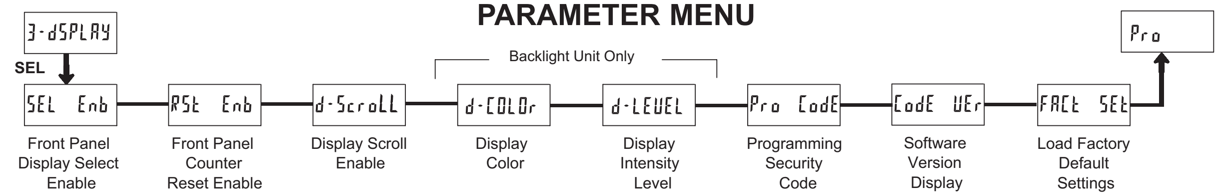




6.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSPLAY)

A

PARAMETER MENU



FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL Enb
YES

YES NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL COUNTER RESET ENABLE (RST)

rSt Enb
YES

YES NO both A-b
NO Count A dSPLAY
Count b

The YES selection allows the **RST** button to reset the selected counter(s). The shaded selections are only active when Counter B is enabled (Dual Count mode or batch counter).

DISPLAY SCROLL ENABLE

d-ScroLL
NO

YES NO

The YES selection allows the display to automatically scroll through the enabled displays. Each display is shown for 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

d-COLOr
rEd

rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEUEL
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

Pro CodE
000

0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used indepentently or along with the Program Mode Lock-out (Pro Loc) selection in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all unit parameters to be viewed and modified. Quick Programming mode permits only user selected values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Entering a Security Code from 1-99 enables Quick Programming mode, and displays a sublist to select what values appear in the Quick Programming menu. All applicable values set to YES in the sublist will be accessible in Quick Programming. The sublist includes Setpoint values (SP1 UAL, SP2 UAL), Output Time-out values (SP1 tOUt, SP2 tOUt), Counter A Count Load value (CntA Ld) and the Display Intensity Level (d-LEUEL) for backlight units.

Programming any Security Code other than 0, requires this code to be entered at the Pro CodE prompt in order to access Full Programming mode. Quick Programming mode, if enabled, is accessed before the Pro CodE prompt.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
not Pro Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at Pro CodE prompt *
		100-999	Pro CodE prompt	With correct code entry at Pro CodE prompt *
Pro Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	Pro CodE prompt	With correct code entry at Pro CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

SOFTWARE VERSION DISPLAY

CodE UEr
NO

NO YES

Select YES to momentarily display the meter software version before advancing to the next parameter. The software version is also displayed at power-up.

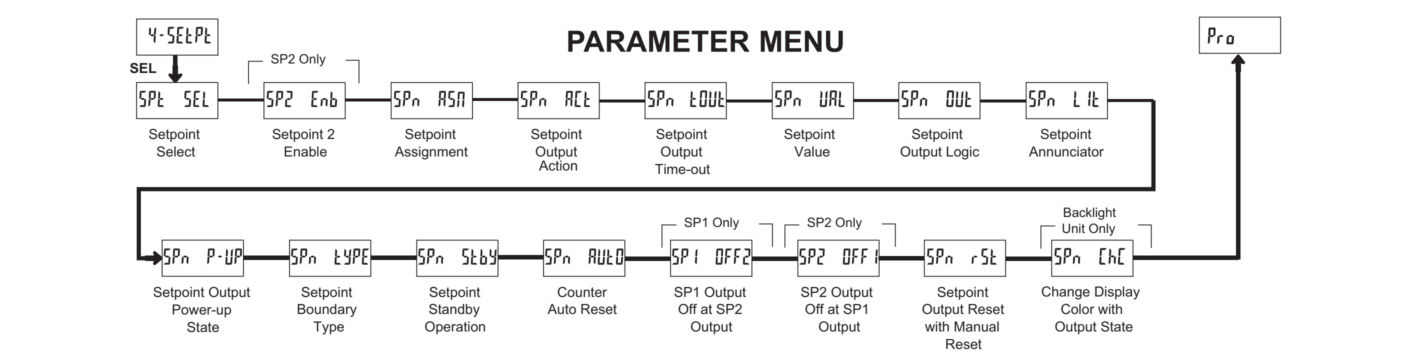
LOAD FACTORY DEFAULT SETTINGS

FACt SEt
NO

NO YES

The YES selection will return the meter to the factory default settings. The meter will display rESEt and then return to Pro, at which time all settings have been changed.

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SEtPt)



The Setpoint Output Parameters are only active when an optional Setpoint Output Module is installed in the meter. Some parameters in the menu will not appear depending on the Setpoint Assignment and Setpoint Output Action. The Setpoint Parameter Availability chart below illustrates this.

SETPOINT SELECT

SPt SEL
NO

NO SP1 SP2

Select the Setpoint Output to be programmed, starting with Setpoint 1. The "n" in the following parameters reflects the chosen Setpoint number. After Setpoint 1 is completely programmed, the display returns to SPt SEL. Repeat steps for Setpoint 2 if both Setpoints are used in the application.

Select NO to exit the Setpoint programming module. The number of Setpoints available is dependent on the Setpoint option module installed.

SETPOINT 2 ENABLE (SP2 Only)

SP2 Enb
NO

NO YES

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPt SEL and Setpoint 2 is disabled.

SETPOINT ASSIGNMENT

SPn ASN
Count A

Count A Count b rAtE

Select the display to which the Setpoint is assigned.

SETPOINT OUTPUT ACTION

SPn ACt
LAtCH

LAtCH t-OUt bOUNd

The parameter selects the action of the Setpoint Output as described in the chart. Boundary output action is not applicable for Counter B assignment.

SPT ACTION	DESCRIPTION	OUTPUT ACTIVATES	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	When Count = Setpoint	At Manual Reset (if SPn rSt=YES)
t-OUt	Timed Output Mode	When Count = Setpoint	After Setpoint Output Time-Out
bOUNd	Boundary Mode (High Acting Type)	When Count ≥ Setpoint	When Count < Setpoint
	Boundary Mode (Low Acting Type)	When Count ≤ Setpoint	When Count > Setpoint

SETPOINT PARAMETER AVAILABILITY

PARAMETER	DESCRIPTION	COUNTER ASSIGNMENT (A or B) *			RATE ASSIGNMENT		
		TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH	TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH
SPn tOUt	Setpoint Output Time-out Value	Yes	No	No	Yes	No	No
SPn VAL	Setpoint Value	Yes	Yes	Yes	Yes	Yes	Yes
SPn OUt	Setpoint Output Logic	Yes	Yes	Yes	Yes	Yes	Yes
SPn LIt	Setpoint Annunciator	Yes	Yes	Yes	Yes	Yes	Yes
SPn P-UP	Setpoint Output Power-up State	No	No	Yes	No	No	Yes
SPn tYPE	Setpoint Boundary Type	No	Yes	No	Yes	Yes	Yes
SPn Stby	Standby Operation (Low acting only)	No	Yes	No	Yes	Yes	Yes
SPn AUtO	Counter Auto Reset	Yes	No	Yes	No	No	No
SP1 OFF2	SP1 Output Off at SP2 (SP1 only)	Yes	No	Yes	No	No	No
SP2 OFF1	SP2 Output Off at SP1 (SP2 only)	Yes	No	Yes	No	No	No
SPn rSt	Output Reset with Manual Reset	Yes	No	Yes	Yes	No	Yes
SPn ChC	Change Display Color w/ Output State	Yes	Yes	Yes	Yes	Yes	Yes

** BOUNDARY Setpoint Action not applicable for Counter B Assignment*

A

SETPOINT OUTPUT TIME-OUT

SPn tOUt
001.00

0.01 to 599.99 seconds

This parameter is only active if the Setpoint Action is set to time out (t-OUt). Enter the value in seconds that the Setpoint output will be active, once the Setpoint Value is reached.

SETPOINT VALUE

SPn VAL
00000100

Count A: -9999999 to 99999999
Count B: 0 to 9999999
Rate: 0 to 999999

Enter the desired Setpoint value. To enter a negative setpoint value, increment digit 8 to display a "-" sign (Counter A only).

SETPOINT OUTPUT LOGIC

SPn OUt
nOr

nOr rEV

Normal (nOr) turns the output "on" when activated and "off" when deactivated. Reverse (rEV) turns the output "off" when activated and "on" when deactivated.

SETPOINT ANNUNCIATOR

SPn LIt
nOr

nOr rEV

Normal (nOr) displays the setpoint annunciator when the corresponding output is "on". Reverse (rEV) displays the setpoint annunciator when the output is "off".

SETPOINT OUTPUT POWER-UP STATE

SPn P-UP
OFF

OFF On SAVE

SAVE will restore the output to the same state it was at before the meter was powered down. On will activate the output at power up. OFF will deactivate the output at power up.

SETPOINT BOUNDARY TYPE

SPn tYPE
HI-ACt

HI-ACt LO-ACt

High Acting Boundary Type activates the output when the assigned display value (SPn ASN) equals or exceeds the Setpoint value. Low Acting activates the output when the assigned display value is less than or equal to the Setpoint.

SETPOINT STANDBY OPERATION

SPn Stby
NO

NO YES

This parameter only applies to Low Acting Boundary Type setpoints. Select YES to disable a Low Acting Setpoint at power-up, until the assigned display value crosses into the output "off" area. Once in the output "off" area, the Setpoint will then function per the description for Low Acting Boundary Type.

COUNTER AUTO RESET

SPn AUtO
NO

NO ZErO-Str CtLd-Str
ZErO-End CtLd-End

This parameter automatically resets the counter to which the setpoint is assigned (SPn ASN) each time the setpoint value is reached. The automatic reset can occur at output start, or at output end if the Setpoint Output Action is programmed for timed output mode. The Reset-to-Count Load selections ("CtLd-") only apply to Counter A assignment. This reset may be different from the Counter A Reset Action selected in Module 1.

SELECTION	ACTION
NO	No Auto Reset.
ZErO-Str	Reset to Zero at the start of output activation.
CtLd-Str	Reset to Count Load value at the start of output activation.
ZErO-End	Reset to Zero at the end of output activation (timed out only).
CtLd-End	Reset to Count Load value at the end of output activation (timed out only).

SETPOINT 1 OUTPUT OFF AT SETPOINT 2 (SP1 Only)

SP1 OFF2
NO

NO Out2-Str Out2-End

This parameter will deactivate Setpoint 1 output at the Start or End of Setpoint 2 output (O1 off at O2). The "-End" setting only applies if Setpoint 2 Output Action is programmed for timed output.

SETPOINT 2 OUTPUT OFF AT SETPOINT 1 (SP2 Only)

SP2 OFF1
NO

NO Out1-Str Out1-End

This parameter will deactivate Setpoint 2 output at the Start or End of Setpoint 1 output (O2 off at O1). The "-End" setting only applies if Setpoint 1 Output Action is programmed for timed output.

SETPOINT OUTPUT RESET WITH MANUAL RESET

SPn rSt
YES

YES NO

Selecting YES causes the Setpoint output to deactivate (reset) when the Setpoint Assigned Counter is reset. The counter reset can occur by the **RST** button, User Input, Counter Reset at Power-up or a serial Reset Counter command.

This output reset will not occur when the Assigned Counter is reset by a Setpoint generated Counter Auto Reset.

CHANGE DISPLAY COLOR WITH OUTPUT STATE

SPn ChC
NO

NO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SErIAL)

PARAMETER MENU

5-SErIAL → SEL → bAUd (Baud Rate) — dAtA (Data Bit) — PAritY (Parity Bit) — Addr (Meter Address) — Abbr (Abbreviated Printing) — Prnt OPt (Print Options) — COPY (Copy Program Settings) → Pro

The Serial Setup Parameters are only active when one of the optional serial communication/programming cards is installed in the meter.

Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements. This section replaces the bulletin shipped with the RS232 and RS485 serial communications plug-in cards. Discard the separate bulletin when using those serial plug-in cards with the CUB5B and CUB5R.

BAUD RATE

bAUd → 9600

300 1200 4800 19200
600 2400 9600 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA → 7-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAritY → Odd

NO Odd EVEN

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to NO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr → 00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr → NO

NO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select NO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS

Prnt OPt → NO

NO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as NO will not be sent.

The "Print All" (Prnt ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, Counter B or Scale Factor B will only be sent if Counter B is enabled (Dual Counter mode or batch count). Likewise, the Setpoint value(s) will not be sent unless an optional setpoint card is installed in the meter.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
Count A	Counter A	YES	CTA
Count b	Counter B	NO	CTB
RAtE	Rate Value	NO	RTE
CntA ScF	Scale Factor A	NO	SFA
Cntb ScF	Scale Factor B	NO	SFB
SP1	Setpoint 1	NO	SP1
SP2	Setpoint 2	NO	SP2
CntA Ld	Counter A Count Load	NO	CLD

COPY PROGRAM SETTINGS

COPY → NO

NO YES

This parameter is used to copy all the program settings from one CUB5 meter directly to another CUB5 meter, through the serial communications cards (RS232 or RS485). The USB programming card cannot be used for the copy procedure. No PC connection or additional software is required. Copying program settings eliminates the need for repetitive programming when multiple meters use identical settings.

Copy Requirements:

To copy program settings from one meter to another requires the following:

1. Both meters must have the same software version (Version 3.1 or later). The version is displayed during the meter power-up sequence, or in Module 3 at the Software Version Display parameter. (See Module 3 for details)
2. The meter receiving the program settings (receiver) must have the Baud Rate set to 9600 baud. Since this is the factory default setting, a new meter will arrive ready for copying. The meter sending the program settings (master) should be set to the desired Baud Rate for the application (if different than 9600). This Baud Rate setting will then be copied to the receiver.

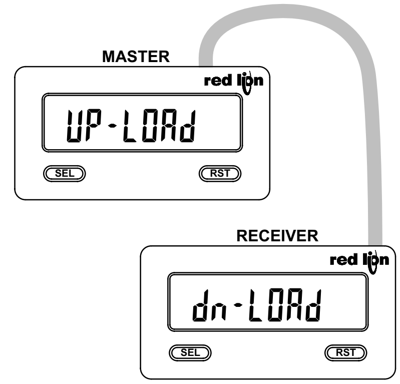
Copy Connections:

To connect the meters for copying, install a serial communications card of the same type into each meter (RS232 or RS485). Connect the meters using the proper cable listed in the chart.

TYPE	DESCRIPTION	PART NUMBER
RS232	Copy Cable RS232 10' (RJ12-RJ12)	CBLRLC02
RS485	Copy Cable RS485 10' (RJ12-RJ12)	CBLRLCS2

Copy Procedure:

1. Connect the master and receiver using the appropriate copy cable.
2. Apply power to the meters. The receiving meter must be operating in the normal display mode (not programming mode).
3. On the master meter, enter programming mode and proceed to the Copy Program Settings parameter in Module 5. Select YES to begin copying.
4. During the copy process (~ 2 sec.), the master meter displays an upload message (UP-LOAd) while the receiver displays a download message (dn-LOAd). This indicates successful communication between the master and receiver. If the receiver message is not displayed, be sure the proper cable is connected.
5. When copying is complete, the receiver displays the power-up sequence and returns to normal operating mode, programmed with all the same settings as the master meter. The master remains at the COPY prompt, ready to connect another receiver for copying.



Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, and numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a count value or setpoint output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Register Identification Chart

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Counter A	CTA	T, V, R	8 digit positive/7 digit negative (with minus sign)
B	Counter B	CTB	T, V, R	7 digit, positive only
C	Rate	RTE	T	6 digit, positive only
D	Scale Factor A	SFA	T, V	6 digit, positive only
E	Scale Factor B	SFB	T, V,	6 digit, positive only
F	Setpoint 1 (Reset Output 1)	SP1	T, V, R	per setpoint Assignment, same as Counter or Rate
G	Setpoint 2 (Reset Output 2)	SP2	T, V, R	per setpoint Assignment, same as Counter or Rate
H	Counter A Count Load Value	CLD	T, V	8 digit positive/7 digit negative (with minus sign)

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Command Response Time section for differences in meter response time when using the * and $ terminating characters.

Command String Examples:

1. Node address = 17, Write 350 to the Setpoint 1 value
   String: N17VF350*
2. Node address = 5, Read Counter A, response time of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 1 output
   String: RF*
4. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to transmit details listed in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> (carriage return)
20	<LF> (line feed)
21	<SP>* (Space)
22	<CR>* (carriage return)
23	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 18) is 12 characters long. When a requested counter or rate value exceeds the meter's display limits, an * (used as an overflow character) replaces a space in byte 7. Byte 8 is always a space.

The remaining ten positions of this field consist of a minus sign (for negative values), a floating decimal point (if applicable), and eight positions for the requested value. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> (carriage return)
14	<LF> (line feed)
15	<SP>* (Space)
16	<CR>* (carriage return)
17	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Counter A = 875
   17 CTA 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 1 = -250.5
   SP1 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 1 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 times the # of characters) / baud rate

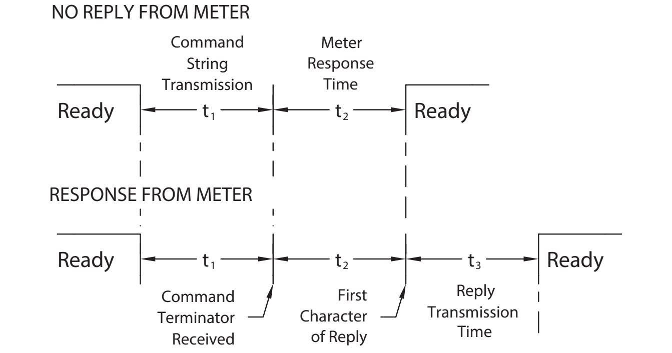
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

t_3 = (10 times the # of characters) / baud rate

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



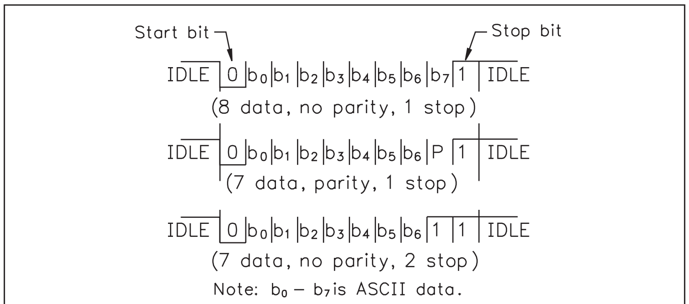
Timing Diagram Figure

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The CUB5 meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

MODEL PAXLC - PAX® LITE COUNTER

- *AVAILABLE IN 6 OR 8-DIGIT VERSIONS*
- *6-DIGIT, 0.56" (14.2 mm) / 8-DIGIT, 0.4" (10.1 mm) HIGH RED LED DISPLAYS*
- *ACCEPTS INPUT COUNT RATES UP TO 25 KHZ*
- *BI-DIRECTIONAL COUNTING*
- *REMOTE RESET CAPABILTY*
- *DISPLAY STORE*
- *COUNT INHIBIT*
- *PROGRAMMABLE SCALE FACTOR*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The PAX® Lite Counter, Model PAXLC, is a versatile totalizing counter that can be adapted to a wide variety of counting, measuring, and positioning readout applications.

The unit features a programmable scale factor, front panel and remote reset, store, inhibit, and a count rate of 25 KHz, while offering an economical solution to any totalizing need.

The PAXLC accepts digital inputs from a variety of sources including switch contacts, NPN-OC and TTL outputs, as well as most standard Red Lion sensors. The input can be scaled to display any desired unit of measure by simply using the programmable scale factor. The meter can accept bi-directional and uni-directional signals.

The meter is programmed through the front panel buttons and the use of DIP switches. The Down Arrow Key will also function as a front panel display reset. Once the front panel programming is complete, the buttons can be disabled by a DIP switch setting.

The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

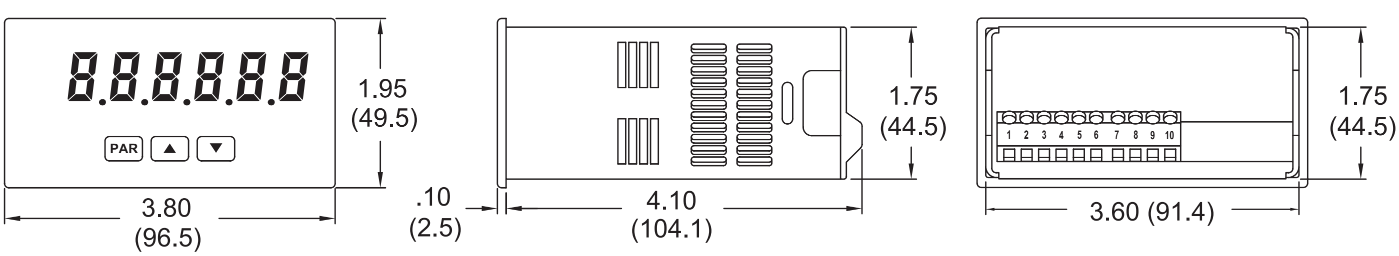


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

PAXL		**0**	**0**

C6 - 6 Digit Counter
C8 - 8 Digit Counter

General Meter Specifications

A

1. **DISPLAY**: 6-digit, 0.56" (14.2 mm) or 8-digit, 0.4" (10.1 mm) 7-segment red LED
   Display Range: 6-digit, -99999 to 999999 or 8-digit, -9999999 to 99999999
   Display Overflow indicated by flashing dot to the right of digit 1
   Decimal points are programmed by front panel keys
2. **POWER**:
   AC Power: 115/230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA.
   Isolation: 2300 Vrms for 1 min. to input and DC Out/In.
   DC Power: 10 to 16 VDC @ 0.1 A max.
3. **SENSOR POWER**: 9 to 17.5 VDC @ 100 mA max.
4. **KEYPAD**: 3 programming keys, the ▼ (Down Arrow) key can also function as the front panel reset button
5. **COUNT INPUT**: (DIP switch selectable)
   Accepts pulses from a variety of sources including switch contacts, NPN-OC and TTL Outputs, as well as most standard Red Lion® sensors
   Logic State: Active Low
   Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
   Current Sinking: Internal 7.8 KΩ pull-up to +12 VDC, I max = 1.9 mA
   Current Sourcing: Internal 3.9 KΩ pull-down, 8 mA max. @ 30 VDC max.
   Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
6. **MAXIMUM COUNT RATE**: 25 KHz max.
7. **CONTROL INPUTS**:
   Count Up/Down Control, Remote Reset, Inhibit, and Store
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Commons: Not isolated
   Logic State: Active Low, 22 KΩ pull-up to +12 V
   Active: V_{IN} < 0.9 VDC
   Inactive: V_{IN} > 3.6 VDC
   Response Time:
   Up/Down and Inhibit: 25 µsec max.
   Reset and Store: 10 msec. max.
8. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters and count values.
9. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 60°C
   Storage Temperature Range: -40 to 60°C
   Operating and Storage Humidity: 0 to 85% max. relative humidity non-condensing
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
   Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
10. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Report # 04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   IP20 Enclosure rating (Rear of unit), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A [2] 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A [2] 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000).

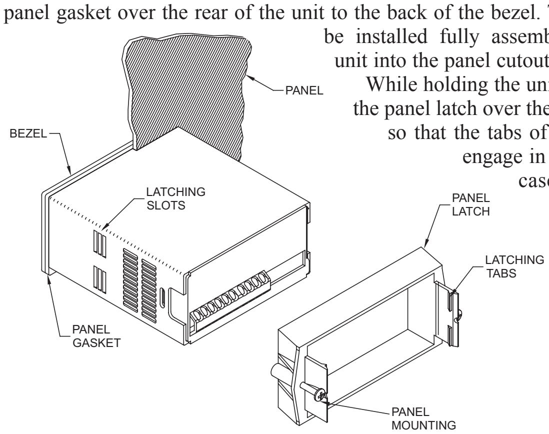
11. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 4.5 inch-lbs (0.51 N-m) max.
12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
13. **WEIGHT**: 12 oz. (340 g)

1.0 Installing the Meter

Installation

The PAX Lite meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



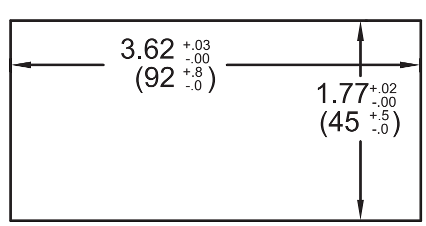
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Switches

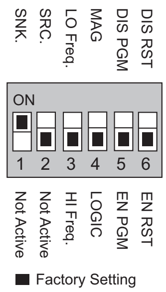
The meter has switches that must be checked and/or changed prior to applying power. To access the power switch, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Power Selection Switch

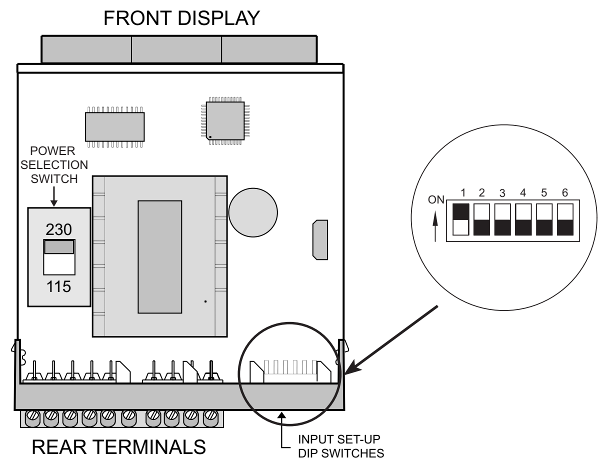
Caution: Insure the AC power selection switch is set for the proper voltage before powering-up the meter. The meter is shipped from the factory in the 230 VAC position.

Setup DIP Switches

A DIP switch is at the rear of the meter. It is used to set up the input, enable/disable programming and front panel reset functions. For the correct input setup, refer to 3.3 Wiring the Meter.



Switch 1
SNK.: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 1.9 mA
Switch 2
SRC: Adds internal 3.9 KΩ pull-down resistor, 8 mA max. @ 30 VDC max.
Switch 3
HI Frequency: Removes damping capacitor and allows max. frequency.
LO Frequency: Limits input frequency to 50 Hz and input pulse widths to 10 msec.
Switch 4
LOGIC: Input trigger levels V_{IL} = 1.5 V max; V_{IH} = 3.75 V max.
MAG: Not used for count applications.
Switch 5
Enable Programming: Enables programming through the front panel buttons.
Disables Programming: Disables the front panel buttons from any programming changes.
Switch 6
Enable Reset: Enables the front panel reset (down arrow key).
Disable Reset: Disables the front panel reset key. *Note: The remote reset terminal is not disabled by this switch.*



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

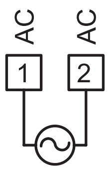
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

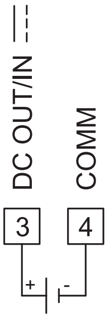
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

3.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC



DC Power
Terminal 3: +VDC
Terminal 4: COMM



3.2 CONTROL INPUT WIRING

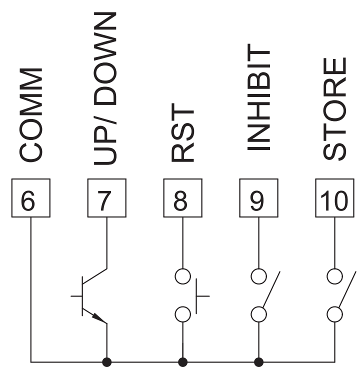
The PAXLC provides a number of control inputs, including Store, Reset, Inhibit and Up/Down control. These inputs are active low (connected to common), so the external switching device should be connected between the control input and common terminals.

Up/Down - This input determines the direction of the count. Unconnected, the meter will count up. When input is pulled low, the meter will count down.

Reset - When this input is pulled low, the meter will reset to zero. If the input remains low or connected to common, the meter will be held in the reset mode, and not able to count.

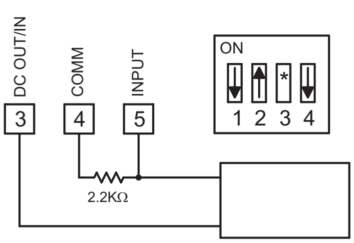
Inhibit - When low, this input will prevent the meter from counting. If the input remains low or connected to the common, the meter will not be able to count.

Store - A low will stop the display from updating. It will freeze the display as long as the input is held low. Once released the display will update to the current count display.

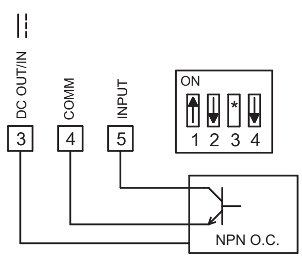


3.3 INPUT WIRING

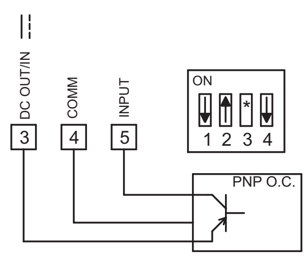
Two Wire Proximity, Current Source



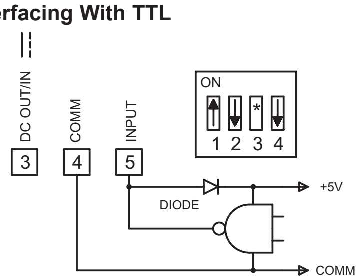
Current Sinking Output



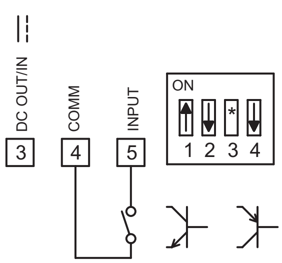
Current Sourcing Output



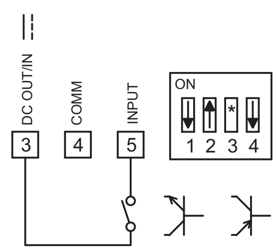
Interfacing With TTL



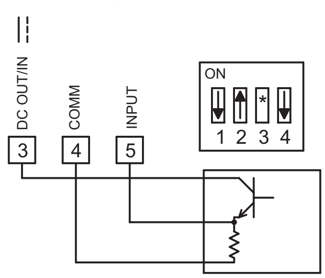
Switch or Isolated Transistor; Current Sink



Switch or Isolated Transistor; Current Source

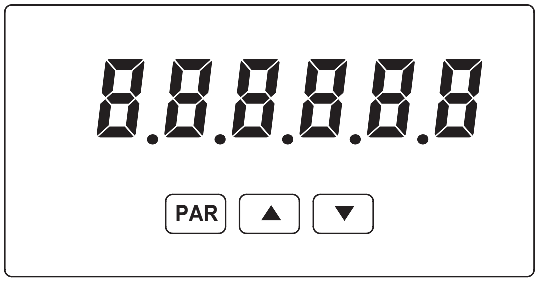


Emitter Follower; Current Source



*Switch position is application dependent.

4.0 Reviewing the Front Buttons and Display



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
▲	No Function	Increment selected digit of parameter value
▼	Front Panel Reset	Select digit position in parameter value

5.0 Scaling the Meter

In many industrial applications, a meter is required to totalize the output of an operation or event. The pulses from a sensor are received by the PAXLC, and then totalized on the display. In many cases the incoming pulses do not represent the desired display readout. For those applications, a scale factor can be entered into the meter, scaling the pulses to obtain the desired readout. The following formula will help provide the scaling values to achieve the desired readout.

$$SF = \frac{DR}{EPU}$$

WHERE:

SF = Scale Factor
DR = Desired Readout* (Single unit of measure, i.e. foot, gallon, etc.)
EPU = Existing Pulses per Unit (Number of pulses per single unit of measure, i.e. foot, gallons, etc.)

**For applications requiring a decimal point, select and program the appropriate decimal point. When calculating the Scale Factor, use the whole value of the number to be displayed, for example, 1.0 feet, the Desired Readout in this case is 10. Do not use decimal points in the Scaling Formula.*

For calculated SF values less than 9.99999

If the Scale Factor is a value less than 9.99999, it can be entered directly into the meter as the Scale Factor and the Scale Multiplier can be left at 1.

For calculated SF values greater than 9.99999

If the Scale Factor is a value over 9.99999 (maximum value), the Scale Multiplier must be used to reduce the calculated SF value until it is less then 9.99999. The Scale Multiplier multiplies the calculated Scale Factor value by 1, 0.1, and 0.01, thus reducing the calculated value accordingly. Select the appropriate Scale Multiplier value that allows the Scale Factor to be a value under 9.99999. Both the Scale Factor and Scale Multiplier can then be entered into the meter.

Example 1:

This application involves counting cases from a production line. The sensor provides a pulse for every can produced. The desired readout is in cases, therefore the incoming pulses need to be converted to obtain the proper readout. The following is used to calculate scale factor.

$$SF = \frac{DR}{EPU}$$

DR = 1 case
EPU = 12 cans/case

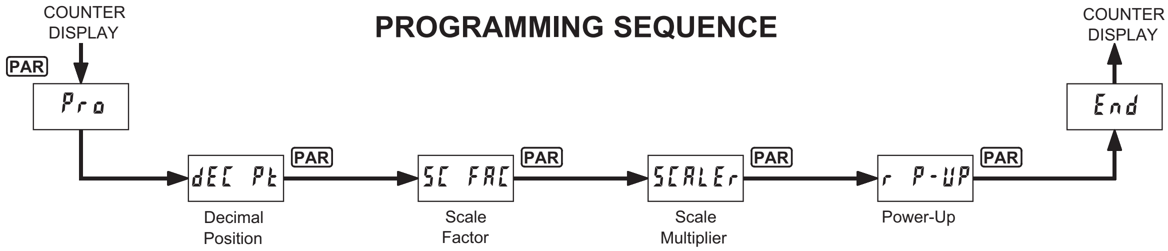
$$SF = \frac{1}{12}$$

SF = 0.083333

Since the Calculated Scale Factor Value is less than 9.99999, it can be entered directly into the meter. The Scale Multiplier can be left at 1.

6.0 PROGRAMMING THE METER

PROGRAMMING SEQUENCE



The Totalizer has four programmable parameters which are entered in the sequence shown above, using the front panel push buttons.

Before programming, refer to the section on Scaling the Meter to determine the Decimal Position, Scale Factor and Scale Multiplier to use for the specific application.

Note: Programming mode can be locked out with the Program Disable DIP switch. With the switch in the Disabled (up) position the meter will not enter programming mode. Refer to the section on DIP switch setup.

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING PARAMETERS

In programming mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

DECIMAL POSITION

dEC Pt ⇆ 0

0 0.00 0.0000
0.0 0.000 0.00000

This parameter selects the decimal point position on the display.

Press the arrow keys (▲ or ▼) to sequence through the selection list until the desired selection is shown. Press the **PAR** key to save the displayed selection and advance to the next parameter.

SCALE FACTOR

SC FAC ⇆ 1.00000

0.00001 to 9.99999

The number of input counts is multiplied by the Scale Factor and the Scale Multiplier to obtain the desired process value. A Scale Factor of 1.00000 and a Scale Multiplier of 1 will result in the display of the actual number of input counts. (See details on scaling calculations.)

The Scale Factor is displayed as a six-digit value with one selected digit flashing (initially digit 6). Press the ▲ (up arrow) key to increment the value of the selected (flashing) digit. Holding the ▲ key automatically scrolls the value of the selected digit.

Press the ▼ (down arrow) key to select the next digit position to the right. Use the ▲ key to increment the value of this digit to the desired number. Press the ▼ key again to select the next digit to be changed. Holding the ▼ key automatically scrolls through each digit position. Repeat the "select and set" sequence until all digits are displaying the desired Scale Factor value. Press the **PAR** key to save the displayed value and advance to the next parameter.

SCALE MULTIPLIER

SCALEr ⇆ 1

1 0.1 0.01

The number of input counts is multiplied by the Scale Multiplier and the Scale Factor to obtain the desired process value. A Scale Multiplier of 1 will result in only the Scale Factor affecting the display. (See details on scaling calculations.)

Press the arrow keys (▲ or ▼) to sequence through the selection list until the desired selection is displayed. Press the **PAR** key to save the selection and exit programming mode.

COUNTER RESET AT POWER-UP

r P-UP ⇆ NO

YES NO

The totalizer may be programmed to reset at each meter power-up.

PROGRAMMING MODE EXIT

The meter exits Programming Mode when the **PAR** key is pressed to save the Scale Multiplier selection. The meter briefly displays End upon exiting Programming Mode. All programmed selections are now transferred to the non-volatile memory and the meter returns to the Counter display.

(If power loss occurs during programming mode, verify parameter changes and reprogram, if necessary, when power is restored.)

PROGRAMMING MODE TIME OUT

The Programming Mode has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the Counter display. When automatic timeout occurs, any changes that were made to the parameter currently being programmed, will not be saved.

FACTORY SETTINGS

The factory settings for the programming parameters are shown above in the alternating display illustrations. The factory settings can be easily restored by removing power from the meter, and then pressing and holding the **PAR** key while power is reapplied. The meter displays rESEt until the **PAR** key is released. The normal power-up sequence then resumes, with the factory settings loaded and saved in non-volatile memory. The Count is reset to 0.

Note: The Program Disable DIP switch must be in the Enabled (down) position to allow loading factory settings. See section on DIP switch setup.

MODEL PAXLCR - PAX LITE DUAL COUNTER AND RATE METER

c UL US LISTED
IND. CONT. EQ.
51EB
For Model No. PAXLCRU0 Only

- *6 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *BUILT-IN BATCH COUNTING CAPABILITY*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAYS*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The PAXLCR is a versatile meter that provides a single or dual counter with rate indication, scaling and dual relay outputs. The 6-digit display has 0.56" high digits with adjustable display intensity. The display can be toggled manually or automatically between the selected counter and rate values.

The meter has two signal inputs and a choice of eight different count modes. These include bi-directional, quadrature and anti-coincidence counting, as well as a dual counter mode. When programmed as a Dual Counter, each counter has separate scaling and decimal point selection.

Rate indication is available in all count modes. The Rate Indicator has separate scaling and decimal point selection, along with programmable display update times. In addition to the signal inputs, the User Input can be programmed to perform a variety of meter control functions.

Two setpoint outputs are provided, each with a Form C relay. The outputs can activate based on either counter or rate setpoint values. An internal batch counter can be used to count setpoint output activations.

The PAXLCR can be powered from a wide range of AC or DC voltages. The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXLCR	Dual Counter & Rate Meter with Dual Relay Output	PAXLCR00
PAXLCRU	UL Listed Dual Counter & Rate Meter with Dual Relay Output	PAXLCRU0

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

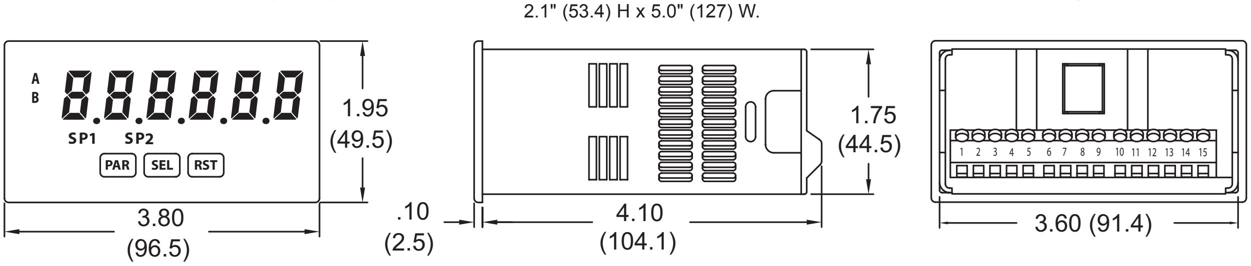
CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **DISPLAY**: 6 digit, 0.56" (14.2 mm) intensity adjustable Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 12 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs
   DC POWER: 21.6 to 250 VDC, 6 W
   DC Out: +24 VDC @ 100 mA if input voltage is greater than 50 VAC/VDC
   +24 VDC @ 50 mA if input voltage is less than 50 VDC
3. **COUNTER DISPLAYS**:
   Counter A: 6-digits, enabled in all count modes
   Display Designator: "A" to the left side of the display
   Display Range: -99999 to 999999
   Counter B: 6-digits, enabled in Dual Count mode or Batch Counter
   Display Designator: "B" to the left side of the display
   Display Range: 0 to 999999 (positive count only)
   Overflow Indication: Display "OLOL" alternates with overflowed count value
   Maximum Count Rates: 50% duty cycle, count mode dependent.
   With setpoints disabled: 25 KHz, all modes except Quadrature x4 (23 KHz).
   With setpoint(s) enabled: 20 KHz, all modes except Dual Counter (14 KHz), Quadrature x2 (13 KHz) and Quadrature x4 (12 KHz).

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.



4. **RATE DISPLAY**: 6-digits, may be enabled or disabled in any count mode
   Display Range: 0 to 999999
   Over Range Display: "OLOL"
   Maximum Frequency: 25 KHz
   Minimum Frequency: 0.01 Hz
   Accuracy: ±0.01%
5. **COUNT/RATE SIGNAL INPUTS (INPUT A and INPUT B)**:
   See Section 2.0 Setting the DIP Switches for complete Input specifications. DIP switch selectable inputs accept pulses from a variety of sources. Both inputs allow selectable active low or active high logic, and selectable input filtering for low frequency signals or switch contact debounce.
   Input A: Logic level or magnetic pickup signals.
   Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
   Mag. pickup sensitivity: 200 mV peak, 100 mV hysteresis, 40 V peak max.
   Input B: Logic level signals only
   Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
6. **USER INPUT**: Programmable
   Software selectable for active logic state: active low, pull-up (24.7 KΩ to +5 VDC) or active high, pull-down resistor (20 KΩ).
   Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 10 msec typ.; 50 msec debounce (activation and release)
7. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and count values when power is removed.
8. **OUTPUTS**:
   Type: Dual Form C contacts
   Isolation to Input & User/Exc Commons: 1400 Vrms for 1 min. Working Voltage: 150 Vrms
   Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
   Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads.
   Response Time: Turn On or Off: 4 msec max.
9. **ENVIRONMENTAL CONDITIONS**:
   Operating temperature: 0 to 50 °C
   Storage temperature: -40 to 70 °C
   Operating and storage humidity: 0 to 85% max. RH (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g's.
   Shock According to IEC 68-2-27: Operational 30 g (10g relay), 11 msec in 3 directions.
   Altitude: Up to 2,000 meters
10. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
12. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    Type 4X Enclosure rating (Face only), UL50
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    IP20 Enclosure rating (Rear of unit), IEC 529
    For Model No. PAXLCRU0 Only: UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion C 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion C: Temporary loss of function which requires operator intervention.

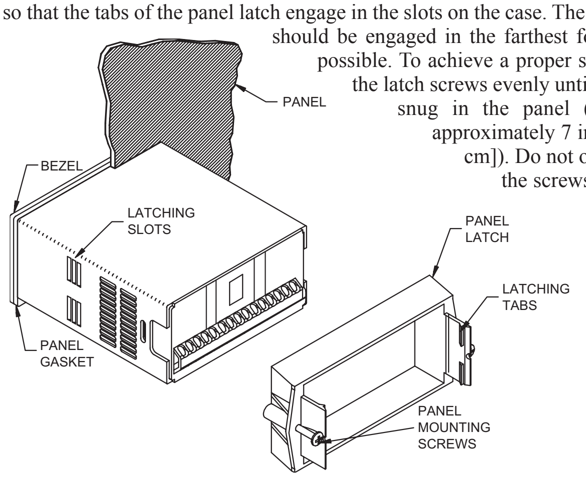
13. **WEIGHT**: 10.4 oz. (295 g)

1.0 INSTALLING THE METER

Installation

The PAX Lite meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



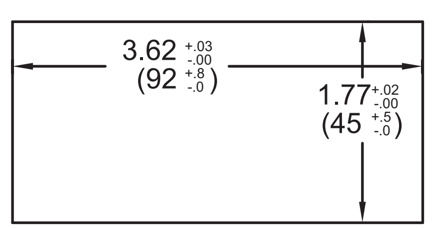
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the DIP Switches

To access the switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start on the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

SWITCH 1 (Input A)

LOGIC: Input A trigger levels V_{IL} = 1.25 V max.; V_{IH} = 2.75 V min.; V_{MAX} = 28 VDC

MAG: 200 mV peak input sensitivity; 100 mV hysteresis; maximum voltage: 40 V peak (28 Vrms); Must also have Input A SRC switch ON. (Not recommended with counting applications.)

SWITCH 2 (Input A) {See Note 1}

SNK.: Adds internal 7.8 KΩ pull-up resistor to +5 VDC, I_{MAX} = 0.7 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 3 (Input A)

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.

SWITCH 4 (Input B) {See Note 1}

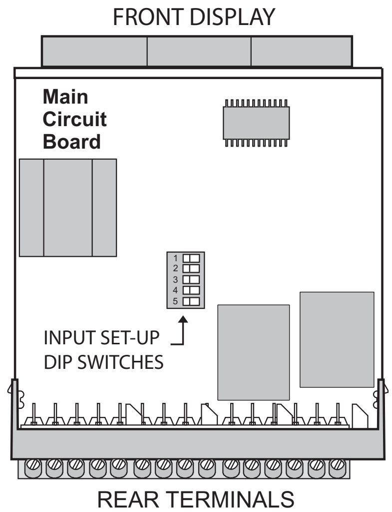
SNK.: Adds internal 7.8 KΩ pull-up resistor to +5 VDC, I_{MAX} = 0.7 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

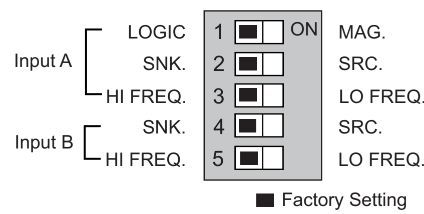
SWITCH 5 (Input B)

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.



Note 1: When the DIP switch is in the SNK position (OFF), the signal input is configured as active low. When the switch is in the SRC position (ON), the signal input is configured as active high.



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

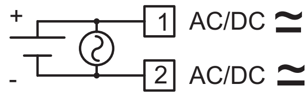
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

3.1 POWER WIRING

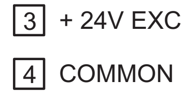
Power

Terminal 1: VAC/DC +
Terminal 2: VAC/DC -



DC Out Power

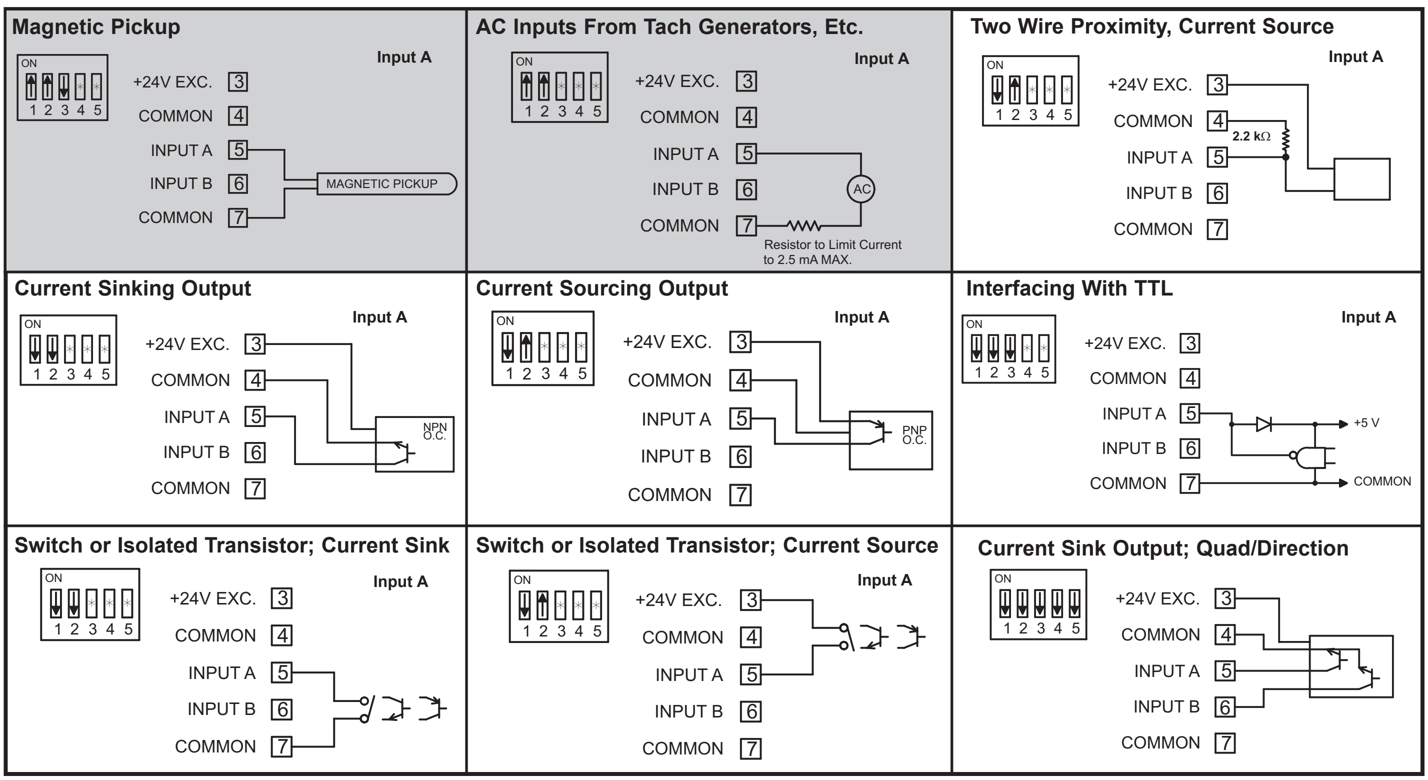
Terminal 3: + 24 VDC OUT
Terminal 4: Common



3.2 INPUT SIGNAL WIRING

The meter provides a choice of eight different count modes using two signal inputs, A and B. The Count Mode selected determines the action of Inputs A and B. Section 5.1, Input Setup Parameters, provides details on count mode selection and input action.

CAUTION: DC common (Terminal 4) is NOT isolated from Input common (Terminal 7) or User common (Terminal 9). In order to preserve the safety of the meter application, DC common must be suitably isolated from hazardous live earth referenced voltage; or Input common and User common must be at protective earth ground potential. If not, hazardous voltage may be present at the Signal or User Inputs, and Input or User common terminals. Appropriate considerations must then be given to the potential of the Input or User common with respect to earth ground.



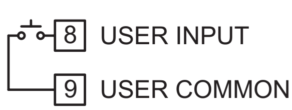
* Switch position is application dependent.

Shaded areas not recommended for counting applications.

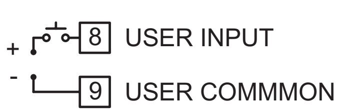
3.3 USER INPUT WIRING

Terminal 8: User Input
Terminal 9: User Common

Current Sinking (Active Low Logic)

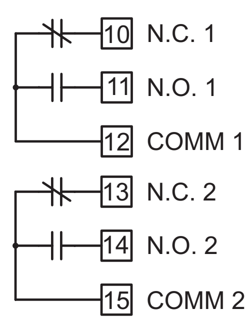


Current Sourcing (Active High Logic)

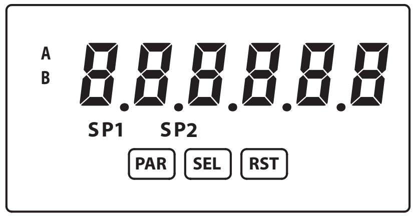


3.4 SETPOINT (OUTPUT) WIRING

Terminal 10: NC 1
Terminal 11: NO 1
Terminal 12: Relay 1 Common
Terminal 13: NC 2
Terminal 14: NO 2
Terminal 15: Relay 2 Common



4.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL	Index display through enabled values	Advance through selection list/select digit position in parameter value
RST	Resets count display(s) and/or outputs	Increment selected digit of parameter value

OPERATING MODE DISPLAY DESIGNATORS

"A" - Counter A value
"B" - Counter B value (dual count or batch)
- Rate value is displayed with no designator

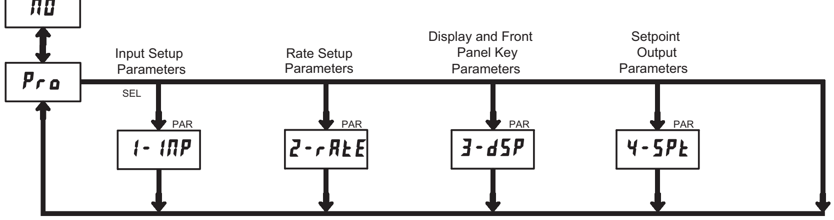
"SP1" - Indicates setpoint 1 output status.
"SP2" - Indicates setpoint 2 output status.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** button. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL & PAR BUTTONS)

The Programming Menu is organized into four modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL** button is used to select the desired module. The displayed module is entered by pressing the **PAR** button.

MODULE MENU (PAR BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro nO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL** and **RST** buttons are used to move through the selections/values for that parameter. Pressing the **PAR** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST** button increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will select the next digit to the left. Pressing the **PAR** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR BUTTON)

The Programming Mode is exited by pressing the **PAR** button with Pro nO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

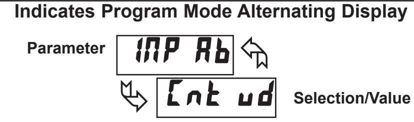
FACTORY SETTINGS

Factory Settings may be completely restored in Module 3. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.

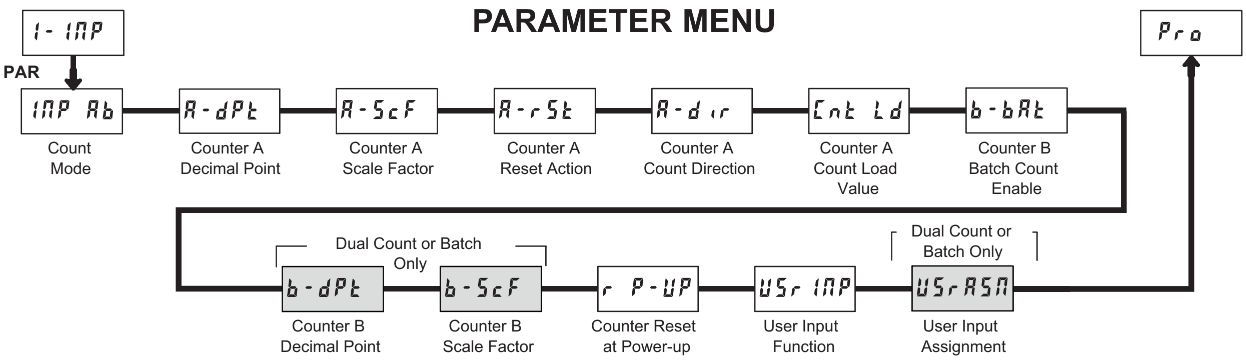
Indicates Program Mode Alternating Display



Factory Settings are shown.

5.1 MODULE 1 - INPUT SETUP PARAMETERS (1- INP)

PARAMETER MENU



Shaded area selections only apply when Counter B is enabled (Dual Count mode or batch counter).

COUNT MODE

INP Ab / Cnt ud

Cnt ud, rt-Cnt, dUAL, qUAd 1, qUAd 2, qUAd 4, AddAdd, AddSub

Select the count mode that corresponds with your application. The input actions are shown in the boxes below. For simple counting applications, it is recommended to use Count with Direction for the count mode. Simply leave the direction input unconnected.

DISPLAY	MODE	INPUT A ACTION	INPUT B ACTION
Cnt ud	Count with Direction	Counter A	Counter A Direction
rt-Cnt	Rate/Counter	Rate only	Counter A Add
dUAL	Dual Counter	Counter A Add	Counter B Add
qUAd 1	Quadrature x1	Count A	Quad A
qUAd 2	Quadrature x2	Count A	Quad A
qUAd 4	Quadrature x4	Count A	Quad A
AddAdd	2 Input Add/Add	Counter A Add	Counter A Add
AddSub	2 Input Add/Subtract	Counter A Add	Counter A Subtract

Note: The Rate indicator signal is derived from Input A in all count modes.

COUNTER A DECIMAL POSITION

A-dPt / 0

0, 0.0, 0.00, 0.000, 0.0000, 0.00000

This selects the decimal point position for Counter A. The selection will also affect Counter A scale factor calculations.

COUNTER A SCALE FACTOR

A-ScF / 01.0000

00.0001 to 99.9999

The number of input counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER A RESET ACTION

A-rSt / ZEro

ZEro, Cnt Ld

When Counter A is reset, it returns to Zero or Counter A Count Load value. This reset action applies to all Counter A resets, except a Setpoint generated Counter Auto Reset programmed in Module 4.

COUNTER A COUNT DIRECTION

A-dir / NOr

NOr, rEU

Reverse (rEU) switches the normal Counter A count direction shown in the Count Mode parameter chart.

COUNTER A COUNT LOAD VALUE

Cnt Ld / 000500

-99999 to 999999

Counter A resets to this value if Reset to Count Load action is selected. To enter a negative Count Load value, increment digit 6 to display a "-" sign.*

COUNTER B BATCH COUNT ENABLE

b-bAt / NO

NO, SP-1, SP-2, SP1-2

The Counter B Batch Count function internally counts the number of output activations of the selected setpoint(s). The count source for the batch counter can be SP1, SP2 or both. Batch counting is available in all count modes except Dual Counter, which uses an external input signal for Counter B.

COUNTER B DECIMAL POSITION

b-dPt / 0

0, 0.0, 0.00, 0.000, 0.0000, 0.00000

This selects the decimal point position for Counter B. The selection will also affect Counter B scale factor calculations.

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

A

COUNTER B SCALE FACTOR

b-ScF
01.0000

00.0001 to 99.9999

The number of input or batch counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input or batch counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER RESET AT POWER-UP

r P-UP
NO

NO	NO	Cnt b
YES	Cnt A	both

The selected counter(s) will reset at each meter power-up.

SCALING FOR COUNT INDICATION

The counter's scale factor is factory set to 1, to provide one count on the display for each pulse that is input to the unit. In many applications, there will not be a one-to-one correspondence between input pulses and display units. Therefore, it is necessary for the meter to scale or multiply the input pulses by a scale factor to achieve the desired display units (feet, meters, gallons, etc.)

The Count Scale Factor Value can range from 00.0001 to 99.9999. It is important to note that the precision of a counter application cannot be improved by using a scale factor greater than one. To accomplish greater precision, more pulse information must be generated per measuring unit. The following formula is used to calculate the scale factor.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

WHERE:

Desired Display Units: Count display units acquired after pulses that occurred.
Number of Pulses: Number of pulses required to achieve the desired display units.

Decimal Point Position:

0	=	1
0.0	=	10
0.00	=	100
0.000	=	1000
0.0000	=	10000
0.00000	=	100000

EXAMPLE 1: The counter display is used to indicate the total number of feet used in a process. It is necessary to know the number of pulses for the desired units to be displayed. The decimal point is selected to show the resolution in hundredths.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

Given that 128 pulses are equal to 1 foot, display total feet with a one-hundredth resolution.

$$\text{Scale Factor} = \frac{1.00}{128} \times 100$$

$$\text{Scale Factor} = 0.007812 \times 100$$
$$\text{Scale Factor} = 0.7812$$

EXAMPLE 2: A manufacturer wants to count the total number of bricks molded in a process yielding 12 bricks per mold. The counter receives 1 pulse per mold and should increase by 12 for each pulse received. Since single brick accuracy is not required, a Scale Factor greater than 1 can be used in this case.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

$$\text{Scale Factor} = \frac{12}{1} \times 1$$

$$\text{Scale Factor} = 12.0000$$

USER INPUT FUNCTION

USr INP
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
ProLoc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
Inh ibt	Inhibit	Inhibit counting for the selected counter(s).
rESEt	Maintained Reset	Level active reset of the selected counter(s).
StorE	Store	Freeze display for the selected counter(s) while allowing counts to accumulate internally.
St-rSt	Store and Reset	Edge triggered reset of the selected counter(s) after storing the count.
d-SEL	Display Select *	Advance once for each activation.
d-LEU	Display Intensity Level *	Increase intensity one level for each activation.
rSt-1	Setpoint 1 Reset *	Reset setpoint 1 output.
rSt-2	Setpoint 2 Reset *	Reset setpoint 2 output.
rSt-12	Setpoint 1 and 2 Reset *	Reset both setpoint 1 and 2 outputs.

** Indicates Edge Triggered function. All others are Level Active functions.*

USER INPUT ASSIGNMENT

USrASN
Cnt A

Cnt A
Cnt b
both

The User Input Assignment is only active when Counter B is enabled and the user input selection performs a Reset, Inhibit or Store function on one or both of the counters.

USER INPUT ACTIVE LEVEL

USrACt
LO

LO HI

Select whether the user input is configured as active low or active high.

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

5.2 MODULE 2 - RATE SETUP PARAMETERS (2-rAtE)

PARAMETER MENU

2-rAtE → PAR → rt-Enb — rt-dPt — StYLE — rt-dSP — rt-InP — LO-Udt — HI-Udt → Pro

rt-Enb	rt-dPt	StYLE	rt-dSP	rt-InP	LO-Udt	HI-Udt
Rate Enable	Rate Decimal Point	Rate Input Scaling Style	Rate Scaling Display Value	Rate Scaling Input Value	Rate Low Update Time	Rate High Update Time

RATE ENABLE

rt-Enb
YES

nO YES

This parameter enables the Rate display. For maximum input frequency, Rate Enable should be set to nO when not in use. When set to nO, the remaining rate parameters are not accessible.

RATE DECIMAL POINT

rt-dPt
0

0 0.0 0.00 0.000 0.0000 0.00000

This selects the decimal point position for the rate display. This parameter does not affect rate scaling calculations.

RATE INPUT SCALING STYLE

StYLE
KEY

KEY APLY

If a Rate Input value (in Hz) and the corresponding Rate Display value are known, the Key-in (KEY) Scaling Style can be used. This allows rate scaling without the presence of a rate input signal.

If the Rate Input value has to be derived from the actual rate input signal, the Apply (APLY) Scaling Style should be used.

RATE SCALING DISPLAY VALUE

rt-dSP
001000

0 to 999999

Enter the desired Rate Display value. This value is entered using the front panel buttons for either Scaling Style.*

RATE SCALING INPUT VALUE

rt-InP
01000.0

0.1 to 99999.9

Enter the corresponding Rate Input value using the Scaling Style selected.

Key-in Style:

Enter the Rate Input value using the front panel buttons. This value is always in pulses per second (Hz).*

Apply Style:

The meter initially shows the stored Rate Input value. To retain this value, press **PAR** to advance to the next parameter. To enter a new value, apply the rate input signal to Input A. Press **RST** and the applied input frequency (in Hz) will appear on the display. To insure the correct reading, wait several rate sample periods (see Rate Low Update Time) or until a consistent reading is displayed. Press **PAR** to store the displayed value as the new Rate Input value.

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

RATE LOW UPDATE TIME (DISPLAY UPDATE)

LO-Udt
01.0

0.1 to 99.9 seconds

The Low Update Time is the minimum amount of time between display updates for the Rate display. Values of 0.1 and 0.2 seconds will update the display correctly but may cause the display to appear unsteady.

RATE HIGH UPDATE TIME (DISPLAY ZERO)

HI-Udt
02.0

0.2 to 99.9 seconds

The High Update Time is the maximum amount of time before the Rate display is forced to zero. (For more explanation, refer to Input Frequency Calculation.) The High Update Time **must** be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.

SCALING FOR RATE INDICATION

To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. These values are internally plotted to a Display value of 0 and Input value of 0.0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The meter is capable of showing a rate display value for any positive slope linear process.

SCALING CALCULATION FOR KEY-IN STYLE

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (rt-dSP) and Scaling Input (rt-InP). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (rt-dSP)	INPUT (rt-InP)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

NOTES:

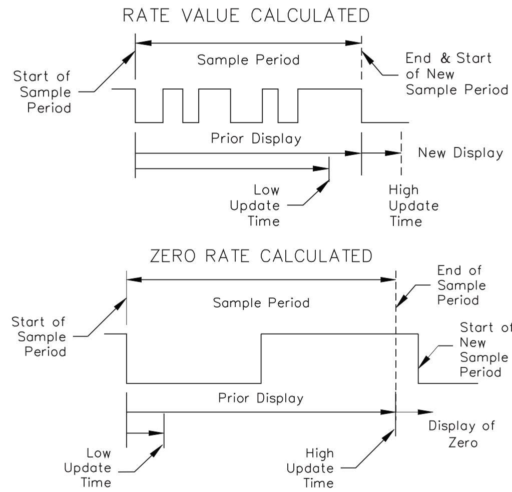
1. If # of pulses per unit is less than 1, multiply both Input and Display values by 10 or 100 as needed to obtain greater accuracy.
2. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
3. Both values must be greater than 0.

EXAMPLE:

1. With 15.1 pulses per foot, show feet per minute in tenths. Scaling Display = 60.0 Scaling Input = 15.1.
2. With 0.25 pulses per gallon, show whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.) Scaling Display = 36000 Scaling Input = 2.5.

INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by the scaling calculation.



5.3 MODULE 3 - Display and Front Panel Key Parameters (3-dSP)

PARAMETER MENU

3-dSP → PAR → SEL-En — rSt-En — ScroLL — d-LEU — CodE — FCS → Pro

SEL-En	rSt-En	ScroLL	d-LEU	CodE	FCS
Display Select Enable	Front Panel Reset Enable	Display Scroll Enable	Display Intensity Level	Programming Security Code	Factory Service Operations

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL-En
YES

NO YES

The YES selection allows the **SEL** key to toggle through the enabled displays.

FRONT PANEL COUNTER RESET ENABLE (RST)

rSt-En
YES

NO NO both
YES Cnt A dSPLAY
Cnt b

The YES selection allows the **RST** key to reset the selected counter(s). The shaded selections are only active when Counter B is enabled (Dual Count Mode or batch counter).

DISPLAY SCROLL ENABLE

ScroLL
NO

NO YES

The YES selection allows the display to automatically scroll through the enabled displays. Each display is shown for 4 seconds.

DISPLAY INTENSITY LEVEL

d-LEU
3

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE
000

0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (ProLoc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all unit parameters to be viewed and modified. Quick Programming mode permits only user selected values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Entering a Security Code from 1-99 enables Quick Programming mode, and displays a sublist to select which values appear in the Quick Programming menu. All of the values set to YES in the sublist are accessible in Quick Programming. The values include Setpoints (SP-1, SP-2), Output Time-outs (tOUt-1, tOUt-2), Count Load value (Cnt Ld) and Display Intensity (d-LEU).

Programming any Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Quick Programming mode, if enabled, is accessed before the CodE prompt appears.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
not ProLoc	———	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
ProLoc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

FACTORY SERVICE OPERATIONS

FCS — NO

NO YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE — 66

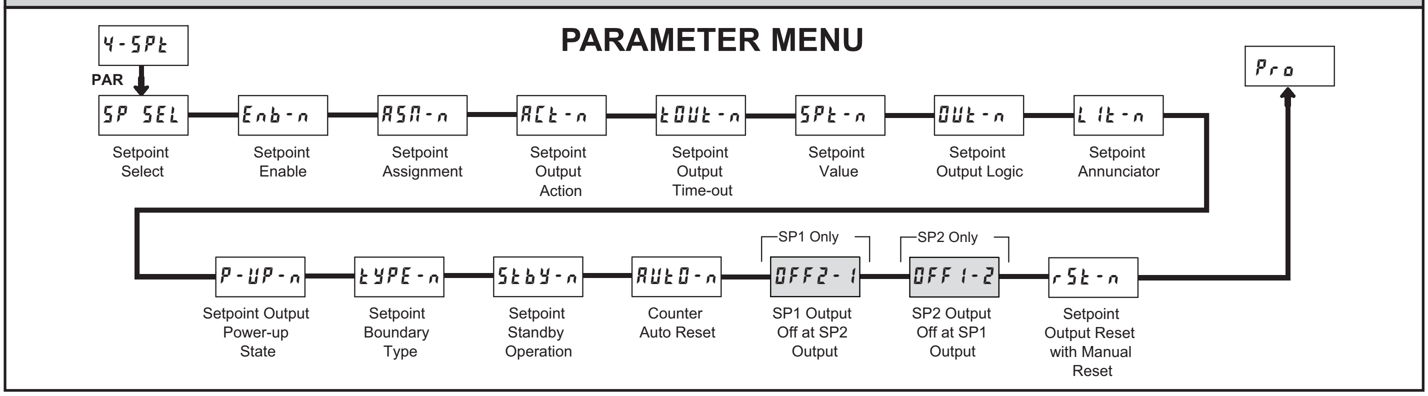
Entering Code 66 will overwrite all user settings with the factory default settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** button to exit the module.

VIEW MODEL AND VERSION DISPLAY

CodE — 50

Entering Code 50 will display the model and version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** button to exit the module.

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



Some Setpoint parameters will not appear depending on the Setpoint Assignment and Setpoint Output Action selected. The Setpoint Parameter Availability chart below illustrates this.

PARAMETER	DESCRIPTION	COUNTER ASSIGNMENT (A or B)*			RATE ASSIGNMENT		
		TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH	TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH
tOUt-n	Setpoint Output Time-out Value	Yes	No	No	Yes	No	No
SPt-n	Setpoint Value	Yes	Yes	Yes	Yes	Yes	Yes
Out-n	Setpoint Output Logic	Yes	Yes	Yes	Yes	Yes	Yes
Lit-n	Setpoint Annunciator	Yes	Yes	Yes	Yes	Yes	Yes
P-UP-n	Setpoint Output Power-up State	No	No	Yes	No	No	Yes
tYPE-n	Setpoint Boundary Type	No	Yes	No	Yes	Yes	Yes
Stby-n	Standby Operation (Low ActingOnly)	No	Yes	No	Yes	Yes	Yes
AUtO-n	Counter Auto Reset	Yes	No	Yes	No	No	No
OFF2-1	SP1 Output Off at SP2 (SP1 only)	Yes	No	Yes	No	No	No
OFF1-2	SP2 Output Off at SP1 (SP2 only)	Yes	No	Yes	No	No	No
rSt-n	Output Reset with Manual Reset	Yes	No	Yes	Yes	No	Yes

* BOUNDARY Setpoint Action not applicable for Counter B assignment.

SETPOINT SELECT

SP SEL — NO

NO
SP-1
SP-2

Select the Setpoint Output to be programmed, starting with Setpoint 1. The "n" in the following parameters reflects the chosen Setpoint number. After the selected setpoint is completely programmed, the display returns to SP SEL. Repeat steps for Setpoint 2 if both Setpoints are being used. Select NO to exit the Setpoint programming module.

SETPOINT ENABLE

Enb-n — NO

NO YES

Select YES to enable the chosen setpoint and access the setup parameters. If NO is selected, the unit returns to SP SEL and the setpoint is disabled.

SETPOINT ASSIGNMENT

ASN-n — Cnt A

Cnt A
Cnt b
rAtE

Select the display to which the Setpoint is assigned.

A

SETPOINT OUTPUT ACTION

ACt-n
LAtCH

LAtCH
t-OUt
bOUnd

This parameter selects the action of the Setpoint output as described in the chart below. Boundary mode is not applicable for Counter B assignment.

SPT ACTION	DESCRIPTION	OUTPUT ACTIVATES	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	When Count = Setpoint	At Manual Reset (if rSt-n=YES)
t-OUt	Timed Output Mode	When Count = Setpoint	After Setpoint Output Time-Out
bOUnd	Boundary Mode (High Acting)	When Count ≥ Setpoint	When Count < Setpoint
	Boundary Mode (Low Acting)	When Count ≤ Setpoint	When Count > Setpoint

SETPOINT OUTPUT TIME-OUT

tOUt-n
001.00

0.01 to 599.99 seconds

This parameter is only active if the Setpoint Action is set to timed output mode (t-OUt). Enter the value in seconds that the output will be active, once the Setpoint Value is reached.

SETPOINT VALUE

SPt-n
000100

Count A: -99999 to 999999
Count B: 0 to 999999
Rate: 0 to 999999

Enter the desired Setpoint value. To enter a negative setpoint value, increment digit 6 to display a "-" sign (Counter A only).

SETPOINT OUTPUT LOGIC

OUt-n
nOr

nOr rEU

Normal (nOr) turns the output "on" when activated and "off" when deactivated. Reverse (rEU) turns the output "off" when activated and "on" when deactivated.

SETPOINT ANNUNCIATOR

LIt-n
nOr

nOr rEU

Normal (nOr) displays the setpoint annunciator when the corresponding output is "on". Reverse (rEU) displays the setpoint annunciator when the output is "off".

SETPOINT OUTPUT POWER-UP STATE

P-UP-n
OFF

OFF
on
SAUE

SAUE will restore the output to the same state it was at before the meter was powered down. on will activate the output at power up. OFF will deactivate the output at power up.

SETPOINT BOUNDARY TYPE

tYPE-n
HI-ACt

HI-ACt LO-ACt

High Acting Boundary Type activates the output when the assigned display value (ASn-n) equals or exceeds the Setpoint value. Low Acting activates the output when the assigned display value is less than or equal to the Setpoint.

SETPOINT STANDBY OPERATION

StbY-n
nO

nO YES

This parameter only applies to Low Acting Boundary Type setpoints. Select YES to disable a Low Acting Setpoint at power-up, until the assigned display value crosses into the output "off" area. Once in the output "off" area, the Setpoint will then function per the description for Low Acting Boundary Type.

COUNTER AUTO RESET

AUtO-n
nO

nO ZEr-St CLd-St
ZEr-En CLd-En

This parameter automatically resets the Setpoint Assigned Counter (A or B) each time the Setpoint value is reached. The automatic reset can occur at output start, or output end if the Setpoint Output Action is programmed for timed output mode. The Reset-to-Count Load selections ("CLd-") only apply to Counter A assignment. This reset may be different from the Counter A Reset Action selected in Module 1.

SELECTION	ACTION
nO	No Auto Reset
ZEr-St	Reset to Zero at the Start of output activation
CLd-St	Reset to Count Load value at the Start of output activation
ZEr-En	Reset to Zero at the End of output activation (timed out only)
CLd-En	Reset to Count Load at the End of output activation (timed out only)

SETPOINT 1 OUTPUT OFF AT SETPOINT 2 (SP1 Only)

OFF2-1
nO

nO
O2-Str
O2-End

This parameter will deactivate Setpoint 1 output at the Start or End of Setpoint 2 output (O1 off at O2). The "-End" setting only applies if Setpoint 2 Output Action is programmed for timed output.

SETPOINT 2 OUTPUT OFF AT SETPOINT 1 (SP2 Only)

OFF1-2
nO

nO
O1-Str
O1-End

This parameter will deactivate Setpoint 2 output at the Start or End of Setpoint 1 output (O2 off at O1). The "-End" setting only applies if Setpoint 1 Output Action is programmed for timed output.

SETPOINT OUTPUT RESET WITH MANUAL RESET

rSt-n
YES

nO YES

Selecting YES causes the Setpoint output to deactivate (reset) when the Setpoint Assigned Counter is reset. The counter reset can occur by the **RST** button, User Input or Counter Reset at Power-up.

This output reset will not occur when the Assigned Counter is reset by a Setpoint generated Counter Auto Reset.

MODEL PAX - 1/8 DIN DIGITAL INPUT PANEL METERS

MODELS: Counter/Rate (PAXI) Counter (PAXC) Rate (PAXR)

- *COUNT, DUAL COUNTER, RATE AND SLAVE DISPLAY*
- *0.56" RED SUNLIGHT READABLE DISPLAY*
- *VARIABLE INTENSITY DISPLAY*
- *10 POINT SCALING FOR NON-LINEAR PROCESSES (PAXI)*
- *FOUR SETPOINT ALARM OUTPUTS (W/Option Card)*
- *RETRANSMITTED ANALOG OUTPUT (W/Option Card) (PAXI)*
- *COMMUNICATION AND BUS CAPABILITIES (W/Option Card) (PAXI)*
- *BUS CAPABILITIES; DEVICENET, MODBUS, AND PROFIBUS-DP*
- *CRIMSON® PROGRAMMING SOFTWARE (PAXI)*
- *ETHERNET(W/ External Gateway) (PAXI)*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The PAX Digital Input Panel Meters offer many features and performance capabilities to suit a wide range of industrial applications. Available in three different models, PAXC Counter/Dual Counter, PAXR Rate Meter and the PAXI which offers both counting and rate in the same package. Refer to pages 4 - 5 for the details on the specific models. The PAXC and PAXR offer only the Setpoint Option, while the PAXI is the fully featured version offering all the capabilities as outlined in this bulletin as well as a slave display feature. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs.

The meters employ a bright 0.56" LED display. The meters are available with a red sunlight readable or standard green LED display. The intensity of the display can be adjusted from dark room applications up to sunlight readable, making it ideal for viewing in bright light applications.

The meters accept digital inputs from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups and all standard RLC sensors. The meter can accept directional, uni-directional or Quadrature signals simultaneously. The maximum input signal varies up to 34 KHz depending on the count mode and function configurations programmed. Each input signal can be independently scaled to various process values.

The Rate Meters provide a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The meters have four setpoint outputs, implemented on Plug-in option cards. The Plug-in cards provide dual FORM-C relays (5A), quad FORM-A (3A), or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

Communication and Bus Capabilities are also available as option cards for the PAXI only. These include RS232, RS485, Modbus, DeviceNet, and Profibus-DP. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meters have a feature that allows a remote computer to directly control the outputs of the meter. With an RS232 or RS485 card installed, it is possible to configure the meter using Red Lion's Crimson software. The configuration data can be saved to a file for later recall.

A linear DC output signal is available as an optional Plug-in card for the PAXI only. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track any of the counter or rate displays.

Once the meters have been initially configured, the parameter list may be locked out from further modification in its entirety or only the setpoint values can be made accessible.

The meters have been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

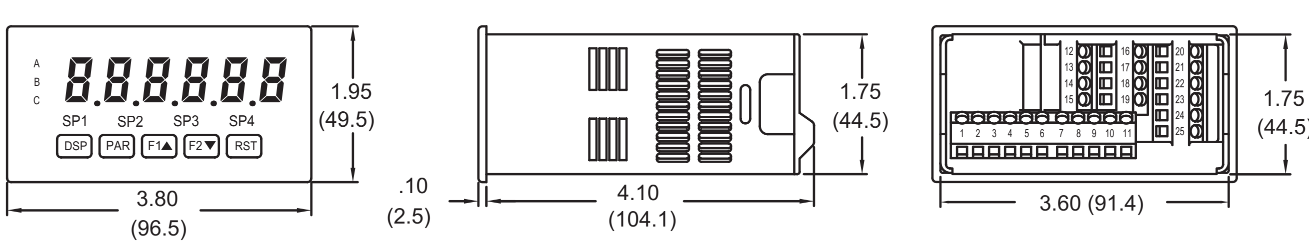
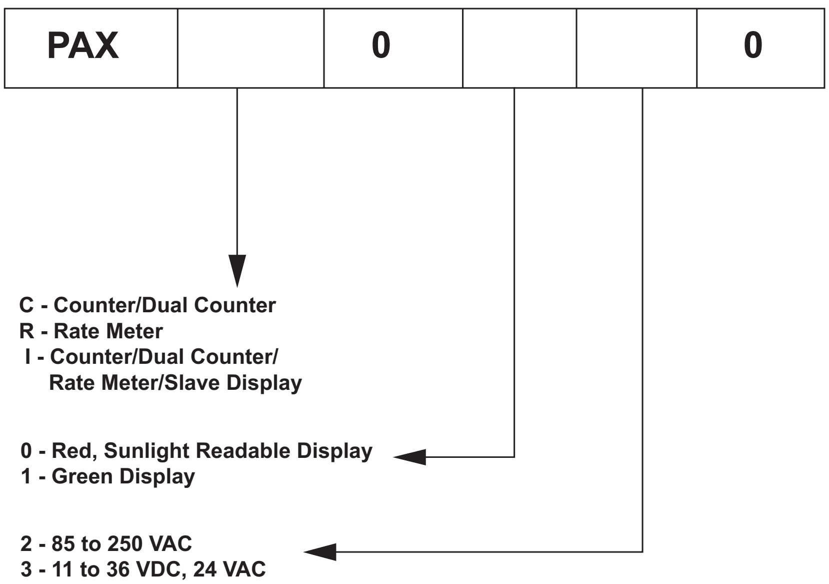


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers



Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC[1]	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXUSB	PAX USB Programming Card (Not included in PAX product UL E179259 file).	PAXUSB00
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	SFCRD[2]	Crimson PC Configuration Software for Windows 2000, XP and Windows 7	SFCRD200
	ICM8	Communication Gateway	ICM80000

Notes:
1. For Modbus communications use RS485 Communications Card and configure Communication Type parameter (tYPE) for Modbus.
2. Crimson software is available for free download from http://www.redlion.net/
3. Shaded areas are only available for the PAXI

GENERAL METER SPECIFICATIONS

1. **DISPLAY:** 6 digit, 0.56" (14.2 mm) red sunlight readable or standard green LED
2. **POWER:**
   AC Versions:
   AC Power: 85 to 250 VAC, 50/60 Hz, 18 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs. (300 V working)
   DC Versions:
   DC Power: 11 to 36 VDC, 14 W
   (derate operating temperature to 40° C if operating <15 VDC and three plug-in option cards are installed)
   AC Power: 24 VAC, ± 10%, 50/60 Hz, 15 VA
   Isolation: 500 Vrms for 1 min. to all inputs and outputs (50 V working).
3. **SENSOR POWER:** 12 VDC, ±10%, 100 mA max. Short circuit protected
4. **KEYPAD:** 3 programmable function keys, 5 keys total
5. **USER INPUTS:** Three programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Commons: Not isolated
   Logic State: Jumper selectable for sink/source logic

INPUT STATE	SINKING INPUTS 5.1 KΩ pull-up to +12 V	SOURCING INPUTS 5.1 KΩ pull-down
Active	V_{IN} < 0.9 VDC	V_{IN} > 2.4 VDC
Inactive	V_{IN} > 2.4 VDC	V_{IN} < 0.9 VDC

   Response Time: 6 msec. typical; function dependent. Certain resets, stores and inhibits respond within 25 µsec if an edge occurs with the associated counter or within 6 msec if no count edge occurs with the associated counter. These functions include CtrStL, CtrStE, HLrStL, HLrStE, InHibt, StOrE, and PrArSt. Once activated, all functions are latched for 50 msec min. to 100 msec max. After that period, another edge/level may be recognized.
6. **MEMORY:** Nonvolatile memory retains all programmable parameters and display values when power is removed.
7. **CERTIFICATIONS AND COMPLIANCES:**
   SAFETY
   UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Enclosure rating (Face only), UL50
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   IP20 Enclosure rating (Rear of unit), IEC 529

   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326:2006: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m (80 MHz to 1 GHz) 3 V/m (1.4 GHz to 2 GHz) 1 V/m (2 GHz to 2.7 GHz)
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV I/O signal 2 kV I/O signal connected to power
Surge	EN 61000-4-5 power signal	Criterion A 1 kV L to L, 2 kV L to G 1 kV
RF conducted interference	EN 61000-4-6	Criterion A 3 Vrms
Power freq magnetic fields	EN 61000-4-8	Criterion A 30 A/m
AC power	EN 61000-4-11	
Voltage dip		Criterion A 0% during 1 cycle 40% during 10/12 cycle 70% during 25/30 cycle
Short interruptions		Criterion C 0% during 250/300 cycles
Emissions:		
Emissions	EN 55011	Class A

   Notes:
   1. Criterion A: Normal operation within specified limits.
   2. Criterion C: Temporary loss of function where system reset occurs.

   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature Range: 0 to 50°C (0 to 45°C with all three plug-in cards installed)
   Storage Temperature Range: -40 to 60°C
   Operating and Storage Humidity: 0 to 85% max. relative humidity non-condensing
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
   Shock According to IEC 68-2-27: Operational 25 g (10 g relay), 11 msec in 3 directions.
   Altitude: Up to 2000 meters
9. **CONNECTIONS:** High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 4.5 inch-lbs (0.51 N-m) max.
10. **CONSTRUCTION:** This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
11. **WEIGHT:** 10.1 oz. (286 g)

MODEL PAXC - 1/8 DIN COUNTER

- *6-DIGIT LED DISPLAY (Alternating 8 digits for counting)*
- *DUAL COUNT QUAD INPUTS*
- *UP TO 3 COUNT DISPLAYS*
- *SETPOINT ALARM OUTPUTS (W/Plug-in card)*

PAXC SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES:
To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	**Single**: Counter A or B				**Dual**: Counter A & B			
Are any setpoints used?	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	18	15	13	12	9	7.5
Count x2	17	13	9	7	9	7	5	4
Quadrature x1	22	19	12	10	7	6	4	3.5
Quadrature x2	17	13	9	7	7	6	4	3.5
Quadrature x4	8	6	4	3				

Notes:
1. Counter Modes are explained in the Module 1 programming section.
2. Listed values are with frequency DIP switch set on HI frequency.

ANNUNCIATORS:
A - Counter A
B - Counter B
C - Counter C
OF - Upper significant digit display of counter
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

COUNTER DISPLAYS:
Maximum display: 8 digits: ± 99999999 (greater than 6 digits, display alternates between high order and low order.)

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

MODEL PAXR - 1/8 DIN RATE METER

- *5-DIGIT LED DISPLAY*
- *RATE INDICATION*
- *MINIMUM/MAXIMUM RATE DISPLAYS*
- *SETPOINT ALARM OUTPUTS (W/Plug-in card)*

PAXR SPECIFICATIONS

ANNUNCIATORS:
r - Rate
H - Maximum (High) Rate
L - Minimum (Low) Rate
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

RATE DISPLAY:
Accuracy: ±0.01%
Minimum Frequency: 0.01 Hz
Maximum Frequency: 34 KHz
Maximum Display: 5 Digits: 99999
Adjustable Display (low) Update: 0.1 to 99.9 seconds
Over Range Display: “r OLOL”

INPUT A:
DIP switch selectable to accept pulses from a variety of sources including TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms

MODEL PAXI - 1/8 DIN COUNTER/RATE METER

- COUNT, RATE AND SLAVE DISPLAY
- 6-DIGIT 0.56" RED SUNLIGHT READABLE DISPLAY
- VARIABLE INTENSITY DISPLAY
- 10 POINT SCALING (FOR NON-LINEAR PROCESSES)
- FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)
- RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)
- COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)
- BUS CAPABILITIES; DEVICENET, MODBUS, AND PROFIBUS-DP
- CRIMSON PROGRAMMING SOFTWARE

PAXI SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES TABLE

To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	Single: Counter A or B (with/without rate) or Rate only								Dual: Counter A & B or Rate not assigned to active single counter							
Are any setpoints used?	N	N	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
Is Prescaler Output used?	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)				(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	21	17	18	15	13	11	13	12	13	11	9	7.5	9	7
Count x2	17	13	16	12	9	7	8	7	9 *	7 *	9 *	7 *	5 *	4 *	5 *	4 *
Quadrature x1	22	19	20	17	12	10	11	10	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x2	17	13	16	12	9	7	8	6	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x4	8	6	8	6	4	3	4	3								
Rate Only	34	N/A	21	N/A	34	N/A	21	N/A								

Notes:

1. Counter Modes are explained in the Module 1 programming section.
2. If using Rate with single counter with direction or quadrature, assign it to Input A for the listed frequency.
3. * Double the listed value for Rate frequency.
4. Listed values are with frequency DIP switch set on HI frequency.
5. Derate listed frequencies by 20% during serial communications. (Placing a 5 msec. delay between serial characters will eliminate the derating.)

ANNUNCIATORS:

A - Counter A
B - Counter B
C - Counter C
r - Rate
H - Maximum (High) Rate
L - Minimum (Low) Rate
OF - Upper significant digit display of counter
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

RATE DISPLAY:

Accuracy: ±0.01%
Minimum Frequency: 0.01 Hz
Maximum Frequency: see Max Signal Frequencies Table.
Maximum Display: 5 Digits: 99999
Adjustable Display (low) Update: 0.1 to 99.9 seconds
Over Range Display: "r OLOL"

COUNTER DISPLAYS:

Maximum display: 8 digits: ± 99999999 (greater than 6 digits, the display alternates between high order and low order.)

INPUTS A and B:

DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.

LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.

MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms

DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

PRESCALER OUTPUT:

NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. With duty cycle of 25% min. and 50 % max.

OPTIONAL PLUG-IN OUTPUT CARDS

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

PAXI COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, a Windows® based program, the RS232, RS485 or USB Cards must be used. *Note: For Modbus communications use RS485 Communications Output Card and configure Communication Type parameter (tYPE) for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC50 - Profibus-DP
PAXCDC20 - RS232 Serial (Terminal)	PAXUSB00 - USB (Mini B)
PAXCDC2C - RS232 Serial (Connector)	

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PAXUSB PROGRAMMING CARD

Type: USB Virtual Comms Port
Connection: Type mini B
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Baud Rate: 1200 to 38,400
Unit Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol)

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson software is a Windows® based program that allows configuration of the PAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. A PAX serial plug-in card or PAX USB programming card is required to program the meter using the software.

SETPOINT CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @120 VAC, inductive load
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads
Response Time: 5 msec. nominal pull-in with 3 msec. nominal release
Timed Output Accuracy: Counter = ± 0.01% + 10 msec.
Rate = ± 0.01% + 20 msec.

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 250 VAC or 30 VDC (resistive load), 1/10 HP @120 VAC, inductive load
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads
Response Time: 5 msec. nominal pull-in with 3 msec. nominal release
Timed Output Accuracy: Counter = ± 0.01% + 10 msec.
Rate = ± 0.01% + 20 msec.

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V
Response Time: Counter = 25 µsec; Rate = Low Update time
Timed Output Accuracy: Counter = ± 0.01% + 10 msec.
Rate = ± 0.01% + 20 msec.

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 24 VDC ± 10% , 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output
Response Time: Counter = 25 µsec; Rate = Low Update time
Timed Output Accuracy: Counter = ± 0.01% + 10 msec.
Rate = ± 0.01% + 20 msec.

PAXI ANALOG OUTPUT CARD (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD - Self-Powered Output (Active)

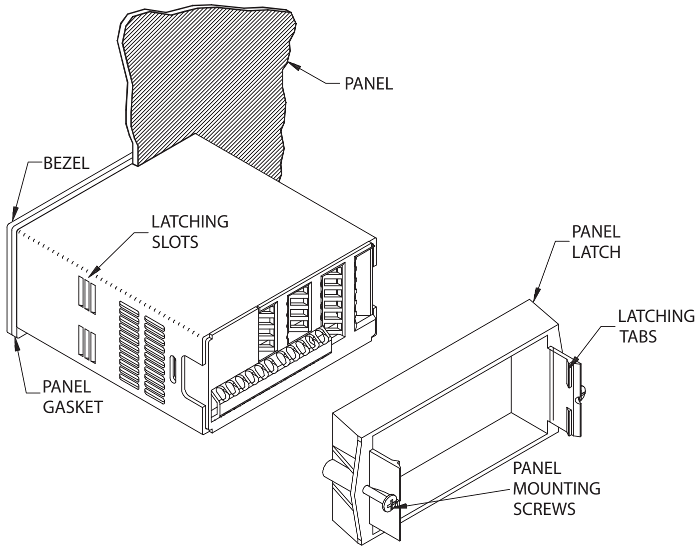
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28°C); 0.4% of FS (0 to 50°C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Response Time: 50 msec. max., 10 msec. typ.

1.0 Installing the Meter

A

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

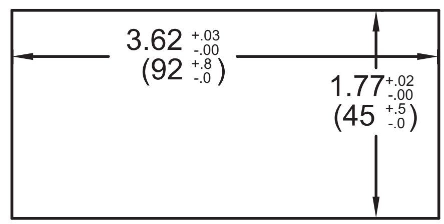
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Jumper and DIP Switches

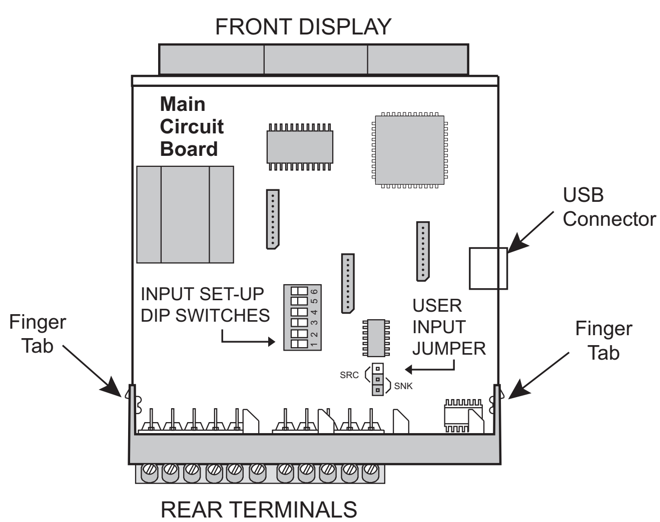
To access the jumper and switches, remove the meter base from the meter case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

2.1 SETTING THE JUMPER

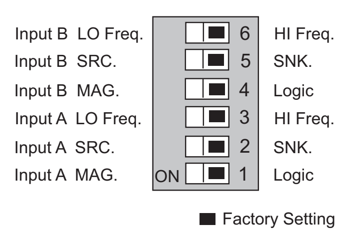
The meter has one jumper for user input logic. When using the user inputs this jumper must be set before applying power. The Main Circuit Board figure shows the location of the jumper and DIP switch.

The user input jumper determines signal logic for the user inputs, when they are used with user functions or for input signal direction. All user inputs are set by this jumper.



2.2 SETTING THE INPUT DIP SWITCHES

The meter has six DIP switches for Input A and Input B terminal set-up that must be set before applying power. NOTE: The PAXR only uses switches 1-3.



SWITCHES 1 and 4

LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.

MAG: 200 mV peak input (must also have SRC on). Not recommended with counting applications.

SWITCHES 2 and 5

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.

SNK.: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 1.9 mA.

SWITCHES 3 and 6

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Also limits input frequency to 50 Hz and input pulse widths to 10 msec.

3.0 Installing Plug-In Cards

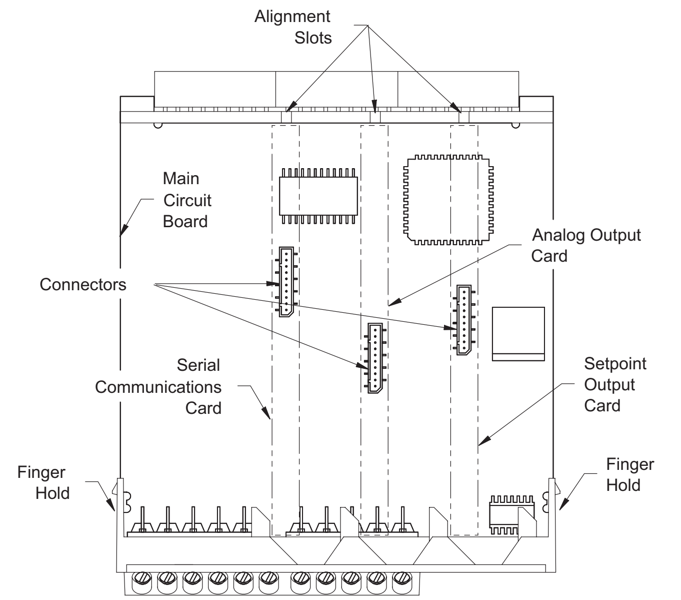
The Plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The Plug-in cards have many unique functions when used with the PAX.
Note: The PAXC and PAXR only use the setpoint option card.

CAUTION: The Plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

To Install:

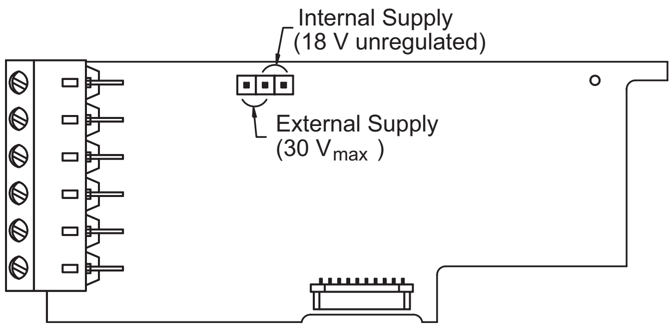
1. With the case open, locate the Plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.*
2. Install the Plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the Plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the Plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

TOP VIEW



Quad Sourcing Open Collector Output Card Supply Select

* If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



4.0 Wiring the Meter

Wiring Overview

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC Installation Guidelines

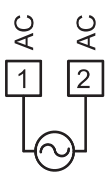
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC# FCOR0000)
   TDK # ZCAT3035-1330A
   Steward # 28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (RLC# LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

4.1 POWER WIRING

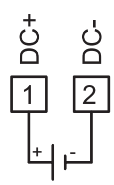
AC Power

Terminal 1: VAC
Terminal 2: VAC



DC Power

Terminal 1: +VDC
Terminal 2: -VDC



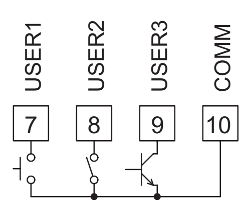
4.2 USER INPUT WIRING

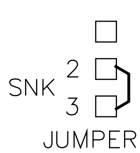
Before connecting the wires, the User Input Logic Jumper should be verified for proper position. If User Input 1 and/or 2 are wired for quadrature or directional counting, an additional switching device should not be connected to that User Input terminal. Only the appropriate User Input terminal has to be wired.

Sinking Logic

Terminals 7-9
Terminal 10 } Connect external switching device between the appropriate User Input terminal and User Comm.

The user inputs of the meter are internally pulled up to +12 V with 5.1 K resistance. The input is active when it is pulled low (<0 .9 V).

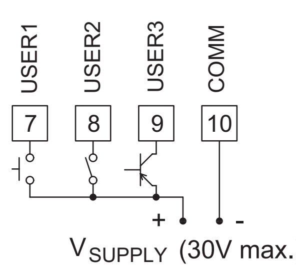


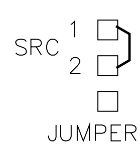


Sourcing Logic

Terminals 7-9:
+ VDC through external switching device
Terminal 10:
-VDC through external switching device

The user inputs of the meter are internally pulled down to 0 V with 5.1 K resistance. The input is active when a voltage greater than 2.4 VDC is applied.

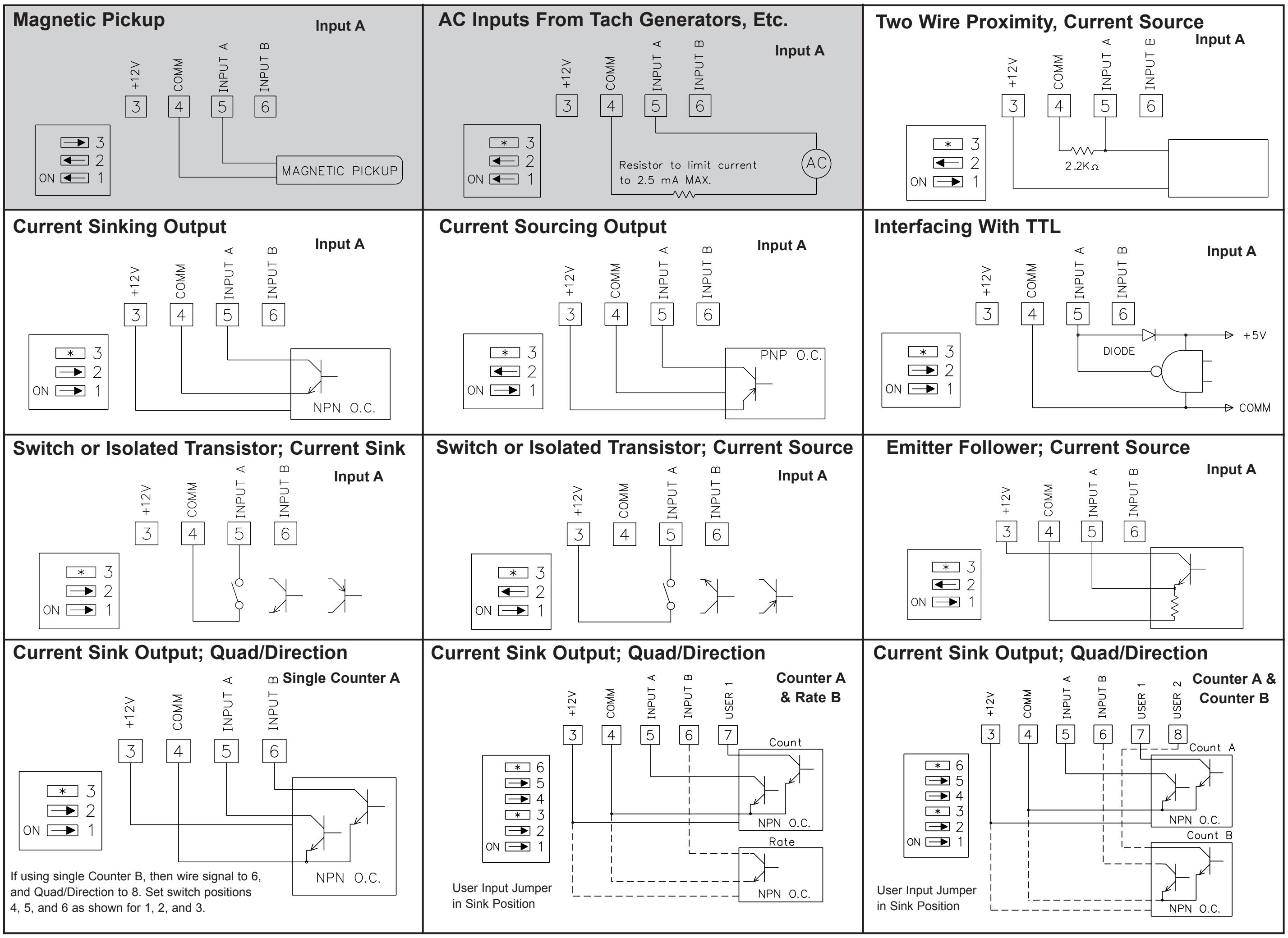




4.3 INPUT WIRING

CAUTION: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth ground; and the common of the isolated plug-in cards with respect to input common.

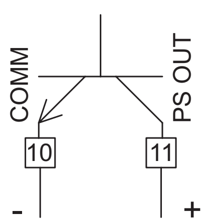
If you are wiring Input B, connect signal to Terminal 6 instead of 5, and set DIP switches 4, 5, and 6 to the positions shown for 1, 2, and 3.



** Switch position is application dependent.*

Shaded areas not recommended for counting applications.

4.4 PAXI PRESCALER OUTPUT WIRING (NPN O.C.)

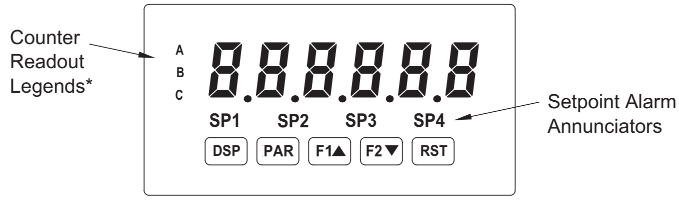


4.5 SETPOINT (ALARMS) WIRING
4.6 SERIAL COMMUNICATION WIRING
4.7 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 Reviewing the Front Buttons and Display

A



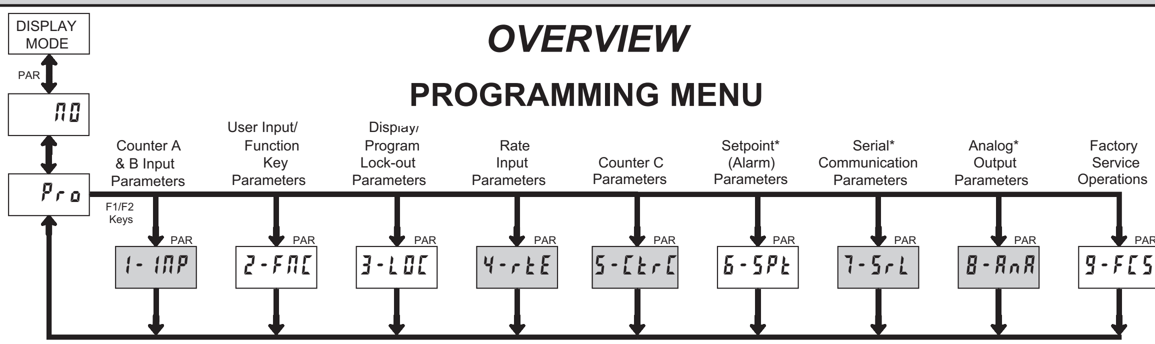
KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through the selected displays.	Quit programming and return to Display Mode
PAR	Access Programming Mode	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1 **	Increment selected parameter value or selections
F2▼	Function key 2; hold for 3 seconds for Second Function 2 **	Decrement selected parameter value or selections
RST	Reset (Function key) ***	Advances digit location in parameter values

* Counters B, and C are locked out in Factory Settings (PAXC and PAXI only).
** Factory setting for the F1, and F2 keys is NO mode.
*** Factory setting for the RST key is dSPrSt (Reset Display).

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



Shaded areas represent program access that is model dependent.

* Only accessible with appropriate plug-in card.

PROGRAMMING MODE ENTRY (PAR KEY)

The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** key. If it is not accessible then it is locked by either a security code, or a hardware lock.

Two types of programming modes are available. Quick Programming Mode permits only certain parameters to be viewed and/or modified. All meter functions continue to operate except the front panel keys change to Programming Mode Operations. Quick Programming Mode is configured in Module 3. Full Programming Mode permits all parameters to be viewed and modified. In this mode, incoming counts may not be recognized correctly, the front panel keys change to Programming Mode Operations and certain user input functions are disabled. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming.

MODULE ENTRY (ARROW & PAR KEYS)

The Programming Menu is organized into nine modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The arrow keys (**F1▲** and **F2▼**) are used to select the desired module. The displayed module is entered by pressing the **PAR** key.

MODULE MENU (PAR KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The arrow keys (**F1▲** and **F2▼**) are used to move through the selections/values for that parameter. Pressing the **PAR** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the **RST** key may be used to select a specific digit to be changed. Once a digit is selected, the arrow keys are used to increment or decrement that digit to the desired number.

PROGRAMMING MODE EXIT (DSP KEY or at Pro NO PAR KEY)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro NO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

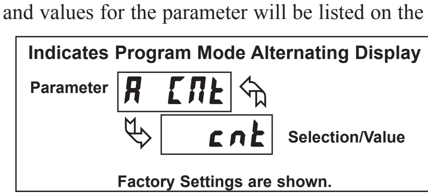
It is recommended to start with Module 1 for counting and Module 4 for rate. If lost or confused while programming, press the **DSP** key and start over. When programming is complete, it is recommended to record the parameter programming on the Parameter User Chart and lock out parameter programming with a user input or lock-out code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point for programming problems. Most parameters can be left at their Factory Settings without affecting basic start-up.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - COUNT A & B INPUT PARAMETERS (1-INP)

A

1-INP

PAR

PAXC & I

PARAMETER MENU

x CNt	xrESEt	xdECPt	xSCFAC	xSCALr	xCNtLd	x P-UP	PrSEN	PrVAL	Pro
Counter x Operating Mode	Counter x Reset Action	Counter x Decimal Position	Counter x Scale Factor	Counter x Scale Multiplier	Counter x Count Load Value	Counter x Reset at Power—up	Prescaler Output Enable	Prescaler Scale Value	

x = Counter A or Counter B

Module 1 is the programming for Counter A, Counter B and the Prescaler Output. Counter B parameters follow the Prescaler parameters. For maximum input frequency, the counters should be set to mode NONE and the Prescaler to NO when they are not in use. When set to NONE or NO, the remaining related parameters are not accessible. A corresponding annunciator indicates the counter being shown in the Display Mode. An Exchange Parameter Lists feature for scale factors and count load values is explained in Module 2.

COUNTER A OPERATING MODE

A CNt — cnt

NONE cnt cntud dcntud quAd1 quAd2 quAd4 dquAd1 dquAd2 cnt2 cntud2 dctud2

Select the operating mode for Counter A.

SELECTION	MODE	DESCRIPTION
NONE		Does not count.
cnt	Count X1	Adds Input A falling edge.
cntud	Count X1 w/direction	Adds Input A falling edge if Input B is high. Subtracts Input A falling edge if Input B is low.
dcntud	Count X1 w/direction	Adds Input A falling edge if User 1 is high. Subtracts Input A falling edge if User 1 is low.
quAd1	Quad X1	Adds Input A rising edge when Input B is high. Subtracts Input A falling edge when Input B is high.
quAd2	Quad X2	Adds Input A rising edge when Input B is high and Input A falling edge when Input B is low. Subtracts Input A falling edge when Input B is high and Input A rising edge when Input B is low.
quAd4	Quad X4	Adds Input A rising edge when Input B is high, Input A falling edge when Input B is low, Input B rising edge when Input A is low, and Input B falling edge when Input A is high. Subtracts Input A falling edge when Input B is high, Input A rising edge when Input B is low, Input B rising edge when Input A is high, and Input B falling edge when Input A is low.
dquAd1	Quad X1	Adds Input A rising edge when User 1 is high. Subtracts Input A falling edge when User 1 is high.
dquAd2	Quad X2	Adds Input A rising edge when User 1 is high and Input A falling edge when User 1 is low. Subtracts Input A falling edge when User 1 is high and Input A rising edge when User 1 is low.
cnt2	Count X2	Adds Input A rising and falling edges.
cntud2	Count X2 w/direction	Adds Input A rising and falling edges if Input B is high. Subtracts Input A rising and falling edge if Input B is low.
dctud2	Count X2 w/direction	Adds Input A rising and falling edges if User 1 is high. Subtracts Input A rising and falling edge if User 1 is low.

COUNTER A RESET ACTION

ArESEt — ZEro

ZEro CNtLd

When Counter A is reset, it returns to zero or Counter A count load value. This reset action affects all Counter A resets, except the Setpoint Counter Auto Reset in Module 6.

COUNTER A DECIMAL POSITION

AdECPt — 0

0 0.00 0.0000 0.0 0.000 0.00000

This selects the decimal point position for Counter A and any setpoint value assigned to Counter A. The selection will also affect Counter A scale factor calculations.

COUNTER A SCALE FACTOR

ASCFAC — 1.00000

0.00001 to 9.99999

The number of input counts is multiplied by the scale factor and the scale multiplier to obtain the desired process value. A scale factor of 1.00000 will result in the display of the actual number of input counts. (Details on scaling calculations are explained at the end of this section.)

COUNTER A SCALE MULTIPLIER

ASCALr — 1

1 0.1 0.01

The number of input counts is multiplied by the scale multiplier and the scale factor to obtain the desired process value. A scale multiplier of 1 will result in only the scale factor affecting the display. (Details on scaling calculations are explained at the end of this section.)

COUNTER A COUNT LOAD VALUE

ACNtLd — 500

-99999 to 999999

When reset to count load action is selected, Counter A will reset to this value.

COUNTER A RESET POWER-UP

A P-UP — NO

YES NO

Counter A may be programmed to reset at each meter power-up.

PAXI: PRESCALER OUTPUT ENABLE

PrSEN — NO

YES NO

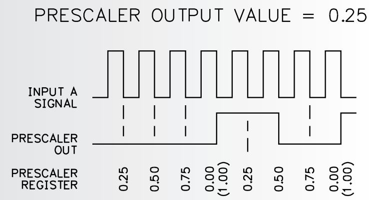
This enables the prescaler output. The prescaler output is useful for providing a lower frequency scaled pulse train to a PLC or another external counter. On each falling edge of Input A, the prescaler output register increments by the prescaler scale value (PrVAL). When the register equals or exceeds 1.0000, a pulse is output and the register is lowered by 1.0000. The prescaler register is reset to zero whenever Counter A is reset (except for Setpoint Counter Auto Reset). (See Prescaler Output Figure.)

PAXI: PRESCALER SCALE VALUE

PrVAL → 1.0000

0.0001 to 1.0000

The prescaler output frequency is the Input A frequency times the prescaler scale value.



COUNTER B OPERATING MODE

b CNt → NONE

NONE   cnt   dcntud   dquAd1
dquAd2   cnt2   dctud2

Select the operating mode for Counter B.

SELECTION	MODE	DESCRIPTION
NONE		Does not count.
cnt	Count X1	Adds Input B falling edge.
dcntud	Count X1 w/direction	Adds Input B falling edge if User 2 is high. Subtracts Input B falling edge if User 2 is low.
dquAd1	Quad X1	Adds Input B rising edge when User 2 is high. Subtracts Input B falling edge when User 2 is high.
dquAd2	Quad X2	Adds Input B rising edge when User 2 is high and Input B falling edge when User 2 is low. Subtracts Input B falling edge when User 2 is high and Input B rising edge when User 2 is low.
cnt2	Count X2	Adds Input B rising and falling edges.
dctud2	Count X2 w/direction	Adds Input B rising and falling edges if User 2 is high. Subtracts Input B rising and falling edge if User 2 is low.

COUNTER B RESET ACTION

brESEt → ZErO

ZErO   CNtLd

When Counter B is reset, it returns to zero or Counter B count load value. This reset action affects all Counter B resets, except the Setpoint Counter Auto Reset Action in Module 6.

COUNTER B DECIMAL POSITION

bdECPt → 0

0   0.00   0.0000
0.0   0.000   0.00000

This selects the decimal point position for Counter B and any setpoint value assigned to Counter B. The selection will also affect Counter B scale factor calculations.

COUNTER B SCALE FACTOR

bSCFAC → 1.00000

0.00001 to 9.99999

The number of input counts is multiplied by the scale factor and the scale multiplier to obtain the desired process value. A scale factor of 1.00000 will result in the display of the actual number of input counts. (Details on scaling calculations are explained at the end of this section.)

COUNTER B SCALE MULTIPLIER

bSCALr → 1

1   0.1   0.01

The number of input counts is multiplied by the scale multiplier and the scale factor to obtain the desired process value. A scale multiplier of 1 will result in only the scale factor affecting the display. (Details on scaling calculations are explained at the end of this section.)

COUNTER B COUNT LOAD VALUE

bCNtLd → 500

-99999 to 999999

When reset to count load action is selected, Counter B will reset to this value.

COUNTER B RESET POWER-UP

b P-UP → NO

YES   NO

Counter B may be programmed to reset at each meter power-up.

8 DIGIT COUNT VALUES

Any counter display value below -99999 or above 999999 (less decimal point) will consist of a two part display. This display alternates between the least 6 significant digits and the remaining most significant digits beginning with "OF" in the display. If the display exceeds ± 99999999 the display will roll to zero and continue counting. Outputs cannot be set to counter values above 6 digits. The annunciator, indicating the counter being displayed, will flash when the value is above 6 digits.

SCALING CALCULATIONS

Each counter has the ability to scale an input signal to a desired display value. This is accomplished by the counter mode (x-CNt), scale factor (xSCFAC), scale multiplier (xSCALr) and decimal point (xdECPt). The scale factor is calculated using:

$$\text{SF (xSCFAC)} = \frac{\text{Desired Display Decimal DDD}}{\text{(Number of pulses per 'single' unit x CM x SM)}}$$

Where:

Desired Display Decimal DDD	xdECPt	Counter Decimal Selection
1	0	None
10	0.0	Tenths
100	0.00	Hundredths
1000	0.000	Thousandths
10000	0.0000	Ten Thousandths
100000	0.00000	Hundred Thousandths

Number of pulses per 'single' unit: pulses per unit generated by the process (i.e. # of pulses per foot)
CM: Counter Mode(x-CNt) times factor of the mode 1,2 or 4.
SM: Scale Multiplier (xSCALr) selection of 1, 0.1 or 0.01.

Example:

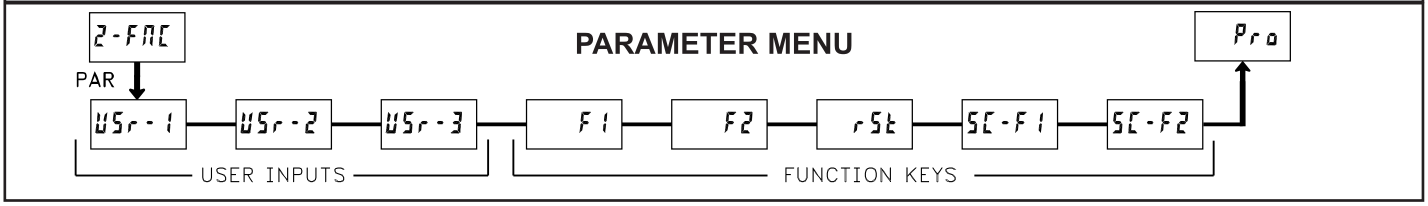
1. Show feet to the hundredths (0.00) with 100 pulses per foot: Scale Factor would be 100 / (100 x 1 x 1) = 1 (In this case, the scale multiplier and counter mode factor are 1)
2. Show feet with 120 pulses per foot: Scale Factor would be 1 / (120 x 1 x 1) = 0.0083333. (In this case, the scale multiplier of 0.01 could be used: 1 / (120 x 1 x 0.01) = 0.83333 or show to hundredths (0.00): 100 / (120 x 1 x 1) = 0.8333.)

General Rules on Scaling

1. It is recommended that, the scale factor be as close as possible to, but not exceeding 1.00000. This can be accomplished by increasing or decreasing the counter decimal point position, using the scale multiplier, or selecting a different count mode.
2. To double the number of pulses per unit, use counter modes direction X2 or quad X2. To increase it by four times, use counter mode quad X4. Using these modes will decrease the maximum input frequency.
3. A scale factor greater than 1.00000 will cause Counter display rounding. In this case, digit jumps could be caused by the internal count register rounding the display. The precision of a counter application cannot be improved by using a scale factor greater than 1. 00000.
4. The number of pulses per single unit must be greater than or equal to the DDD value for the scale factor to be less than or equal to one.
5. Lowering the scale factor can be accomplished by lowering the counter decimal position. (Example: 100 (Hundredths)/10 pulses = 10.000 lowering to 10 (Tenths)/10 = 1.000.)

6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)

A



Module 2 is the programming for rear terminal user inputs and front panel function keys.

Three rear terminal user inputs are individually programmable to perform specific meter control functions. While in the Display Mode, the function is executed when the user input transitions to the active state. (Refer to the user input specifications for active state response times.) Certain user input functions are disabled in "full" Programming Mode.

Three front panel function **F1**, **F2** and **RST** keys are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed when the key is pressed. Holding the **F1** and **F2** function keys for three seconds executes a secondary function. It is possible to program a secondary function without a primary function. The front panel key functions are disabled in both Programming Modes.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions are performed every time any of those user inputs or function keys transition to the active state. All functions are available to both user inputs and function keys.

Some of the user functions have a sublist of parameters. The sublist is accessed when **PAR** is pressed at the listed function. The function will only be performed for the parameters entered as YES. If a user input or function key is configured for a function with a sublist, then that sublist will need to be scrolled through each time to access the following user inputs or function keys parameters.

NO FUNCTION

USr-1 / NO   F1 / NO

With this selection, NO function is performed. This is the factory setting for all user inputs and function keys except the Reset (**RST**) Key.

NOTE: When a user input is used to accept a quad or directional input signal, then that user input should be programmed for NO function.

PROGRAMMING MODE LOCK-OUT

USr-1 / PLOC

Programming Mode is locked-out, as long as activated (maintained action). In Module 3, certain parameters can be setup where they are still accessible during Programming Mode Lockout. A security code can be configured to allow complete programming access during user input lockout. Function keys should not be programmed for PLOC.

ADVANCE DISPLAY

USr-1 / dSPSEL   F1 / dSPSEL

When activated (momentary action), the display advances to the next display that is not locked out from the Display Mode.

RESET DISPLAY

USr-1 / dSPrSt   F1 / dSPrSt

When activated (momentary action), the shown display is reset. This is the factory setting for the Reset (**RST**) Key.

EXCHANGE PARAMETER LISTS

USr-1 / LISt   F1 / LISt

Two lists of values are available for SP-1, SP-2, SP-3, SP-4, ASCFAC, bSCFAC, CSCFAC, ACNtLd, bCNtLd, CCNtLd. The two lists are named LISt-A and LISt-b. If a user input is used to select the list then LISt-A is selected when the user input is not active and and LISt-b is selected when the user input is active, (maintained action). If a front panel key is used to select the list then the list will toggle for each key press, (momentary action). The meter will suspend ALL operations for approximately 1 msec. while the new values are loaded. The display will only indicate which list is active when the list is changed or when entering any Programming Mode.

To program the values for LISt-A and LISt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the values for SP-1, SP-2, SP-3, SP-4, ASCFAC, bSCFAC, CSCFAC, ACNtLd, bCNtLd, CCNtLd. If any other parameters are changed then the other list values must be reprogrammed.

Shaded parameters do not apply to the PAXR.

PAXI: PRINT REQUEST

USr-1 / PrINt   F1 / PrINt

The meter issues a block print through the serial port when activated. The data transmitted during the print request is configured in Module 7. If the user input is still active after the transmission is complete (about 100 msec.), an additional transmission will occur. Only one transmission will take place with each function key depression. This selection will only function when a serial communications Plug-in card is installed in the meter.

PAXI: PRINT REQUEST AND RESET DISPLAYS

USr-1 / PrNrSt   F1 / PrNrSt

The meter issues a block print through the serial port when activated just like the Print Request function. In addition, when activated (momentary action), the meter performs a reset of the displays configured as YES. The print aspect of this action only functions when a serial communication plug-in card is installed. The reset action functions regardless.

DISPLAY	DESCRIPTION	FACTORY
A CNt	Counter A	NO
b CNt	Counter B	NO
C CNt	Counter C	NO
HI	Maximum	NO
LO	Minimum	NO

A

MAINTAINED (LEVEL) RESET AND INHIBIT

USr-1 F1

CtrStL CtrStL

The meter performs a reset and inhibits the displays configured as YES, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
A CNt	Counter A	NO
b CNt	Counter B	NO
C CNt	Counter C	NO
HI	Maximum	NO
LO	Minimum	NO

PAXR: MAINTAINED (LEVEL) RESET AND INHIBIT

USr-1 F1

HLrStL HLrStL

The meter performs a reset and inhibits the displays configured as YES, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
HI	Maximum	NO
LO	Minimum	NO

MOMENTARY (EDGE) RESET

USr-1 F1

CtrStE CtrStE

When activated (momentary action), the meter resets the displays configured as YES. (Momentary resets improve max. input frequencies over maintained resets.)

DISPLAY	DESCRIPTION	FACTORY
A CNt	Counter A	NO
b CNt	Counter B	NO
C CNt	Counter C	NO
HI	Maximum	NO
LO	Minimum	NO

PAXR: MOMENTARY (EDGE) RESET

USr-1 F1

HLrStE HLrStE

When activated (momentary action), the meter resets the displays configured as YES. (Momentary resets improve max. input frequencies over maintained resets.)

DISPLAY	DESCRIPTION	FACTORY
HI	Maximum	NO
LO	Minimum	NO

INHIBIT

USr-1 F1

INHIbt INHIbt

The meter inhibits the displays configured as YES, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
A CNt	Counter A	NO
b CNt	Counter B	NO
C CNt	Counter C	NO
HI	Maximum	NO
LO	Minimum	NO

STORE DISPLAY

USr-1 F1

StOrE StOrE

The meter holds (freeze) the displays configured as YES, as long as activated (maintained action). Internally the counters and max. and min. values continue to update.

DISPLAY	DESCRIPTION	FACTORY
A CNt	Counter A	NO
b CNt	Counter B	NO
C CNt	Counter C	NO
HI	Maximum	NO
LO	Minimum	NO

DEACTIVATE SETPOINT MAINTAINED (LEVEL)

USr-1 F1

SPrStL SPrStL

The meter deactivates the setpoints configured as YES, as long as activated (maintained action). This action only functions with a Setpoint card installed.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

DEACTIVATE SETPOINT MOMENTARY (EDGE)

USr-1 F1

SPrStE SPrStE

When activated (momentary action), the meter deactivates the setpoints configured as YES. This action only functions with a Setpoint card installed.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

HOLD SETPOINT STATE

USr-1 F1

SPHOLd SPHOLd

The meter holds the state of the setpoints configured as YES, as long as activated (maintained action). This action only functions with a Setpoint plug-in card installed.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

ACTIVATE SETPOINT MAINTAINED (LEVEL)

USr-1 F1

SPSEtL SPSEtL

The meter activates the setpoints configured as YES, as long as activated (maintained action). This action only functions with a Setpoint card installed.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

ACTIVATE SETPOINT MOMENTARY (EDGE)

USr-1 F1

SPSEtE SPSEtE

When activated (momentary action), the meter activates the setpoints configured as YES. This action only functions with a Setpoint card installed.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

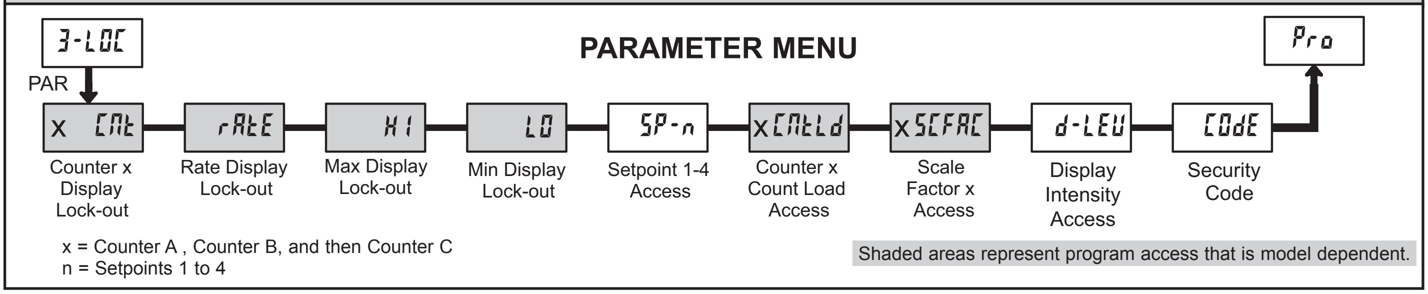
CHANGE DISPLAY INTENSITY LEVEL

USr-1 F1

d-LEU d-LEU

When activated (momentary action), the display intensity changes to the next intensity level (of 4). The four levels correspond to Display Intensity Level (d-LEU) settings of 0, 3, 8 & 15.

6.3 MODULE 3 - DISPLAY AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)



Module 3 is the programming for Display lock-out and "Full" and "Quick" Program lock-out.

When in the Display Mode, the available displays can be read consecutively by repeatedly pressing the **DSP** key. An annunciator indicates the display being shown. These displays can be locked from being visible. It is recommended that the display be set to LOC when the corresponding function is not used.

SELECTION	DESCRIPTION
rEd	Visible in Display Mode
LOC	Not visible in Display Mode

"Full" Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input. When locked and the **PAR** key is pressed, the meter enters a Quick Programming Mode. In this mode, setpoint, count load, scale factor values, and the Display Intensity Level (d-LEU) parameter can still be read and/or changed per the selections below.

SELECTION	DESCRIPTION
rEd	Visible but not changeable in Quick Programming Mode
ENt	Visible and changeable in Quick Programming Mode
LOC	Not visible in Quick Programming Mode

COUNTER A B C DISPLAY LOCK-OUT
RATE DISPLAY LOCK-OUT
MAX. MIN. DISPLAY LOCK-OUT

A CNt — rEd
b CNt — LOC
C CNt — LOC

rAtE — rEd
HI — LOC
LO — LOC

These displays can be programmed for LOC or rEd.

Shaded areas are model dependent.

SETPOINT 1 to 4 ACCESS LOCK-OUT

SP-1 — LOC
SP-2 — LOC
SP-3 — LOC
SP-4 — LOC

The setpoint displays can be programmed for LOC, rEd, or ENt (See the following table). Accessible only with the Setpoint Plug-in card installed.

COUNT LOAD A B C ACCESS LOCK-OUT

ACNtLd — LOC
bCNtLd — LOC
CCNtLd — LOC

The Count Load Values can be programmed for LOC, rEd, or ENt.

SCALE FACTOR A B C ACCESS LOCK-OUT

ASCFAC — LOC
bSCFAC — LOC
CSCFAC — LOC

The Scale Factor values can be programmed for LOC, rEd, or ENt.

DISPLAY INTENSITY ACCESS LOCK-OUT

d-LEU — LOC

The Display Intensity Level can be programmed for LOC, rEd, or ENt.

SECURITY CODE

COdE — 0

0 to 999

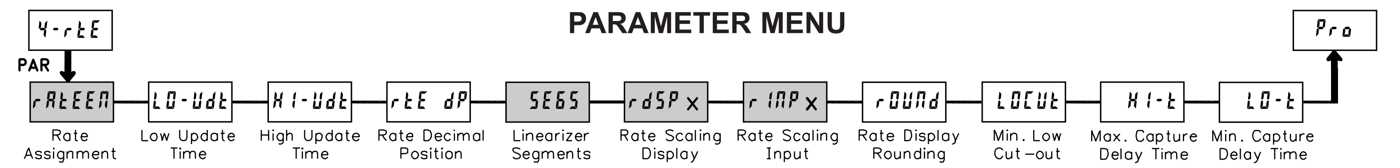
Entry of a non-zero value will cause the prompt COdE to appear when trying to access the "Full" Programming Mode. Access will only be allowed after entering a matching security code or universal code of 222. With this lock-out, a user input would not have to be configured for Program Lock-out. However, this lock-out is overridden by an inactive user input configured for Program Lock-out.

PROGRAMMING MODE ACCESS

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN PAR KEY IS PRESSED	"FULL" PROGRAMMING MODE ACCESS
0	not PLOC	————	"Full" Programming	Immediate access.
>0	not PLOC	————	Quick Programming	After Quick Programming with correct code # at COdE prompt.
>0	PLOC	Active	Quick Programming	After Quick Programming with correct code # at COdE prompt.
>0	PLOC	Not Active	"Full" Programming	Immediate access.
0	PLOC	Active	Quick Programming	No access
0	PLOC	Not Active	"Full" Programming	Immediate access.

Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming (all meter parameters are accessible).

6.4 MODULE 4 - RATE INPUT PARAMETERS (4-rtE) - PAXR & I



Module 4 is the programming for the Rate parameters. For maximum input frequency, Rate assignment should be set to NO when not in use. When set to NO, the remaining related parameters are not accessible. The Rate value is shown with an annunciator of 'r' in the Display Mode.

Note: For PAXR, r INP is actually rtE INP on the unit's display and rdSP is actually rtEdSP on the unit's display.

PAXI: RATE ASSIGNMENT

rAtEEn
rAtE-A

NO rAtE-A rAtE-b

For measuring the rate (speed) of pulses on Input A, select rAtE-A. For Input B select rAtE-b. This assignment is independent of the counting modes.

LOW UPDATE TIME (DISPLAY UPDATE)

LO-Udt
1.0

0.1 to 99.9 seconds

The Low Update Time is the minimum amount of time between display updates for the Rate display. Values of 0.1 and 0.2 seconds will update the display correctly but may cause the display to appear unsteady. The factory setting of 1.0 will update the display every second minimum.

HIGH UPDATE TIME (DISPLAY ZERO)

HI-Udt
2.0

0.2 to 99.9 seconds

The High Update Time is the maximum amount of time before the Rate display is forced to zero. (For more explanation, refer to Input Frequency Calculation.) The High Update Time **must** be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.

RATE DECIMAL POSITION

rtE dP
0

0 0.00 0.0000
0.0 0.000

This selects the decimal point position for Rate, Minimum and Maximum rate displays and any setpoint value assigned to these displays. This parameter does not affect rate scaling calculations.

PAXI: LINEARIZER SEGMENTS

SEGS
0

0 to 9

This parameter specifies the number of linear segments used for the Rate Scaling function. Each linear segment has two scaling points which define the upper and lower endpoints of the segment. The number of segments used depends on the linearity of the process and the display accuracy required as described below.

Linear Application – 2 Scaling Points

Linear processes use a single segment (two scaling points) to provide a linear Rate display from 0 up to the maximum input frequency. For typical zero based frequency measurements (0 Hz = 0 on display), leave SEGS=0 (factory setting). For non-zero based 2 scaling point applications, set SEGS=1, to enter both the zero segment (r INP 0 & rdSP 0) and segment 1 (r INP 1 & rdSP 1).

Non-linear Application – Up to 10 Scaling Points

Non-linear processes may utilize up to nine segments (ten scaling points) to provide a piece-wise linear approximation representing the non-linear function. The Rate display will be linear throughout each individual segment (i.e. between sequential scaling points). Thus, the greater the number of segments, the greater the conformity accuracy. Several linearization equations are available in the software.

About Scaling Points

Each Scaling Point is specified by two programmable parameters: A desired Rate Display Value (rdSP) and a corresponding Rate Input Value (r INP). Scaling points are entered sequentially in ascending order of Rate Input Value.

Two scaling points must be programmed to define the upper and lower endpoints of the first linear segment. Setting SEGS=0, automatically factory sets the first scaling point to 0.0 for typical single segment, zero based applications. When multiple segments are used, the upper scaling point for a given segment becomes the lower scaling point for the next sequential segment. Thus, for each additional segment used, only one additional scaling point must be programmed.

The following chart shows the Scaling Points, the corresponding Parameter mnemonics, and the Factory Default Settings for each point.

SEGMENT	SCALING POINT	DISPLAY PARAMETER	DISPLAY DEFAULT	INPUT PARAMETER	INPUT DEFAULT
	1	rdSP 0	000000	r INP 0	00000.0
1	2	rdSP 1	001000	r INP 1	01000.0
2	3	rdSP 2	002000	r INP 2	02000.0
3	4	rdSP 3	003000	r INP 3	03000.0
4	5	rdSP 4	004000	r INP 4	04000.0
5	6	rdSP 5	005000	r INP 5	05000.0
6	7	rdSP 6	006000	r INP 6	06000.0
7	8	rdSP 7	007000	r INP 7	07000.0
8	9	rdSP 8	008000	r INP 8	08000.0
9	10	rdSP 9	009000	r INP 9	09000.0

PAXI: RATE DISPLAY VALUE FOR SCALING POINT 1

rdSP 0
0

0 to 999999

Confirm the Rate Display Value for the first Scaling Point is 0. This parameter is automatically set to 0 and does not appear when SEGS=0. *(See Note)*

PAXI: RATE INPUT VALUE FOR SCALING POINT 1

r INP 0
0.0

0 to 99999.9

Confirm the Rate Input Value for the first Scaling Point is 0.0. *(See Note)*

Note: For all linear and most non-linear applications, the Scaling Point 1 parameters (rdSP 0 and r INP 0) should be set to 0 and 0.0 respectively. Consult the factory before using any non-zero values for Scaling Point 1. These parameters are automatically set to 0 and do not appear when SEGS=0.

RATE DISPLAY VALUE FOR SCALING POINT 2

rdSP 1
1000

0 to 999999

Enter the desired Rate Display Value for the second Scaling Point by using the arrow keys.

RATE INPUT VALUE FOR SCALING POINT 2

r INP 1 — 1000.0 — 0 to 99999.9

Enter the corresponding Rate Input Value for the second Scaling Point by using the arrow keys. Rate Input values for scaling points can be entered by using the Key-in or the Applied method described below.

Key-in Method:
Enter the Rate Input value (r INP) that corresponds to the entered Rate Display value (rdSP) by pressing the **F1** or **F2** keys. This value is always in pulses per second (Hz).

Applied Method:
Apply an external rate signal to the appropriate input terminals. At the Rate Input Value (r INP) press and hold the **F1** and **F2** keys at the same time. The applied input frequency (in Hz) will appear on the display. (To verify correct reading wait for at least the length of the Low Update Time. Then press and hold the **F1** and **F2** keys at the same time again. The new value should be ± 0.1% of the previous entered value.) Press **PAR** to enter the displayed frequency as the Rate Input value. To prevent the displayed value from being entered, press **DSP**. This will take the meter out of Programming Mode and the previous Rate Input value will remain.

RATE DISPLAY ROUND

rOUNd — 1 — 1, 2, 5, 10, 20, 50, 100

Rounding values other than one round the Rate display to the nearest increment selected (e.g. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Rate display.

LOW CUT OUT

LOCUt — 0 — 0 to 999999

The Low Cut Out value forces the Rate display to zero when the Rate display falls below the value entered.

MAXIMUM CAPTURE DELAY TIME

HI-t — 2.0 — 0.0 to 999.9 seconds

When the Rate value is above the present Maximum rate value for the entered amount of time, the meter will capture that Rate value as the new Maximum value. A delay time helps to avoid false captures of sudden short spikes. Maximum detection will only function if Rate is assigned to Input A or B. The Maximum rate value is shown with an annunciator of 'H' in the display and will continue to function independent of being displayed.

MINIMUM CAPTURE DELAY TIME

LO-t — 2.0 — 0.0 to 999.9 seconds

When the Rate value is below the present Minimum rate value for the entered amount of time, the meter will capture that Rate value as the new Minimum value. A delay time helps to avoid false captures of sudden short spikes. Minimum detection will only function if Rate is assigned to Input A or B. The Minimum rate value is shown with an annunciator of 'L' in the display and will continue to function independent of being displayed.

RATE DISPLAY EXCEEDED

If the rate of the input signal causes a display that exceeds the capacity of the Rate display (5 digits, 99999), then the display will indicate an overflow condition by showing "r OLOL". During this overflow condition, the Minimum and Maximum rate values will stay at their values even during resets.

RATE SCALING

To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. (The Display and Input values can be entered by Key-in or Applied Methods.) These values are internally plotted to a Display value of 0 and Input value of 0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The PAXI and PAXR are capable of showing a rate display value for any linear process.

KEY-IN SCALING METHOD CALCULATION

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (rdSPx) and Scaling Input (r INPx). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (rdSPx)	INPUT (r INPx)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

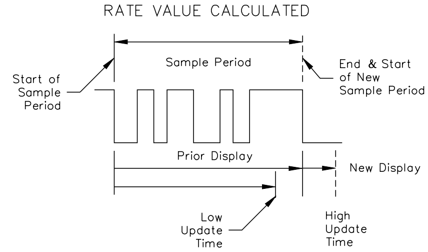
NOTES:
1. If # of pulse per unit is less than 10, then multiply both Input and Display values by 10.
2. If # of pulse per unit is less than 1, then multiply both Input and Display values by 100.
3. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
4. Both values must be greater than 0.0.

EXAMPLE:
1. With 15.1 pulses per foot, show feet per minute in tenths. Scaling Display = 60.0 Scaling Input = 15.1.
2. With 0.25 pulses per gallon, show whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.) Scaling Display = 36000 Scaling Input = 2.5.

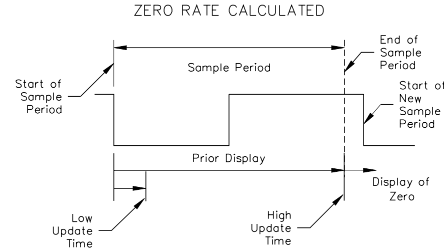
INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by either scaling method.

RATE VALUE CALCULATED



ZERO RATE CALCULATED



6.5 MODULE 5 - COUNTER C INPUT PARAMETERS (5-CtrC)

A

PAXC & I **PARAMETER MENU**

5-CtrC → PAR → Pro

C CNt	CrESEt	CdECPt	CSCFAC	CSCALr	CCNtLd	C P-UP
Counter C Operating Mode	Counter C Reset Action	Counter C Decimal Position	Counter C Scale Factor	Counter C Scale Multiplier	Counter C Count Load Value	Counter C Reset at Power-up

Module 5 is the programming for Counter C. For maximum input frequency, the counter operating mode should be set to NONE when not in use. When set to NONE the remaining related parameters are not accessible. The C annunciator indicates that Counter C is being shown in the Display Mode. An Exchange Parameter List feature for scale factor and count load values is explained in Module 2.

COUNTER C OPERATING MODE

C CNt
NONE

NONE A Add Ab Sub Ab SLAVE

Select the operating mode for Counter C.

NONE Does not count.

A Counter C counts the incoming pulses from Counter A input as per Counter A mode of operation. The signal is scaled only according to Counter C parameters.

Add Ab Counter C counts the incoming pulses from Counter A and B inputs as per Counter A and B modes of operation. The result is scaled only according to Counter C parameters. (Example: If Counter A is set for Count X1 mode and Counter B is set for Count X2 mode, then Counter C will increment by 1 for each pulse received on Input A and increment by 2 for each pulse received on Input B. Counter C scale settings are then applied and the result is displayed.)

Sub Ab Counter C counts the incoming pulses from Counter A and B inputs as per Counter A and B modes of operation and subtracts the B counts from the A counts. The result is scaled only according to Counter C parameters. (Example: If Counter A is set for Count X1 mode and Counter B is set for Count X2 mode, then Counter C will increment by 1 for each pulse received on Input A and decrement by 2 for each pulse received on Input B. Counter C scale settings are then applied and the result is displayed.)

Note: When using Add Ab or Sub Ab, Counter A, B and C must all be reset at the same time for the math to be performed on the display values.

SLAVE (PAXI only) See Serial Communications for details.

COUNTER C RESET ACTION

CrESEt
ZErO

ZErO CNtLd

When Counter C is reset, it returns to zero or Counter C count load value. This reset action affects all Counter C resets, except the Setpoint Counter Auto Reset Action in Module 6.

COUNTER C DECIMAL POSITION

CdECPt
0

0 0.00 0.0000
0.0 0.000 0.00000

This selects the decimal point position for Counter C and any setpoint value assigned to Counter C. The selection will also affect Counter C scale factor calculations.

COUNTER C SCALE FACTOR

CSCFAC
1.00000

0.00001 to 9.99999

The number of input counts is multiplied by the scale factor and the scale multiplier to obtain the desired process value. A scale factor of 1.00000 will result in the display of the actual number of input counts. For the A mode of operation, the input signal is scaled directly. For Add Ab and Sub Ab modes of operation, the math is performed on the input signals and then the result is scaled. To achieve correct results, both Input A and Input B must provide the same amount of pulses per unit of measurement. (Details on scaling calculations are explained at the end of Module 1 section.)

COUNTER C SCALE MULTIPLIER

CSCALr
1

1 0.1 0.01

The number of input counts is multiplied by the scale multiplier and the scale factor to obtain the desired process value. A scale multiplier of 1 will result in only the scale factor affecting the display. (Details on scaling calculations are explained at the end of Module 1 section.)

COUNTER C COUNT LOAD VALUE

CCNtLd
500

-99999 to 999999

When reset to count load action is selected, Counter C will reset to this value.

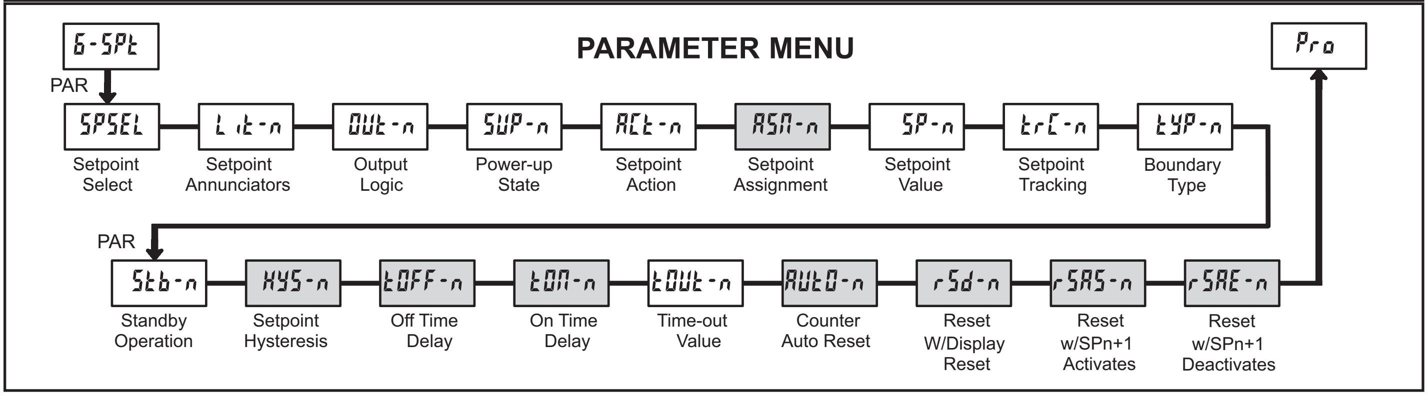
COUNTER C RESET POWER-UP

C P-UP
NO

YES NO

Counter C may be programmed to reset at each meter power-up.

6.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPt)



Module 6 is the programming for the setpoint (alarms) output parameters. To have setpoint outputs, a setpoint Plug-in card needs to be installed into the PAX (see Ordering Information). Depending on the card installed, there will be two or four setpoint outputs available. For setpoint hardware and wiring details, refer to the bulletin shipped with the plug-in card. For maximum input frequency, unused Setpoints should be configured for OFF action.

The setpoint assignment and the setpoint action determine certain setpoint feature availability. The chart below illustrates this.

SETPOINT PARAMETER AVAILABILITY

PARAMETER	DESCRIPTION	RATE			COUNTER		
		TIMED OUT tOUt	BOUNDARY bOUnd	LATCH LAtCH	TIMED OUT tOUt	BOUNDARY bOUnd	LATCH LAtCH
LIt-n	Annunciators	Yes	Yes	Yes	Yes	Yes	Yes
OUt-n	Output Logic	Yes	Yes	Yes	Yes	Yes	Yes
SUP-n	Power Up State	Yes	Yes	Yes	Yes	Yes	Yes
SP-n	Setpoint Value	Yes	Yes	Yes	Yes	Yes	Yes
trC-n	Setpoint Tracking	Yes	Yes	Yes	Yes	Yes	Yes
tYP-n	Boundary Type	Yes	Yes	Yes	No	Yes	No
Stb-n	Standby Operation	Yes	Yes	Yes	No	Yes	No
HYS-n	Setpoint Hysteresis	No	Yes	No	No	No	No
tOFF-n	Setpoint Off Delay	No	Yes	No	No	No	No
tOn-n	Setpoint On Delay	Yes	Yes	Yes	No	No	No
tOUt-n	Setpoint Time Out	Yes	No	No	Yes	No	No
AUtO-n	Counter Auto Reset	No	No	No	Yes	No	Yes
rSd-n	Reset With Display Reset	No	No	No	Yes	No	Yes
rSAS-n	Reset When SPn+1 Activates	No	No	No	Yes	No	Yes
rSAE-n	Reset When SPn+1 Deactivates	No	No	No	Yes	No	Yes

SETPOINT SELECT

SPSEL → nO

nO SP-1 SP-2 SP-3 SP-4

Select a setpoint (alarm output) to open the remaining module menu. (The "n" in the following parameters will reflect the chosen setpoint number.) After the chosen setpoint is programmed, the display will default to SPSEL nO. Select the next setpoint to be programmed and continue the sequence for each setpoint. Pressing **PAR** at SPSEL nO will exit Module 6.

SETPOINT ANNUNCIATORS

LIt-n → nOr

OFF nOr rEU FLASH

OFF disables the display of the setpoint annunciator. Normal (nOr) displays the corresponding setpoint annunciator of an "on" alarm output. Reverse (rEU) displays the corresponding setpoint annunciator of an "off" alarm output. FLASH flashes the display and the corresponding setpoint annunciator of an "on" alarm output.

SETPOINT OUTPUT LOGIC

OUt-n → nOr

nOr rEU

Normal (nOr) turns the output "on" when activated and "off" when deactivated. Reverse (rEU) turns the output "off" when activated and "on" when deactivated.

SETPOINT POWER UP STATE

SUP-n → OFF

SAUE On OFF

SAUE will restore the output to the same state it was at before the meter was powered down. On will activate the output at power up. OFF will deactivate the output at power up.

A

SETPOINT ACTION

ACt-n

OFF

OFF tOUt bOUNd LAtCH

OFF: When not using a setpoint, it should be set to OFF (no action).

For Counter Assignments:

tOUt With Timed Out action, the setpoint output activates when the count value equals the setpoint value and deactivates after the Time Out value. This action is not associated with Boundary types.

bOUNd With boundary action, the setpoint output activates when the count value is greater than or equal to (for tYP = HI) or less than or equal to (for tYP = LO) the setpoint value. The setpoint output will deactivate when the count value is less than (for tYP = HI) or greater than (for tYP = LO) the setpoint value.

LAtCH With Latch action, the setpoint output activates when the count value equals the setpoint value. The output remains active until reset. This action is not associated with Boundary types.

For Rate Assignments:

tOUt With Timed Out action, the setpoint output cycles when the rate value is greater than or equal to (for tYP = HI) or less than or equal to (for tYP = LO) the setpoint value. The Setpoint Time Out (tOUt-n) and Setpoint On Delay (tON-n) values determine the cycling times.

bOUNd With Boundary action, the setpoint output activates when the rate value is greater than or equal to (for tYP = HI) or less than or equal to (for tYP = LO) the setpoint value. The setpoint output will deactivate (Auto reset) as determined by the hysteresis value.

LAtCH With Latch action, the setpoint output activates when the rate value is equal to the setpoint value. The setpoint output remains active until reset. If after reset, the rate value is greater than or equal to (for tYP = HI) or less than or equal to (for tYP = LO) the setpoint value, the output will reactivate.

PAXC & I: SETPOINT ASSIGNMENT

ASN-n

A CNt

A CNt b CNt C CNt rAtE

Select the display that the setpoint is to be assigned.

SETPOINT VALUE

SP-n

100

-99999 to 999999

Enter the desired setpoint value. Setpoint values can also be entered in the Quick Programming Mode when the setpoint is configured as ENt in Module 3. (See Module 2 for Exchange Parameter Lists explanation.)

SETPOINT TRACKING

trC-n

NO

NO SP-1 SP-2 SP-3
SP-4 ACNtLd bCNtLd CCNtLd

If a selection other than NO is chosen, then the value of the setpoint being programmed (“n”) will track the entered selection’s value. Tracking means that when the selection’s value is changed, the “n” setpoint value will also change (or follow) by the same amount.

SETPOINT BOUNDARY TYPE

tYP-n

HI

HI LO

HI activates the output when the assigned display value (ACt-n) equals or exceeds the setpoint value. LO activates the setpoint when the assigned display value is less than or equal to the setpoint.

SETPOINT STANDBY OPERATION

Stb-n

NO

YES NO

Selecting YES will disable low acting setpoints at a power up until the display value crosses into the alarm “off” area. Once in the alarm “off” area, the setpoint will function according to the configured setpoint parameters.

PAXI & R: SETPOINT HYSTERESIS

HYS-n

0

0 to 9999

The hysteresis value is added to (for tYP = LO), or subtracted from (for tYP = HI), the setpoint value to determine at what value to deactivate the associated setpoint output. Hysteresis is only available for setpoints assigned to the Rate with boundary action.

PAXI & R: SETPOINT OFF DELAY

tOFF-n

0.00

0.00 to 99.99 seconds

This is the amount of time the Rate display must meet the setpoint deactivation requirements (below hysteresis for high acting and above hysteresis for low acting) before the setpoint’s output deactivates.

PAXI & R: SETPOINT ON DELAY

tON-n

0.00

0.00 to 99.99 seconds

This is the amount of time the Rate display must meet the setpoint activation requirements (below setpoint for tYP = LO and above setpoint for tYP = HI) before the setpoint’s output activates. If the Rate Setpoint Action is Timed Out, this is the amount of time the output is off during the on / off output cycling.

SETPOINT TIME OUT

tOUt-n

1.00

0.00 to 99.99 seconds

If the setpoint action is Timed Out and the setpoint is assigned to Rate, then this is the amount of time the output is on during the on / off output cycling. If the setpoint action is Timed Out and the setpoint is assigned to Count, then this is the amount of time the output will activate once the count value equals the setpoint value.

PAXC & I: COUNTER AUTO RESET

AUtO-n

NO

NO 2ErOAS CLdAS
2ErOAE CLdAE

This automatically resets the display value of the Setpoint Assignment (ASN-n) counter each time the setpoint value is reached. This reset may be different than the Counter’s Reset Action (xrESEt) in Module 1 or 5.

SELECTION	ACTION
NO	No auto reset.
2ErOAS	Reset to zero at the start of output activation.
CLdAS	Reset to count load value at the start of output activation.
2ErOAE	Reset to zero at the end of output activation. (tOUt action only).
CLdAE	Reset to count load value at the end of output activation. (tOUt action only).

PAXC & I: SETPOINT RESET WITH DISPLAY RESET

rSd-n
NO

YES NO

Select YES, so the setpoint output will deactivate (reset) when the Setpoint Assignment (ASN-n) counter display resets. The only exception is if the assigned counter is reset by a Counter Auto reset generated by another setpoint.

PAXC & I: SETPOINT RESET WHEN SPn+1 ACTIVATES

rSAS-n
NO

YES NO

Select YES, so the setpoint output will deactivate (reset) when SPn +1 activates. (Example: SP1 deactivates when SP2 activates and SP4 when SP1 activates.) The last setpoint will wrap around to the first.

PAXC & I: SETPOINT RESET WHEN SPn+1 DEACTIVATES

rSAE-n
NO

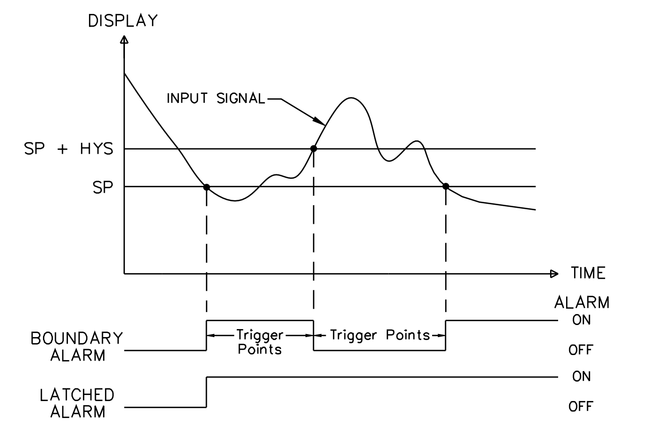
YES NO

Select YES, so the setpoint output will deactivate (reset) when SPn +1 activates and then times out (deactivates). This function may only be used if the SPn+1 is programmed for Setpoint Action of tOUt. (Example SP1 deactivates when SP2 is activated and then times out.) The last setpoint will wrap around to the first.

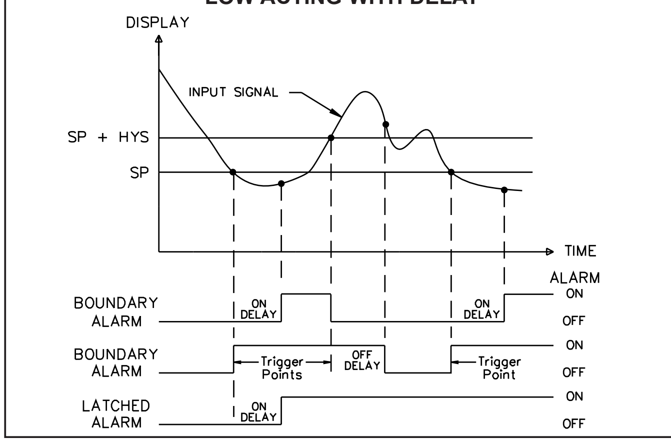
PAXR & I: SETPOINT (ALARM) FIGURES FOR RATE

(For Reverse Action, The Alarm state is opposite.)

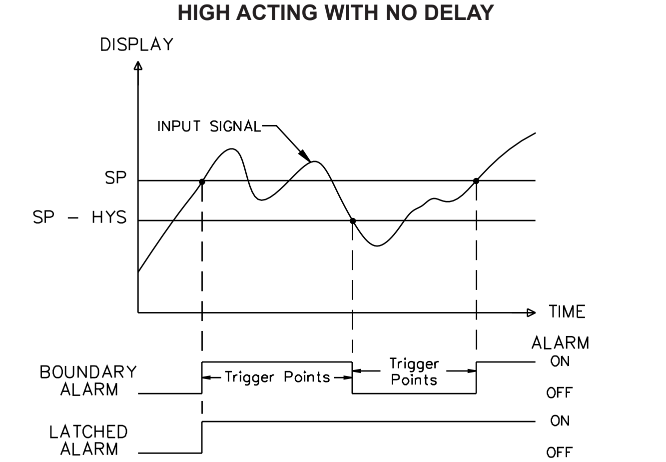
LOW ACTING WITH NO DELAY



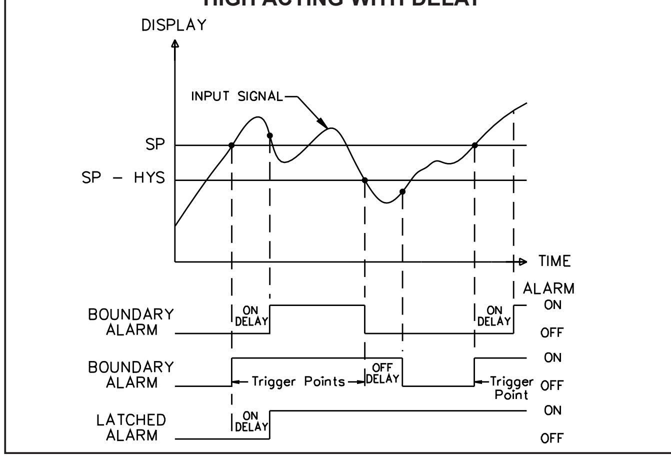
LOW ACTING WITH DELAY



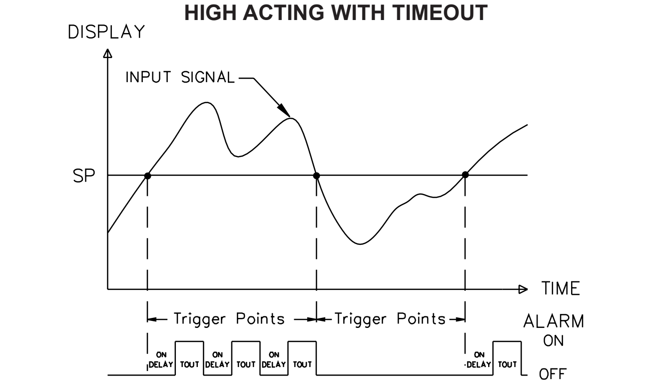
HIGH ACTING WITH NO DELAY



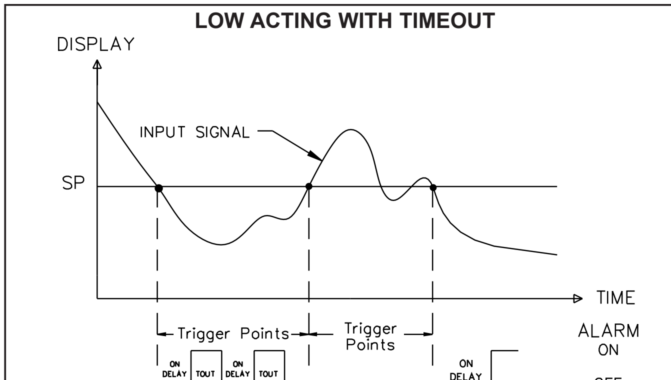
HIGH ACTING WITH DELAY



HIGH ACTING WITH TIMEOUT

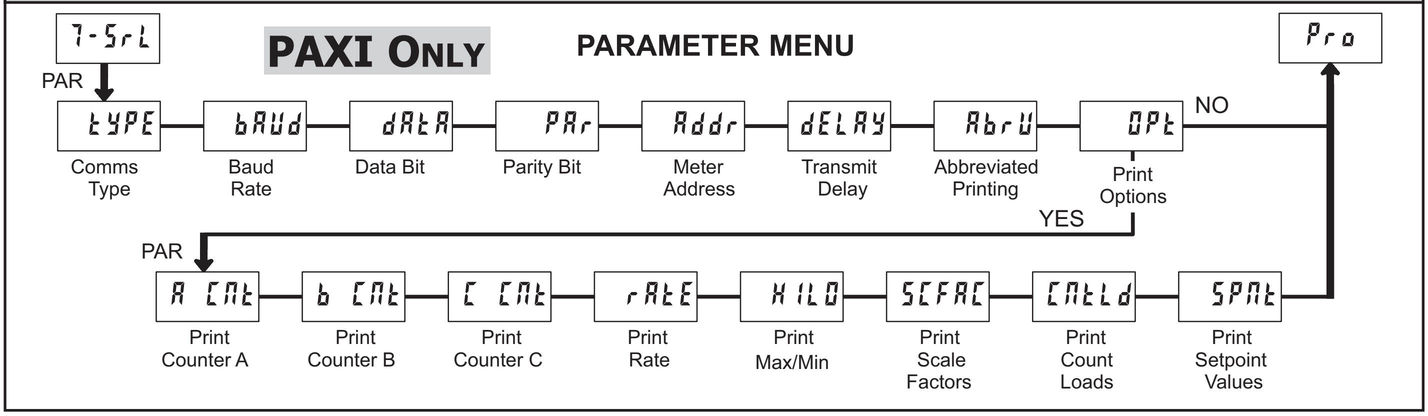


LOW ACTING WITH TIMEOUT



6.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL)

PAXI ONLY



Module 7 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the PAXI with those of the host computer or other serial device, such as a terminal or printer. This programming module can only be accessed if an RS232 or RS485 Serial Communications card is installed.

This section also includes an explanation of the commands and formatting required for communicating with the PAXI. In order to establish serial communications, the user must have host software that can send and receive ASCII characters or Modbus protocol. Red Lion's Crimson software can be used for configuring the PAXI (See Ordering Information). For serial hardware and wiring details, refer to the bulletin shipped with the plug-in card.

This section does NOT apply to the DeviceNet or Profibus-DP communication cards. For details on the operation of the Fieldbus cards, refer to the bulletin shipped with each card.

COMMUNICATIONS TYPE

tYPE
MbrtU

MbrtU - Modbus RTU
MbASC - Modbus ASCII
rLC - RLC Protocol (ASCII)

Select the desired communications protocol. Modbus protocol provides access to all meter values and parameters. Since Modbus is included within the PAXI, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd
38400

1200 2400 4800
9600 19200 38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment is capable of transmitting and receiving.

DATA BIT

dAtA
8

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr
NO

NO Odd EVEN

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr
247

1 to 247 - Modbus
0 to 99 - RLC Protocol

Enter the serial meter (node) address. The address range is dependent on the tYPE parameter. With a single unit, configured for RLC protocol (tYPE = rLC), an address is not needed and a value of zero can be used. With multiple units (RS485 applications), a unique 2 digit address number must be assigned to each meter.

TRANSMIT DELAY

dELAY
0.010

0.000 to 0.250 seconds

Following a transmit value ('*' terminator) or Modbus command, the PAXI will wait this minimum amount of time before issuing a serial response.

Parameters below only appear when Communications Type parameter (tYPE) is set to rLC.

ABBREVIATED PRINTING

Abr U
NO

YES NO

Select NO for full print or Command T transmissions (meter address, parameter data and mnemonics) or YES for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. (If the meter address is 0, it will not be sent during a full transmission.)

PRINT OPTIONS

OPt
NO

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, parameter data and mnemonics) can be sent to a printer or computer as a block.

PARAMETER	DESCRIPTION	FACTORY	MNEMONIC
A CNt	Counter A	YES	CTA
b CNt	Counter B	NO	CTB
C CNt	Counter C	NO	CTC
rAtE	Rate	NO	RTE
H ILO	Max. & Min.	NO	MIN MAX
SCFAC	A B C Scale Factors	NO	SFA SFB SFC
CNtLd	A B C Count Load	NO	LDA LDB LDC
SPNt	1 2 3 4 Setpoints *	NO	SP1 SP2 SP3 SP4

**Setpoints are plug-in card dependent.*

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communications Type Parameter (tYPE) be set to Modbus RTU (MbrtU) or Modbus ASCII (MbASC).

PAXI CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAXI to PC.
3. Supply power to PAXI.
4. Configure serial parameters to Modbus RTU (MbrtU), 38,400 baud, address 247. (Note:These are the factory default settings.)
5. Create a new file (File, New) or open an existing PAXI V3.0+ database.
6. Configure Crimson Link options (Link, Options) to the serial port which the communication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 64 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 64 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 64 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAXI. "Total Good Comms" is the total messages received by the PAXI with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAXI_V3 <a><b><0300h><0040h><0040h><0010h>
<a> = SP Card Status. "0"-None, "2"-Dual, "4"-Quad
<b> = Linear Card Status. "0"-Not Installed, "1"-Installed
<0300h> = Software Version Number (e.g. 3.00)
<0040h><0040h> = Max Register Reads/Writes (64)
<0010h> = Number of GUID/Scratch Pad Registers (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAXI MODBUS REGISTER TABLE

This table shows the most commonly used registers for the PAXI. The complete register table listing is available at http://www.redlion.net.

Values less than 65,535 will be in (Lo word). Values greater than 65,535 will continue into (Hi word). Negative values are represented by two's complement of the combined (Hi word) and (Lo word). The PAXI should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Counter A Value (Hi word)	-99999999	999999999	0	Read/Write	1 = 1 Display Unit
40002	Counter A Value (Lo word)					
40003	Counter B Value (Hi word)	-99999999	999999999	0	Read/Write	1 = 1 Display Unit
40004	Counter B Value (Lo word)					
40005	Counter C Value (Hi word)	-99999999	999999999	0	Read/Write	1 = 1 Display Unit
40006	Counter C Value (Lo word)					
40007	Rate Value (Hi word)	0	99999	0	Read/Write	1 = 1 Display Unit
40008	Rate Value (Lo word)					
40009	Min (Lo) Value (Hi word)	0	99999	0	Read/Write	1 = 1 Display Unit
40010	Min (Lo) Value (Lo word)					
40011	Max (Hi) Value (Hi word)	0	99999	0	Read/Write	1 = 1 Display Unit
40012	Max (Hi) Value (Lo word)					
40013	Counter A Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40014	Counter A Scale Factor (Lo word)					
40015	Counter B Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40016	Counter B Scale Factor (Lo word)					
40017	Counter C Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40018	Counter C Scale Factor (Lo word)					
40019	Counter A Count Load (Hi word)	-99999	999999	500	Read/Write	Active List (A or B)
40020	Counter A Count Load (Lo word)					
40021	Counter B Count Load (Hi word)	-99999	999999	500	Read/Write	Active List (A or B)
40022	Counter B Count Load (Lo word)					
40023	Counter C Count Load (Hi word)	-99999	999999	500	Read/Write	Active List (A or B)
40024	Counter C Count Load (Lo word)					
40025	Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	Active List (A or B)
40026	Setpoint 1 Value (Lo word)					

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40027	Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	Active List (A or B)
40028	Setpoint 2 Value (Lo word)					
40029	Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	Active List (A or B)
40030	Setpoint 3 Value (Lo word)					
40031	Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	Active List (A or B)
40032	Setpoint 4 Value (Lo word)					
	Manual Mode Registers					
40036	Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = S1, Bit 3 = S2, Bit 2 = S3, Bit 1 = S4, Bit 0 = Linear Output
40037	Analog Output Register (AOR)	0	4095	0	Read/Write	Linear Output Card written to only if Linear Output is in Manual Mode (MMR bit 0 = 1).
40038	Setpoint Output Register (SOR)	0	15	N/A	Read/Write	Status of Setpoint Outputs. Bit State: 0=Off, 1=On. Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4. Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40039	Reset Output Register	0	15	0	Read/Write	Bit State: 1= Reset Output, bit is returned to zero following reset processing; Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to RLC Protocol (rLC).

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $. The <CR> is also available as a terminator when Counter C is in the SLAVE mode.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a two digit node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. For node address 1 through 9, a leading zero character is not required. (The only exception is a numeric transmission when Counter C is set for slave mode.) This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters *, $ or when Counter C is set for slave mode <CR>. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Sending Numeric Data

Numeric data sent to the meter must be limited to the digit range shown under transmit details in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	COMMAND	TRANSMIT DETAILS
A	Count A	CTA	T, V, R	6 digit (V), 8 digit (T)
B	Count B	CTB	T, V, R	6 digit (V), 8 digit (T)
C	Count C	CTC	T, V, R	6 digit (V), 8 digit (T)
D	Rate	RTE	T, V	5 digit, positive only
E	Min (Lo) Value	MIN	T, V, R	6 digit, positive only
F	Max (Hi) Value	MAX	T, V, R	6 digit, positive only
G	Scale Factor A	SFA	T, V	6 digit, positive only
H	Scale Factor B	SFB	T, V	6 digit, positive only
I	Scale Factor C	SFC	T, V	6 digit, positive only
J	Counter Load A	LDA	T, V	5 negative / 6 positive
K	Counter Load B	LDB	T, V	5 negative / 6 positive
L	Counter Load C	LDC	T, V	5 negative / 6 positive
M	Setpoint 1	SP1	T, V, R	5 negative / 6 positive
O	Setpoint 2	SP2	T, V, R	5 negative / 6 positive
Q	Setpoint 3	SP3	T, V, R	5 negative / 6 positive
S	Setpoint 4	SP4	T, V, R	5 negative / 6 positive
U	Auto/Manual Register	MMR	T, V	0 – auto, 1 - manual
W	Analog Output Register	AOR	T, V	0 – 4095 normalized
X	Setpoint Register	SOR	T, V	0 – not active, 1 – active

Command String Examples:

1. Address = 17, Write 350 to Setpoint 1.
   String: N17VM350$
2. Address = 5, Read Count A value.
   String: N5TA*
3. Address = 0, Reset Setpoint 4 output.
   String: RS*

RECEIVING DATA FROM THE METER

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response mode is established in Module 7.

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node (meter) Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted (bytes 1 and 2) are the unit address. If the address assigned is 00, two spaces are substituted. A space (byte 3) follows the unit address field. The next three characters (bytes 4 to 6) are the register mnemonic. The numeric data is transmitted next.

The numeric field (bytes 7 to 18) is 12 characters long. When the requested value exceeds eight digits for count values or five digits for rate values, an * (used as an overflow character) replaces the space in byte 7. Byte 8 is always a space. The remaining ten positions of this field (bytes 9 to 18) consist of a minus sign (for negative values), a floating decimal point (if applicable), and eight positions for the requested value. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with <CR> (byte 19), and <LF> (byte 20). When a block print is finished, an extra <SP> (byte 21), <CR> (byte 22), and <LF> (byte 23) are used to provide separation between the transmissions.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Meter Response Examples:

1. Address = 17, full field response, Count A = 875
   17 CTA 875 <CR><LF>
2. Address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

AUTO/MANUAL MODE REGISTER (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

```
U abcde
  ││││└─e = Analog Output
  │││└──d = SP4
  ││└───c = SP3
  │└────b = SP2
  └─────a = SP1
```

Example: VU00011* places SP4 and Analog in manual.

ANALOG OUTPUT REGISTER (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047* will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

SETPOINT OUTPUT REGISTER (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A “0” in the setpoint location means the output is off and a “1” means the output is on.

```
X abcd
  │││└─ d = SP4
  ││└── c = SP3
  │└─── b = SP2
  └──── a = SP1
```

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10* will result in output 1 on and output 2 off.

COUNTER C SLAVE COMMUNICATIONS

Counter C may be programmed for **SLAVE**, to act as a serial slave display. By doing this, the carriage return <CR> is added as a valid command terminator character for all serial command strings. The <CR> as a terminator may be very useful for standard serial commands, even if Counter C is never displayed or sent a slave message. The $ terminator should not be used in the slave mode. If numeric values are not to be saved to memory, then send the value as a literal transmission with <CR> terminator.

The Counter C slave display is right aligned. It has a capacity of displaying six characters. When less than six characters are received, blank spaces will be placed in front of the characters. If more than six characters are sent, then only the last six are displayed. The meter has a 192 character buffer for the slave display. If more than 192 characters are sent, the additional characters are discarded until a terminator is received. Counter C processes numeric and literal transmissions differently.

Numeric Transmissions

When a string that does not begin with #, T, V, P or R is received, the meter processes it as a Numeric transmission. In this case, only the recognized numbers and punctuation are displayed. All other characters in the string are discarded. If a negative sign appears anywhere in the string the resulting number will be negative. Only the most significant decimal point is retained. If no numerical characters are received, then the numeric value will be zero. The numeric display can be used for setpoint (boundary action only) and analog output functions. When using this display for setpoint and analog output values, the decimal point position must match the programming entered through the front panel. The numeric value is retained in Counter C memory until another Numeric transmission is received.

Recognized Numbers = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Recognized Punctuation = period, comma, minus

Literal Transmissions

When a string that begins with # is received, the meter processes it as a Literal transmission. In this case, any unrecognized characters will be replaced with a space. A Literal display will replace a Numeric value in the Counter C display. However, it will not remove a previous Numeric value from Counter C memory or prevent the Counter C outputs from functioning with the Numeric value. Literal transmissions are only possible when using RS232 or RS485 cards.

Recognized Characters = a, b, c, d, e, f, g, h, i, j, l, n, o, p, q, r, s, t, u, y, z (in upper or lower case)
Recognized Numbers = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Recognized Punctuation = period, comma, minus, blank

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*, $ or slave only <CR>) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the Serial Transmit Delay parameter (dELAY). The ‘*’ or ‘<CR>’ terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15 msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with “$” results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

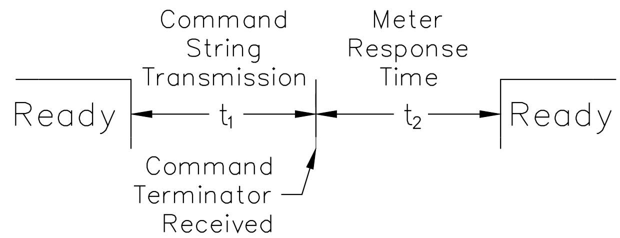
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

$$t_3 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

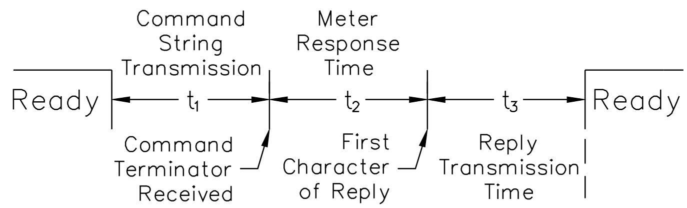
The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

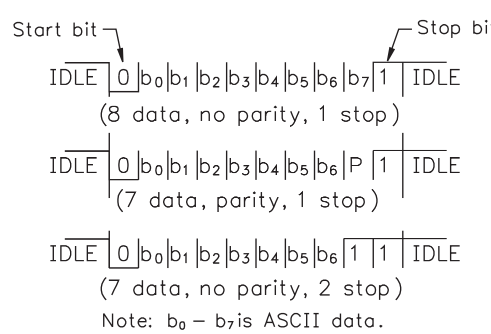
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

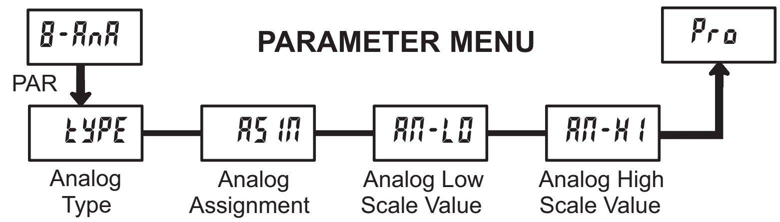
Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAXI.

6.8 MODULE 8 - ANALOG OUTPUT PARAMETERS (8-AnA)

PAXI ONLY

PARAMETER MENU



Module 8 is the programming for the analog output parameters. To have an analog output signal, an analog output plug-in card needs to be installed (See Ordering Information). For analog output hardware and wiring details, refer to the bulletin shipped with the plug-in card.

ANALOG TYPE

tYPE
4-20

SELECTION	RANGE
0-20	0 to 20 mA
4-20	4 to 20 mA
0-10	0 to 10 V

Enter the analog output type. For voltage output use terminals 16 and 17. For current output use terminals 18 and 19. Only one range can be used at a time.

ANALOG ASSIGNMENT

AS IN
rAtE

A CNt b CNt C CNt
rAtE LO HI

Select the display that the analog output is to follow:

A CNt = Counter A Value	rAtE = Rate Value
b CNt = Counter B Value	LO = Minimum Value
C CNt = Counter C Value	HI = Maximum Value

ANALOG LOW SCALE VALUE

AN-LO
0

-99999 to 999999

Enter the display value within the selected Analog Assignment that corresponds to the low limit of the type selected.

The decimal point is determined by the decimal point setting of the assigned counter or rate. The scale value can not be set to read values with more than 6 digits. Reverse acting output is possible by reversing the scaling values.

ANALOG HIGH SCALE VALUE

AN-HI
1000

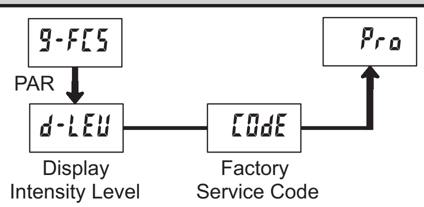
-99999 to 999999

Enter the display value within the selected Analog Assignment that corresponds to the high limit of the type selected.

The decimal point is determined by the decimal point setting of the assigned counter or rate. The scale value can not be set to read values with more than 6 digits. Reverse acting output is possible by reversing the scaling values.

6.9 MODULE 9 - FACTORY SERVICE OPERATIONS (9-FCS)

PARAMETER MENU



DISPLAY INTENSITY LEVEL

d-LEV
3

Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in Quick Programming Mode when enabled.

RESTORE FACTORY DEFAULTS

COdE
66

Use the arrow keys to display COdE 66 and press **PAR**. The meter will display rESEt and then returns to COdE 50. Press **DSP** key to return to the Display Mode. This will overwrite all user settings with the factory settings.

Pressing the **PAR** and **DSP** keys at the same time on power-up will load the factory settings and display Err4. This allows operation in the event of a memory failure or corrupted data. Immediately press **RST** key and reprogram the meter. If the meter is powered down again before pressing the **RST** key, the existing dynamic data will not be overwritten.

A

UNIT TYPE AND VERSION

CODE 51

The meter briefly displays the unit type followed by the current firmware version (VEr x.x), and then returns to CODE 50. This information is also displayed during the meter power-up sequence.

INPUT A AND B LOGIC SELECTION

CODE 55

The Count Inputs A and B are factory configured for falling edge triggered (active low) operation in single edge count modes. The Counter Operating Mode descriptions in the Input programming section reflect this logic. If an application is better suited to use rising edge triggered (active high) operation, the Input Logic for Input A and/or Input B can be changed by entering Code 55.

INP A LO-ACt   LO-ACt   HI-ACt

Selecting HI-ACt sets the Input A logic to rising edge triggered (active high) operation. Be advised that all references to Input A falling edge and Input A rising edge will be reversed for the Counter Operating Mode descriptions.

INP b LO-ACt   LO-ACt   HI-ACt

Selecting HI-ACt sets the Input B logic to rising edge triggered (active high) operation. Be advised that all references to Input B falling edge and Input B rising edge will be reversed for the Counter Operating Mode descriptions.

PAXI: CALIBRATION

CODE 48

The only item in the PAXI meter that can be calibrated is the Analog Output. The Count A and B values are scaled using the parameters in Module 1, Counter C value is scaled using Module 5 and the Rate value is scaled using Module 4. If the meter appears to be indicating incorrectly or inaccurately, refer to the Troubleshooting section.

When Analog Out recalibration is required (generally every 2 years), it should be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters.

Calibration may be aborted by disconnecting power to the meter before exiting Module 9. In this case, the existing calibration settings remain in effect.

***Note**: Allow a 30 minute warm-up period before staring calibration.*

Analog Output Card Calibration

Before starting, verify that a precision meter with an accuracy of 0.05% or better (voltmeter for voltage output and/or current meter for current output) is connected and ready. Then perform the following procedure:

1. Use the arrow keys to display CODE 48 and press **PAR**.
2. CALOUt is displayed. Use the arrow keys to select YES and press **PAR**.
3. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAXI arrow keys to adjust the output so that the external meter display matches the selection being calibrated. When the external reading matches, or if the range is not being calibrated, press **PAR**.

SELECTION	EXTERNAL METER	ACTION
0.0_A	0.00	Adjust if necessary, press **PAR**
4.0_A	4.00	Adjust if necessary, press **PAR**
20.0_A	20.00	Adjust if necessary, press **PAR**
0.0u	0.00	Adjust if necessary, press **PAR**
10.0u	10.00	Adjust if necessary, press **PAR**

4. When CodE 50 appears, press **PAR** twice and remove the external meters.

TROUBLESHOOTING

For further assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	REMEDIES
NO DISPLAY	**CHECK**: Power level, power connections
PROGRAM LOCKED-OUT	**CHECK**: Active (lock-out) user input **ENTER**: Security code requested
CERTAIN DISPLAYS ARE LOCKED OUT	**CHECK**: Module 3 programming
INCORRECT DISPLAY VALUE or NOT COUNTING	**CHECK**: Input wiring, DIP switch setting, input programming, scale factor calculation, input signal level, user input jumper, lower input signal frequency
USER INPUT NOT WORKING CORRECTLY	**CHECK**: User input wiring, user input jumper, user input being used for signal, Module 2
OUTPUT DOES NOT WORK	**CHECK**: Corresponding plug-in card installation, output configuration, output wiring
JITTERY DISPLAY	**CHECK**: Wiring is per EMC installation guidelines, input signal frequency, signal quality, scaling, update time, DIP switch setting
"r OLOL" RATE	**CHECK**: Lower input signal frequency, reduce rate scaling
MODULES or PARAMETERS NOT ACCESSIBLE	**CHECK**: Corresponding plug-in card installation, related controlling parameter selected
ERROR CODE (Err 1-4)	**PRESS**: Reset key (if unable to clear contact factory.)
SERIAL COMMUNICATIONS	**CHECK**: Wiring, connections, meter and host settings

Shaded areas are model dependent.

Model PAXI - 1/8 DIN Dual Counter/Rate Meter

This is a brief overview of the PAXI. For complete specifications and programming information, see the **PAX Digital Input Panel Meters Bulletin** starting on **page 68**.

- *COUNTER, DUAL COUNTER, RATE AND SLAVE DISPLAY*
- *6-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *VARIABLE INTENSITY DISPLAY*
- *10 POINT SCALING (FOR NON-LINEAR PROCESSES)*
- *FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)*
- *RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)*
- *BUS CAPABILITIES; DEVICENET, MODBUS, AND PROFIBUS-DP*
- *CRIMSON PROGRAMMING SOFTWARE*

C UL US LISTED
IND. CONT. EQ.
51EB

PAXI SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES TABLE

To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	**Single**: Counter A or B (with/without rate) or Rate only								**Dual**: Counter A & B or Rate not assigned to active single counter							
Are any setpoints used?	N	N	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
Is Prescaler Output used?	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)				(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	21	17	18	15	13	11	13	12	13	11	9	7.5	9	7
Count x2	17	13	16	12	9	7	8	7	9 *	7 *	9 *	7 *	5 *	4 *	5 *	4 *
Quadrature x1	22	19	20	17	12	10	11	10	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x2	17	13	16	12	9	7	8	6	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x4	8	6	8	6	4	3	4	3								
Rate Only	34	N/A	21	N/A	34	N/A	21	N/A								

ANNUNCIATORS:
- A - Counter A
- B - Counter B
- C - Counter C
- r - Rate
- H - Maximum (High) Rate
- L - Minimum (Low) Rate
- OF - Upper significant digit display of counter
- SP1 - setpoint 1 output state
- SP2 - setpoint 2 output state
- SP3 - setpoint 3 output state
- SP4 - setpoint 4 output state

RATE DISPLAY:
- Accuracy: ±0.01%
- Minimum Frequency: 0.01 Hz
- Maximum Frequency: see Max Signal Frequencies Table.
- Maximum Display: 5 Digits: 99999
- Adjustable Display (low) Update: 0.1 to 99.9 seconds
- Over Range Display: "r OLOL"

COUNTER DISPLAYS:
Maximum display: 8 digits: ± 99999999 (greater than 6 digits display Alternates between high order and low order.)

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.

LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.

MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms

DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

PRESCALER OUTPUT:
NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. With duty cycle of 25% min. and 50 % max.

MODEL PAX2D – 1/8 DIN DIGITAL INPUT PANEL METER

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

- *COUNT, DUAL COUNTER WITH MATH FUNCTIONS*
- *RATE, DUAL RATE WITH MATH FUNCTIONS*
- *SLAVE DISPLAY*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *10 POINT RATE SCALING FOR NON-LINEAR PROCESSES*
- *PROGRAMMABLE UNITS DISPLAY*
- *BUS CAPABILITIES; DEVICENET, Modbus, AND PROFIBUS-DP*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The PAX2D Digital Panel Meter offers many features and performance capabilities that are not available on standard panel meters. The basic meter is a dual counter and dual rate meter all in the same package. A third counter and third rate display allows the user to do simple math functions. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs.

Highlighting the PAX2D is a dual line, display with a large 0.71" tri-color 6 digit top display line and a 0.35", 9 digit green bottom display line. The meter also offers programmable units display providing the ability to tag the display with units of measure. Display color change capability provides machine operators a visual indication of changing conditions, even when the operator is not close enough to read the actual display value. In addition, a universal power supply provides the ultimate in flexibility for both AC and DC power.

The meter accepts digital inputs from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups and all standard RLC sensors. The meter can process directional, uni-directional or Quadrature signals simultaneously. The meter accepts input signals up to 50 KHz maximum depending on the count mode and function configurations programmed. Each input signal can be independently scaled to various process values.

The meter provides a MAX and MIN rate reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The meter has up to four setpoint outputs, implemented on plug-in option cards. The plug-in cards provide dual FORM-C relays, quad FORM-A, or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

The PAX2 can be programmed to utilize Modbus protocol. With Modbus, the user has access to most configuration parameters. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meter has a feature that allows a remote computer to directly control the outputs of the meter. Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and Profibus-DP.

The PAX2 includes a built-in USB programming port. With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2 without the need of any additional option cards.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track any of the counter, rate, max or min displays, or any setpoint value.

After the meter has been initially configured, the parameter programming may be locked out from further modification in its entirety, or allowing selected values accessible for quick entry.

The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel,extensive testing of noise effects with regard to CE requirements, the meter provides a tough reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.

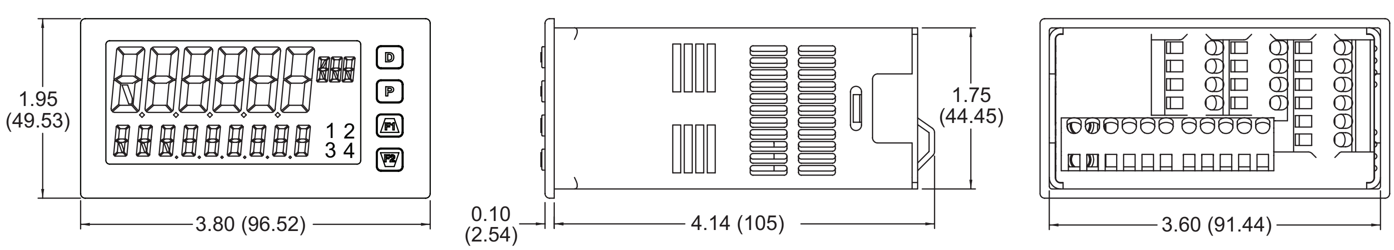


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2D	Digital Input Panel Meter	PAX2D000

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC [1]	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	SFCRD [2]	Crimson PC Configuration Software for Windows 2000, XP and Windows 7	SFCRD200
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Notes:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.
2. Crimson software is available for free download from http://www.redlion.net/

General Meter Specifications

1. **DISPLAY**: Negative image LCD
   Top Line - 6 digit, 0.71" (18 mm), with tri-color backlight (red, green or orange), display range: -199,999 to 999,999;
   Bottom Line - 9 digit, 0.35" (8.9 mm), with green backlight, display range: - 199,999,999 to 999,999,999
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **SENSOR POWER**: +18 VDC, ±5% @ 60 mA max., short circuit protected
4. **ANNUNCIATORS**:
   Line 1 Units Display – Programmable 3 digit units annunciator with tri-color backlight (red, green or orange)
   Setpoint Output Status Indicators - Red backlight color
   1 - Setpoint 1 output
   2 - Setpoint 2 output
   3 - Setpoint 3 output
   4 - Setpoint 4 output
5. **KEYPAD**: 2 programmable function keys, 4 keys total
6. **COUNTER DISPLAYS**: 6-digit (top line) or 9-digit (bottom line)
   Top Line Display Range: -199,999 to 999,999
   Bottom Line Display Range: -199,999,999 to 999,999,999
   Over Range Display: OUEr
   Under Range Display: UndEr
   Display Designators: CtA, Ctb, CtC (top line), A, b, C (bottom line)
   Maximum Count Rates: 50% duty cycle, count mode dependent
   If setpoints disabled: 35 KHz for all modes except Quadrature x4 (32 KHz)
   If setpoint(s) enabled: 20 KHz for any mode except Quadrature x1 (19 KHz), Quadrature x2 (17 KHz) and Quadrature x4 (10 KHz)
7. **RATE DISPLAYS**: 6-digit (top or bottom line)
   Rate A or Rate B Display Range: 0 to 999,999
   Rate C, Rate Max (High) or Min (Low) Display Range: -199,999 to 999,999
   Over Range Display: OUEr
   Under Range Display: UndEr
   Display Designators: RtA, Rtb, RtC, Hi, Lo (top or bottom line)
   Maximum Frequency: 50 KHz
   Minimum Frequency: 0.001 Hz
   Display Update Time: 0.1 to 999.9 seconds
   Accuracy: ±0.01%
8. **SIGNAL INPUTS (INPUT A and INPUT B)**:
   See Section 2.0 Setting the DIP Switches for complete input specifications. DIP switch selectable inputs accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors. Inputs accept current sinking or current sourcing outputs and provide selectable input filtering for low frequency signals or switch contact debounce.
   DUAL COUNT MODES:
   When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Input Active parameter (USrACt) .
9. **USER INPUTS**: Three programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Common: Not isolated.
   Response Time: 12 msec. max.
   Logic State: User Selectable for sinking (active low) or sourcing (active high)

INPUT STATE	SINKING INPUTS	SOURCING INPUTS
	20KΩ pull-up to +3.3V	20KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

10. **PRESCALER OUTPUT:**
    NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. Duty cycle 25% min. and 50 % max.
11. **MEMORY**: Nonvolatile memory retains all programmable parameters and count values when power is removed.
12. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50 °C
    Storage Temperature Range: -40 to 60 °C
    Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
    Shock to IEC 68-2-27: Operational 25 g (10 g relay)
    Operating and Storage Humidity: 0 to 85% max. RH non-condensing
    Altitude: Up to 2000 meters
13. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    IEC/EN 61010-1
    RoHS Compliant
    UL Listed: File #E179259
    Type 4X Indoor Enclosure rating (Face only)
    IP65 Enclosure rating (Face only)
    IP20 Enclosure rating (Rear of unit)
    Refer to EMC Installation Guidelines section of the bulletin for additional information.
14. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)
15. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
16. **WEIGHT**: 8 oz. (226.8 g)

OPTIONAL PLUG-IN OUTPUT CARDS

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2D meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2D meter. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC50 - Profibus-DP
PAXCDC20 - RS232 Serial (Terminal)	
PAXCDC2C - RS232 Serial (Connector)	

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. Crimson can be downloaded at www.redlion.net

SETPOINT CARDS (PAXCDS)

The PAX2D meter has 4 available setpoint alarm output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

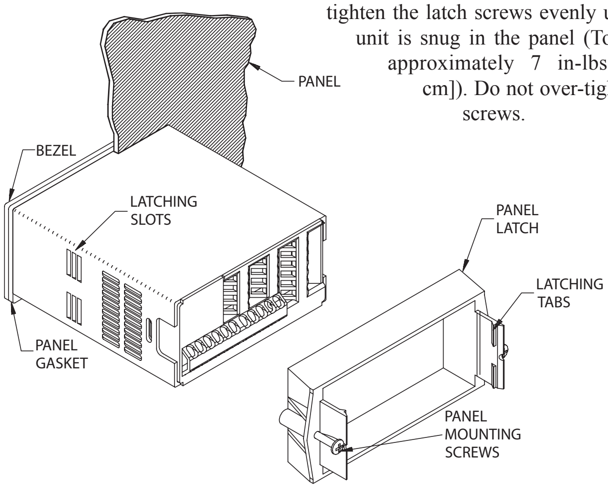
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Response Time: 50 msec max., 10 msec typicat

1.0 Installing the Meter

Installation

The PAX2D meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



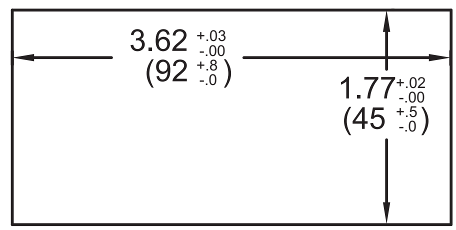
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

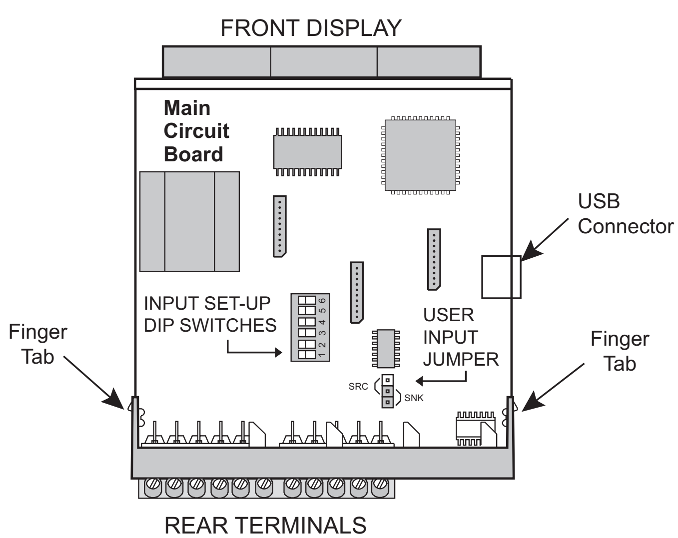
PANEL CUT-OUT



2.0 Setting the DIP Switches

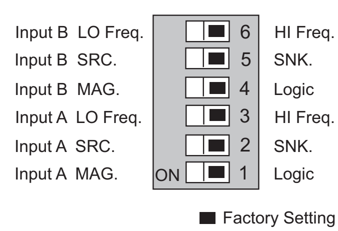
To access the switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.



SETTING THE INPUT DIP SWITCHES

The meter has six DIP switches for Input A and Input B terminal set-up that must be set before applying power.



SWITCHES 1 and 4

LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.

MAG: 200 mV peak input sensitivity; 100 mV hysteresis; maximum voltage: ± 40 V peak (28 Vrms); Input impedance: 3.9 KΩ @ 60 Hz; Must also have SRC switch ON. (Not recommended with counting applications.)

SWITCHES 2 and 5

SNK.: Adds internal 7.8 KΩ pull-up resistor to +5 VDC, I_{MAX} = 0.7 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.

SWITCHES 3 and 6

HI Frequency: Removes damping capacitor and allows max. frequency.

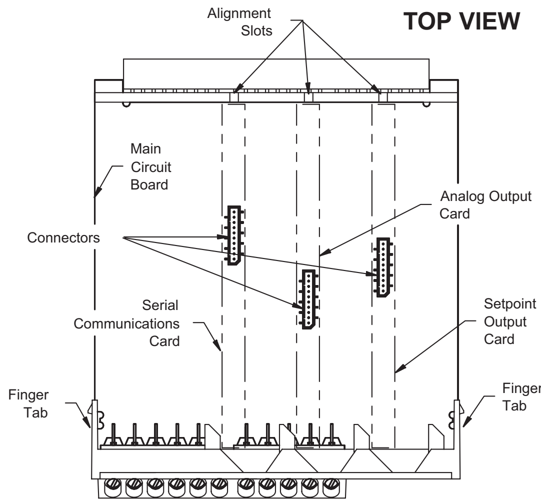
LO Frequency: Adds a damping capacitor for switch contact bounce. Also limits input frequency to maximum 50 Hz and input pulse widths to minimum 10 msec.

3.0 Installing Plug-In Cards

A

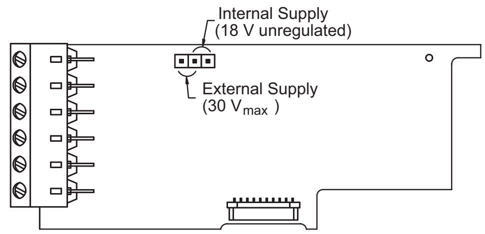
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX2D.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

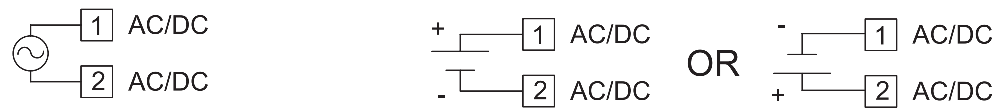
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

AC Power **DC Power**

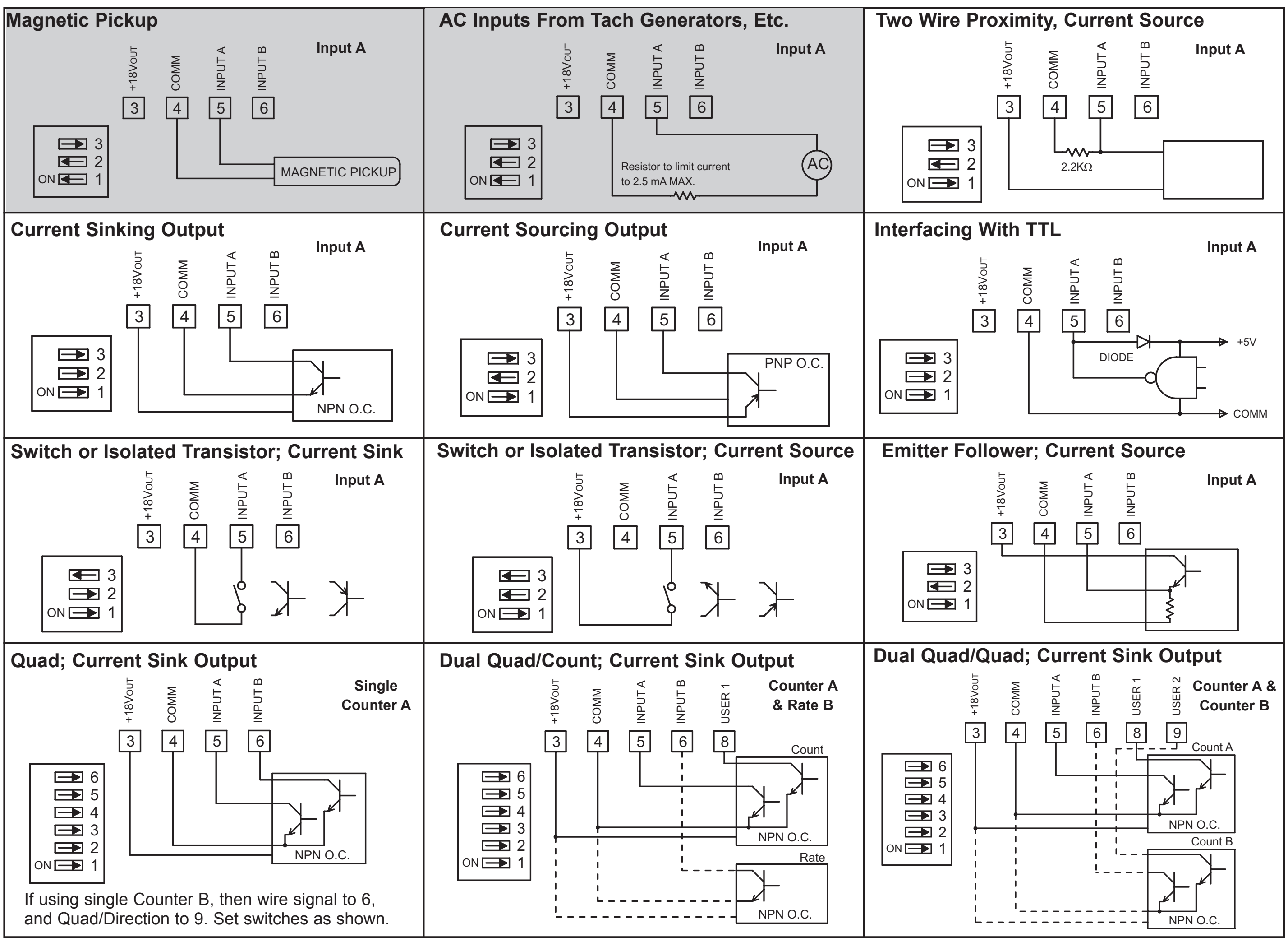


The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

4.2 INPUT SIGNAL WIRING

CAUTION: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth ground; and the common of the isolated plug-in cards with respect to input common.

If you are wiring Input B, connect signal to Terminal 6 instead of 5, and set DIP switches 4, 5, and 6 to the positions shown for 1, 2, and 3.



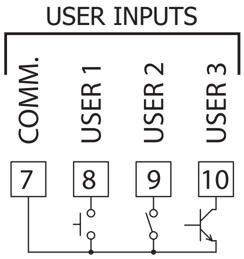
Shaded areas not recommended for counting applications.

4.3 USER INPUT WIRING

If User Input 1 and/or 2 are wired for quadrature or directional counting, an additional switching device should not be connected to that User Input terminal. User Input terminal does not need to be wired in order to remain in inactive state.

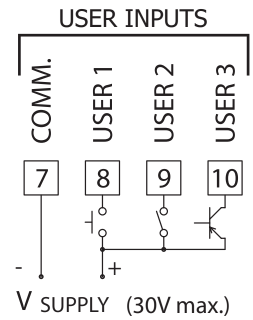
Sinking Logic (USrACt LO)

When the USrACt parameter is programmed to LO, the user inputs of the meter are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (USrACt HI)

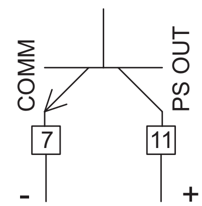
When the USrACt parameter is programmed to HI , the user inputs of the meter are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



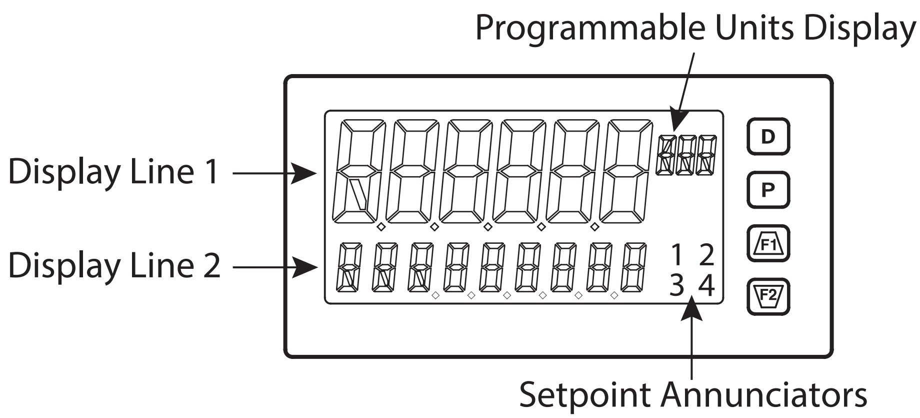
4.4 SETPOINT (ALARMS) WIRING
4.5 SERIAL COMMUNICATION WIRING
4.6 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

4.7 PRESCALER OUTPUT WIRING (NPN O.C.)



5.0 FRONT PANEL KEYS AND DISPLAY OVERVIEW



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
D	Index through enabled Line 2 display values	Return to the previous menu level (momentary press) Quick exit to Display Mode (press and hold)
P	Enter full programming mode or access the parameter and hidden display loops; Press and hold to skip parameters and go directly to Code or Programming Menu	Access the programming parameter menus, store selected parameter and index to next parameter
F1	User programmable Function key 1; hold for 3 seconds for user programmable second function 1 Index through enabled Line 1 values (factory setting)	Increment selected parameter value; Hold F1 and momentarily press F2 key to increment next decade or **D** key to increment by 1000's
F2	User programmable Function key 2; hold for 3 seconds for user programmable second function 2 Reset Line 1 (factory setting)	Decrement selected parameter value; Hold F2 and momentarily press F1 key to decrement next decade or **D** key to decrement by 1000's

DISPLAY LINE 1

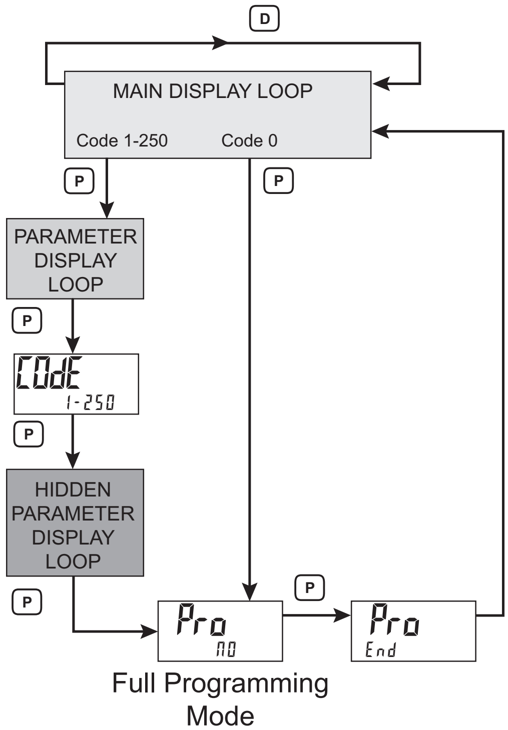
Line 1 is the large, 6-digit top line display. Counter values, rate values and the maximum (Hi) and minimum (Lo) rate capture values can be shown on Line 1. The 3-digit Units mnemonic characters can be used to indicate which Line 1 display value is shown. Standard or custom mnemonics are available for the Line 1 values. See Line 1 parameters in the Display Parameters programming section for configuration details.

DISPLAY LINE 2

Line 2 is the smaller, 9-digit bottom line display. Counter values, rate values, rate capture values, setpoint values and parameter List A/B status can all be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value. See Line 2 parameters in the Display Parameters programming section for configuration details.

LINE 2 DISPLAY LOOPS

The PAX2D offers three display loops to allow users quick access to needed information.



Main Display Loop

In the Main display loop, the D key is pressed to sequence through the selected Line 2 values. A left justified 2 or 3-character mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the user functions programmed in the User Input parameter section.

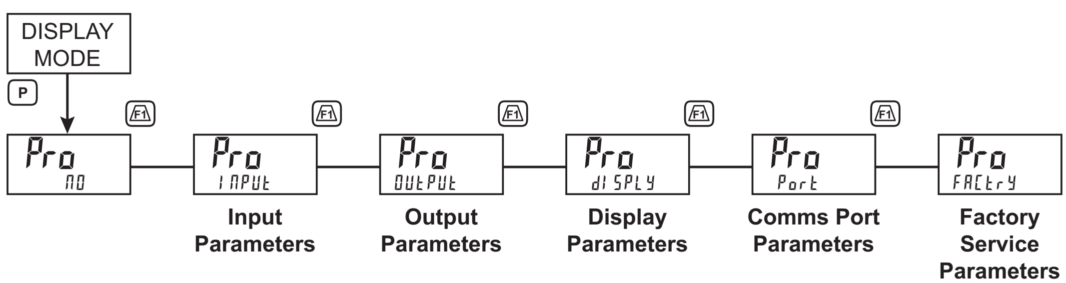
Parameter and Hidden Parameter Display Loops

These Display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming mode. These values include Parameter List A/B selection, setpoints, scale factors, counter load values and display (color, intensity and contrast) settings. To utilize the Parameter or Hidden Parameter Display Loops, a security code (1-250) must be programmed. (See Programming Security Code in the Display Parameters programming section for details.)

The Parameter Display Loop is accessed by pressing the **P** key. The selected Parameter Display Loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter Display Loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on the application needs.

While in the Parameter and Hidden Parameter loops, pressing the **D** key will return the meter to the Main Display Loop. To directly access the Code prompt, press and hold the **P** key. This can be done from the Main display loop or at any point during the Parameter display loop. Also, to directly access Full Programming mode while in the Hidden Parameter loop, press and hold the **P** key to bypass any remaining Hidden Parameter loop values.

6.0 PROGRAMMING THE PAX2D



It is recommended that program settings be recorded as programming is performed. A blank Parameter Value Chart is provided at the end of this bulletin.

PROGRAMMING MODE ENTRY

The Programming Mode is entered by pressing the **P** key. Full Programming Mode will be accessible unless the meter is programmed to use the Parameter loop or Hidden Parameter loop on the Line 2 display. In this case, programming access will be limited by a security code and/or a hardware program lock. (Refer to the previous section for details on Line 2 display loops and limited programming access.) Full Programming Mode permits all parameters to be viewed and modified. In this mode, the front panel keys change to Programming Mode Operations and certain user input functions are disabled.

MODULE ENTRY

The Programming Menu is organized into five modules. These modules group together parameters that are related in function. The F1 and F2 keys are used to select the desired module. The displayed module is entered by pressing the **P** key.

MODULE MENU

Upon entering a module, a parameter selection sub-menu is provided to choose the specific parameter type for programming. For example, this includes counter, rate and user input under the Input Parameter menu. Use the F1 and F2 keys to select the desired parameter type, and press the **P** key to enter the parameter menu.

PARAMETER MENU

Upon entering the Parameter Menu, the **P** key is pressed to advance to a specific parameter to be changed. After completing the parameter menu, or upon pressing the **D** key, the display returns to the initial entry point for the parameter menu. For each additional press of the **D** key, the display returns to the previous level within the module until exiting the module entirely.

SELECTION/VALUE ENTRY

For each parameter, the top line display shows the parameter while the bottom line shows the selections/value for that parameter. The F1 and F2 keys are used to move through the selections/values for the parameter. Pressing the **P** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

Numerical Value Entry

If the parameter is programmed for enter (Entr), the F1 and F2 keys are used to change the parameter values in any of the display loops.

The F1 and F2 keys will increment or decrement the parameter value. When the F1 or F2 key is pressed and held, the value automatically scrolls. The longer the key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the opposite arrow key (F2 or F1) to shift decades (10's 100's, etc), or momentarily press the **D** key and the value scrolls by 1000's as the arrow key is held. Releasing the arrow key removes the decade or 1000's scroll feature. The arrow keys can then be used to make small value changes as described above.

As an alternative, a Select and Set value entry method is provided. This can be used in combination with the value scrolling described above. To change the selected digit in the numerical value, press both the F1 and F2 keys simultaneously. The next digit to the left will be selected (flashing). If both keys are pressed and held, the selected digit will scroll from right to left until one or both keys are released.

Once a digit is selected, the arrow keys are used to increment or decrement that digit to the desired number.

PROGRAMMING MODE EXIT

To exit the Programming Mode, press and hold the **D** key (from anywhere in the Programming Mode) or press the **P** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **P** key must be pressed to store the change before pressing the **D** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with the Input Parameters and proceed through each module in sequence. If lost or confused while programming, press and hold the **D** key to exit programming mode and start over. It is recommended that program settings be recorded as programming is performed. When programming is complete lock out programming with a user input or lock-out code.

Factory Settings may be completely restored in the Factory Service Operations module. This is useful when encountering programming problems.

INPUT PARAMETERS (INPUt)

INPUT SELECT

INPUt
COUNt

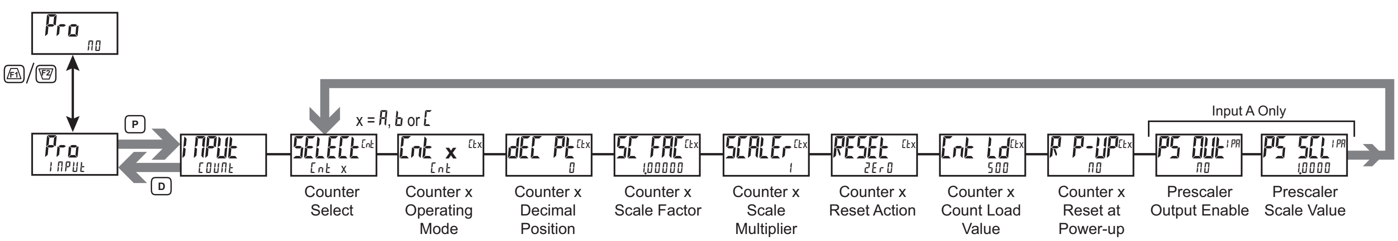
COUNt RAtE USEr

Select the Count, Rate or User Input to be programmed.

COUNTER INPUT PARAMETERS (COUNt)

This section details the programming for Counter A and the Prescaler Output, Counter B, and Counter C. For maximum input frequency, the counters not being used should be set to mode NONE. The Prescaler should be set to NO when it is not in use. When set to NONE or NO, the remaining related parameters are not accessible. A Select Parameter List feature for Scale Factors and Count Load values is explained in the User Input programming section.

In the display depictions shown in this section, "x" represents A, B, or C for the counter being programmed.



COUNTER SELECT

SELECt
Cnt A

Cnt A Cnt b Cnt C

Select the Counter to be programmed.

COUNTER OPERATING MODE

Cnt x
Cnt

Choose the operating mode for the selected counter.

Counter A Selections

SELECTION	MODE	DESCRIPTION
NONE	None	Does not count.
Cnt	Count X1	Adds Input A falling edge.
CntUd	Count X1 w/direction	Adds Input A falling edge if Input B is high. Subtracts Input A falling edge if Input B is low.
dCntUd	Dual Count X1 w/direction	Adds Input A falling edge if User 1 is high. Subtracts Input A falling edge if User 1 is low.
AddAdd	Dual Input X1 Add/Add	Adds Input A falling edge and Input B falling edge.
AddSub	Dual Input X1 Add/Subtract	Adds Input A falling edge. Subtracts Input B falling edge.
qUAd1	Quad X1	Adds Input A rising edge when Input B is high. Subtracts Input A falling edge when Input B is high
qUAd2	Quad X2	Adds Input A rising edge when Input B is high and Input A falling edge when Input B is low. Subtracts Input A falling edge when Input B is high and Input A rising edge when Input B is low.
qUAd4	Quad X4	Adds Input A rising edge when Input B is high, Input A falling edge when Input B is low, Input B rising edge when Input A is low, and Input B falling edge when Input A is high. Subtracts Input A falling edge when Input B is high, Input A rising edge when Input B is low, Input B rising edge when Input A is high, and Input B falling edge when Input A is low.
dqUAd1	Dual Count Quad X1	Adds Input A rising edge when User 1 is high. Subtracts Input A falling edge when User 1 is high.
dqUAd2	Dual Count Quad X2	Adds Input A rising edge when User 1 is high and Input A falling edge when User 1 is low. Subtracts Input A falling edge when User 1 is high and Input A rising edge when User 1 is low.
Cnt2	Count X2	Adds Input A rising and falling edges.
CntUd2	Count X2 w/direction	Adds Input A rising and falling edges if Input B is high. Subtracts Input A rising and falling edge if Input B is low.
dCtUd2	Dual Count X2 w/direction	Adds Input A rising and falling edges if User 1 is high. Subtracts Input A rising and falling edge if User 1 is low.

Counter B Selections

SELECTION	MODE	DESCRIPTION
NONE	None	Does not count.
bAtCH	Batch	Counter B internally counts the number of output activations of the selected setpoint(s). The count source is selected in the Yes/No sub-menu shown for each setpoint (bAt S1 thru bAt S4).
Cnt	Count X1	Adds Input B falling edge.
dCntUd	Dual Count X1 w/direction	Adds Input B falling edge if User 2 is high. Subtracts Input B falling edge if User 2 is low.
dQUAd1	Dual Count Quad X1	Adds Input B rising edge when User 2 is high. Subtracts Input B falling edge when User 2 is high.
dQUAd2	Dual Count Quad X2	Adds Input B rising edge when User 2 is high and Input B falling edge when User 2 is low. Subtracts Input B falling edge when User 2 is high and Input B rising edge when User 2 is low.
Cnt2	Count X2	Adds Input B rising and falling edges.
dCtUd2	Dual Count X2 w/direction	Adds Input B rising and falling edges if User 2 is high. Subtracts Input B rising and falling edge if User 2 is low.

Counter C Selections

SELECTION	MODE	DESCRIPTION
NONE	None	Does not count.
Cnt A	Counter A	Counter C counts the incoming pulses from Counter A input as per Counter A mode of operation. The signal is scaled only according to Counter C parameters.
Cnt b	Counter B	Counter C counts the incoming pulses from Counter B input as per Counter B mode of operation. The signal is scaled only according to Counter C parameters.
Add Ab	Counter A + Counter B	Counter C counts the incoming pulses from Counter A and B inputs as per Counter A and B modes of operation. The result is scaled only according to Counter C parameters. (Example: If Counter A is set for Count X1 mode and Counter B is set for Count X2 mode, then Counter C will increment by 1 for each pulse received on Input A and increment by 2 for each pulse received on Input B. Counter C scale settings are then applied and the result displayed.)
Sub Ab	Counter A – Counter B	Counter C counts the incoming pulses from Counter A and B inputs as per Counter A and B modes of operation and subtracts the B counts from the A counts. The result is scaled only according to Counter C parameters. (Example: If Counter A is set for Count X1 mode and Counter B is set for Count X2 mode, then Counter C will increment by 1 for each pulse received on Input A and decrement by 2 for each pulse received on Input B. Counter C scale settings are then applied and the result displayed.)

Note: Counter A, B and C must all be reset at the same time for the math to be performed on the display values.

bAtCH	Batch	Counter C internally counts the number of output activations of the selected setpoint(s). The count source is selected in the Yes/No sub-menu shown for each setpoint (bAt S1 thru bAt S4).
SLAVE	Slave	Counter C functions as a serial slave display. See Serial Communications section for details.

COUNTER DECIMAL POSITION

dEC Pt Ctx
0

0 0.00 0.0000
0.0 0.000 0.00000

This selects the decimal point position for the selected counter, and any setpoint value assigned to that counter. The selection will also affect that counter's scale factor calculations.

COUNTER SCALE FACTOR

SC FAC Ctx
1.00000

0.00001 to 9.99999

The number of input counts for the selected counter is multiplied by the scale factor and the scale multiplier to obtain the desired process value. A scale factor of 1.00000 will result in the display of the actual number of input counts. For **Add Ab** and **Sub Ab** modes of operation, the math is performed on the input signals and then the result is scaled by Counter C scaling. To achieve correct results, both Input A and Input B must provide the same amount of pulses per unit of measurement. (Details on scaling calculations are explained at the end of this section.) Scale Factor values can also be entered during Program Lockout, if enabled in the Parameter Display loop. See "Line 2 Display Access" in the Display Parameter Module.

COUNTER SCALE MULTIPLIER

SCALEr Ctx
1

10 1 0.1 0.01

The number of input counts for the selected counter is multiplied by the scale multiplier and the scale factor to obtain the desired process value. (Details on scaling calculations are explained at the end of this section.)

COUNTER RESET ACTION

RESEt Ctx
ZErO

ZErO Cnt Ld

When the selected counter is reset, it returns to zero or the counter count load value. This reset action applies to all selected counter resets, except a setpoint generated counter auto reset programmed in the Setpoint Output Parameter Module.

COUNTER COUNT LOAD VALUE

Cnt Ld Ctx
500

-199999 to 999999

When Reset To Count Load action is chosen, the selected counter will reset to this value. Count Load values can also be entered during Program Lockout, if enabled in the Parameter Display loop. See "Line 2 Display Access" in the Display Parameter Module.

COUNTER RESET AT POWER-UP

R P-UP Ctx
NO

NO YES

The selected counter may be programmed to reset at each meter power-up.

◇◇

The next two parameters will only appear when programming Counter A.

PRESCALER OUTPUT ENABLE

PS OUt 1PA
NO

NO YES

This enables the prescaler output. The prescaler output is useful for providing a lower frequency scaled pulse train to a PLC or another external counter. On each falling edge of Input A, the prescaler output register increments by the prescaler scale value (PS SCL). When the register equals or exceeds 1.0000, a pulse is output and the register is lowered by 1.0000. The prescaler register is reset to zero whenever Counter A is reset (except for Setpoint Counter Auto Reset). (See Prescaler Output Figure.)

PRESCALER SCALE VALUE

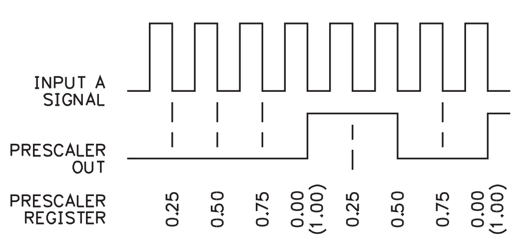
PS SCL 1PA
1.0000

0.0001 to 1.0000

The prescaler output frequency is the Input A frequency times the prescaler scale value.

PRESCALER OUTPUT FIGURE

Prescaler Output Value = 0.25



SCALING CALCULATION

Each counter has the ability to scale an input signal to a desired display value. This is accomplished by the counter mode (Cnt x), decimal point (dEC Pt), scale factor (SC FAC), and scale multiplier (SCALEr). The scale factor is calculated using:

$$\text{SF (SC FAC)} = \frac{\text{DDD}}{\text{(Number of pulses per 'single' unit X CMF X SM)}}$$

Where:

Number of pulses per 'single' unit: pulses per unit generated by the process (i.e. # of pulses per foot)
CMF: Counter Mode(Cnt x) times factor of the mode 1,2 or 4.
SM: Scale Multiplier (SCALEr) selection of 10, 1, 0.1 or 0.01.
DDD: Desired Display Decimal (1 =1, 1.0 = 10, 1.00 = 100, etc.)

Example:

1. Indicate feet to the hundredths (0.00) with 100 pulses per foot: Scale Factor would be 100 / (100 x 1 x 1) = 1 (In this case, the scale multiplier and counter mode factor are 1)
2. Indicate feet with 120 pulses per foot: Scale Factor would be 1 / (120 x 1 x 1) = 0.0083333. (In this case, the scale multiplier of 0.01 could be used: 1 / (120 x 1 x 0.01) = 0.83333 or show to hundredths (0.00): 100 / (120 x 1 x 1) = 0.8333.)

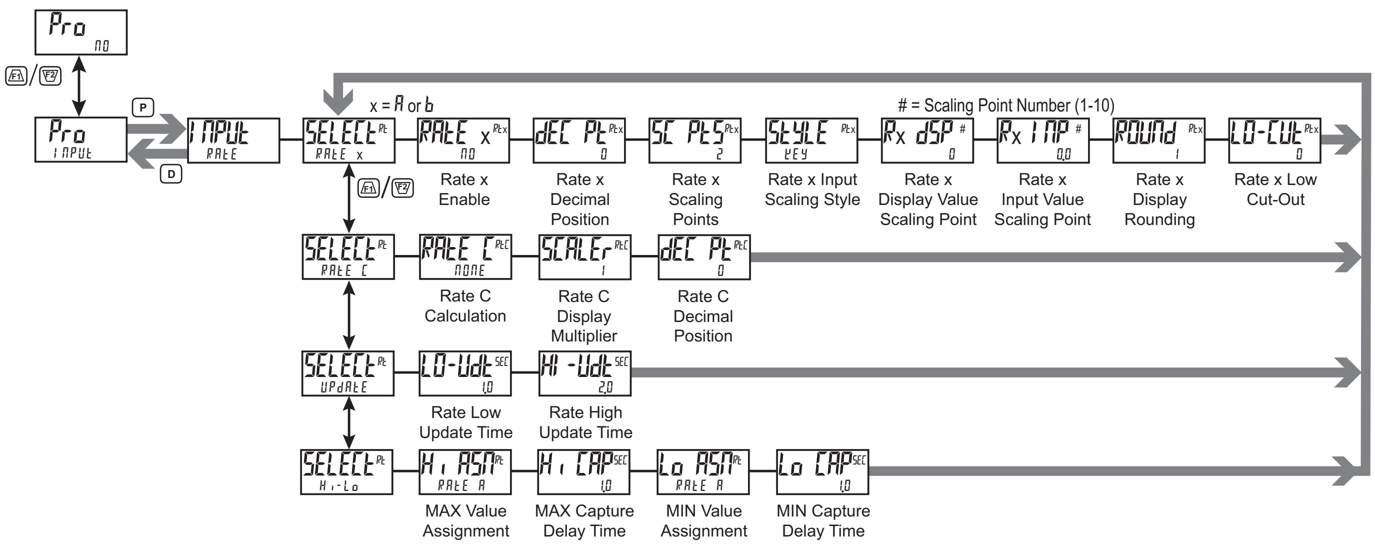
General Rules on Scaling

1. It is recommended that, the scale factor be as close as possible to, but not exceeding 1.00000. This can be accomplished by increasing or decreasing the counter decimal point position, using the scale multiplier, or selecting a different count mode.
2. To double the number of pulses per unit, use counter modes direction X2 or quad X2. To increase it by four times, use counter mode quad X4. Using these modes will decrease the allowable maximum input frequency.
3. A scale factor greater than 1.00000 will cause Counter display rounding. In this case, digit jumps could be caused by the internal count register rounding the display. The precision of a counter application cannot be improved by using a scale factor greater than 1. 00000.
4. The number of pulses per single unit must be greater than or equal to the DDD value in order for the scale factor to be less than or equal to one.
5. Lowering the scale factor can be accomplished by lowering the counter decimal position. (Example: 100 (Hundredths)/10 pulses = 10.000 lowering to 10 (Tenths)/10 = 1.000.)

A

RATE INPUT PARAMETERS (RAtE)

This section details programming for the Rate indicators (A, B and C) and the Maximum and Minimum Rate Capture displays. For maximum input frequency, the Rate indicators should be disabled when they are not in use. When Rate Enable (Rate A and B) or Rate Calculation (Rate C) is set to NO or NONE, the remaining related parameters are not accessible. In the display depictions shown in this section, "x" represents A or B for the rate indicator being programmed.



RATE SELECTION

SELECt RAtE A — RAtE A, RAtE b, RAtE C, UPdAtE, Hi-Lo

Select the Rate parameters to be programmed.

RATE ENABLE

RAtE x NO — NO, YES

Select YES to measure the rate (speed) of pulses on the corresponding Input. Rate measurement is independent of the corresponding Counter count modes.

RATE DECIMAL POSITION

dEC Pt 0 — 0, 0.0, 0.00, 0.000, 0.0000

This selects the decimal point position for the selected Rate indicator.

RATE SCALING POINTS

SC PtS 2 — 2 to 10

This parameter sets the number of scaling points for the Rate Scaling function. The number of scaling points used depends on the linearity of the process and the display accuracy required.

About Scaling Points

Each scaling point is specified by two programmable parameters: A desired Rate Display Value (Rx dSP) and a corresponding Rate Input Value (Rx INP). Scaling points are entered sequentially in ascending order of Rate Input value. Each scaling point defines the upper endpoint of a linear segment, with the lower endpoint being the previous scaling point.

Linear Application – 2 Scaling Points

Linear processes use two scaling points to provide a linear Rate display from 0 up to the maximum input frequency. For typical zero based frequency measurements, the lower point is set to display 0 for 0 Hz input (factory setting) and the upper point set to display the desired value for a given input frequency. For non-zero based applications, the lower point is set to the desired display for 0 Hz input.

Non-linear Application – Up to 10 Scaling Points

For non-linear processes, up to 10 scaling points may be used to provide a piece-wise linear approximation representing the non-linear function. The Rate Display will be linear between sequential scaling points. Thus, the greater the number of scaling points, the greater the conformity accuracy. The Crimson software provides several linearization equations for common Rate applications.

RATE INPUT SCALING STYLE

STYLE Rtx / KEY — KEY APPLY

Rate Input values for scaling points can be entered by using the Key-in or the Applied style described below.

Key-in:

Enter the Rate Input value by pressing the F1 or F2 keys. This value is always in pulses per second (Hz).

Applied:

The existing programmed Rate Input value will appear. To retain this value, press the **P** key to continue to the next parameter. To enter a new value, apply an external rate signal to the appropriate input terminal. Press the F2 key and the applied input frequency (in Hz) will be displayed. To insure the correct reading, wait until a consistent reading is displayed, then press the **P** key to accept this value as the Rate Input Value and continue to the next parameter. Follow the same procedure if using more than 2 scaling points.

RATE DISPLAY VALUE SCALING POINT 1

Rx dSP 1 / 0 — 0 to 999999

For all zero-based applications (display value 0 for 0 Hz input), the Display Value and Input Value for Scaling Point 1 should be set to 0 and 0.0 respectively. For non-zero based applications, enter the desired Display Value for a 0 Hz input.

RATE INPUT VALUE SCALING POINT 1

Rx INP 1 / 0.0 — 0.0 to 99999.9

Normally the Rate Input Value for Scaling Point 1 is 0.0.

RATE DISPLAY VALUE SCALING POINT 2

Rx dSP 2 / 1000 — 0 to 999999

Enter the desired Rate Display Value for Scaling Point 2.

RATE INPUT VALUE SCALING POINT 2

Rx INP 2 / 1000.0 — 0.0 to 99999.9

Enter the corresponding Rate Input Value for Scaling Point 2, by using the Input Scaling Style selected.

RATE DISPLAY ROUNDING

ROUNd Rtx / 1 — 1 5 20 100 / 2 10 50

Rounding values other than '1' round the Rate display to the nearest increment selected (e.g. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Rate display.

RATE LOW CUT-OUT

LO-CUt Rtx / 0 — 0 to 999999

The Low Cut Out value forces the Rate display to zero when the Rate display falls below the value entered.

RATE SCALING

To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. (The Display and Input values can be entered by Key-in or Applied Methods.) These values are internally plotted to a Display value of 0 and Input value of 0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate.

KEY-IN SCALING METHOD CALCULATION

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (Rx dSP) and Scaling Input (Rx INP). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (Rx dSP)	INPUT (Rx INP)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

NOTES:

1. If # of pulse per unit is less than 10, then multiply both Input and Display values by 10.
2. If # of pulse per unit is less than 1, then multiply both Input and Display values by 100.
3. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.

EXAMPLE:

1. With 15.1 pulses per foot, indicate feet per minute in tenths. Scaling Display = 60.0 Scaling Input = 15.1.
2. With 0.25 pulses per gallon, indicate whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.) Scaling Display = 36000 Scaling Input = 2.5.

RATE C PARAMETERS

SELECt Rt / RAtE C

RATE C CALCULATION

RAtE C RtC / NONE

Select the calculation for the Rate C display.

SELECTION	MODE	DESCRIPTION
NONE	None	Rate C disabled.
Add Ab	SUM (A+B)	Rate C shows the sum of Rate A and Rate B.
Sub Ab	DIFFERENCE (A-B)	Rate C shows the difference of Rate A and Rate B.
Pct Ab	RATIO (A/B)	Rate C shows the percentage of Rate A to Rate B.
Pct At	PERCENT OF TOTAL (A/A+B)	Rate C shows the percentage of Rate A to the total of Rate A and Rate B.
Pct dr	PERCENT DRAW (A-B/B)	Rate C shows the percent draw between Rate A and Rate B.

RATE C DISPLAY MULTIPLIER

SCALEr RtC 1 — 1 10 100 1000

Set the Display Multiplier to obtain the desired Rate C display resolution. For Rate C percentage calculations, the result is internally multiplied by 100 to show percent as a whole number. By using a Display Multiplier of 10, 100 or 1000, along with the proper decimal point position, percentage can be shown in tenths, hundredths or thousandths respectively.

RATE C DECIMAL POSITION

dEC Pt RtC 0 — 0 0.0 0.00 0.000 0.0000

Select the decimal point position for Rate C.

RATE UPDATE PARAMETERS

SELECt Rt UPdAtE

RATE LOW UPDATE TIME (DISPLAY UPDATE)

LO-Udt SEC 1.0 — 0.1 to 999.9 seconds

The Low Update Time is the minimum amount of time between display updates for all enabled Rate displays. Small Low Update Time values may increase the possibility of the display indicating an unstable input (jittery display). The factory setting of 1.0 will update the display at a minimum of every second.

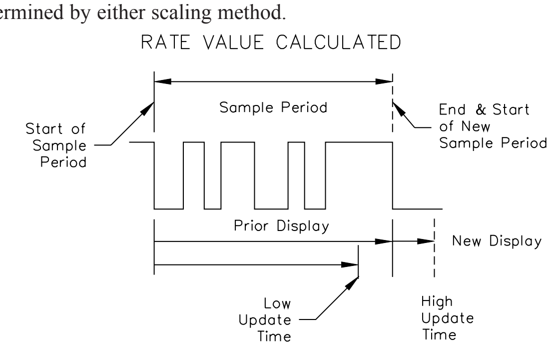
RATE HIGH UPDATE TIME

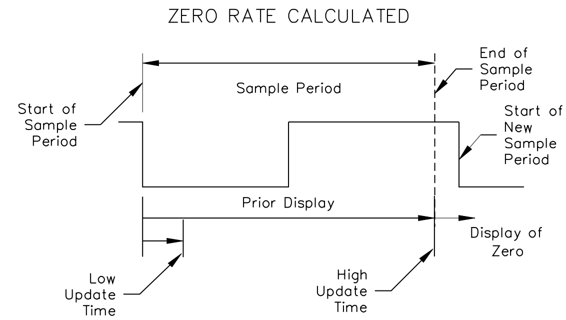
HI -Udt SEC 2.0 — 0.2 to 999.9 seconds

The High Update Time is the maximum amount of time before the enabled Rate displays are forced to zero. (For more explanation, refer to Input Frequency Calculation.) The High Update Time must be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.

INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by either scaling method.





RATE MAXIMUM/MINIMUM CAPTURE PARAMETERS

SELECt Rt Hi-Lo

MAXIMUM CAPTURE VALUE ASSIGNMENT

Hi ASN Rt RAtE A — RAtE A RAtE b RAtE C

Select the Rate display to which the Maximum Capture value is assigned.

MAXIMUM CAPTURE DELAY TIME

Hi CAP SEC 1.0 — 0.0 to 999.9 seconds

When the assigned Rate value is above the present Maximum rate value for the entered amount of time, the meter will capture that Rate value as the new Maximum value. A delay time helps to avoid false captures of sudden short spikes.

MINIMUM CAPTURE VALUE ASSIGNMENT

Lo ASN Rt RAtE A — RAtE A RAtE b RAtE C

Select the Rate display to which the Minimum Capture value is assigned.

MINIMUM CAPTURE DELAY TIME

Lo CAP SEC 1.0 — 0.0 to 999.9 seconds

When the assigned Rate value is below the present Minimum rate value for the entered amount of time, the meter will capture that Rate value as the new Minimum value. A delay time helps to avoid false captures of sudden short spikes.

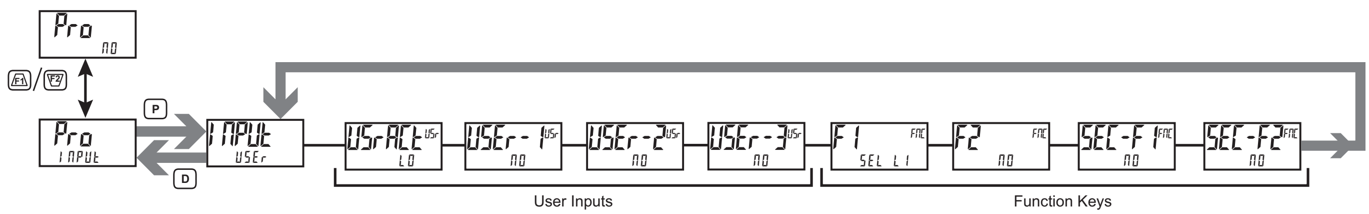
USER INPUT/FUNCTION KEY PARAMETERS (USEr)

This section details the programming for the rear terminal User Inputs and front panel Function Keys. Three user inputs are individually programmable to perform specific meter control functions. While in the Display Mode, the function is executed when the user input transitions to the active state. (Refer to the user input specifications for response times.) Certain User input functions are disabled in Programming Mode. Two front panel function keys, F1 and F2, are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed when the key is pressed. Holding the F1 or F2 function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function. The front panel key functions are disabled while in Programming Mode.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions are performed every time any of those user inputs or function keys transition to the active state.

The List user function has a value assignment sublist, which appears when the **P** key is pressed and LISt is selected. The function will only be performed for the assignment values selected as YES. If a user input or function key is configured for a function with a sublist, then that sublist will need to be scrolled through each time to access the remaining user inputs or function keys following the sublist.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. In the parameter explanations, USEr-n represents all user inputs. Fn represents both function keys and second function keys.



USER INPUT ACTIVE STATE

USrACt USr / LO   LO   HI

Select the desired active state for the User Inputs. Select LO for sink input, active low. Select HI for source input, active high.

NO FUNCTION

USEr-n USr / NO   Fn FNC / NO

No function is performed if activated. This is the factory setting for all user inputs and second function keys.

PROGRAMMING MODE LOCK-OUT

USEr-n USr / PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

SELECT LINE 1 DISPLAY

USEr-n USr / SEL L1   Fn FNC / SEL L1

When activated (momentary action), the display advances to the next Line 1 display that has been made available (in the Display Module, Line 1/Select sub-menu). This is the factory setting for function key F1.

SELECT LINE 2 DISPLAY

USEr-n USr / SEL L2   Fn FNC / SEL L2

When activated (momentary action), the display advances to the next Line 2 display that has been made available (in the Display Module, Line 2/Access sub-menu).

RESET LINE 1 DISPLAY

USEr-n USr / RSt L1   Fn FNC / RSt L1

When activated (momentary action), resets the current Line 1 Display value. This is the factory setting for function key F2.

RESET LINE 2 DISPLAY

USEr-n USr / RSt L2   Fn FNC / RSt L2

When activated (momentary action), resets the current Line 2 Display value.

RESET LINE 1 AND LINE 2 DISPLAYS

USEr-n USr / RStL12   Fn FNC / RStL12

When activated (momentary action), resets both the current Line 1 Display value and Line 2 Display value.

CHANGE DISPLAY COLOR

USEr-n USr / Color   Fn FNC / Color

When activated (momentary action), Line 1 will change color green to red, red to orange, orange to green.

ADJUST DISPLAY INTENSITY LEVEL

USEr-n USr / d-LEU   Fn FNC / d-LEU

When activated (momentary action), the display intensity changes to the next intensity level.

ADJUST DISPLAY CONTRAST LEVEL

USEr-n USr / d-Cont   Fn FNC / d-Cont

When activated (momentary action), the display contrast changes to the next higher level.

TURN OFF METER DISPLAY

USEr-n USr / d-OFF   Fn FNC / d-OFF

Turns off the display backlight when activated. If a user input is used, the backlight is off when the user input is active (maintained action). If a front panel key is used, the backlight will toggle for each key press (momentary action). The backlight is always on in programming mode.

SELECT PARAMETER LIST

USEr-n USr LISt | Fn FNC LISt

Two lists of values are available to allow the user to switch between two sets of Setpoints, Scale Factors, Counter Load values and Units mnemonics. The two lists are List A and List B. If a user input is used to select the list then List A is selected when the user input is not active and List B is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed.

A submenu is used to select whether the programmed Units Mnemonics are included in the List function. Select YES in the submenu to have different Units Mnemonics for List A and List B. Select NO to display the same mnemonics regardless of the list selected.

To program the values for List A and List B, first complete the programming of all the parameters with List A selected. Exit programming and switch to List B. Re-enter programming and program the desired values for the parameters included in the List.

DISPLAY	DESCRIPTION	FACTORY
UNItS	Units Mnemonics	NO

PRINT REQUEST

USEr-n USr Print | Fn FNC Print

The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Port (Serial) module. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

PRINT REQUEST AND RESET DISPLAYS

USEr-n USr Pr-rSt | Fn FNC Pr-rSt

The meter issues a block print through the serial port when activated just like the Print Request function. In addition, when activated (momentary action), the meter performs a reset of the displays configured as YES in the sublist. Both the Print and Reset actions will only function when the serial type parameter (tYPE) is set to Red Lion protocol (rLC).

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

MAINTAINED (LEVEL) RESET AND INHIBIT

USEr-n USr RSt-L | Fn FNC RSt-L

The meter performs a reset and inhibits the displays configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

MOMENTARY (EDGE) RESET

USEr-n USr RSt-E | Fn FNC RSt-E

When activated (momentary action), the meter resets the displays configured as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

INHIBIT

USEr-n USr Inhibt | Fn FNC Inhibt

The meter inhibits the displays configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

STORE DISPLAY

USEr-n USr StorE | Fn FNC StorE

The meter holds (freezes) the displays configured as YES in the sublist, as long as activated (maintained action). Internally, the counters and max and min values continue to update.

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

STORE AND RESET DISPLAY

USEr-n USr St-rSt | Fn FNC St-rSt

The meter holds (freezes) the displays and then performs a reset of the displays configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	NO
Cnt b	Counter B	NO
Cnt C	Counter C	NO
Hi	Maximum	NO
Lo	Minimum	NO

SETPOINT DEACTIVATE (RESET) MAINTAINED (LEVEL)

USEr-n USr SPr-L | Fn FNC SPr-L

The meter deactivates (resets) the setpoint outputs configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

A

SETPOINT DEACTIVATE (RESET) MOMENTARY (EDGE)

USEr-n USr
SPr-E

Fn FNC
SPr-E

When activated (momentary action), the meter deactivates (resets) the setpoint outputs configured as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

SETPOINT ACTIVATE (SET) MOMENTARY (EDGE)

USEr-n USr
SPS-E

Fn FNC
SPS-E

When activated (momentary action), the meter activates (sets) the setpoint outputs configured as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

SETPOINT ACTIVATE (SET) MAINTAINED (LEVEL)

USEr-n USr
SPS-L

Fn FNC
SPS-L

The meter activates (sets) the setpoint outputs configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

HOLD SETPOINT STATE

USEr-n USr
SPHOLd

Fn FNC
SPHOLd

The meter holds the state of the setpoint outputs configured as YES in the sublist, as long as activated (maintained action).

DISPLAY	DESCRIPTION	FACTORY
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

OUTPUT PARAMETERS (OUtPUt)

OUTPUT SELECT

OUtPUt
SEtPNt

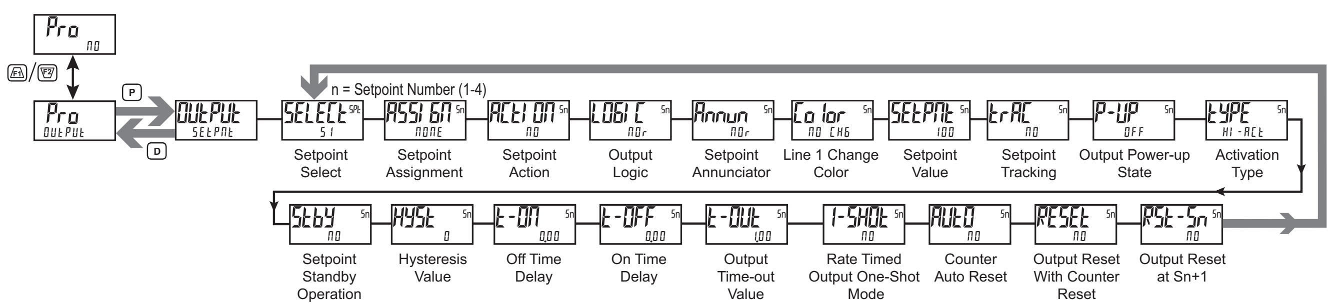
SEtPNt ANALOG

Select the Setpoint or Analog output to be programmed. The Analog output selection only appears if an analog output plug-in card is installed in the meter.

SETPOINT OUTPUT PARAMETERS (SEtPNt)

This section details the programming for the setpoints. To have output capabilities, a setpoint Plug-in card needs to be installed into the PAX2D (see Ordering Information). Depending on the card installed, there will be two or four setpoint outputs available. If no output card is installed, programming for the setpoints is still available. An Exchange Parameter Lists feature for setpoint values is explained in User Input programming. For maximum input frequency, unused setpoints should be configured for NO action.

The Setpoint Assignment and Setpoint Output Action determine setpoint feature availability. The Setpoint Parameter Availability chart illustrates this.



SETPOINT PARAMETER AVAILABILITY

PARAMETER	DESCRIPTION	COUNTER ASSIGNMENT			RATE ASSIGNMENT		
		TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH	TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH
LOGIC	Setpoint Output Logic	Yes	Yes	Yes	Yes	Yes	Yes
Annun	Setpoint Annunciator	Yes	Yes	Yes	Yes	Yes	Yes
Color	Setpoint Line 1 Color	Yes	Yes	Yes	Yes	Yes	Yes
SEtPNt	Setpoint Value	Yes	Yes	Yes	Yes	Yes	Yes
trAC	Setpoint Tracking	Yes	Yes	Yes	Yes	Yes	Yes
P-UP	Setpoint Output Power-up State	No	No	Yes	No	No	Yes
tYPE	Setpoint Activation Type	No	Yes	No	Yes	Yes	Yes
Stby	Standby Operation	No	Yes	No	Yes	Yes	Yes
HYSt	Setpoint Hysteresis	No	No	No	Yes	Yes	No
t-ON	Setpoint On Time Delay	No	No	No	Yes	Yes	Yes
t-OFF	Setpoint Off Time Delay	No	No	No	No	Yes	No
t-OUt	Setpoint Output Time-out Value	Yes	No	No	Yes	No	No
1-SHOt	Rate Timed Output One-shot	No	No	No	Yes	No	No
AUtO	Counter Auto Reset	Yes	No	Yes	No	No	No
RESEt	Output Reset with Manual Reset	Yes	No	Yes	No	No	No
RSt-Sn	Setpoint Output Reset at Sn+1	Yes	No	Yes	No	No	No

SETPOINT SELECT

SELECt SPt
S1

S1 S2 S3 S4

Select the Setpoint output to be programmed. The "Sn" in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display returns to the Setpoint Select menu. Repeat steps for each setpoint to be programmed.

The number of outputs available is setpoint output card dependent (2 or 4). If no output card is installed, programming is still available for all setpoints. This allows the Line 1 color change feature to provide a visual indication when a setpoint value has been reached, even if no setpoint output card is being used.

SETPOINT ASSIGNMENT

ASSIGN Sn
NONE

NONE Cnt x RAtE x

Select the display to which the setpoint is assigned.

SELECTION	DISPLAY VALUE
NONE	Manual Mode operation (See SERIAL RLC PROTOCOL)
Cnt x	Counter Display Value (x = A, B or C)
RAtE x	Rate Display Value (x = A, B or C)

SETPOINT ACTION

ACtION Sn
NO

NO LAtCH t-OUt bOUNd

Select the desired Setpoint Output Action. Choose NO (no action) if a setpoint is unused or for manual mode operation. See "Setpoint (Alarm) Figures for Rate" for a visual detail of Rate Assigned setpoint actions.

For Counter Assignments:

LAtCH LATCH Action - The setpoint output activates when the count value equals the setpoint value. The output remains active until reset.

t-OUt TIMED OUT Action - The setpoint output activates when the count value equals the setpoint value and deactivates after the Time Out value.

bOUNd BOUNDARY Action - The setpoint output activates when the count value is greater than or equal to (for tYPE = HI-ACt) or less than or equal to (for tYPE = LO-ACt) the setpoint value. The setpoint output will deactivate when the count value is less than (for tYPE = HI-ACt) or greater than (for tYPE = LO-ACt) the setpoint value.

For Rate Assignments:

LAtCH LATCH Action - The setpoint output activates when the rate value is equal to the setpoint value. The setpoint output remains active until reset. If after reset, the rate value is greater than or equal to (for tYPE = HI-ACt) or less than or equal to (for tYPE = LO-ACt) the setpoint value, the output will reactivate.

t-OUt TIMED OUT Action - The setpoint output cycles when the rate value is greater than or equal to (for tYPE = HI-ACt) or less than or equal to (for tYPE = LO-ACt) the setpoint value. The Setpoint Time Out (t-OUt) and Setpoint On Delay (t-ON) values determine the cycling times. One-shot mode provides a single output pulse (t-OUt) rather than on/off cycling.

bOUNd BOUNDARY Action - The setpoint output activates when the rate value is greater than or equal to (for tYPE = HI-ACt) or less than or equal to (for tYPE = LO-ACt) the setpoint value. The setpoint output will deactivate (Auto reset) as determined by the Hysteresis value.

OUTPUT LOGIC

LOGIC Sn
NOr

NOr rEU

Enter the output logic of the alarm output. The NOr logic leaves the output operation as normal. The rEU logic reverses the output logic. In rEU, the alarm states in the Setpoint Alarm Figures are reversed.

SETPOINT ANNUNCIATOR

Annun Sn
NOr

NOr rEU FLASH OFF

The NOr mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEU mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASH mode flashes the corresponding setpoint annunciators of "on" alarm outputs. The OFF mode disables display setpoint annunciators.

LINE 1 CHANGE COLOR

Color Sn
NO CHG

NO CHG GrEEN OrANGE rEd
GrnOrG rEdOrG rEdGrn LINE 1

This parameter allows the Line 1 Display to change color, or alternate between two colors, when the alarm is activated. When multiple alarms are programmed to change color, the highest numbered active alarm (S4-S1) determines the display color.

The NO CHG selection will maintain the color displayed prior to the alarm activation. The LINE 1 selection sets the display to the Display (Line 1) Color (Color).

SETPOINT VALUE

SEtPNt Sn
100

-199999 to 999999

Enter desired setpoint alarm value. Setpoint values can also be entered in the Display Mode during Program Lockout when the setpoint is programmed as Entr in the Display (Line 2) Access parameters. The decimal point position is determined by the Setpoint Assignment value.

SETPOINT TRACKING

trAC Sn
NO

NO S2 S4 CLd b
S1 S3 CLd A CLd C

If a selection other than NO is chosen, then the value of the setpoint being programmed ("n") will track the entered selection's value. Tracking means that when the selection's value is changed, the "n" setpoint value will also change (or follow) by the same amount.

OUTPUT POWER-UP STATE

P-UP Sn
OFF

OFF ON SAUE

OFF will deactivate the output at power up. ON will activate the output at power up. SAUE will restore the output to the same state it was at before the meter was powered down.

ACTIVATION (BOUNDARY) TYPE

tYPE Sn
HI-ACt

HI-ACt LO-ACt

HI-ACt activates the output when the assigned display value (ASSIGN) equals or exceeds the setpoint value. LO-ACt activates the output when the assigned display value is less than or equal to the setpoint.

SETPOINT STANDBY OPERATION

Stby Sn
NO

NO YES

This parameter only applies to low acting setpoint activation (boundary) type setpoints. Select YES to disable a low acting setpoint at power-up, until the assigned display value crosses into the output "off" area. Once in the output "off" area, the setpoint will function per the description for low acting activation (boundary) type.

HYSTERESIS VALUE

HYSt Sn
0

0 to 59999

The hysteresis value is added to (for tYPE = LO-ACt), or subtracted from (for tYPE = HI-ACt), the setpoint value to determine at what value to deactivate the associated setpoint output. Hysteresis is only available for Rate assigned setpoints.

ON TIME DELAY

t-ON Sn
0.00

0.00 to 599.99 seconds

This is the amount of time the assigned Rate display must meet the setpoint activation requirements (below setpoint for Low Acting and above setpoint for High Acting), before the setpoint output activates. If the Rate Setpoint Action is Timed-Out, this is the amount of time the output is OFF during the ON/OFF output cycling. This parameter is only available for Rate assigned setpoints.

OFF TIME DELAY

t-OFF Sn
0.00

0.00 to 599.99 seconds

This is the amount of time the assigned Rate display must meet the setpoint deactivation requirements (below hysteresis for High Acting and above hysteresis for Low Acting), before the setpoint output deactivates. This parameter is only available for Rate assigned setpoints.

OUTPUT TIME-OUT

t-OUt Sn
1.00

0.00 to 599.99 seconds

If the setpoint action is Timed Out and the setpoint is assigned to Counter, then this is the amount of time the output will activate once the count value equals the setpoint value. If the setpoint action is Timed Out and the setpoint is assigned to Rate, then this is the amount of time the output is ON during the ON / OFF output cycling. If Rate Timed Output One-Shot mode is enabled, then this is the time duration for the one-shot output pulse.

RATE TIMED OUTPUT ONE-SHOT

1-SHOt Sn
NO

NO YES

If the setpoint action is Timed Out and the setpoint is assigned to Rate, select YES to have the output activate for a single pulse (one-shot) when the assigned Rate display meets the setpoint activation requirements. Select NO for ON / OFF output cycling per the "Setpoint (Alarm) Figures For Rate" diagram.

COUNTER AUTO RESET

AUtO Sn
NO

NO ZEr-St CLd-St
ZEr-En CLd-En

This automatically resets the display value of the Setpoint Assigned Counter each time the setpoint value is reached. The automatic reset can occur at output start or output end if the setpoint output action is programmed for timed output mode. The counter may be reset to zero or the count load value. This reset may be different from the counter reset action programmed in the Input Parameter (INPUt) menu section.

SELECTION	ACTION
NO	No Auto Reset
ZEr-St	Reset to Zero at the Start of output activation
CLd-St	Reset to Count Load value at the Start of output activation
ZEr-En	Reset to Zero at the End of output activation (timed out only)
CLd-En	Reset to Count Load at the End of output activation (timed out only)

OUTPUT RESET WITH COUNTER RESET

rESEt Sn
NO

NO YES

Selecting YES causes the Setpoint output to deactivate (reset) when the Setpoint Assigned Counter is reset. The only exception is when the assigned counter is reset by a setpoint generated counter auto reset.

OUTPUT RESET AT Sn+1

RSt-Sn Sn
NO

NO Sn-Str Sn-End

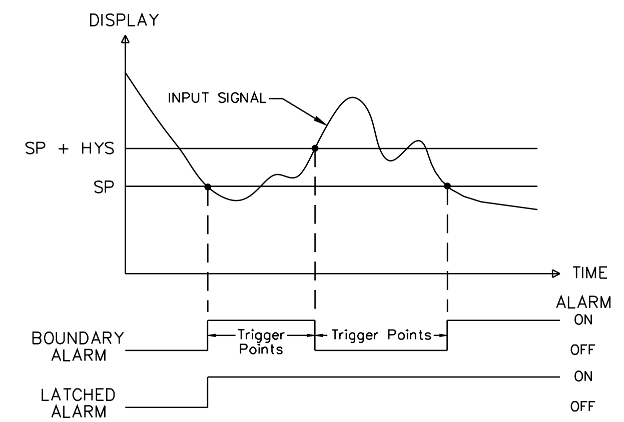
Selecting Sn-Str causes the setpoint output to deactivate (reset) when setpoint Sn + 1 activates. (Example: S1 deactivates when S2 activates, and S4 when S1 activates.) The last setpoint will wrap around to the first.

Selecting Sn-End causes the setpoint output to deactivate (reset) when setpoint Sn + 1 activates and then times out (deactivates). This selection only applies if the Sn + 1 setpoint action is Timed Out. (Example: S1 deactivates when S2 is activated and then times out.) The last setpoint will wrap around to the first. This parameter is only available for Counter assigned setpoints.

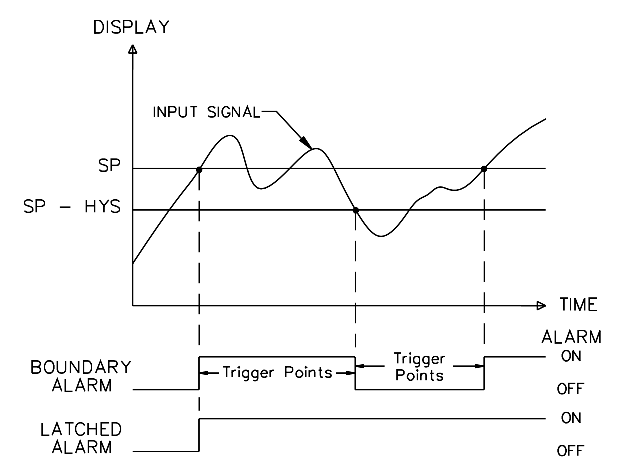
Setpoint (Alarm) Figures for Rate

(For Reverse Logic, The Alarm state is opposite.)

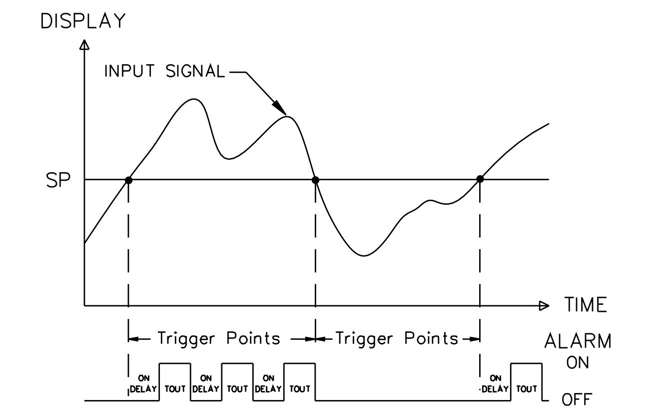
LOW ACTING WITH NO DELAY



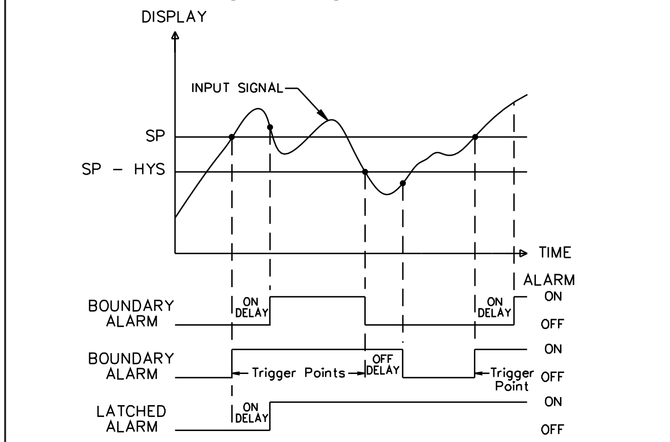
HIGH ACTING WITH NO DELAY



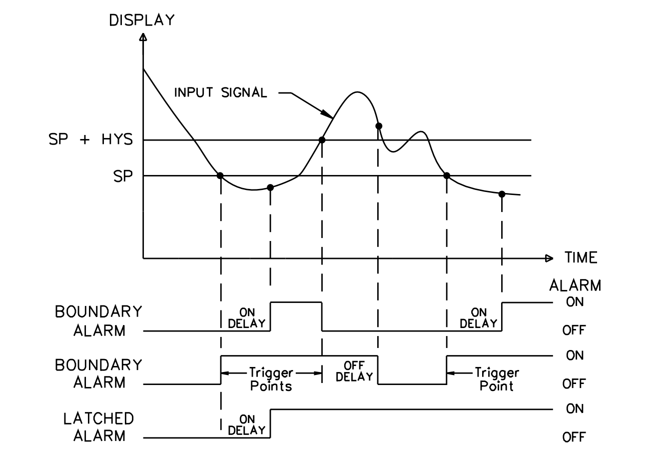
HIGH ACTING WITH TIMEOUT



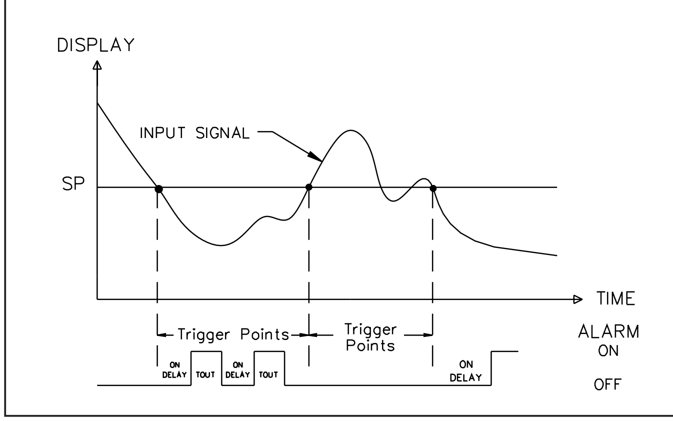
HIGH ACTING WITH DELAY



LOW ACTING WITH DELAY

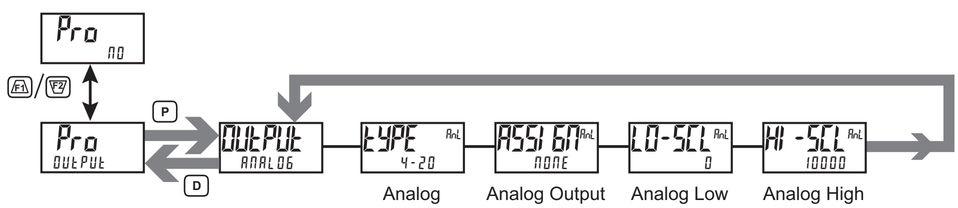


LOW ACTING WITH TIMEOUT



ANALOG OUTPUT PARAMETERS (AnALoG)

This section is only accessible with the optional PAXCDL Analog card installed (see Ordering Information).



Analog Output Type | Analog Output Assignment | Analog Low Scale Value | Analog High Scale Value

ANALOG OUTPUT TYPE

4-20 0-10 0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

Enter the source for the analog output to retransmit:

SELECTION	DISPLAY VALUE
nonE =	Manual Mode operation . (See Serial RLC Protocol in the Communications Port module).
Cnt x =	Counter Display Value (x = A, B or C)
RAtE x =	Rate Display Value (x = A, B or C)
Hi =	Maximum Display Value
Lo =	Minimum Display Value
S1-S4 =	Setpoint Value (S1-S4)

ANALOG LOW SCALE VALUE

- 199999 to 999999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

- 199999 to 999999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

DISPLAY PARAMETERS (dISPLY)

A

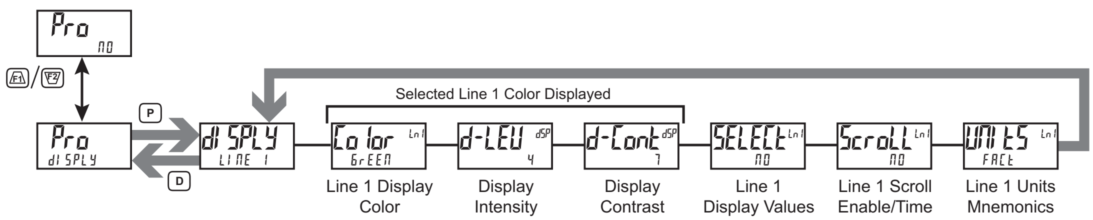
DISPLAY LINE SELECT

dISPLY LINE 1 — LINE 1 LINE 2

Select the Display Line to be programmed.

LINE 1 PARAMETERS (LINE 1)

This section details programming for the Line 1 (Top Line) Display. The Input, Gross, Tare, Total, Maximum (HI) and Minimum (LO) capture values and setpoints can be shown on the Line 1 display. The 3-digit Units mnemonic characters can be used to indicate which Line 1 display value is shown. Standard or custom mnemonics are available for Line 1 values.



LINE 1 DISPLAY COLOR

Color Ln1 GrEEN — GrEEN rEd OrANGE

Enter the desired Display Line 1 and programmable Units Display color.

DISPLAY INTENSITY LEVEL

d-LEV dSP 4 — 1 to 4

Enter the desired Display Intensity Level (1-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter can also be accessed in the Parameter display loop when enabled.

DISPLAY CONTRAST LEVEL

d-Cont dSP 7 — 0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively adjusts up or down as the levels are changed. This parameter can also be accessed in the Parameter display loop when enabled.

LINE 1 DISPLAY VALUE SELECT/ENABLE

SELECt Ln1 NO — NO YES

Enter YES to select which values will be shown on the Line 1 display. A sub-menu provides Yes/No selection for each available Line 1 value. Values set to YES in the sub-menu will be displayable on Line 1.

DISPLAY	DESCRIPTION	FACTORY
Cnt A	Counter A	YES
Cnt b	Counter B	NO
Cnt C	Counter C	NO
RAtE A	Rate A	NO
RAtE b	Rate B	NO
RAtE C	Rate C	NO
HI	Max Value	NO
Lo	Min Value	NO

LINE 1 DISPLAY SCROLL ENABLE/TIME

ScroLL Ln1 NO — NO 1 to 15 seconds

If Line 1 Display Scrolling is desired, set the scroll time in seconds.

LINE 1 UNITS MNEMONIC(S)

UNItS Ln1 FACt — OFF LAbEL CUSt FACt

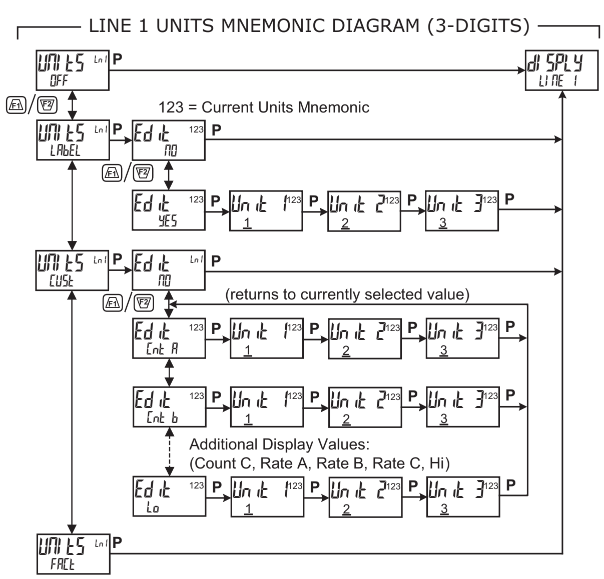
Select the mode for Line 1 Units Mnemonic(s). See LINE 1 UNITS MNEMONIC DIAGRAM for programming details.

SELECTION	MODE	DESCRIPTION
OFF	OFF	No Line 1 mnemonic shown.
LAbEL	LABEL	Single programmable mnemonic shown for all Line 1 values.
CUSt	CUSTOM	Custom programmable mnemonics shown for each Line 1 value.
FACt	FACTORY	Factory default mnemonics shown for each Line 1 value.

The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P Q R S t U V W Y Z 0 1
2 3 4 5 6 7 8 9 c e g h i m n o q r u w - = [ ] / ° _ blank

Two character spaces are required to display this character.



LINE 2 PARAMETERS (LINE 2)

This section details programming for the Line 2 (Bottom Line) Display. The Counter values, Rate values, Rate Capture values, Setpoint values and Parameter List A/B status can all be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value.

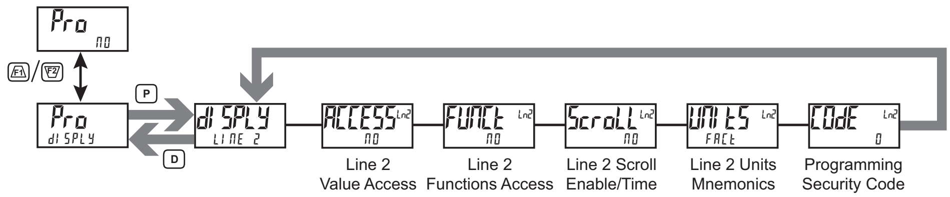
Main Display Loop

In the Main Display Loop, the selected values can be consecutively read on Line 2 by pressing the **D** key. A left justified 2 or 3-character mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the User functions programmed in the User Input program section.

Parameter Display Loop and Hidden Parameter Loop

These display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming Mode. These values include Parameter List A/B selection, Setpoints, Scale Factors, Counter Load values and Display Settings (color, intensity and contrast). To utilize the Parameter or Hidden Parameter loops, a security code (1-250) must be programmed. (See Programming Security Code at the end of this section.)

The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter Loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt.



LINE 2 VALUE ACCESS

nO YES

Select YES to program the Value Access setting for each available Line 2 parameter. Line 2 values can be made accessible in either the Main (**D** key), Parameter (**P** key) or Hidden (**P** key following code entry) display loops.

Each parameter must be configured for one of the following settings. Not all settings are available for each parameter, as shown in the Parameter Value Access table.

SELECTION	DESCRIPTION
LOC	Not viewed on Line 2 Display (Factory Default Setting)
d-rEAd	View in Main display loop. Cannot change or reset.
d-rSt	View and reset in Main display loop.
d-Entr	View and change in Main display loop
P-rEAd	View in Parameter display loop. Cannot change or reset.
P-Entr	View and change in Parameter display loop
HidE	View and change in Hidden Parameter display loop

LINE 2 FUNCTIONS ACCESS

nO YES

Select YES to display the following list of functions that can be made available at the end of the Parameter (P-Entr) or Hidden (HidE) display loops. Each Line 2 Function can be programmed for LOC, P-Entr, or HidE.

The more critical and frequently used functions should be first assigned to the User Inputs and User Function keys, however if more functions are needed than what can be obtained with user inputs and function keys, these will provide a means to provide that access. Refer to Input module, User sub-menu section for a description of the function.

SELECTION	DESCRIPTION
r-L1	Reset Line 1 Display Value
r-CtA	Reset Counter A
r-Ctb	Reset Counter B
r-CtC	Reset Counter C
r-AbC	Reset Counters A, B and C
r-Hi	Reset Maximum Rate Capture Value
r-Lo	Reset Minimum Rate Capture Value
r-HL	Reset Max and Min Rate Capture Values
Print	Print Request (Block Print)

LINE 2 PARAMETER VALUE ACCESS

DISPLAY	DESCRIPTION	NOT VIEWED	MAIN DISPLAY LOOP (D KEY)			PARAMETER DISPLAY LOOP (P KEY)		HIDDEN LOOP
		LOC	d-rEAd	d-rSt	d-Entr	P-rEAd	P-Entr	HidE
Cnt A	Counter A	X	X	X				
Cnt b	Counter B	X	X	X				
Cnt C	Counter C	X	X	X				
RAtE A	Rate A	X	X					
RAtE b	Rate B	X	X					
RAtE C	Rate C	X	X					
Hi	Max Value	X	X	X				
Lo	Min Value	X	X	X				
LISt	Parameter List A/B	X	X		X	X	X	X
Sn	Setpoint Value (S1-S4) *	X	X		X	X	X	X
SC FAC	Scale Factor A, B, C *	X				X	X	X
Cnt Ld	Counter Load A, B, C *	X				X	X	X
Color	Line 1 Display Color	X				X	X	X
d-LEV	Display Intensity Level	X				X	X	X
d-Cont	Display Contrast Level	X				X	X	X

* Indicates multiple value entries.

LINE 2 DISPLAY SCROLL ENABLE/TIME

ScroLL Ln2 / nO

nO   1 to 15 seconds

If Line 2 Display Scrolling is desired, set the scroll time in seconds.

LINE 2 UNITS MNEMONIC(S)

UnItS Ln2 / FACt

OFF   CUSt   Lb-CSt   Lb Ln1
LAbEL   FACt   Lb-FAC   L1-FAC

Select the mode for Line 2 Units Mnemonic(s). See LINE 2 UNITS MNEMONIC DIAGRAM for programming details.

SELECTION	MODE	DESCRIPTION
OFF	OFF	No Line 2 mnemonics shown.
LAbEL	LABEL	Single programmable mnemonic shown as a separate item in the Line 2 Display loop. No individual mnemonics are shown with the other Line 2 Display values.
CUSt	CUSTOM	Individual Custom programmable mnemonics shown with each value in the Line 2 Display loop.
FACt	FACTORY	Individual Factory default mnemonics shown with each value in the Line 2 Display loop.
Lb-CSt	LABEL & CUSTOM	A programmable mnemonic shown as a separate item in the Line 2 Display loop. Also, individual Custom programmable mnemonics shown with each value in the Line 2 Display loop.
Lb-FAC	LABEL & FACTORY	A programmable mnemonic shown as a separate item in the Line 2 Display loop. Also, individual Factory default mnemonics shown with each value in the Line 2 Display loop.
Lb Ln1	LINE 1 INDEXED LABELS	Individual programmable mnemonics, indexed to the Line 1 Display value, are shown as a separate item in the Line 2 Display loop. These same mnemonics are also shown with each value in the Line 2 Display loop.
L1-FAC	LINE 1 INDEXED LABELS & FACTORY	Individual programmable mnemonics, indexed to the Line 1 Display value, are shown as a separate item in the Line 2 Display loop. Also, individual Factory default mnemonics are shown with each value in the Line 2 Display loop.

The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P q r S t U W Y 2 0 1
2 3 4 5 6 7 8 9 a c e g h i m n o u w - = [ ] / ° _ blank

Two character spaces are required to display this character.

PROGRAMMING SECURITY CODE

CodE Ln2 / 0

0 to 250

To activate either the Parameter or Hidden Parameter display loops, a security code (1-250) must be entered. If a "0" security code is programmed, pressing the **P** key takes you directly to the Full Programming Mode.

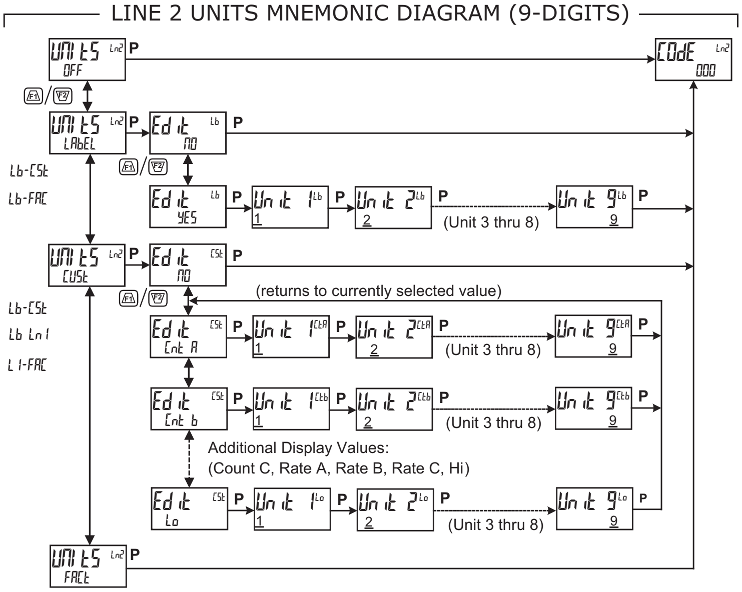
The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Input [User] module).

Two programming modes are available. Full Programming Mode allows all parameters to be viewed and modified. Parameter display loop mode provides access to those selected parameters, that can be viewed and/or modified without entering the Full programming mode.

The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN P KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
0	not PLOC	————	Full Programming	Immediate Access
0	PLOC	Not Active	Full Programming	Immediate Access
0	PLOC	Active	Enter Parameter Display Loop	No Access
>0	not PLOC	————	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at CodE prompt.
>0	PLOC	Not Active	Full Programming	Immediate Access
>0	PLOC	Active	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at CodE prompt.

LINE 2 UNITS MNEMONIC DIAGRAM (9-DIGITS)



COMMUNICATIONS PORT PARAMETERS (Port)

A

To select SErIAL, an optional communication card must be installed.

PORT SELECT

Port
USb

USb   SErIAL

Select the Communications Port to be programmed.

USB PORT PARAMETERS (USb)

USB CONFIGURATION

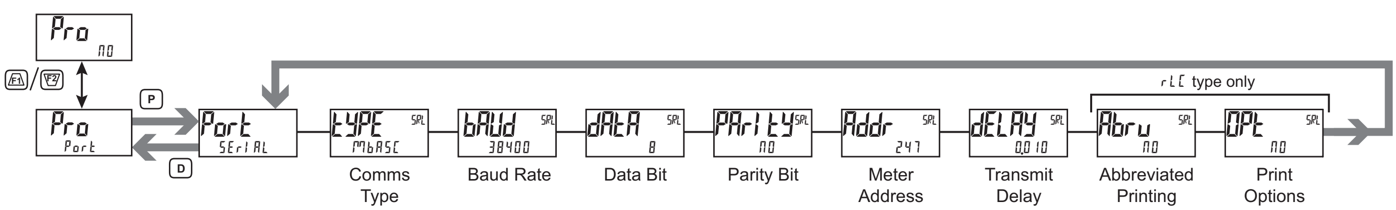
CONFIG USb
AUtO

AUtO   SErIAL

AUtO   Meter automatically configures USB port settings to operate with Crimson configuration software. When a USB cable is attached to PAX2S and PC, the port is internally set to Modbus RTU protocol, 38400 baud, 8 bits, and Unit Address 247. The Serial Port settings programmed below will not change, or show this.

SErIAL   Configures USB port to utilize the Serial Port settings and protocol programmed below.

SERIAL PORT PARAMETERS (SErIAL)



COMMUNICATIONS TYPE

tYPE SRL
MbASC

MbrtU - Modbus RTU
MbASC - Modbus ASCII
rLC - RLC Protocol (ASCII)

Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2D, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd SRL
38400

1200   4800   19200
2400   9600   38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

DATA BIT

dAtA SRL
8

7   8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link. For MbrtU communication type, data bit setting is fixed at 8 bits.

PARITY BIT

PArItY SRL
nO

nO   EVEn   Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits. Parity is not available if dAtA is set for 8 bit.

METER UNIT ADDRESS

Addr SRL
247

1 to 247 - Modbus
0 to 99 - RLC Protocol

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

dELAY SRL
0.010

0.000 to 0.250 seconds

Following a Modbus command or RLC Transmit Value command, the PAX2D will wait this minimum amount of time in seconds before issuing a serial response

The following programming steps are only available when Communications Type (tYPE) is programmed for rLC.

A

ABBREVIATED PRINTING

Abru SRL
nO

nO YES

Select nO for full print or Command T transmissions (meter address, mnemonics and parameter data) or YES for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, it will not be sent during a full transmission.

PRINT OPTIONS

OPt SRL
nO

nO YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or nO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
Cnt A	Counter A	YES	CTA
Cnt b	Counter B	nO	CTB
Cnt C	Counter C	nO	CTC
RAtE A	Rate A	nO	RTA
RAtE b	Rate B	nO	RTB
RAtE C	Rate C	nO	RTC
Hi	Max Value	nO	MAX
Lo	Min Value	nO	MIN
SC FAC	Scale Factor A & B	nO	SFA, SFB
Cnt Ld	Counter Load A & B	nO	CLA, CLB
SEtPNt	Setpoint Values	nO	SP1 - SP4

SERIAL COMMUNICATIONS

The PAX2D supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 PAX option cards, the PAX2D supports both the RLC protocol and also supports Modbus communications. The PAX Modbus option card should not be used with the PAX2D, as the PAX2D internal Modbus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2D with the Crimson programming software. It can also be used as a virtual serial communications port following installation of the PAX2D USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2D and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2D CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2D.
3. Insure USB Configuration (CONFIG) in USB Port Parameters is set to AUtO (factory default setting).
4. Attach USB cable (USB A to Mini-B) between PC and PAX2D.
5. Create a new file (File, New) or open an existing PAX2D database within Crimson.
6. Configure Crimson Link options (Link, Options) to the serial port which the USB cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communications Type Parameter (tYPE) be set to "MbrtU" or "MbASC".

PAX2D CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2D to PC.
3. Supply power to PAX2D.
4. Configure serial parameters (SErIAL) to Modbus RTU "MbrtU", 38,400 baud, address 247.
5. Create a new file (File, New) or open an existing PAX2D database within Crimson.
6. Configure Crimson Link options (Link, Options) to the serial port which the communication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 64 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 64 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 64 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAX2. "Total Good Comms" is the total messages received by the PAX2D with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAX2D ab<0100h><40h><40h><10h>
a = SP Card, "0"-No SP, "2" or "4" SP
b = Linear Card "0" = None, "1" = Yes
<0100> Software Version Number (1.00)
<40h>Max Register Reads (64)
<40h>Max Register Writes (64)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAX2D FRERQUENTLY USED MODBUS REGISTER TABLE

Only frequently used registers are shown below. The entire Modbus Register Table can be found at www.redlion.net.
Values less than 65,535 will be in (Lo word). Values greater than 65,535 will continue into (Hi word). Negative values are represented by two's complement of the combined (Hi word) and (Lo word).
Note 1: The PAX2D should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Counter A Value (Hi word)	-199999999	999999999	0	Read/Write	
40002	Counter A Value (Lo word)					
40003	Counter B Value (Hi word)	-199999999	999999999	0	Read/Write	
40004	Counter B Value (Lo word)					
40005	Counter C Value (Hi word)	-199999999	999999999	0	Read/Write	
40006	Counter C Value (Lo word)					
40007	Rate A Value (Hi word)	N/A	N/A	N/A	Read Only	
40008	Rate A Value (Lo word)					
40009	Rate B Value (Hi word)	N/A	N/A	N/A	Read Only	
40010	Rate B Value (Lo word)					
40011	Rate C Value (Hi word)	N/A	N/A	N/A	Read Only	
40012	Rate C Value (Lo word)					
40013	Max (Hi) Value (Hi word)	-199999	999999	0	Read/Write	
40014	Max (Hi) Value (Lo word)					
40015	Min (Lo) Value (Hi word)	-199999	999999	0	Read/Write	
40016	Min (Lo) Value (Lo word)					
40017	Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	Active List (A or B)
40018	Setpoint 1 Value (Lo word)					
40019	Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	Active List (A or B)
40020	Setpoint 2 Value (Lo word)					
40021	Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	Active List (A or B)
40022	Setpoint 3 Value (Lo word)					
40023	Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	Active List (A or B)
40024	Setpoint 4 Value (Lo word)					
40025	Counter A Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40026	Counter A Scale Factor (Lo word)					
40027	Counter B Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40028	Counter B Scale Factor (Lo word)					
40029	Counter C Scale Factor (Hi word)	1	999999	100000	Read/Write	Active List (A or B)
40030	Counter C Scale Factor (Lo word)					
40031	Counter A Count Load (Hi word)	-199999	999999	500	Read/Write	Active List (A or B)
40032	Counter A Count Load (Lo word)					
40033	Counter B Count Load (Hi word)	-199999	999999	500	Read/Write	Active List (A or B)
40034	Counter B Count Load (Lo word)					
40035	Counter C Count Load (Hi word)	-199999	999999	500	Read/Write	Active List (A or B)
40036	Counter C Count Load (Lo word)					
40037	Setpoint Output Register (SOR)	0	15	N/A	Read/Write	Status of Setpoint Outputs. Bit State: 0=Off, 1=On. Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4. Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40038	Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = S1, Bit 3 = S2, Bit 2 = S3, Bit 1 = S4, Bit 0 = Linear Output
40039	Reset Output Register	0	15	0	Read/Write	Bit State: 1= Reset Output, bit is returned to zero following reset processing; Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4
40040	Analog Output Register (AOR)	0	4095	0	Read/Write	Linear Output Card written to only if Linear Output is in Manual Mode (MMR bit 0 = 1).

SERIAL RLC PROTOCOL COMMUNICATIONS

A

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to rLC .

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $. The <CR> is also available as a terminator when Counter C is in the SLAVE mode.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a two digit node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. For node address 1 through 9, a leading zero character is not required. (The only exception is a numeric transmission when Counter C is set for slave mode.) This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters *, $ or when Counter C is set for slave mode <CR>. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Sending Numeric Data

Numeric data sent to the meter must be limited to the digit range shown under transmit details in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	COMMAND	TRANSMIT DETAILS
A	Count A	CTA	T, V, R	9 positive, 8 ½ negative
B	Count B	CTB	T, V, R	9 positive, 8 ½ negative
C	Count C	CTC	T, V, R	9 positive, 8 ½ negative
D	Rate A	RTA	T	6 digit, positive only
E	Rate B	RTB	T	6 digit, positive only
F	Rate C	RTC	T	6 positive, 5 ½ negative
G	Max (Hi) Value	MAX	T, V, R	6 positive, 5 ½ negative
H	Min (Lo) Value	MIN	T, V, R	6 positive, 5 ½ negative
I	Scale Factor A	SFA	T, V	6 digit, positive only
J	Scale Factor B	SFB	T, V	6 digit, positive only
K	Counter Load A	CLA	T, V	6 positive, 5 ½ negative
L	Counter Load B	CLB	T, V	6 positive, 5 ½ negative
M	Setpoint 1	SP1	T, V, R	6 positive, 5 ½ negative
O	Setpoint 2	SP2	T, V, R	6 positive, 5 ½ negative
Q	Setpoint 3	SP3	T, V, R	6 positive, 5 ½ negative
S	Setpoint 4	SP4	T, V, R	6 positive, 5 ½ negative
U	Auto/Manual Register	MMR	T, V	0 – auto, 1 - manual
W	Analog Output Register	AOR	T, V	0 – 4095 normalized
X	Setpoint Register	SOR	T, V	0 – not active, 1 – active

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1.
   String: N17VM350$
2. Node address = 5, Read Count A value.
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output.
   String: RS*

RECEIVING DATA FROM THE METER

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response mode is selected in Serial Port Parameters (Abru).

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Meter Response Examples:

1. Node address = 17, full field response, Count A = 875
   17 CTA 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

```
U abcde
  ||||└─e = Analog Output
  |||└──d = SP4
  ||└───c = SP3
  |└────b = SP2
  └─────a = SP1
```

Example: VU00011* places SP4 and Analog in manual.

Analog Output Register (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047* will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Setpoint Output Register (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A “0” in the setpoint location means the output is off and a “1” means the output is on.

```
X abcd
  |||└── d = SP4
  ||└─── c = SP3
  |└──── b = SP2
  └───── a = SP1
```

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10* will result in output 1 on and output 2 off.

COUNTER C SERIAL SLAVE DISPLAY

Counter C may be programmed for SLAUE to act as a serial slave display. In this mode, the carriage return <CR> is added as a valid command terminator character for all serial command strings. The <CR> as a terminator may be very useful for standard serial commands, even if Counter C is never displayed or sent a slave message. The <*> and <$> are also recognized as valid terminators for the serial slave.

The Counter C slave display is right aligned, and has the capacity of displaying six characters on Line 1 or nine characters on Line 2. When less than the full display of characters is received, blank spaces are placed in front of the characters. If more than the full display of characters is received, only the last six (or nine) characters are displayed. The meter has an internal 300 character buffer for the slave display. If more than 300 characters are received, the additional characters are discarded until a <CR> is received. At that point, the last six (or nine) characters in the buffer are displayed.

Counter C processes Numeric and Literal slave transmissions as follows.

Numeric Transmissions

When a string that does not begin with #, T, V, P or R is received, the meter processes it as a Numeric transmission. In this case, only numbers and a minus sign can be displayed. All other characters in the string are discarded. If a minus sign appears anywhere in the string the resulting number will be negative. If a decimal point is desired, it is programmed in Counter C setup and is ignored in the serial string. If no numerical characters are received, then the numeric value will be zero.

The numeric display can be used for setpoint (boundary action only) and analog output functions. The numeric value is retained in Counter C memory until another Numeric transmission is received. If a numeric values is not to be saved to non-volatile memory, send the value as a literal transmission.

Note: Numeric transmissions sent to meter addresses 1 through 9 must have a leading zero character sent with the address (i.e. N01 through N09).

Literal Transmissions

When a string that begins with # is received, the meter processes it as a Literal transmission. In this case, only numeric and alphabetic characters or a minus sign (dash) will be processed. Any other non-alphanumeric character will be discarded. Non-displayable alphabetic characters (M, W and X) will be replaced with a space. A Literal display overrides any Units Mnemonics characters, when shown on Line 2.

A Literal display will replace a Numeric value in the Counter C display. However, it will not remove a previous Numeric value from Counter C memory or prevent the Counter C assigned outputs from functioning with the previous Numeric value.

Displayable Alphabetic Characters:

ASCII	A	b	C	d	E	F	G	H	I	J	K	L	N	O	P	q	r	S	t	U	V	Y	Z
DISPLAY	A	b	C	d	E	F	G	H	I	J	K	L	N	O	P	q	r	S	t	U	U	Y	Z

(Both uppercase and lowercase ASCII characters are accepted.)

Downloading Data from a G3 to a PAX2D

Communications:
Port: RS232 Comms Raw Serial Port
Port Driver: <system> Raw Serial Port

Programming:
PortPrint(2, “N01” + IntToText(Var1, 10, 6) + “\r”);

This program is called from the Global On Tick. It sends “N01” (the meter address), followed by the ASCII equivalent of Var1, then a carriage return.

A

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \text{\# of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the Serial Transmit Delay parameter (dELAY). The standard command line terminating character is "*". This terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15 msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with "$" results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

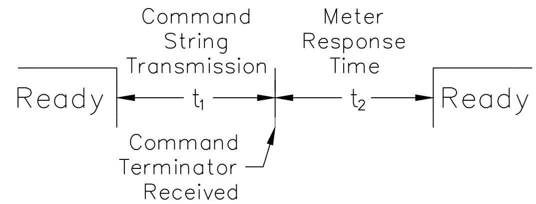
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \text{\# of characters}) / \text{baud rate.}$$

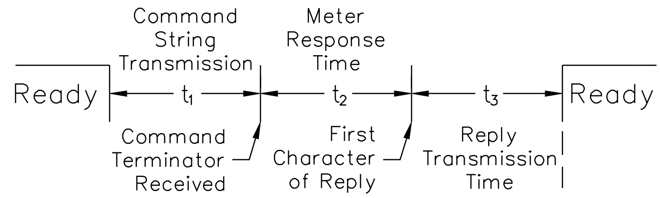
At the end of t_3, the meter is ready to receive the next command. The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

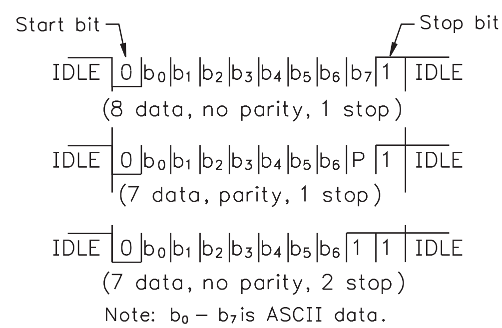
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX meter.

FACTORY SERVICE OPERATIONS (FACtrY)

FACTORY SERVICE CODE

CODE 50 FCS   0-250

Enter the Service Code for the desired operation.

RESTORE FACTORY DEFAULTS

CODE 66 FCS — P — rESEt — CODE 50 FCS

Use the F1 and F2 keys to display CODE 66 and press **P**. The meter will flash rESEt and then return to CODE 50. Press the **P** key to return to Display Mode. This will overwrite all user settings with the factory settings. The only exception is the User Mnemonics which retain their programmed values (see Code 69).

RESTORE FACTORY DEFAULTS (w/Units Mnemonics)

CODE 69 FCS — P — rESEt — CODE 50 FCS

Same as Code 66, except the User Mnemonics are also returned to the factory default settings (blank).

MODEL AND CODE VERSION

CODE 51 FCS — P — P2d FCS UEr x.xx — CODE 50 FCS

The meter will briefly display the model (P2d) on Line 1, and the current firmware version (UEr x.xx) on Line 2, and then return to CODE 50.

INPUT A AND B LOGIC SELECTION

CODE 55 FCS

The Count Inputs A and B are factory configured for falling edge triggered (active low) operation in single edge count modes. The Counter Operating Mode descriptions in the Input programming section reflect this logic. If an application is better suited to use rising edge triggered (active high) operation, the Input Logic for Input A and/or Input B can be changed by entering Code 55.

INP A LOG LO-ACt   LO-ACt   HI-ACt

Selecting HI-ACt sets the Input A logic to rising edge triggered (active high) operation. Be advised that all references to Input A falling edge and Input A rising edge will be reversed for the Counter Operating Mode descriptions.

INP b LOG LO-ACt   LO-ACt   HI-ACt

Selecting HI-ACt sets the Input B logic to rising edge triggered (active high) operation. Be advised that all references to Input B falling edge and Input B rising edge will be reversed for the Counter Operating Mode descriptions.

METER CALIBRATION

CODE 48 FCS — P — CAL FCS NO   NO   RAtE   AnLOut

Enter Code 48 and choose Rate or Analog Output calibration.

The only items in the PAX2D meter that can be calibrated are the Rate Indicator accuracy and the Analog Output. The Rate Indicator is scaled in the Rate Input Parameter programming section. The Analog Output signal is scaled in the Analog Output Parameter section. If the Rate display or the Analog Output appears to be indicating incorrectly or inaccurately, refer to the Troubleshooting section to make sure the meter is properly scaled for the application.

If Rate accuracy or Analog Output recalibration is required (generally every 2 years), it should be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters.

Note: Allow a 30 minute warm-up period before staring calibration.

Rate Accuracy Calibration

OFFSEt Pct 0.0080   -0.0100 to 0.0100 percent

Rate Indicator calibration is done by adjusting the Rate Accuracy Offset value. This value provides a Rate calculation adjustment factor expressed in percent of the display reading. An adjustment range of ± 0.01% is provided, which equals ± 1 count for a display reading of 10,000.

The initial offset value is set during factory test. To calibrate, connect a precision signal generator with an accuracy of 0.005% or better to Input A on the PAX2D. (Refer to the Rate Input Parameter programming section for Rate setup details.) Using the Rate A Decimal Point position and Scaling Display parameters, program the meter to read the input frequency with maximum display resolution (i.e. 6-digit display reading). Compare the Rate display to the signal generator output frequency. Adjust the Rate Accuracy Offset value higher (for low Display reading) or lower (for high Display Reading) until the Rate display matches the signal generator.

Analog Output Card Calibration

Before starting, verify that a precision meter with an accuracy of 0.05% or better (voltmeter for voltage output and/or current meter for current output) is connected and ready. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2D F1 and F2 keys to adjust the output so that the external meter display matches the selection being calibrated. When the external reading matches, or if the range is not being calibrated, press the **P** key to advance to the next range. When all the desired ranges have been calibrated, exit programming mode and remove the external meters.

DISPLAY	EXTERNAL METER	ACTION
0.000A	0.00 mA	Adjust if necessary, press **P**
0.004A	4.00 mA	Adjust if necessary, press **P**
0.020A	20.00 mA	Adjust if necessary, press **P**
0.0u	0.00 V	Adjust if necessary, press **P**
10.0u	10.00 V	Adjust if necessary, press **P**

TROUBLESHOOTING

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections.
No Display After Power-Up	Check Display Module: d-LEV, d-Cont, and LINE 1 program settings.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CODE 0 prompt. (Universal access code = 222)
No Line 1 Display	Check program settings for Line 1 Display Value Select/Enable. Confirm at least one Line 1 Display Value is enabled (YES).
No Line 2 Display	Check program settings for Line 2 Value Access. Confirm at least one Line 2 Parameter Value is enabled in Main Display Loop (d-rEAd, d-rSt, d-Entr).
No Line 1 Units Mnemonic Display	Check program settings for Line 1 Units Mnemonic(s).
Display of OVEr or UndEr	Value exceeds Display capacity of the meter. See General Meter Specifications.
Incorrect Display Value or Not Counting	Check Input wiring, DIP switch setting, Input programming, Scale Factor calculation, Input signal level, User Input Logic setting, lower input signal frequency.
User Input Not Functioning	Check User Input wiring, User Logic setting, User Function settings, User Input being used as a signal input in dual count modes (see Counter Operating Modes).
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: ErrKEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EE PAr Error Code: EE Pdn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ErrPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EE Lin	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

PRESET COUNTERS

B

The Trusted Source for Innovative Control Solutions

QUICK Specs

	Preset Counters			
	DUAL OUTPUTS			MULTI OUTPUTS
	CUB5	C48C	PAXLCR	PAXC
				
Description	Counter/Rate Meter	1/16 DIN Counter	1/8 DIN Counter/Rate Meter With Setpoint Capability	1/8 DIN Counter With Setpoint Capability
Dimensions (Height) x (Width)	39 mm (H) x 75 mm (W)	50 mm (H) x 50 mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97 mm (W)
Display	8 Digit, .46" (12mm) Reflective, Green and Red Backlight LCD	2 x 6 Digit, Main Display .3" (7mm) Sec. Display .2" (5mm) Reflective and Backlight LCD	6 Digit, .56" (14mm) Red LED	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity
Counting Capability	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch
Max. Input Frequency	20,000 Counts/Sec. Program Dependent	12,000 Counts/Sec. Model and Program Dependent	20,000 Counts/Sec. Program Dependent	34,000 Counts/Sec. 34,000 Counts/Sec. Program Dependent
Input Scaling & Decimal Points	Yes	Yes	Yes	Yes
Reset Capability	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote
Sensor Power	No Yes, with Micro Line Power Supply	12 VDC @ 100 mA	24 VDC @ 100 mA, over 50 V 24 VDC @ 50 mA, under 50 V	12 VDC @ 100 mA
Setpoint Capability	Single Form C Relay Dual Sinking	Single Form A Dual Form A Current Sinking	Dual Form C Relays	Dual Form C Quad Form A Quad Sinking Quad Sourcing
Communications	RS485	RS485	No	No
Power Source	9 to 28 VDC	85 to 250 VAC 18 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 11 to 36 VDC 24 VAC
Page Number	Page 135	Page 136	Page 142	Page 143

B

QUICK Specs

Preset Counters

MULTI OUTPUTS

	PAXI	PAX2D	LEGEND	LEGEND PLUS
Description	1/8 DIN Counter/Rate Meter With Output Option Card Capability	1/8 DIN Dual Line Counter/Dual Counter, Rate/Dual Rate Meter With Output Card Capability	Counter/Rate Meter	Counter/Rate Meter with Messaging Capability
Dimensions (Height)x(Width)	50 mm (H) x 97 mm (W)	50 mm (H) x 97mm (W)	75 mm (H) x 75 mm (W)	75 mm (H) x 75 mm (W)
Display	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .71" (18mm) Tri-color backlight Bottom Line: 9 Digit, .35" (9mm) Green backlight	2 x 8 Digit, .3" (7mm) Backlight LCD	2 x 8 Digit, .3" (7mm) Backlight LCD, Dual Color Version
Counting Capability	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch Foot/Inch
Max. Input Frequency	34,000 Counts/Sec. Program Dependent	50,000 Counts/Sec. Program Dependent	23,000 Counts/Sec. Model and Program Dependent	15,000 Counts/Sec. Model and Program Dependent
Input Scaling & Decimal Points	Yes	Yes	Yes	Yes
Reset Capability	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote
Sensor Power	12 VDC @ 100 mA	18 VDC @ 60 mA	12 VDC @ 100 mA	12 VDC @ 100 mA
Setpoint Capability	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing	1,2,4 or 6 Preset Capability, Dual Relay Current Sinking	1,2,4 or 6 Preset Capability, Dual Relay Current Sinking
Communications	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 or RS485 Modbus DeviceNet Profibus	RS485	RS232 RS485
Power Source	85 to 250 VAC 11 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC	115/230 VAC 12 VDC	115/230 VAC 12 VDC
Page Number	Page 144	Page 145	*	*

*See website for product information.

B

QUICK Specs

Preset Counters

DUAL OUTPUTS

	GEM1 / 2	GEM41 / 42	GEM33	LIBC
				
Description	Counter or Rate Meter	Counter/Rate Meter or Dual Count Capability	Batch Counter	Counter
Dimensions (Height) x (Width)	69 mm (H) x 133 mm (W)	69 mm (H) x 133 mm (W)	69 mm (H) x 133 mm (W)	72 mm (H) x 72 mm (W)
Display	6 Digit, .56" (14mm) LED	6 Digit, .56" (14mm) LED	6 Digit, .56" (14mm) LED	4 Digit, .4" (10mm) LED 4 Digit, .5" (13mm) LCD
Counting Capability	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Dual Count	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Dual Count	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Uni-Directional Up/Down
Max. Input Frequency	10,000 Counts/Sec. Model and Program Dependent	10,000 Counts/Sec. Model and Program Dependent	10,000 Counts/Sec. Model and Program Dependent	2500 Counts/Sec.
Input Scaling & Decimal Points	Yes	Yes	Yes	No
Reset Capability	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote
Sensor Power	12 VDC @ 100 mA	12 VDC @ 100 mA	12 VDC @ 100 mA	12 VDC @ 100 mA
Setpoint Capability	Single or Dual Form C Current Sinking	Single or Dual Form C Current Sinking	Single or Dual Form C Current Sinking	Single or Dual Form C, Solid State
Communications	20 mA Current Loop	20 mA Current Loop	20 mA Current Loop	No
Power Source	115/230 VAC 11 to 14 VDC	115/230 VAC 11 to 14 VDC	115/230 VAC 11 to 14 VDC	115/230 VAC 11 to 14 VDC
Page Number	*	*	*	*

*See website for product information.

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **CUBC**	■ Display: .2" (5 mm) Reflective LCD ■ Power Source: 115/230 VAC, 10 to 28 VDC, 10 to 28 VAC ■ Count Speed: 12 KHz Max.	 **C48C**	■ Display: 2 x 6, Main Display .3" (7 mm), Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC ■ Count Speed: 12 KHz Max.
 **LYNX**	■ Display: .3" (8 mm) Reflective LCD ■ Power Source: 115/230 VAC, 11 to 14 VDC, 21.5 to 30 VDC ■ Count Speed: 2500 Hz Max.	 **C48C**	■ Display: 2 x 6, Main Display .3" (7 mm), Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC ■ Count Speed: 12 KHz Max. **Panel Cut-Out Dimension Differences**
 **SCP**	■ Display: None ■ Power Source: 115/230 VAC, 12 VDC ■ Count Speed: 10 KHz Max.	 **PAXLCR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 50 to 250 VAC, 21.6 to 250 VDC ■ Count Speed: 20 KHz Max. ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **SCD**	■ Display: 6 Digit, .43" (11 mm) Red LED ■ Power Source: 115/230 VAC, 12 VDC ■ Count Speed: 10 KHz Max.	 **PAXLCR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 50 to 250 VAC, 21.6 to 250 VDC ■ Count Speed: 20 KHz Max. ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **SC2**	■ Display: 6 Digit, .43" (11 mm) Red LED ■ Power Source: 115/230 VAC, 12 VDC ■ Count Speed: 10 KHz Max.	 **PAXLCR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 50 to 250 VAC, 21.6 to 250 VDC ■ Count Speed: 20 KHz Max. ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **GEM1, 2, 33, 41 and 42**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC or 11 to 14 VDC ■ Count Speed: 10 KHz Max.	 **PAXI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 11 to 36 VDC ■ Count Speed: 34 KHz Max. ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **LIBRA**	■ Display: 4 Digit, .4" (10 mm) LED or .5" (13 mm) LCD ■ Power Source: 115/230 VAC, 11 to 14 VDC ■ Count Speed: 2500 Hz	 **C48C**	■ Display: 2 x 6, Main Display .3" (7 mm), Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC ■ Count Speed: 12 KHz Max. **Panel Cut-Out Dimension Differences**
 **IMI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Count Speed: 50 KHz Max.	 **PAXI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 11 to 36 VDC ■ Count Speed: 34 KHz Max. ■ Requires Appropriate Option Card

Note: Refer to the current product literature, as some differences may exist.

B

This page intentionally left blank.

MODEL CUB5 - MINIATURE ELECTRONIC 8-DIGIT DUAL COUNTER AND RATE INDICATOR

This is a brief overview of the CUB5. For complete specifications and programming information, see the **CUB5 Bulletin** starting on **page 35.**

c UL US LISTED
IND. CONT. EQ.
51EB

- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.46" (11.7 mm) HIGH DIGITS*
- *OPTIONAL RELAY OUTPUT MODULE*
- *OPTIONAL COMMS OUTPUT MODULES*
- *COUNT SPEEDS UP TO 20 KHZ*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *ANTI-COINCIDENCE COUNTING (ADD/ADD & ADD/SUB)*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

SPECIFICATIONS

COUNTER DISPLAYS:

Counter A: 8-digits, enabled in all count modes
Display Range: -9999999 to 99999999
Overflow Indication: Display flashes "Cnt OUEr"

Counter B: 7-digits, enabled in Dual Counter mode only
Display Designator: "b" to the left side of the display
Display Range: 0 to 9999999 (positive count only)
Overflow Indication: Display flashes "bCntOUEr"

Maximum Count Rates: 50% duty cycle
Without setpoint option card: 20 KHz (all count modes)
With setpoint option card: 20 KHz for any count mode except Quadrature x4 (18 KHz) and Dual Counter (17 KHz)

RATE DISPLAY: 6-digits, may be enabled or disabled in any mode

Display Designator: "A" to the left side of the display
Display Range: 0 to 999999
Over Range Display: "A OLOLOL"
Maximum Frequency: 20 KHz
Minimum Frequency: 0.01 Hz
Accuracy: ±0.01%

COUNT/RATE SIGNAL INPUTS (INP A and INP B):

Input A: DIP switch selectable to accept pulses from a variety of sources. See Section 2.0 Setting the DIP Switches for Input A specifications.

Input B: Logic signals only
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Current sinking: Internal 10KΩ pull-up resistor to +9 to 28 VDC
Filter (LO Freq.): Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec min.

C48C SERIES - 1/16 DIN COUNTERS

MODEL C48CS - SINGLE PRESET
MODEL C48CD - DUAL PRESET
MODEL C48CB - THREE PRESET BATCH

- *LCD, 7 SEGMENT, 2 LINE, 6 DIGIT DISPLAY, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE MODELS WITH RED TOP LINE AND GREEN BOTTOM LINE BACKLIGHTING*
- *QUADRATURE SENSING (Up to 4 times resolution)*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *FIELD REPLACEABLE RELAY OUTPUT BOARDS*
- *STATUS INDICATORS FOR OUTPUTS*
- *NEMA 4X/IP65 SEALED BEZEL*
- *PARAMETER SECURITY VIA PROGRAMMABLE OPERATOR ACCESS PRIVILEGES AND PROTECTED VALUE MENU*
- *PROGRAMMABLE USER INPUTS AND FRONT PANEL FUNCTION KEY*
- *HORIZONTAL OR VERTICAL STACKING OF MULTIPLE UNITS*
- *85 to 250 VAC OR 18 to 36 VDC/24 VAC POWERED UNITS*
- *RS485 SERIAL COMMUNICATIONS OPTION*
- *CHOICE OF NUMERIC DATA ENTRY MODES*

UL Recognized Component, File # E137808

DESCRIPTION

The Model C48 Counter is available as a Standard Counter or a Batch Counter. The Standard Counter is available with single or dual presets. The Batch Counter has a main process counter with dual presets and a secondary counter with a single preset. The secondary counter can be selected to function as a batch or a total counter.

The C48C features a 7 segment, 2 line by 6 digit reflective or backlit LCD display. For the backlit versions, the main display line is red and shows the count value or the Batch/Total value when preset 3 or output 3 is viewed in the secondary display. The smaller secondary display line is green and can be used to view the prescaler value, preset values, output time values or Batch/Total count values (Batch model).

The C48C offers a choice of nine programmable counting modes for use in applications requiring bi-directional, anti-coincidence, and quadrature counting. The unit may be programmed to register counts on both edges of the input signal providing frequency doubling capability. DIP switches are used for input configuration set-up and to provide a Program Disable function.

Four front panel push-buttons are used for programming the operating modes and data values, changing the viewed display, and performing user programmable functions, e.g. reset, etc. The C48C can be configured for one of two numeric data entry methods, digit entry or automatic scrolling. The digit entry method allows for the selection and incrementing of digits individually. The automatic scrolling method allows for the progressive change of one through all digit positions by pressing and holding the “up” or “down” button.

The Program Disable DIP switch, a user-programmable code value, and an external user input selected for Program Disable can be utilized to provide multi-level protection against unauthorized changes to data values and unit configuration.

The C48 Counter has programmable User Inputs and a programmable front panel function key. The user inputs can be configured as sinking (active low) or sourcing (active high) inputs via a single plug jumper. The user inputs and the front panel function key can be configured to provide a variety of functions.

The Standard Counter with Dual Presets is available with solid-state or Relay outputs. The Single Preset model has a solid-state and relay output. The Batch Counter has relay outputs for Output 2 and the Batch/Total Output 3, with Output 1 available as solid-state. The Batch Counter is also available with three solid-state outputs. For all C48 Counters, the solid-state outputs are available in a choice of NPN current sinking or PNP current sourcing, open-collector transistor outputs. All relay output boards are field replaceable.

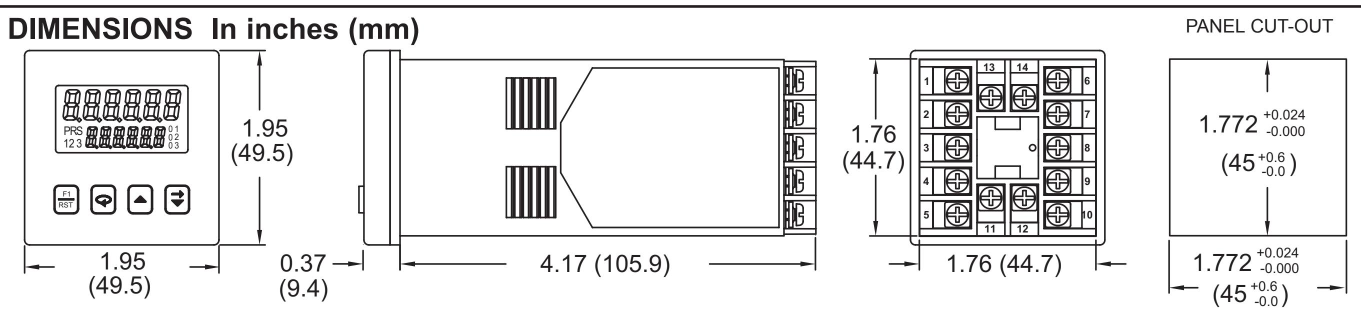
A Prescaler Output model is available as a Dual Preset, with solid-state outputs. The Prescaler Output is useful for providing a lower frequency scaled pulse train to a PLC or another external totalizing counter. The Prescaler Output provides a programmable width output pulse for every count or every 10 counts registered on the display.

The optional RS-485 serial communication interface provides two-way communication between a C48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each C48 on the line can be programmed from 0 to 99. Data from the C48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFC48, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

Optional programming software (SFC48) is available to program all unit configuration parameters. The software allows unit configurations to be created, uploaded, downloaded, and saved to a file for later use or multi-unit programming.

The unit is constructed of a lightweight, high impact plastic case with a textured front panel and a clear display window. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the C48 Counters extremely reliable in industrial environments.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **DISPLAY:** 2 Line by 6 digit LCD display. Positive image reflective or negative image transmissive with red (top line) and green (bottom line) backlighting
   Main Display: 0.3" (7.62 mm) high digits
   Secondary Display: 0.2" (5.08 mm) high digits
   Annunciators:
   Value: PRS, 1, 2, and 3
   Output: 01, 02, and 03.
2. **POWER REQUIREMENTS**:
   AC Versions:
   AC Power: 85 to 250 VAC, 50/60 Hz, 9 VA max.
   DC Power: 11 to 14 VDC @ 150 mA max. (Non PNP output models)
   Note: Models with PNP current sourcing outputs must be powered from AC.
   DC Versions (C48XXX1X):
   CONTINUOUS:
   DC Power: 18 to 36 VDC; 5.5 W max.
   AC Power: 24 VAC ±10%; 50/60 Hz; 7 VA max.
   Note: The +10% tolerance range on AC input voltage must be strictly adhered to. DO NOT EXCEED 26.4 VAC.
   PEAK (START-UP CURRENT):
   AC or DC Power: 500 mA peak start-up current for 10 msec max.

   DC OUT (V_{SRC} IN) - Terminal 10
   For units which do not have PNP current sourcing outputs, this terminal provides a DC output for sensor power (+12 VDC +/-15%). The maximum sensor current is 100 mA.
   For units with PNP current sourcing outputs, this terminal serves a dual purpose depending on the application's PNP output voltage level and current requirements.
   1. The terminal may be used as a +12 VDC output for sensor power. In this case, the PNP output voltage level will be +12 VDC (±15%). A maximum of 100 mA is available for the combination of sensor current and PNP output sourcing current.
   2. If a higher PNP output voltage level or additional output sourcing current is desired, an external DC supply may be connected between the "DC OUT (V_{SRC} IN)" and "COMM." terminals. This supply will determine the PNP output voltage level, and must be in the range of +13 to +30 VDC.
      An external DC supply can also provide the additional output sourcing current required in applications where two or more PNP outputs are "ON" simultaneously. However, the maximum current rating of 100 mA per individual output must not be exceeded, regardless of external supply capacity.
3. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters and count values.
4. **SENSOR POWER**: +12 VDC (± 15%) @ 100 mA max.
5. **COUNT INPUTS A & B**: Accepts count pulses from a variety of sources, DIP switch selectable.
   Current Sourcing: 3.9KΩ pull-down, V_{IN} max = 30 VDC
   Current Sinking: 7.8KΩ pull-up to 12 VDC; I_{SNK} = 1.8 mA max.
   Debounce: 50 Hz max.
   Lo Bias: V_{IL} = 1.5 VDC max., V_{IH} = 3.75 VDC min.
   Hi Bias: V_{IL} = 5.5 VDC max., V_{IH} = 7.5 VDC min.
6. **MAX. COUNT RATE**: Model dependent. All listed values are in KHz.
   Note: Max. count rates for X2 & X4 modes are given for 50 % duty cycle signals and quad signals with 90° phase shift.

Single Preset Model C48CS

PRESCALER VALUE	C1-Usr C1-Ud	C2-Usr C2-Ud	*Ad-Sub Ad-Ad	QUAD X1	QUAD X2	QUAD X4
0.00001-0.99999	8.4	4.1	9.4	5.4	4.5	2.1
1.00000	12	5.9	12.4	6.5	6	3
1.00001-2	6.6	3.2	6.8	4.3	3.3	1.6
2.00001-3	5.3	2.6	5.6	3.7	2.6	1.3
3.00001-4	4.3	2.1	4.6	3	2.2	1.1
4.00001-5	3.6	1.8	3.8	2.7	1.8	0.9
5.00001-6	3.1	1.5	3.4	2.4	1.6	0.8
6.00001-7	2.8	1.4	3.2	2.1	1.4	0.7
7.00001-8	2.6	1.3	2.8	1.9	1.3	0.6
8.00001-9	2.3	1.1	2.4	1.8	1.1	0.5
9.00001-9.99999	2.1	1	2.3	1.7	1.1	0.5

Dual Preset Model C48CD

PRESCALER VALUE	C1-Usr C1-Ud	C2-Usr C2-Ud	*Ad-Sub Ad-Ad	QUAD X1	QUAD X2	QUAD X4
0.00001-0.99999	8.3	4.1	8.6	4.5	4.1	2.1
1.00000	11.5	5.7	11.5	6	5.8	3
1.00001-2	6.5	3.2	6.6	4	3.2	1.6
2.00001-3	5	2.4	5.2	3.4	2.5	1.3
3.00001-4	4.1	2	4.4	2.8	2	1
4.00001-5	3.4	1.7	3.8	2.5	1.7	0.8
5.00001-6	2.9	1.4	3.2	2.2	1.4	0.7
6.00001-7	2.7	1.3	2.8	2	1.3	0.6
7.00001-8	2.2	1.1	2.4	1.8	1.2	0.6
8.00001-9	2.2	0.9	2.3	1.6	1.1	0.5
9.00001-9.99999	1.9	0.9	2	1.5	0.9	0.4

Batch Model C48CB
With Counter 2 configured as a Batch Counter (C2 ASn = bAtch)

PRESCALER VALUE	C1-Usr C1-Ud	C2-Usr C2-Ud	*Ad-Sub Ad-Ad	QUAD X1	QUAD X2	QUAD X4
0.00001-0.99999	8.3	4.1	8.4	3.7	3.6	2.2
1.00000	11.4	5.5	11.8	4.3	4.2	3
1.00001-2	6.5	3.2	6.6	3.2	3	1.6
2.00001-3	5	2.5	5.4	2.8	2.5	1.3
3.00001-4	4.1	2	4.2	2.4	2	1
4.00001-5	3.4	1.7	3.8	2.1	1.7	0.8
5.00001-6	2.9	1.4	3.2	1.9	1.5	0.7
6.00001-7	2.7	1.3	2.8	1.7	1.3	0.6
7.00001-8	2.4	1.1	2.6	1.6	1.2	0.6
8.00001-9	2.2	1.1	2.4	1.5	1.1	0.5
9.00001-9.99999	1.9	0.9	2.2	1.4	1	0.4

Batch Model C48CB
With Counter 2 configured as a Total Counter (C2 ASn = totAL)

PRESCALER VALUE	C1-Usr C1-Ud	C2-Usr C2-Ud	* Ad-Sub Ad-Ad	QUAD X1	QUAD X2	QUAD X4
0.00001-0.99999	6.5	3.3	6.6	3.5	3.3	1.6
1.00000	8.5	3.6	8.6	4	4	2.1

Prescaler Output Model C48CP

PRESCALER VALUE	C1-Usr C1-Ud	C2-Usr C2-Ud	* Ad-Sub Ad-Ad	QUAD X1	QUAD X2	QUAD X4
0.00001-0.99999	6.2	N/A	N/A	N/A	N/A	N/A
1.00000	8	N/A	N/A	N/A	N/A	N/A

* - *Inputs A & B rates summed.*

7. **USER INPUTS**: Configurable as current sinking (active low) or current sourcing (active high) inputs via a single plug jumper.
   Current Sinking: V_{IL} = 1.5 VDC max, 22 KΩ pull-up to 5 VDC.
   Current Sourcing: V_{IH} = 3.5 VDC min., V_{IN} max = 30 VDC; 22 KΩ pull-down.
   Response Time = 10 msec max.
   Inhibit Response Time = 250 µsec max.
8. **OUTPUTS**: (Output type and quantity, model dependent)
   Solid-State:
   NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1.1 VDC max.; V_{OH} = 30 VDC max.
   PNP Open Collector: I_{SRC} = 100 mA max.(See note); V_{OH} = 12 VDC ±15% (using internal supply); V_{OH} = 13 to 30 VDC (using external supply).
   Note: The internal supply of the C48C can provide a total of 100 mA for the combination of sensor current and PNP output sourcing current. The supply voltage is +12 VDC (±15%), which will be the PNP output voltage level when using only the internal supply.
   If additional PNP output sourcing current or a higher output voltage level is desired, an external DC supply may be connected between the "DC Out/In" and "Comm." terminals. This supply will determine the PNP output voltage level, and must be in the range of +13 to +30 VDC.
   An external supply can provide the additional output sourcing current required in applications where two or more outputs are "ON" simultaneously. However, the maximum rating of 100 mA per individual output must not be exceeded, regardless of external supply capacity.

8. **OUTPUTS**: (Output type and quantity, model dependent) **Cont'd**
   Relay: Form A contact, Rating = 5 A @ 250 VAC, 30 VDC (resistive load), 1/10 HP @ 120 VAC (inductive load)
   Relay Life Expectancy: 100,000 cycles min. at max. load rating
   Programmable Timed Output: User selectable output time resolution.
   0.01 Second Resolution: 0.01 to 99.99 sec, ± 0.01% +20 msec max. (Prescalers less than 2)
   0.1 Second Resolution: 0.1 to 999.9 sec, ± 0.01% + 100 msec (Prescalers less than 2)
   Note: For Prescaler values above 2, the timed delay output is affected by the count speed (rate).
9. **RS485 SERIAL COMMUNICATIONS (Optional)**: Up to 32 units can be connected.
   Baud Rate: Programmable from 1200 to 9600 baud
   Address: Programmable from 0 to 99
   Data Format: 10 Bit Frame, 1 start bit, 7 or 8 data bits, 1 or No Parity bit, and 1 stop bit
   Parity: Programmable for Odd (7 data bits), Even (7 data bits), or None (8 data bits)
10. **CERTIFICATIONS AND COMPLIANCES**:
   UL Recognized Component, File #E137808
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Simulation of cordless telephone	ENV 50204	Level 3; 10 V/m
		900 MHz ± 5 MHz
		200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A

Notes:
AC VERSIONS
1. A power line filter, RLC#LFIL0000 or equivalent, was installed when the unit was DC powered.
DC VERSIONS
To insure compliance with the EMC standards listed above, do not connect any wires from the terminal(s) labeled "COMM." to the "DC-" supply terminal (12), when powering the unit from a DC supply.

Refer to EMC Installation Guidelines section of the manual for additional information.

11. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0°C to 50°C
   Storage Temperature: -40°C to 70°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C.
   Altitude: Up to 2000 meters
12. **ELECTRICAL CONNECTIONS**: Wire clamping screw terminals.
13. **CONSTRUCTION**: Black plastic case with collar style panel latch. The panel latch can be installed for horizontal or vertical stacking. Black plastic textured bezel with clear display viewing window. Unit assembly with circuit boards can be removed from the case without removing the case from the panel or disconnecting the wiring. Front panel meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.
14. **WEIGHT**: 6.0 oz (170 g)

SINGLE PRESET MODELS

The C48CS has a solid-state output that operates in parallel with a relay output. The solid-state output is available as an NPN or PNP open collector transistor.

DUAL PRESET MODELS

The C48CD has two outputs that are activated from presets 1 and 2 respectively. These outputs can be relay outputs, or solid-state outputs. The solid-state outputs are available as NPN or PNP open-collector transistors. Units with solid-state outputs can be ordered with an optional prescaler output (C48CP).

3 PRESET BATCH MODELS

The C48CB has a secondary counter that can be used for batch counting, or to keep a total count. This second counter can be programmed to operate in one of eight operating modes. Outputs 1 and 2 are assigned to the primary process counter (C1). Output 3 is assigned to the secondary Batch/Total counter (C2). The three preset batch unit can be ordered with solid-state or relay outputs. Units with solid-state outputs have a User Input 2 terminal available. The relay model has a relay output for Output 2 and Output 3 (Batch/Total). Output 1 is available only as solid-state.

PRESCALER OUTPUT MODELS

The C48CP is a dual preset counter with solid-state outputs. These models have an additional output configured as a prescaler output. Each time the least significant digit of the display increments, the Prescaler output provides a pulse. The width of this pulse is variable in that the output will turn off after a programmed number of count input pulses has occurred (1-9). The Prescaler output can also be programmed to activate when the 10's digit of the display increments, rather than the least significant digit.

Note: Prescaler Output models are limited to two programmable count modes and prescaler values of 1.00000 or less. See Count Input Modes for available modes.

FRONT PANEL FEATURES

The C48 Counters feature a dual line display. In the normal operating mode (main display), the count or batch/total value is shown on the top line and presets, prescaler, or output time values are shown on the bottom line. The bottom line values can be programmed to be viewable only, viewable and changeable, or locked (not viewable) from the main display.

In the operating mode, the presets, prescaler, and output time values are accessible providing that these values are not programmed for 'L'ocked. Values that are accessible (changeable) can be changed immediately when viewed in the secondary display.

FRONT PANEL KEYPAD

F1 RST - Performs user Programmed Function

- Cycles through secondary displays.
- Enters Protected Value Menu or Programming Mode when pushed and held for 2 seconds.
- Scrolls through programming parameters.
- Enters Data Values.

- Selects next available mode in programming mode.
- Increments digit in Digit Entry mode.
- Increments value in Auto Scrolling entry mode.

- Selects Digit to right when in Digit Entry mode.
- Decrements value in Auto Scrolling entry mode.

USER INTERFACE/PROGRAMMING MODES

The operating modes of the C48C are programmed using the front panel keypad. To enter the programming menu, the key is pushed and held for 2 seconds. Within the programming menu, the key is used to sequence through the list of programming parameters.

PROGRAMMING MENU

EntrY - Digit or Auto Scrolling Data Entry Mode
Ac PSc - Accessibility of Prescaler Value
PScALr - Prescaler Value
dEc Pt - Decimal Point Position
Cnt In - Count Input Modes
OPEr 1 - Counter 1 Operating Mode
C2 ASn - Counter 2 Assignment (C48CB only)
OPEr 2 - Counter 2 Operating Mode (C48CB only)
Ac PrS - Accessibility of Preset Values
PrESEt - Preset 1, 2, and 3 Values
P1trAC - P1 Track P2 (not available on C48CS)
Ac Out - Accessibility of Output Time Values
OutrES - Output Resolution
OutPut - Output 1, 2, and 3 Time Values
rEUOut - Reverse Output/Relay Logic
rEUAnu - Reverse Output Annunciator Logic
OutP.uP - Power Up Output State
USr In1 - User Input 1
USr In2 - User Input 2 (Not available on Batch Relay Models)
USr Inb - User Input b
USr F1 - User F1 Key
CodE - Programming/Protected Parameter menu Code
ScroLL - Scroll Display
SErSEt - Serial Baud Rate & Parity Settings (RS485 option only)
SErAdr - Serial Unit Address (RS485 option only)
SErAbr - Abbreviate Serial Mnemonics (RS485 option only)
PrnOPt - Print Options (RS485 option only)
PrnrSt - Print & Reset Count Value (RS485 option only)
PScOAt - Prescaler Output Pulse (C48CP only)
PScLEn - Prescaler Output Pulse Length {width} (C48CP only)
FAcSEt - Load Factory Default Settings

Program Security/Operator Accessible Values

The Program Disable DIP switch, programmable code value, User Input (programmed for Program Disable), and the Accessible Value parameters provide various levels of security against unauthorized programming changes. The accessible values parameters provide individual access or locking of each value.

Protected Value Menu

The Protected Value Menu allows access to selected presets, prescaler and timed output values without having them viewable or changeable from the main display. To enter the protected menu, the key is pressed and held, and a programmed code value is entered.

Programming Numeric Data Values

The Presets may be accessible when the unit is in its operating mode. Pressing the key will sequence the secondary display through the available preset, prescaler and Batch/Total count values.

To change a data value it must be visible on the secondary display. Pressing the or key will allow changing of the value. If the data entry method has been set to “digit entry”, pressing the key multiple times will select other digits. Pressing the key will increment the selected digit. If the data entry method is set to “Auto scrolling”, the data value can be changed by pressing and holding the or keys to change one or all digits of the display.The data value will be entered when the key is pushed, or the old value will be retained if no key activity is detected for 10 seconds.

Count Input Modes - Cnt In

This parameter controls the count/control function of Inputs A and B. It also allows Input B to be used as a User Input with the same programmable functions as the dedicated User Inputs.

MODE	INPUT A	INPUT B
C1-USr	Count	User Input *
C2-USr	Count (X2)	User Input
C1-Ud	Count	Up/Dn Control *
C2-Ud	Count (X2)	Up/Dn Control
Ad-Sub	Add Count	Subtract Count
Ad-Ad	Add Count	Add Count
QUAd 1	Quad X1 Inputs	
QUAd 2	Quad X2 Inputs	
QUAd 4	Quad X4 Inputs	

* *These are the only count input modes available on the Prescaler Output Model.*

Programmable Operating Modes - OPEr

These modes determine the operational characteristics of the counter. In the tables, 01, 02, and 03, refer to Outputs 1,2, and 3 respectively.

SINGLE PRESET OPERATING MODES
1 - Manual Reset to Zero, Latched Output
2 - Manual Reset to Zero, Timed Output
3 - Manual Reset to Preset, Latched Output
4 - Manual Reset to Preset, Timed Output
5 - Auto Reset to Zero, Timed Output
6 - Auto Reset to Preset, Timed Output
7 - Auto Reset to Zero at Timed Output End
8 - Auto Reset to Preset at Timed Output End

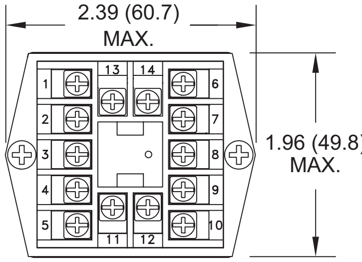
DUAL PRESET AND BATCH COUNTER 1 OPERATING MODES
1 - Manual Reset to Zero, Latched Outputs
2 - Manual Reset to Zero, 01 Timed, 02 Latched
3 - Manual Reset to Zero, 01 and 02 Timed
4 - Manual Reset to Zero, 01 off at 02, 02 Latched
5 - Manual Reset to Zero, 01 off at 02, 02 Timed
6 - Manual Reset to Preset 2, Latched Outputs
7 - Manual Reset to Preset 2, 01 Timed, 02 Latched
8 - Manual Reset to Preset 2, 01 and 02 Timed
9 - Manual Reset to Preset 2, 01 off at 02, 02 Latched
10 - Manual Reset to Preset 2, 01 off at 02, 02 Timed
11 - Auto Reset to Zero, 01 and 02 Timed
12 - Auto Reset to Zero, 01 off at 02, 02 Timed
13 - Auto Reset to Preset 2, 01 and 02 Timed
14 - Auto Reset to Preset 2, 01 off at 02, 02 Timed
15 - Auto Reset to Zero at 02 End, 01 and 02 Timed
16 - Auto Reset to Zero at 02 End, 01 off at 02, 02 Timed
17 - Auto Reset to Preset 2 at 02 End, 01 and 02 Timed
18 - Auto Reset to Preset 2 at 02 End, 01 off at 02, 02 Timed

COUNTER 2 OPERATING MODES (C48CB Only)
1 - Manual Reset to Zero, 03 Latched
2 - Manual Reset to Zero, 03 Timed
3 - Manual Reset to Preset 3, 03 Latched
4 - Manual Reset to Preset 3, 03 Timed
5 - Auto Reset to Zero, 03 Timed
6 - Auto Reset to Zero at 03 Timed Output End
7 - Auto Reset to Preset 3, 03 Timed
8 - Auto Reset to Preset 3 at 03 Timed Output End

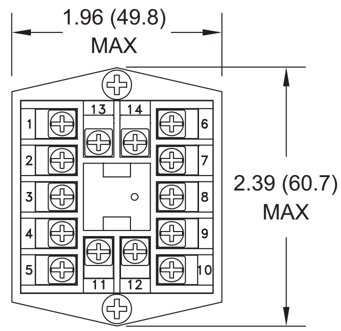
MULTIPLE UNIT STACKING

The C48C is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of the units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

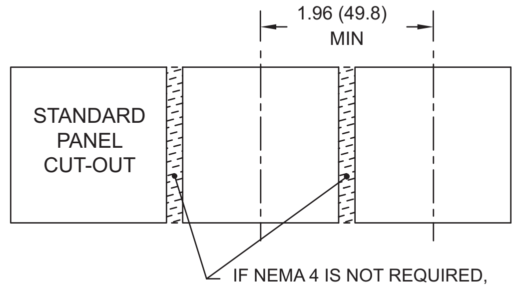


PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING



PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING.
HORIZONTAL ARRANGEMENT SHOWN.



IF NEMA 4 IS NOT REQUIRED, THIS PANEL MATERIAL MAY BE REMOVED.

SLOW DOWN & CUT TO LENGTH WITH TOTAL FOOTAGE

To improve production efficiency, a wallpaper manufacturing plant is installing cut to length counters on the roll form machines. Currently, electro-mechanical counters are used for length measurements. The operator slows the machine down upon arriving at the desired length, stops and then cuts. The addition of the C48CB batch counters eliminates the operator's manual observation and control.

The operator programs the required cut length as Preset 2. Preset 1 is preprogrammed for tracking and will automatically follow Preset 2. Preset 1 is used as the slow down, and is set for a value 0.25 yards less than Preset 2. The process count is programmed to automatically reset at the Preset 2 cut length of 11.00 yards, and begin counting for the next roll. Counter 2 is programmed as a totalizer and is recorded and reset (via key switch) at the end of the operator's shift. The C48CB was ordered with the RS-485 serial communication option. Future plans include a data acquisition program to interrogate the C48CB's. A 100 ppr rotary pulse generator is shaft coupled to a 4" pinch roller for length measurement. Display units desired is 0.01 yards. Program Security features are set to allow access to Preset 2 only. This allows the operator to change the required cut length, but prevents acidental changes to other programming parameters that may adversely affect process operation. After all programming is complete, the Program Disable DIP switch is moved to the up position to enable the Program Security function.

Circumference Of Pinch Roller:

circumference = $\pi \times$ diameter

12.56636 = 3.14159×4.00

Pulses Per Yard:

$$\frac{36 \text{ inches}}{1 \text{ yard}} \times \frac{1 \text{ rev}}{12.56636"} = 2.8647913 \text{ rev/yard}$$

2.8647913 rev/yard × 100 ppr/rev = 286.47913 pulses/yard

Prescaler:

$$\text{Prescaler} = \frac{\text{Display units}}{\text{number of pulses}}$$

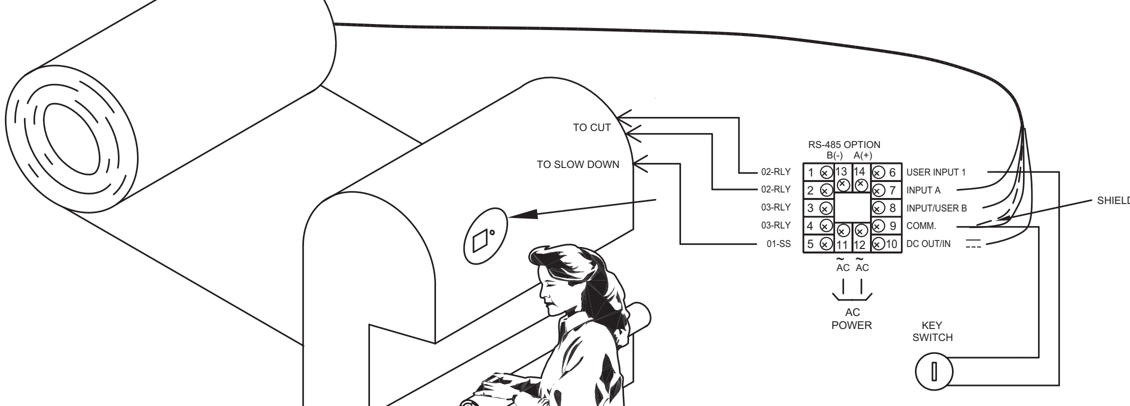
$$= \frac{100}{286.47913}$$

Prescaler = 0.34907

Products:
C48CB108
RPGQ0100

PROGRAMMING

EntrY	AutoSc
Ac PSc	-L (locked)
PScALr	0.34907
dEc Pt	----.--
Cnt In	QUAd 1
OPEr 1	12
C2 ASn	totAL
OPEr 2	02
Ac PrS	-L-Y-L
PrESEt	PRS1 10.75 (value 0.25 less than PRS2 for slowdown)
PrESEt	PRS2 11.00 (cut length)
PrESEt	PRS3 9000.00 (Set high so output does not activate)
P1trAc	YES
Ac Out	-L-L-L
OutrES	0.01SEC
OutPut	1t 0.10
OutPut	2t 1.00
OutPut	3t 0.10
rEUOut	-n-n-n
rEUAnu	-n-n-n
OutP.uP	-F-F-F
USr In1	rSt.2-E
USr F1	rSt.-E
CodE	003
ScroLL	no
SErSEt	960
SErAdr	00
SErAbr	no
PrnOPt	08
PrnrSt	no
FAcSEt	no



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	*NPN O.C. OUTPUT(S)	RELAY OUTPUT(S) (Note)	RS485	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
					18-36 VDC/24 VAC	85 to 250 VAC
C48CS	1 Preset Counter, Reflective LCD	Yes	Yes	No	C48CS013	C48CS003
	1 Preset Counter, Backlit LCD	Yes	Yes	No	C48CS113	C48CS103
C48CD	2 Preset Counter, Reflective LCD	Yes	No	Yes	C48CD015	C48CD005
	2 Preset Counter, Reflective LCD	No	Yes	No	C48CD012	C48CD002
	2 Preset Counter, Reflective LCD	No	Yes	Yes	C48CD017	C48CD007
	2 Preset Counter, Backlit LCD	Yes	No	No	C48CD110	C48CD100
	2 Preset Counter, Backlit LCD	Yes	No	Yes	C48CD115	C48CD105
	2 Preset Counter, Backlit LCD	No	Yes	No	C48CD112	C48CD102
	2 Preset Counter, Backlit LCD	No	Yes	Yes	C48CD117	C48CD107
C48CP	2 Preset Counter w/Prescaler Output, Reflective LCD	Yes	No	Yes	C48CP015	C48CP005
	2 Preset Counter w/Prescaler Output, Backlit LCD	Yes	No	No	C48CP110	C48CP100
	2 Preset Counter w/Prescaler Output, Backlit LCD	Yes	No	Yes	C48CP115	C48CP105
C48CB	3 Preset Batch Counter, Reflective LCD	Yes (O1)	Yes	No	N/A	C48CB003
	3 Preset Batch Counter, Reflective LCD	Yes (O1)	Yes	Yes	N/A	C48CB008
	3 Preset Batch Counter, Reflective LCD	Yes	No	Yes	N/A	C48CB005
	3 Preset Batch Counter, Backlit LCD	Yes (O1)	Yes	No	N/A	C48CB103
	3 Preset Batch Counter, Backlit LCD	Yes (O1)	Yes	Yes	N/A	C48CB108
	3 Preset Batch Counter, Backlit LCD	Yes	No	No	C48CB110	C48CB100
	3 Preset Batch Counter, Backlit LCD	Yes	No	Yes	N/A	C48CB105

Note: On Batch Relay Models, Outputs 2 and 3 are Relays, and Output 1 (O1) is a solid-state output.
*** PNP O.C. output(s) versions available, contact the factory.*

B

RELAY OUTPUT BOARDS

MODEL NO.	DESCRIPTION	NPN O.C. OUTPUT(S)	PNP O.C. OUTPUT(S)	RELAY OUTPUT(S)	PART NUMBER
RBC48	Single Preset	Yes	No	Yes	RBC48001
		No	Yes	Yes	RBC48002
	Dual Preset	No	No	Yes	RBC48003
	Batch	Yes	No	Yes	RBC48004
		No	Yes	Yes	RBC48005

ACCESSORIES

MODEL	DESCRIPTION	PART NUMBER
SFC48	PC Configuration Software for Windows 3.x and 95 (3.5" disk) (for RS-485 Models)	SFC48

MODEL PAXLCR - 1/8 DIN PAX LITE DUAL COUNTER AND RATE METER

This is a brief overview of the PAXLCR. For complete specifications and programming information, see the
PAX Lite Dual Counter and Rate Meter Bulletin starting on **page 57**.

- *6 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *BUILT-IN BATCH COUNTING CAPABILITY*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAYS*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

ANNUNCIATORS:
A - Counter A value
B - Counter B value (dual count or batch)
- Rate value is displayed with no designator
SP1 - Indicates setpoint 1 output status
SP2 - Indicates setpoint 2 output status

COUNTER DISPLAYS:
Counter A: 6-digits, enabled in all count modes
Display Designator: “A” to the left side of the display
Display Range: -99999 to 999999
Counter B: 6-digits, enabled in Dual Count mode or Batch Counter
Display Designator: “B” to the left side of the display
Display Range: 0 to 999999 (positive count only)
Overflow Indication: Display “OLOL” alternates with overflowed count value
Maximum Count Rates: 50% duty cycle, count mode dependent.
With setpoints disabled: 25 KHz, all modes except Quadrature x4 (23 KHz).
With setpoint(s) enabled: 20 KHz, all modes except Dual Counter (14 KHz), Quadrature x2 (13 KHz) and Quadrature x4 (12 KHz).

RATE DISPLAY: 6-digits, may be enabled or disabled in any count mode
Display Range: 0 to 999999
Over Range Display: “OLOL”
Maximum Frequency: 25 KHz
Minimum Frequency: 0.01 Hz
Accuracy: ±0.01%

COUNT/RATE SIGNAL INPUTS (INPUT A and INPUT B):
See Section 2.0 Setting the DIP Switches for complete Input specifications. DIP switch selectable inputs accept pulses from a variety of sources. Both inputs allow selectable active low or active high logic, and selectable input filtering for low frequency signals or switch contact debounce.
Input A: Logic level or magnetic pickup signals.
Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
Mag. pickup sensitivity: 200 mV peak, 100 mV hysteresis, 40 V peak max.
Input B: Logic level signals only
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC

MODEL PAXC - 1/8 DIN COUNTER

This is a brief overview of the PAXC. For complete specifications and programming information, see the **PAX Digital Input Panel Meters Bulletin** starting on **page 68**.

- *6-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY (Alternating 8 digits for counting)*
- *DUAL COUNT QUAD INPUTS*
- *UP TO 3 COUNT DISPLAYS*
- *FOUR SETPOINT ALARM OUTPUTS (W/Plug-in card)*

B

c UL US LISTED
IND. CONT. EQ.
51EB

PAXC SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES:
To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	**Single**: Counter A or B				**Dual**: Counter A & B			
Are any setpoints used?	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	18	15	13	12	9	7.5
Count x2	17	13	9	7	9	7	5	4
Quadrature x1	22	19	12	10	7	6	4	3.5
Quadrature x2	17	13	9	7	7	6	4	3.5
Quadrature x4	8	6	4	3				

Notes:
1. Counter Modes are explained in the Module 1 programming section.
2. Listed values are with frequency DIP switch set on HI frequency.

ANNUNCIATORS:
A - Counter A
B - Counter B
C - Counter C
OF - Upper significant digit display of counter
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

COUNTER DISPLAYS:
Maximum display: 8 digits: ± 99999999 (greater than 6 digits display Alternates between high order and low order.)

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

MODEL PAXI - 1/8 DIN DUAL COUNTER/RATE METER

This is a brief overview of the PAXI. For complete specifications and programming information, see the **PAX Digital Input Panel Meters Bulletin** starting on **page 68**.

c UL US LISTED
IND. CONT. EQ.
51EB

- COUNTER, DUAL COUNTER, RATE AND SLAVE DISPLAY
- 6-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY
- VARIABLE INTENSITY DISPLAY
- 10 POINT SCALING (FOR NON-LINEAR PROCESSES)
- FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)
- RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)
- COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)
- BUS CAPABILITIES; DEVICENET, MODBUS, AND PROFIBUS-DP
- CRIMSON PROGRAMMING SOFTWARE

PAXI SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES TABLE

To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	**Single**: Counter A or B (with/without rate) or Rate only								**Dual**: Counter A & B or Rate not assigned to active single counter							
Are any setpoints used?	N	N	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
Is Prescaler Output used?	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)				(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	21	17	18	15	13	11	13	12	13	11	9	7.5	9	7
Count x2	17	13	16	12	9	7	8	7	9 *	7 *	9 *	7 *	5 *	4 *	5 *	4 *
Quadrature x1	22	19	20	17	12	10	11	10	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x2	17	13	16	12	9	7	8	6	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x4	8	6	8	6	4	3	4	3								
Rate Only	34	N/A	21	N/A	34	N/A	21	N/A								

ANNUNCIATORS:
- A - Counter A
- B - Counter B
- C - Counter C
- r - Rate
- H - Maximum (High) Rate
- L - Minimum (Low) Rate
- UF - Upper significant digit display of counter
- SP1 - setpoint 1 output state
- SP2 - setpoint 2 output state
- SP3 - setpoint 3 output state
- SP4 - setpoint 4 output state

RATE DISPLAY:
- Accuracy: ±0.01%
- Minimum Frequency: 0.01 Hz
- Maximum Frequency: see Max Signal Frequencies Table.
- Maximum Display: 5 Digits: 99999
- Adjustable Display (low) Update: 0.1 to 99.9 seconds
- Over Range Display: "r OLOL"

COUNTER DISPLAYS:
Maximum display: 8 digits: ± 99999999 (greater than 6 digits display Alternates between high order and low order.)

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.

LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.

MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms

DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

PRESCALER OUTPUT:
NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. With duty cycle of 25% min. and 50 % max.

MODEL PAX2D - 1/8 DIN DIGITAL INPUT PANEL METER

This is a brief overview of the PAX2D. For complete specifications and programming information, see the **PAX2D Digital Input Panel Meter Bulletin** starting on **page 98**.

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

- *COUNT, DUAL COUNTER WITH MATH FUNCTIONS*
- *RATE, DUAL RATE WITH MATH FUNCTIONS*
- *SLAVE DISPLAY*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *10 POINT RATE SCALING FOR NON-LINEAR PROCESSES*
- *PROGRAMMABLE UNITS DISPLAY*
- *BUS CAPABILITIES; DEVICENET, Modbus, AND PROFIBUS-DP*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

SPECIFICATIONS

POWER:
AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
DC Power: 21.6 to 250 VDC, 8 W
Isolation: 2300 Vrms for 1 min. to all inputs and outputs.

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +5 VDC, I_{MAX} = 0.7 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz; Must also have SRC switch ON. (Not recommended with counting applications.)
Maximum input voltage: ±40 V peak, 28 Vrms
DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

SENSOR POWER:
+18 VDC, ± 5% @ 60 mA max.; short circuit protected

USER INPUTS: Three programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.

PRESCALER OUTPUT:
NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. Duty cycle 25% min. and 50 % max.

ENVIRONMENTAL CONDITIONS:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -40 to 60 °C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 25 g (10 g relay)
Operating and Storage Humidity: 0 to 85% max. RH non-condensing
Altitude: Up to 2000 meters

CERTIFICATIONS AND COMPLIANCES:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Listed: File #E179259
Type 4X Indoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)

CONNECTIONS: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)

CONSTRUCTION: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

WEIGHT: 8 oz. (226.8 g)

This page intentionally left blank.

RATE METERS

The Trusted Source for Innovative Control Solutions

C

QUICK Specs

Rate Meters

	INDICATION			CONTROL
	DT8	PAXLR	PAXLPT	CUB5
				
Description	Rate Indicator	1/8 DIN Rate Indicator	1/8 DIN Process Time Indicator	Counter/Rate Meter with Output Option Card Capability
Dimensions (Height) x (Width)	39 mm (H) x 75mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	39 mm (H) x 75mm (W)
Display	5 Digit, .6" (15mm) Reflective, Green and Red Backlight LCD	6 Digit, .56" (14mm) LED	6 Digit, .56" (14mm) LED Decimal and Chronometer Modes	6 Digit, .46" (12mm) Reflective, Green and Red Backlight LCD
Measurement Format	Selectable Time Base Range 4 msec to 32 sec.	Adjustable Time Interval	Adjustable Time Interval	Adjustable Time Interval
Max. Input Frequency	10,000 Counts/Sec.	25,000 Counts/Sec.	25,000 Counts/Sec.	20,000 Counts/Sec.
Decimal Points	No	Yes	Yes	Yes
Sensor Power	No Yes, with Micro Line Power Supply	9 to 17.5 VDC @ 100 mA	9 to 17.5 VDC @ 100 mA	No Yes, with Micro Line Power Supply
Setpoint Capability	No	No	No	Single Form C Relay Dual Sinking
Communications	No	No	No	RS485
Power Source	3 Volt Lithium Battery, Backlighting 9 - 28 VDC @ 35 mA	115/230 VAC 10 to 16 VDC	115/230 VAC 10 to 16 VDC	9 to 28 VDC
Page Number	Page 153	Page 158	Page 169	Page 157

QUICK Specs

Rate Meters

CONTROL

	PAXLCR	PAXR	PAXI	PAX2D
				
Description	1/8 DIN Counter/Rate Meter with Setpoint Capability	1/8 DIN Rate Meter with Setpoint Card Capability	1/8 DIN Counter/Rate Meter with Output Option Card Capability	1/8 DIN Dual Line Counter/Dual Counter, Rate/Dual Rate Meter With Output Option Card Capability
Dimensions (Height)x(Width)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)
Display	6 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .7" (18mm) Tri-color backlight Bottom Line: 9 Digit, .35" (9mm) Green backlight
Measurement Format	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch	Adjustable Time Interval	Adjustable Time Interval	Uni-Directional Up/Down Inhibit Add/Subtract Add/Add Quadrature Batch
Max. Input Frequency	20,000 Counts/Sec. Program Dependent	34,000 Counts/Sec.	34,000 Counts/Sec.	50,000 Counts/Sec. Program Dependent
Decimal Points	Yes	Yes	Yes	Yes
Sensor Power	24 VDC @ 100 mA, over 50 V 24 VDC @ 50 mA, under 50 V	12 VDC @ 100 mA	12 VDC @ 100 mA	18 VDC @ 60 mA
Setpoint Capability	Dual Form C Relays	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing
Communications	No	No	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 or RS485 Modbus DeviceNet Profibus
Power Source	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 11 to 36 VDC 24 VAC	85 to 250 VAC 11 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC
Page Number	Page 165	Page 166	Page 167	Page 168

*See website for product information.

QUICK Specs

Rate Meters

	INDICATION	CONTROL
	GEM52	MDC
Description	Dual Rate Meter with Math Functions	Motor Drive Controller
Dimensions (Height) x (Width)	69 mm (H) x 133 mm (W)	75 mm (H) x 75 mm (W)
Display	6 Digit, .56" (14mm) LED	2 x 8 Digit, .3" (7mm) Red Backlight LCD
Measurement Format	Adjustable Time Interval Ratio (A/B), Difference (A-B), Draw [(A-B)/B] or Dual Rate	Master & Follower Modes Loop Response: 10 msec (Master) 20 msec (Follower)
Max. Input Frequency	10,000 Counts/Sec.	20,000 Counts/Sec.
Decimal Points	Yes	Yes
Sensor Power	12 VDC @ 100 mA	12 VDC @ 100 mA
Setpoint Capability	Single or Dual Form C Current Sinking	3 Current Sinking 0 to 15 VDC
Communications	20 mA Current Loop	No
Power Source	115/230 VAC 11 to 14 VDC	115/230 VAC
Page Number	*	*

*See website for product information.

C

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **DT5**	■ Display: 4 Digit, .35" (9 mm) Reflective LCD ■ Power Source: 2 "N" Alkaline Batteries ■ Measurement Format: Fixed One Second	 **DT8**	■ Display: 5 Digit, .6" (15 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base
 **DT6**	■ Display: 4 Digit, .35" (9 mm) Reflective LCD ■ Power Source: 2 "N" Alkaline Batteries or 5 to 24 VDC ■ Measurement Format: Time Base	 **DT8**	■ Display: 5 Digit, .6" (15 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base
 **DT7**	■ Display: 5 Digit, .6" (15 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base	 **DT8**	■ Display: 5 Digit, .6" (15 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base
 **DT9**	■ Display: 5 Digit, .46" (12 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base	 **DT8**	■ Display: 5 Digit, .6" (15 mm) Reflective and Backlight LCD ■ Power Source: Internal Battery ■ Measurement Format: Time Base
 **DT3A**	■ Display: 4 Digit, .43" (11 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement Format: Fixed One Second	 **PAXLR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Measurement Format: Programmable Scaling and Update ■ Use PMKA1 Panel **Panel Cut-Out Dimension Differences**
 **DT3D**	■ Display: 4 Digit, .43" (11 mm) Red LED ■ Power Source: 115/230 VAC, 12 VDC ■ Measurement Format: Time Base	 **PAXLR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Measurement Format: Programmable Scaling and Update ■ Use PMKA1 Panel **Panel Cut-Out Dimension Differences**
 **APLR & APLRI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC, 11 to 14 VDC ■ Measurement Format: Time Base	 **PAXLR**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Measurement Format: Programmable Scaling and Update **Panel Cut-Out Dimension Differences**
 **APLPT**	■ Display: 4 or 5 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 11 to 14 VDC ■ Measurement Format: Process Time	 **PAXLPT**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 10 to 16 VDC ■ Measurement Format: Programmable Scaling and Update **Panel Cut-Out Dimension Differences**
 **IMI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Count Speed: 50 KHz Max.	 **PAXI**	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC, 11 to 36 VDC ■ Count Speed: 34 KHz Max. ■ Requires Appropriate Option Card

Note: Refer to the current product literature, as some differences may exist.

This page intentionally left blank.

DITAK 8 - ADJUSTABLE TIMEBASE 5-DIGIT RATE INDICATOR

- *LCD, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE WITH YELLOW/GREEN OR RED BACKLIGHTING*
- *0.6 INCH (15.2 mm) HIGH DIGITS*
- *ADJUSTABLE TIMEBASE FROM 4 MSEC TO 63 SEC*
- *INTERNAL LITHIUM BATTERY PROVIDES OVER 5 YEARS OF CONTINUOUS OPERATION*
- *NEMA 4X/IP65 SEALED FRONT PANEL BEZEL*
- *ACCEPTS MAGNETIC OR LOGIC TYPE SIGNAL INPUTS*
- *WIRE CONNECTIONS MADE VIA SCREW CLAMP TYPE TERMINALS*

CE

C

DESCRIPTION

The Ditak 8 is a self-powered rate indicator which features selectable Timebase Increments by setting the appropriate DIP switches on the rear of the unit. The internal 3.6 VDC lithium battery will operate continuously for at least 5 years. It has a 5-digit LCD display with 0.6 inch (15.2 mm) high digits. The displays are available in positive image reflective (black digits, reflective background) or negative image transmissive (illuminated digits, dark background) with red or yellow/green backlighting. Backlight version units require power from an external 9 to 28 VDC supply.

The unit is constructed of a lightweight, high impact plastic case with a clear viewing window. The sealed front panel meets NEMA 4X/IP65 specifications for wash-down and/or dusty environments, when properly installed.

The optional Micro Line/Sensor Power Supply (MLPS1000) is designed to attach to the rear of an installed Ditak 8. The optional supply can be powered from 85 to 250 VAC, and can provide power for the backlighting of a unit and most sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

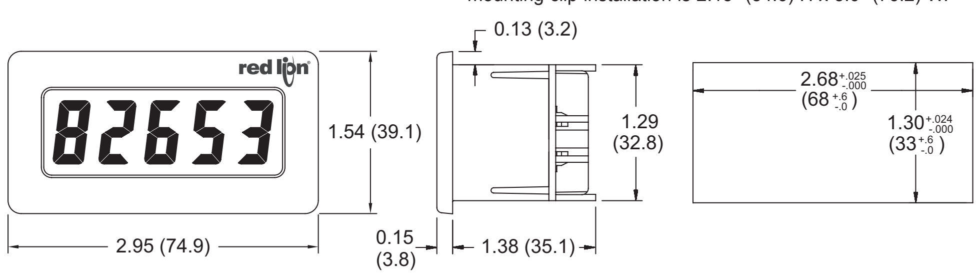
1. **DISPLAY**: 5-Digit LCD, 0.6" (15.2 mm) high digits.
2. **POWER SOURCE**: Internal 3.6 V lithium battery provides over 5 years of continuous service (battery life is dependent upon usage).
3. **BACKLIGHT POWER REQUIREMENTS**: 9 to 28 VDC @ 35 mA. Above 26 VDC, derate operating temperature to 50 °C. Must use the MLPS1 or an NEC Class 2 or Limited Power Source (LPS) rated power supply.
4. **SIGNAL INPUT**: 0 to 10 KHz from a magnetic or bi-polar output (with a 50% duty cycle). Min. input sensitivity is 0.9 V. Max. input = 28 VDC.
5. **TIMEBASE**: Adjustable in 1/256 sec (3.906 msec) increments via DIP switches located at the rear of the unit. Timebase ranges from 3.906 msec to 63.99 sec; 0.01% ±1 digit accuracy.
6. **ENVIRONMENTAL CONDITIONS**: Operating Temperature: 0 to 60 °C (Above 50 °C derate backlight operating voltage to 26 VDC max.)
   Storage Temperature: -40 to 80 °C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0 °C to 60 °C.
   Vibration According to IEC 68-2-6: Operational 5 to 500 Hz, in X, Y, Z direction for 1.5 hours, 5 g's.
   Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
7. **CONSTRUCTION**: High impact plastic case with clear viewing window (Panel gasket and mounting clip included). Installation Category I, Pollution Degree 2.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
DT8	Adjustable Timebase Tachometer	DT800000
	Adjustable Timebase Tachometer with Yellow/ Green Backlighting	DT800010
	Adjustable Timebase Tachometer with Red Backlighting	DT800020
MLPS	Micro Line Sensor/Power Supply	MLPS1000

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.0" (76.2) W.



SPECIFICATIONS (Cont'd)

8. **CERTIFICATIONS AND COMPLIANCES**:

SAFETY

IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP65 Enclosure rating (Face only), IEC 529

Type 4X Enclosure rating (Face only), UL50

ELECTROMAGNETIC COMPATIBILITY

Emissions and Immunity to EN 61326: 2006: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:

Electrostatic discharge	EN 61000-4-2	Criterion A
		4 kV contact discharge
		8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A
		10 V/m (80 MHz to 1 GHz)
		3 V/m (1.4 GHz to 2 GHz)
		1 V/m (2 GHz to 2.7 GHz)
Fast transients (burst)	EN 61000-4-4	Criterion A
	power	2 kV
	I/O signal	1 kV
Surge	EN 61000-4-5	Criterion A
	power	1 kV L to L, 2 kV L to G
RF conducted interference	EN 61000-4-6	Criterion A
		3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A
		30 A/m
AC power	EN 61000-4-11	Criterion A
Voltage dip		0% during 1 cycle
		40% during 10/12 cycle
		70% during 25/30 cycle
Short interruptions		Criterion B
		0% during 250/300 cycles

Emissions:

Emissions	EN 55011	Class B

Notes:

1. Criterion A: Normal operation within specified limits.

2. Criterion B: Temporary loss of performance from which the unit self-recovers.

Refer to the EMC Installation Guidelines section of this bulletin for additional information.

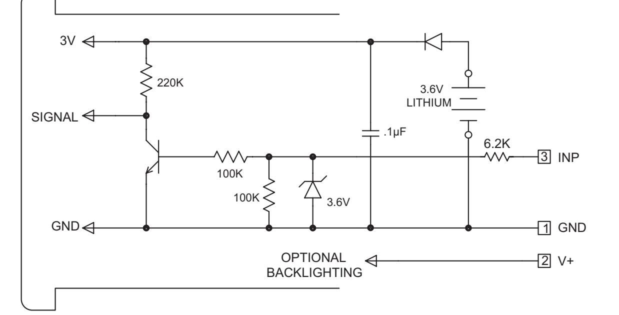
9. **WEIGHT:** 3.4 oz (96.4 g)

EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. In extremely high EMI environments, additional measures may be needed. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: *Reference manufacturer's instructions when installing a line filter.*
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

BLOCK DIAGRAM

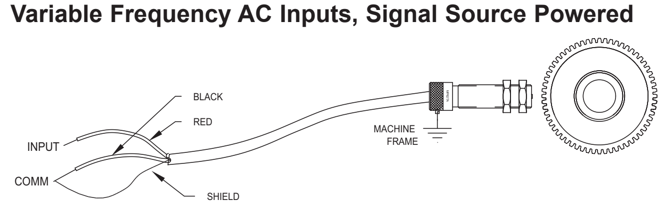


WIRING CONNECTIONS

The electrical connections are made via rear screw-clamp terminals located on the back of the unit. All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker. When wiring the unit, use the label to identify the wire position with the proper function. Strip the wire, leaving approximately 1/4" bare wire exposed (stranded wires should be tinned with solder). Insert the wire into the screw-clamp terminal and tighten the screw until the wire is clamped tightly. Each terminal can accept up to two #14 AWG wires.

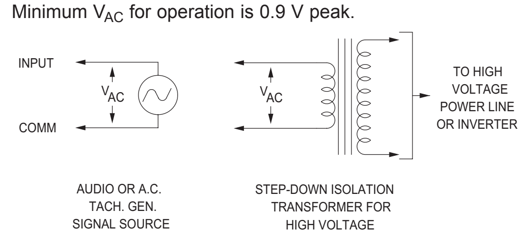
The backlighting for a backlight version unit is powered between Terminal 2 (V+) and Terminal 1 (GND).

Variable Frequency AC Inputs, Signal Source Powered

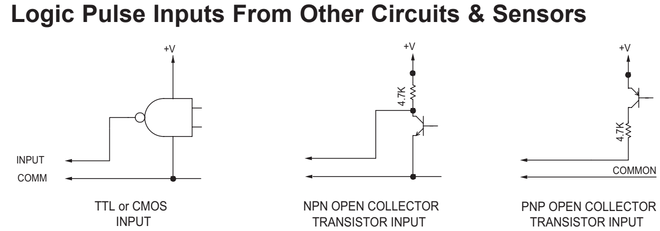


Variable Frequency AC Inputs, Signal Source Powered

Minimum V_{AC} for operation is 0.9 V peak.

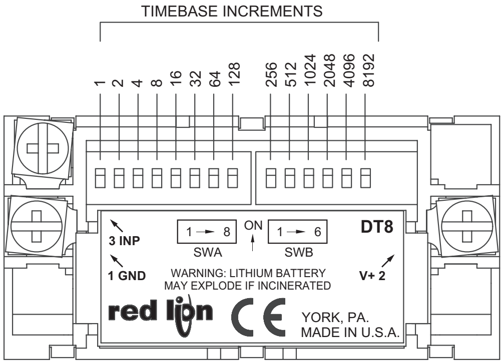


Logic Pulse Inputs From Other Circuits & Sensors



REAR PANEL DIP SWITCHES

When viewing the Ditak 8 from the rear, there are two banks of DIP switches located along the top edge of the PC board. The bank of eight switches to the left is labeled SWA and the bank of six switches to the right is labeled SWB. All of the switches are used to select the desired Timebase.



WARNING: *Lithium battery may explode if incinerated.*

TIMEBASE SELECTION

The Ditak 8 has a Timebase selection range from 3.906 msec to 63.99 sec. SWA 1 is set to the "ON" position for the minimum Timebase setting. SWA 1 through SWB 6 are set to the "ON" position for the maximum Timebase setting. A specific Timebase setting is achieved by adding the appropriate individual Timebase increments.

SWITCH	TIMEBASE INCREMENTS
SWA 1	1
SWA 2	2
SWA 3	4
SWA 4	8
SWA 5	16
SWA 6	32
SWA 7	64
SWA 8	128

SWITCH	TIMEBASE INCREMENTS
SWB 1	256
SWB 2	512
SWB 3	1024
SWB 4	2048
SWB 5	4096
SWB 6	8192

The Timebase increment total is computed according to the following formula:

$$\text{TIMEBASE INCREMENT TOTAL (TBIT)} = \frac{\text{DR x 15,361}}{\text{RPM x PPR}}$$

WHERE:

DR	=	Desired Reading
RPM	=	Revolutions Per Minute
PPR	=	Pulses Per Revolution

Example: Find the appropriate Timebase DIP switch setting for desired parameters.

Desired Readout (DR)	=	2500
Revolutions Per Minute (RPM)	=	1250
Pulses Per Revolution (PPR)	=	50

$$\text{TIMEBASE INCREMENT TOTAL (TBIT)} = \frac{\text{2500 x 15,361}}{\text{1250 x 50}}$$

TBIT = 614.44

TBIT = 614 {round to the nearest whole number}

TBIT = 614

DIP SWB 2	-	512		
		102	-	Needed
DIP SWA 7	-	64		
		38	-	Needed
DIP SWA 6	-	32		
		6	-	Needed
DIP SWA 3	-	4		
		2	-	Needed
DIP SWA 2	-	2		
		0	-	Needed

Note: If no timebase switches are turned on, the Ditak 8 will default to 3.906 msec timebase.

DIP switches SWA 2, 3, 6, 7, and SWB 2 are all set to the "ON" position for a Timebase Increment Total of 614. If it is desired to know what the approximate Timebase is in seconds, use the following formula:

TBIT x 0.003906	=	Time in seconds
614 x 0.003906	=	2.398 sec.

TYPICAL APPLICATION

CONVEYOR BELT SPEED INDICATOR

It is desired to display the rate of a conveyor belt used to carry PC Boards through an infrared soldering chamber that is variable from 0 to 10 feet per minute. The rate must be adjusted depending on the size of the boards being soldered. The display of the rate indicator must read in feet per minute. The shaft of the variable speed motor contains a keyway. A speed of 100 RPM will produce a belt speed of 10 ft/min. A proximity sensor is used to monitor the speed of the shaft. The Ditak 8 can be used to display the belt speed in this application. The output signal of the sensor is connected to the Ditak 8 Terminal 3 (INP). The sensor common and shield are connected to the Ditak 8 Terminal 1 (GND). The Timebase setting is to be determined by using the formula.

TIMEBASE INCREMENT TOTAL (TBIT) =

$$\frac{\text{DR x 15,361}}{\text{RPM x PPR}} = \frac{\text{10 x 15,361}}{\text{100 x 1}}$$

Desired Reading	=	10
MAX RPM Of Shaft	=	100
Pulses Per Revolution	=	1

TBIT = 1536.1

TBIT = 1536 {round to the nearest whole number}

TBIT = 1536

DIP SWB 3	-	1024		
		512	-	Needed
DIP SWB 2	-	512		
		0	-	Needed

INSTALLATION ENVIRONMENT

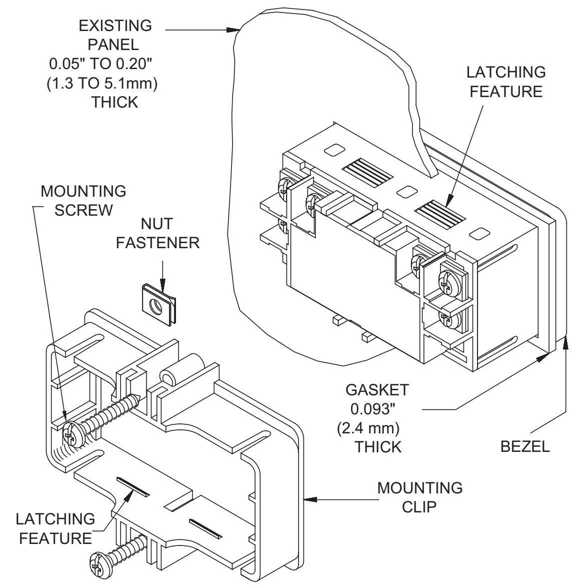
The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation.Placing the unit near devices that generate excessive heat should be avoided. The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents.Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

INSTALLATION

The Ditak 8 meets NEMA4X/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel. A sponge rubber gasket, mounting clip, two screws, and nut fasteners are provided to install and seal the unit in the panel cut-out.

The following procedure assures proper installation:

1. Cut panel opening to specified dimensions. Remove burrs and clean panel opening.
2. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Slide nut fastener into slot on mounting clip and then insert mounting screw through nut on both sides of mounting clip. Tip of mounting screw should NOTproject through hole on clip.
4. Install Ditak unit through panel cut-out.
5. Slide mounting clip over rear of unit until clip is against back of panel. The mounting clip and Ditak housing have a latching feature to hold the unit in place until tightened.
   Note: Hold the Ditak front bezel in place when sliding the mounting clip into position.
6. Alternately tighten each mounting screw to ensure uniform gasket pressure. Visually inspect the gasket for proper seal. The gasket should be compressed approximately 75 to 80% of its original thickness.



7. If the gasket is not adequately compressed and the mounting screws cannot be tightened any further, loosen mounting screws and insure that the clip is latched as close as possible to the panel.
8. Repeat step #6 for tightening the mounting screws.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

C

MODEL CUB5 - MINIATURE ELECTRONIC 8-DIGIT DUAL COUNTER AND RATE INDICATOR

This is a brief overview of the CUB5. For complete specifications and programming information, see the **CUB5 Bulletin** starting on **page 35**.

c UL US LISTED
IND. CONT. EQ.
51EB

CE

- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.46" (11.7 mm) HIGH DIGITS*
- *OPTIONAL RELAY OUTPUT MODULE*
- *OPTIONAL COMMS OUTPUT MODULES*
- *COUNT SPEEDS UP TO 20 KHZ*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *ANTI-COINCIDENCE COUNTING (ADD/ADD & ADD/SUB)*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

SPECIFICATIONS

COUNTER DISPLAYS:
Counter A: 8-digits, enabled in all count modes
Display Range: -9999999 to 99999999
Overflow Indication: Display flashes “Cnt OUEr”
Counter B: 7-digits, enabled in Dual Counter mode only
Display Designator: “b” to the left side of the display
Display Range: 0 to 9999999 (positive count only)
Overflow Indication: Display flashes “bCntOUEr”
Maximum Count Rates: 50% duty cycle
Without setpoint option card: 20 KHz (all count modes)
With setpoint option card: 20 KHz for any count mode except Quadrature x4 (18 KHz) and Dual Counter (17 KHz)
RATE DISPLAY: 6-digits, may be enabled or disabled in any mode
Display Designator: “A” to the left side of the display
Display Range: 0 to 999999
Over Range Display: “A OLOLOL”
Maximum Frequency: 20 KHz
Minimum Frequency: 0.01 Hz
Accuracy: ±0.01%
COUNT/RATE SIGNAL INPUTS (INP A and INP B):
Input A: DIP switch selectable to accept pulses from a variety of sources. See Section 2.0 Setting the DIP Switches for Input A specifications.
Input B: Logic signals only
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Current sinking: Internal 10KΩ pull-up resistor to +9 to 28 VDC
Filter (LO Freq.): Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec min.

MODEL PAXLR - PAX® LITE RATE METER

- RATE INDICATION
- 6-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAYS
- INPUT RATES UP TO 25 KHZ
- ACCEPTS A WIDE VARIETY OF SENSORS
- PROGRAMMABLE SCALING
- PROGRAMMABLE UPDATE TIME
- PROGRAMMABLE DECIMAL POINTS
- NEMA 4X/IP65 SEALED FRONT BEZEL

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The PAX® Lite Rate Meter, Model PAXLR, provides the versatility and flexibility needed to accommodate virtually any rate measuring application. The meter has the ability to scale for direct readout in terms of the units being measured. Whether a machine produces bottles, cloth, wire, or beverage mix, operation is enhanced when the rate readout is expressed directly in bottles/min., feet/min., gallons/min., or whatever units are needed in plant applications.

The PAXLR can accommodate magnetic pickups, logic sensors, and NPN open collector sensors. The pulses are received and scaled, so the desired display can be achieved. The meter is programmed through both the front panel buttons and DIP switches. Once the programming is complete, the front panel buttons can be disabled by a DIP switch setting.

The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough, yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

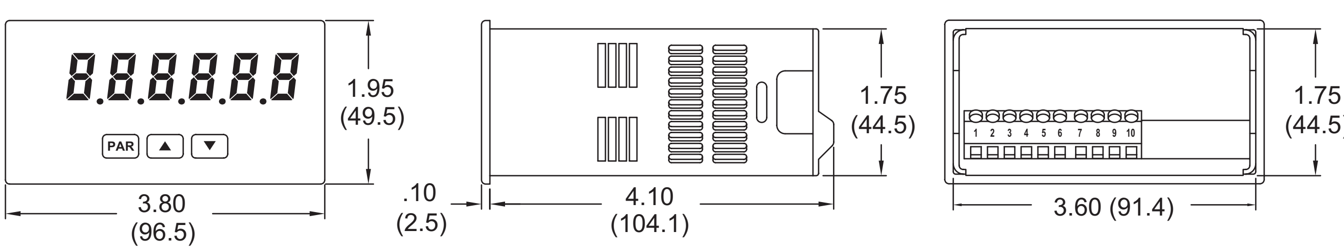


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	R0	0	0

R0 - 6 Digit Rate Meter

General Meter Specifications

1. **DISPLAY**: 6-digit, 0.56" (14.2 mm), 7-segment red LED.
   Decimal points are programmed by front panel keys.
2. **POWER**:
   AC Power: 115/230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA
   Isolation: 2300 Vrms for 1 min. to input and DC Out/In.
   DC Power: 10 to 16 VDC @ 0.1 A max.
3. **SENSOR POWER**: 9 to 17.5 VDC @ 100 mA max.
4. **KEYPAD**: 3 programming keys, the ▼ (Down Arrow) key can also function as the front panel reset button.
5. **INPUT**: (DIP switch selectable)
   Accepts pulses from a variety of sources including NPN-OC, PNP-OC, TTL Outputs, Magnetic Pickups and all standard Red Lion sensors.
   Logic: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
   Current Sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA
   Current Sourcing: Internal 3.9 KΩ pull-down, 8 mA max. @ 30 VDC max.
   MAGNETIC PICK-UP:
   Sensitivity: 200 mV peak
   Hysteresis: 100 mV
   Input impedance: 3.9KΩ @ 60 Hz
   Maximum input voltage: ±40 V peak, 30 Vrms
6. **INPUT FREQUENCY RANGE**:
   Max Frequency: 25 KHz
   Min Frequency: 0.01 Hz
   Accuracy: ±0.01%
7. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters and display values.
8. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0° to 60 °C
   Storage Temperature: -40° to 60 °C
   Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
   Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
9. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Report # 04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   IP20 Enclosure rating (Rear of unit), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A [2] 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A [2] 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

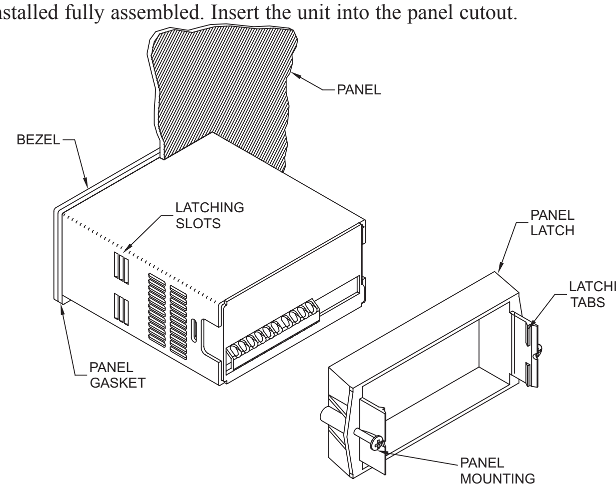
Notes:
1. Criterion A: Normal operation within specified limits.
2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000).

10. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage Capacity: 30-14 AWG copper wire.
    Torque: 4.5 inch-lbs (0.51 N-m) max.
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
12. **WEIGHT**: 12 oz (340 g)

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

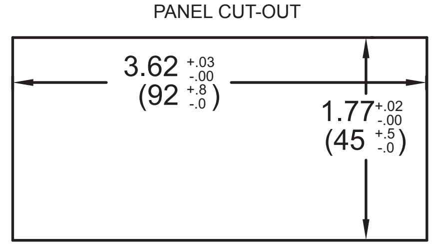
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 SETTING THE SWITCHES

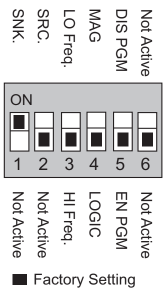
The meter has switches that must be checked and/or changed prior to applying power. To access the power switch, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Power Selection Switch

Caution: Insure the AC power selection switch is set for the proper voltage before powering-up the meter. The meter is shipped from the factory in the 230 VAC position.

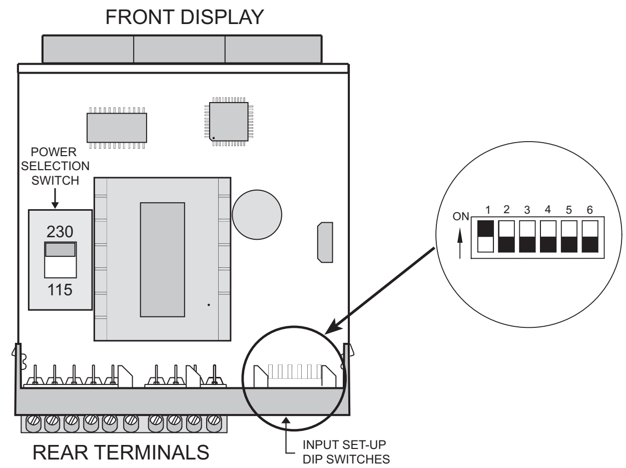
Set-Up DIP Switches

A DIP switch is located at the rear of the meter, and is fully accessible when the unit is in the case. It is used for the selection of the input parameters and program disable.



SWITCH 1
SNK.: Adds internal 7.8 KΩ pull-up resistor to + 12 VDC, I_{MAX} = 1.9 mA.
SWITCH 2
SRC.: Adds internal 3.9 KΩ pull-down resistor, 8 mA max. @ 30 VDC max.

SWITCH 3
HI Frequency: Removes damping capacitor and allows max. frequency.
LO Frequency: Limits input frequency to 50 Hz and input pulse widths to 10 msec.
SWITCH 4
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V max.
MAG: 200 mV peak input (must have SRC on).
SWITCH 5
Enable Programming: Enables programming through the front panel buttons.
Disables Programming: Disables the front panel buttons from any programming changes.
SWITCH 6
Not Active for the Rate Meter



C

3.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

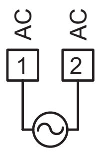
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

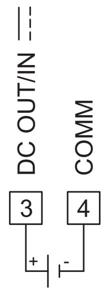
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

3.1 POWER WIRING

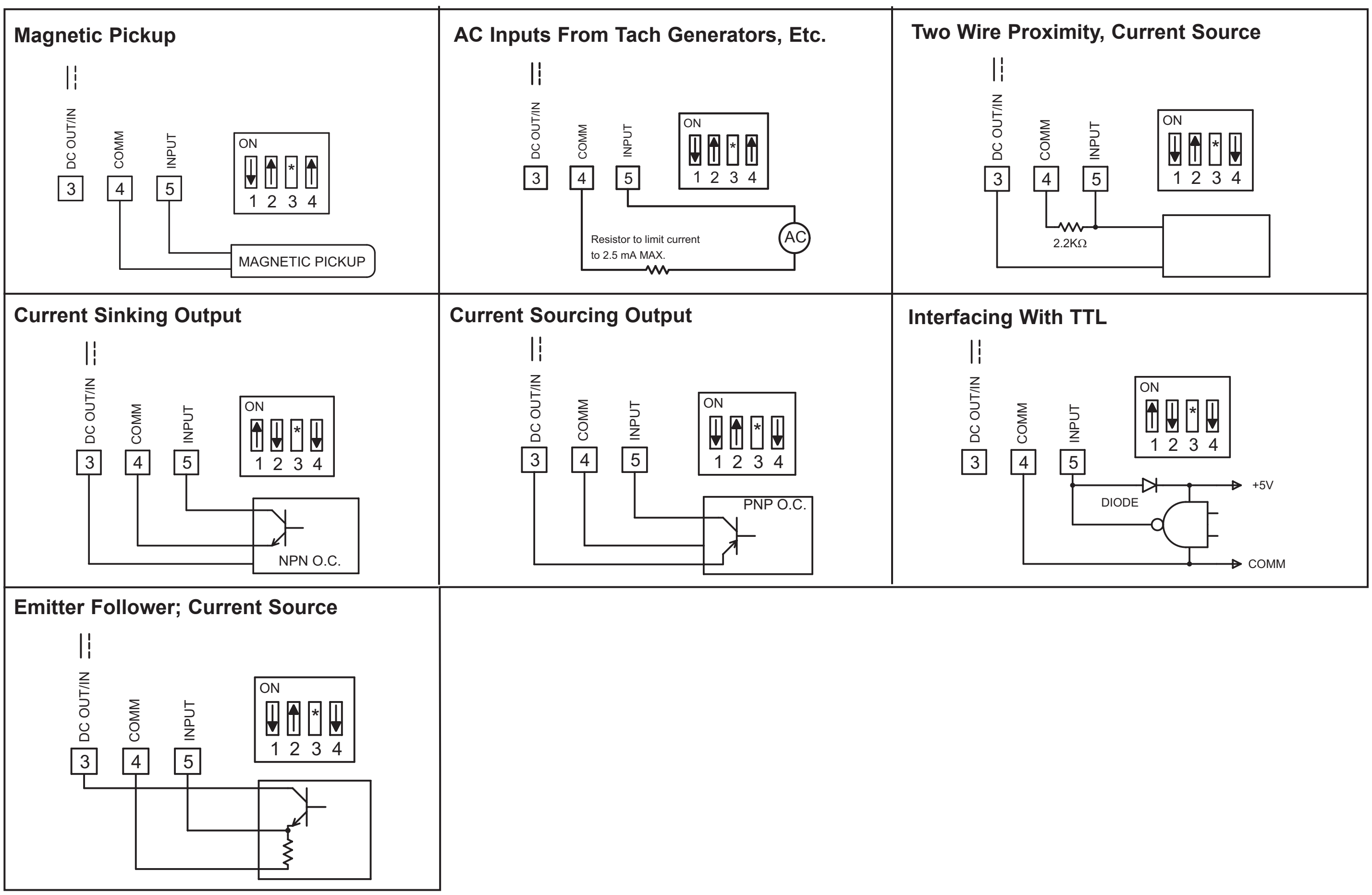
AC Power
Terminal 1: VAC
Terminal 2: VAC



DC Power
Terminal 3: +VDC
Terminal 4: COMM

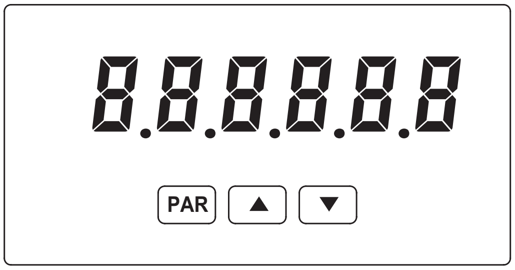


3.2 INPUT WIRING



*Switch position is application dependent.

4.0 Reviewing the Front Buttons and Display



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
▲	No Function	Increment selected digit of parameter value
▼	No Function	Select digit position in parameter value

5.0 Scaling the Meter

RATE SCALING

To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. These values are internally plotted to a Display value of 0 and Input value of 0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The location of the scaling point should be near the process end limit for the best possible accuracy. The PAXLR is capable of showing a rate display value for any linear process.

SCALING CALCULATION

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (rt-dSP) and Scaling Input (rt- INP). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (rt-dSP)	INPUT (rt- INP)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

NOTES:

1. If # of pulses per unit is less than 10, then multiply both Input and Display values by 10.
2. If # of pulses per unit is less than 1, then multiply both Input and Display values by 100.
3. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
4. Both values must be greater than 0.0.

EXAMPLE:

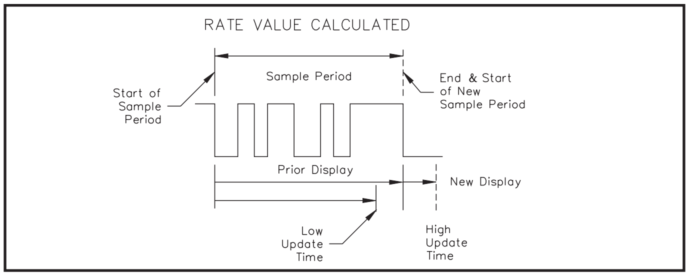
1. With 15.1 pulses per foot, show feet per minute in tenths.
   Scaling Display = 60.0 Scaling Input = 15.1
2. With 0.25 pulses per gallon, show whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.)
   Scaling Display = 36000 Scaling Input = 2.5

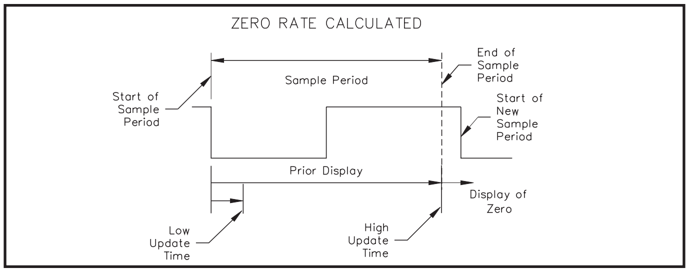
RATE DISPLAY OVERFLOW

The rate of the input signal along with the programmed scaling values can cause the calculated rate display to exceed the meter's 6-digit capacity. If this occurs, the display will show "OLOLOL" to indicate an overflow condition.

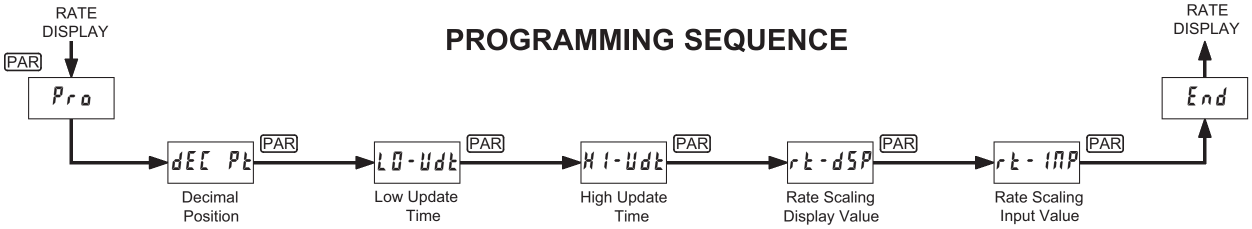
INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by either scaling method.





6.0 PROGRAMMING THE METER



C

The Rate Indicator has five programmable parameters which are entered in the sequence shown above, using the front panel push buttons.

Before programming, refer to the section on Scaling the Meter to determine the Rate Scaling Display Value and Rate Scaling Input Value to use for the specific application.

Note: Programming mode can be locked out with the Program Disable DIP switch. With the switch in the Disabled (up) position the meter will not enter programming mode. Refer to the section on DIP switch setup.

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING PARAMETERS

In programming mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

DECIMAL POSITION

dEC Pt
0

0 0.0 0.00
0.000 0.0000 0.00000

This parameter selects the decimal point position on the display. The selection does not affect scaling calculations.

Press the arrow keys (▲ or ▼) to sequence through the selection list until the desired selection is shown. Press the **PAR** key to save the displayed selection and advance to the next parameter.

ENTERING NUMERICAL VALUES

The parameters which follow are displayed as a multi-digit numerical values with one selected digit flashing (initially the far left digit). Press the ▲ (up arrow) key to increment the value of the selected (flashing) digit. Holding the ▲ key automatically scrolls the value of the selected digit.

Press the ▼ (down arrow) key to select the next digit position to the right. Use the ▲ key to increment the value of this digit to the desired number. Press the ▼ key again to select the next digit to be changed. Holding the ▼ key automatically scrolls through each digit position.

Repeat the "select and set" sequence until all digits are displaying the desired numerical value. Press the **PAR** key to save the displayed value and advance to the next parameter.

LOW UPDATE TIME (DISPLAY UPDATE)

LO-Udt
1.0

0.1 to 99.9 seconds

The Low Update Time is the minimum amount of time between display updates. The factory setting of 1.0 allows a minimum of one second between updates. Low values below 0.3 seconds will update the display correctly, but may cause the display to appear unsteady.

For more details on display updating, refer to Input Frequency Calculation.

HIGH UPDATE TIME (DISPLAY ZERO)

HI-Udt
2.0

0.2 to 99.9 seconds

The High Update Time is the maximum amount of time before the display is forced to zero. The High Update Time **must** be higher than the Low Update Time and also higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0 will force the display to zero for speeds below 0.5 Hz or one pulse every 2 seconds.

For more details on display updating, refer to Input Frequency Calculation.

RATE SCALING DISPLAY VALUE

rt-dSP
1000

0 to 999999

Enter the desired Rate Display value to be shown for the corresponding Rate Input value entered below. For more explanation, refer to Rate Scaling.

If a decimal point was selected in the Decimal Position (dEC Pt) parameter, it will be displayed at the same position for this parameter value.

RATE SCALING INPUT VALUE

rt-INP
1000.0

0 to 99999.9

Enter the Rate Input value that corresponds to the Rate Display value entered above. This value is always in pulses per second (Hz). For more explanation, refer to Rate Scaling.

PROGRAMMING MODE EXIT

The meter exits Programming Mode when the **PAR** key is pressed to save the Rate Scaling Input Value. The meter briefly displays End upon exiting Programming Mode. All programmed selections are now transferred to the non-volatile memory and the meter returns to the Rate display.

(If power loss occurs during programming mode, verify parameter changes and reprogram, if necessary, when power is restored.)

PROGRAMMING MODE TIME OUT

The Programming Mode has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the Rate display. When automatic timeout occurs, any changes that were made to the parameter currently being programmed, will not be saved.

FACTORY SETTINGS

The factory settings for the programming parameters are shown above in the alternating display illustrations. The factory settings can be easily restored by removing power from the meter, and then pressing and holding the **PAR** key while power is reapplied. The meter displays rESEt until the **PAR** key is released. The normal power-up sequence then resumes, with the factory settings loaded and saved in non-volatile memory.

Note: The Program Disable DIP switch must be in the Enabled (down) position to allow loading factory settings. See section on DIP switch setup.

MODEL PAXLCR - 1/8 DIN PAX LITE DUAL COUNTER AND RATE METER

This is a brief overview of the PAXLCR. For complete specifications and programming information, see the **PAX Lite Dual Counter and Rate Meter Bulletin** starting on **page 57**.

- *6 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE SCALING FOR COUNT AND RATE*
- *BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL*
- *QUADRATURE SENSING (UP TO 4 TIMES RESOLUTION)*
- *BUILT-IN BATCH COUNTING CAPABILITY*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAYS*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

ANNUNCIATORS:
A - Counter A value
B - Counter B value (dual count or batch)
- Rate value is displayed with no designator
SP1 - Indicates setpoint 1 output status
SP2 - Indicates setpoint 2 output status

COUNTER DISPLAYS:
Counter A: 6-digits, enabled in all count modes
Display Designator: "A" to the left side of the display
Display Range: -99999 to 999999
Counter B: 6-digits, enabled in Dual Count mode or Batch Counter
Display Designator: "B" to the left side of the display
Display Range: 0 to 999999 (positive count only)
Overflow Indication: Display "OLOL" alternates with overflowed count value
Maximum Count Rates: 50% duty cycle, count mode dependent.
With setpoints disabled: 25 KHz, all modes except Quadrature x4 (23 KHz).
With setpoint(s) enabled: 20 KHz, all modes except Dual Counter (14 KHz), Quadrature x2 (13 KHz) and Quadrature x4 (12 KHz).

RATE DISPLAY: 6-digits, may be enabled or disabled in any count mode
Display Range: 0 to 999999
Over Range Display: "OLOL"
Maximum Frequency: 25 KHz
Minimum Frequency: 0.01 Hz
Accuracy: ±0.01%

COUNT/RATE SIGNAL INPUTS (INPUT A and INPUT B):
See Section 2.0 Setting the DIP Switches for complete Input specifications. DIP switch selectable inputs accept pulses from a variety of sources. Both inputs allow selectable active low or active high logic, and selectable input filtering for low frequency signals or switch contact debounce.
Input A: Logic level or magnetic pickup signals.
Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
Mag. pickup sensitivity: 200 mV peak, 100 mV hysteresis, 40 V peak max.
Input B: Logic level signals only
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC

Model PAXR - 1/8 DIN Rate Meter

This is a brief overview of the PAXR. For complete specifications and programming information, see the
PAX Digital Input Panel Meters Bulletin starting on **page 68**.

- *5-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *RATE INDICATION*
- *MINIMUM/MAXIMUM RATE DISPLAYS*
- *FOUR SETPOINT ALARM OUTPUTS (W/Plug-in card)*
- *VARIABLE INTENSITY DISPLAY*

c UL US LISTED
IND. CONT. EQ.
51EB

PAXR SPECIFICATIONS

ANNUNCIATORS:
r - Rate
H - Maximum (High) Rate
L - Minimum (Low) Rate
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

RATE DISPLAY:
Accuracy: ±0.01%
Minimum Frequency: 0.01 Hz
Maximum Frequency: 34 KHz
Maximum Display: 5 Digits: 99999
Adjustable Display (low) Update: 0.1 to 99.9 seconds
Over Range Display: "r OLOL"

INPUT A:
DIP switch selectable to accept pulses from a variety of sources including TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms

Model PAXI - 1/8 DIN Dual Counter/Rate Meter

This is a brief overview of the PAXI. For complete specifications and programming information, see the
PAX Digital Input Panel Meters Bulletin starting on **page 68**.

c UL US LISTED
IND. CONT. EQ.
51EB

CE

- *COUNTER, DUAL COUNTER, RATE AND SLAVE DISPLAY*
- *6-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *VARIABLE INTENSITY DISPLAY*
- *10 POINT SCALING (FOR NON-LINEAR PROCESSES)*
- *FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)*
- *RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)*
- *BUS CAPABILITIES; DEVICENET, MODBUS, AND PROFIBUS-DP*
- *CRIMSON PROGRAMMING SOFTWARE*

C

PAXI SPECIFICATIONS

MAXIMUM SIGNAL FREQUENCIES TABLE

To determine the maximum frequency for the input(s), first answer the questions with a yes (Y) or no (N). Next determine the Count Mode to be used for the counter(s). If dual counters are used with different Count Modes, then the lowest frequency applies to both counters.

FUNCTION QUESTIONS	**Single**: Counter A or B (with/without rate) or Rate only								**Dual**: Counter A & B or Rate not assigned to active single counter							
Are any setpoints used?	N	N	N	N	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y
Is Prescaler Output used?	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Is Counter C used?	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
COUNT MODE	(Values are in KHz)				(Values are in KHz)				(Values are in KHz)				(Values are in KHz)			
Count x1	34	25	21	17	18	15	13	11	13	12	13	11	9	7.5	9	7
Count x2	17	13	16	12	9	7	8	7	9 *	7 *	9 *	7 *	5 *	4 *	5 *	4 *
Quadrature x1	22	19	20	17	12	10	11	10	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x2	17	13	16	12	9	7	8	6	7 *	6 *	6 *	5 *	4 *	3.5 *	3.5 *	3 *
Quadrature x4	8	6	8	6	4	3	4	3								
Rate Only	34	N/A	21	N/A	34	N/A	21	N/A								

ANNUNCIATORS:
A - Counter A
B - Counter B
C - Counter C
r - Rate
H - Maximum (High) Rate
L - Minimum (Low) Rate
UF - Upper significant digit display of counter
SP1 - setpoint 1 output state
SP2 - setpoint 2 output state
SP3 - setpoint 3 output state
SP4 - setpoint 4 output state

RATE DISPLAY:
Accuracy: ±0.01%
Minimum Frequency: 0.01 Hz
Maximum Frequency: see Max Signal Frequencies Table.
Maximum Display: 5 Digits: 99999
Adjustable Display (low) Update: 0.1 to 99.9 seconds
Over Range Display: "r OLOL"

COUNTER DISPLAYS:
Maximum display: 8 digits: ± 99999999 (greater than 6 digits display Alternates between high order and low order.)

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz
Maximum input voltage: ±40 V peak, 30 Vrms
DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

PRESCALER OUTPUT:
NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max.
V_{OH} = 30 VDC max. With duty cycle of 25% min. and 50 % max.

MODEL PAX2D - 1/8 DIN DIGITAL INPUT PANEL METER

This is a brief overview of the PAX2D. For complete specifications and programming information, see the
PAX2D Digital Input Panel Meter Bulletin starting on **page 98**.

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

- *COUNT, DUAL COUNTER WITH MATH FUNCTIONS*
- *RATE, DUAL RATE WITH MATH FUNCTIONS*
- *SLAVE DISPLAY*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *10 POINT RATE SCALING FOR NON-LINEAR PROCESSES*
- *PROGRAMMABLE UNITS DISPLAY*
- *BUS CAPABILITIES; DEVICENET, Modbus, AND PROFIBUS-DP*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

SPECIFICATIONS

POWER:
AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
DC Power: 21.6 to 250 VDC, 8 W
Isolation: 2300 Vrms for 1 min. to all inputs and outputs.

INPUTS A and B:
DIP switch selectable to accept pulses from a variety of sources including switch contacts, TTL outputs, magnetic pickups and all standard RLC sensors.
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
Current sinking: Internal 7.8 KΩ pull-up to +5 VDC, I_{MAX} = 0.7 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, V_{MAX} = 30 VDC.
Filter: Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec. minimum.
MAGNETIC PICKUP:
Sensitivity: 200 mV peak
Hysteresis: 100 mV
Input impedance: 3.9 KΩ @ 60 Hz; Must also have SRC switch ON. (Not recommended with counting applications.)
Maximum input voltage: ±40 V peak, 28 Vrms
DUAL COUNT MODES:
When any dual count mode is used, then User Inputs 1 and/or 2 will accept the second signal of each signal pair. The user inputs do not have the Logic/Mag, HI/LO Freq, and Sink/Source input setup switches. The user inputs are inherently a logic input with no low frequency filtering. Any mechanical contacts used for these inputs in a dual count mode must be debounced externally. The user input may only be selected for sink/source by the User Jumper placement.

SENSOR POWER:
+18 VDC, ± 5% @ 60 mA max.; short circuit protected

USER INPUTS: Three programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.

PRESCALER OUTPUT:
NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1 VDC max. V_{OH} = 30 VDC max. Duty cycle 25% min. and 50 % max.

ENVIRONMENTAL CONDITIONS:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -40 to 60 °C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 25 g (10 g relay)
Operating and Storage Humidity: 0 to 85% max. RH non-condensing
Altitude: Up to 2000 meters

CERTIFICATIONS AND COMPLIANCES:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Listed: File #E179259
Type 4X Indoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)

CONNECTIONS: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)

CONSTRUCTION: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

WEIGHT: 8 oz. (226.8 g)

MODEL PAXLPT - PAX® LITE PROCESS TIME METER

- *PROCESS TIME INDICATION*
- *6-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAYS*
- *DISPLAY MODES 999999 OR 999-59*
- *INPUT RATES UP TO 25 KHZ*
- *ACCEPTS A WIDE VARIETY OF SENSORS*
- *PROGRAMMABLE SCALING*
- *PROGRAMMABLE DECIMAL POINTS*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The PAX® Lite Process Time Meter, Model PAXLPT, displays a value representing the time between a beginning and end point of a process, such as a conveyor oven.

The PAXLPT's display will update inversely in relation to the input signal frequency. As input frequency increases (representing speed), the PAXLPT time display will decrease indicating a reduction in the duration of process time. For example, the bake time through an oven will decrease the faster the conveyor runs.

The display can be programmed for two operating modes. Operating in the 6 digit mode, the PAXLPT can readout in any whole value, such as seconds, minutes, or hours. This mode also provides capability for decimal points. The 5 digit mode functions as a chronometer, which has a maximum display value of 999-59. This formats the display to allow the meter to readout in hours and minutes, minutes and seconds, etc.

The PAX Lite Process Time Indicator also has a feature called *"moving window average"*. This allows one time disturbances, or irregularly spaced items to be averaged over eight inputs, thus keeping display fluctuations to a minimum while still updating the display on every pulse. This feature can be enabled or disabled by a rear DIP switch.

The PAXLPT can accept many different types of sensors including magnetic pickups, logic sensors, and NPN open collector sensors, as well as switch contact closure sensors.

The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

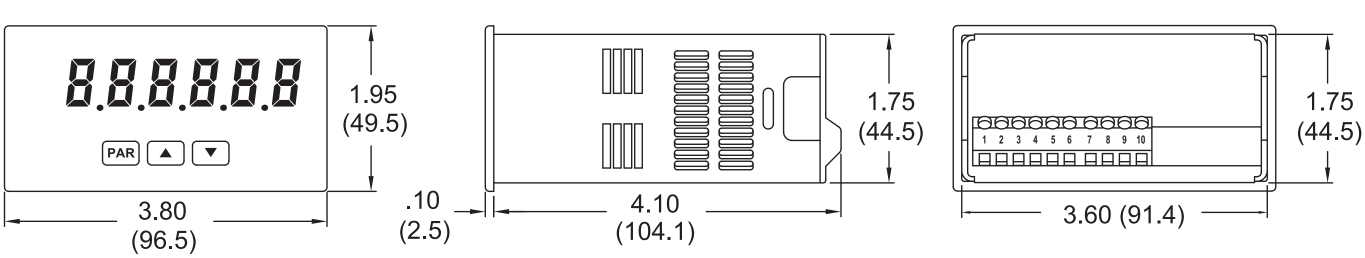


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	PT	0	0

PT - 6 Digit Process Time Meter

General Meter Specifications

1. **DISPLAY**: 6-digit, 0.56" (14.2 mm), 7-segment red LED.
   Decimal points are programmed by front panel keys (6 digit mode only)
2. **POWER**:
   AC Power: 115/230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA.
   Isolation: 2300 Vrms for 1 min. to input and DC Out/In.
   DC Power: 10 to 16 VDC @ 0.1 A max.
3. **SENSOR POWER**: 9 to 17.5 VDC @ 100 mA max.
4. **KEYPAD**: 3 programming keys
5. **INPUT**: (DIP switch selectable)
   Accepts pulses from a variety of sources including NPN-OC, PNP-OC, TTL Outputs, Magnetic Pickups and all standard Red Lion® sensors.
   Logic State: Active Low
   Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V min.
   Current Sinking: Internal 7.8 KΩ pull-up to +12 VDC, I_{MAX} = 1.9 mA
   Current Sourcing: Internal 3.9 KΩ pull-down, 8 mA max. @ 30 VDC max.
   MAGNETIC PICK-UP:
   Sensitivity: 200 mV peak
   Hysteresis: 100 mV
   Input impedance: 3.9KΩ @ 60 Hz
   Maximum input voltage: ±40 V peak, 30 Vrms
6. **INPUT FREQUENCY RANGE**:
   Max Frequency: 25 KHz
   Min Frequency: 0.05 Hz
   Accuracy: ±0.02%
   Note: When the input pulse rate is 3 Hz or lower, the unit will utilize, if enabled, a technique known as a "moving window average." (This continually averages the last eight input pulses.)
7. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters.
8. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0 ° to 60 °C
   Storage Temperature: -40 ° to 60 °C
   Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
   Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
9. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Report # 04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   IP20 Enclosure rating (Rear of unit), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 2 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000).

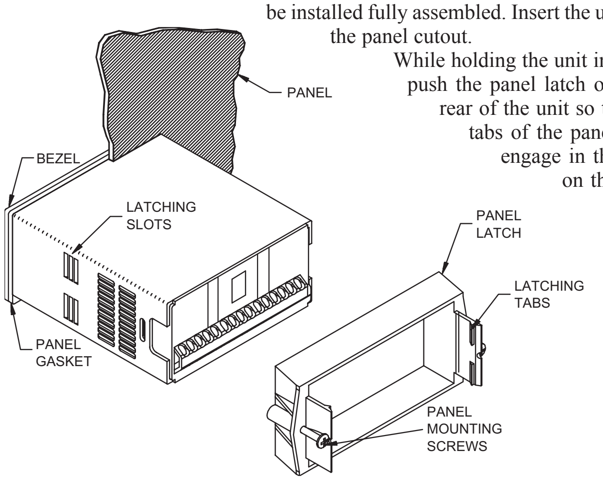
10. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage Capacity: 30-14 AWG copper wire.
    Torque: 4.5 inch-lbs (0.51 N-m) max.
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
12. **WEIGHT**: 12 oz (340 g)

1.0 Installing the Meter

Installation

The PAX Lite meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case.



The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

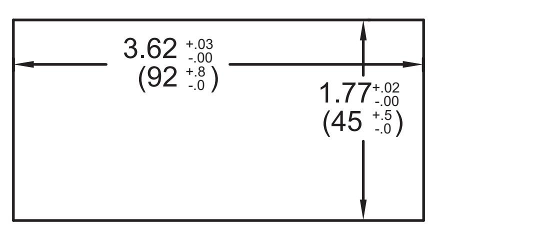
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Jumper and Switches

The meter has a jumper and switches, which must be checked and/or changed prior to applying power. To access the power switch and the jumper, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Power Selection Switch

Caution: Insure the AC power selection switch is set for the proper voltage before powering-up the meter. The meter is shipped from the factory in the 230 VAC position.

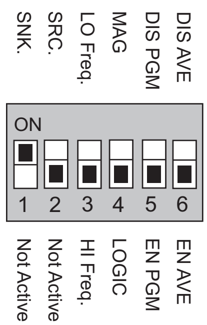
Mode Selection Jumper

Inside the meter is also the Mode Selection Jumper, located near the display board. This jumper will select operation in the 6 digit mode or 5 digit (chronometer) mode. When the jumper is positioned toward the display board, the unit will be in the 6 digit mode of operation. With the jumper positioned away from the display board, the meter is in the 5 digit (chronometer) mode. This unit ships from the factory in the 6 digit mode.

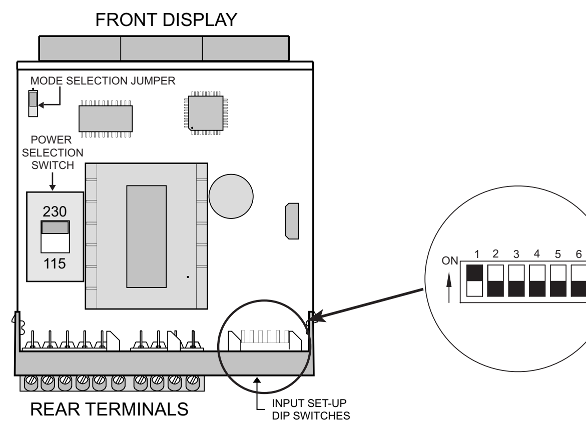
C

Set-Up DIP Switches

A DIP switch is located at the rear of the meter, and is fully accessible when the unit is in the case. It is used for the selection of the input parameters and program disable. For the correct input setup, refer to 3.2 Input Wiring.



SWITCH 1
SNK.: Adds internal 7.8 KΩ pull-up resistor to + 12 VDC, I_{MAX} = 1.9 mA
SWITCH 2
SRC.: Adds internal 3.9 KΩ pull-down resistor, 8 mA max. @ 30 VDC max.
SWITCH 3
HI Frequency: Removes damping capacitor and allows max. frequency.
LO Frequency: Limits input frequency to 50 Hz and input pulse widths to 10 msec.
SWITCH 4
LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V max.
MAG: 200 mV peak input (must have SRC on)
SWITCH 5
Enable Programming: Enables programming through the front panel buttons
Disables Programming: Disables the front panel buttons from any programming changes
SWITCH 6
Enable Averaging: Enables moving windows averaging feature.
Disable Averaging: Disables moving windows averaging feature.



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

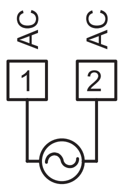
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

3.1 POWER WIRING

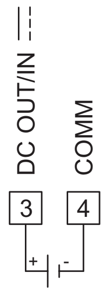
AC Power

Terminal 1: VAC
Terminal 2: VAC



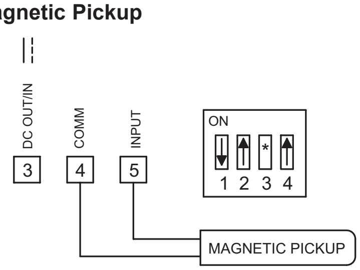
DC Power

Terminal 3: +VDC
Terminal 4: COMM

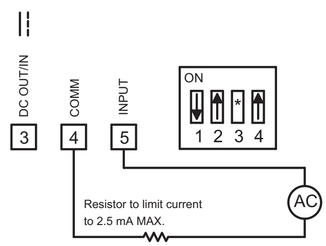


3.2 INPUT WIRING

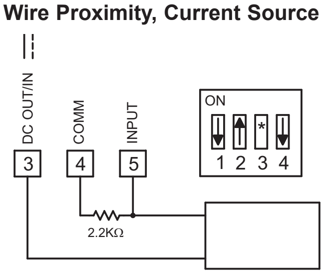
Magnetic Pickup



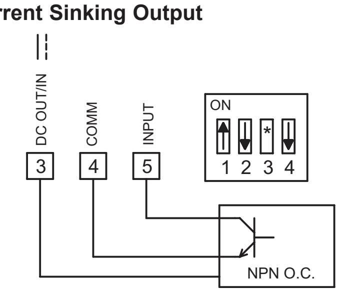
AC Inputs From Tach Generators, Etc.



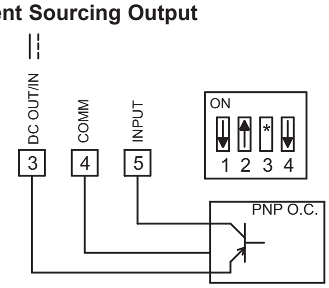
Two Wire Proximity, Current Source



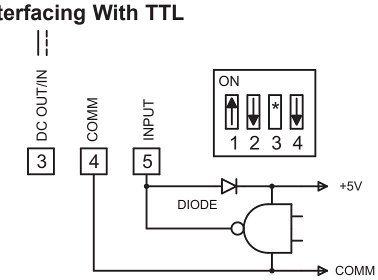
Current Sinking Output



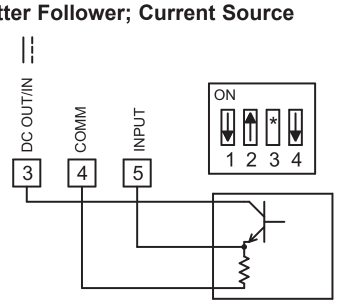
Current Sourcing Output



Interfacing With TTL



Emitter Follower; Current Source



*Switch position is application dependent.

4.0 Reviewing the Front Buttons and Display

KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
▲	No Function	Increment selected digit of parameter value
▼	No Function	Select digit position in parameter value

5.0 Scaling the Meter

In many industrial applications, a meter is required to display the process time of an operation or event. The pulses from a sensor are received by the PAXLPT, and then scaled to produce just such a readout. The following formula will help provide the scaling values to achieve the desired readout.

SF = DR x PPS

WHERE:

SF = Scale Factor
DR = Desired Readout*
PPS = Pulses per Second

To calculate the PPS multiply the RPM (Revolutions per Minute) by the PPR (Pulses per Revolution) and divide by 60.

$$\frac{\text{RPM x PPR}}{60}$$

**For applications requiring a decimal point, select and program the appropriate decimal point. When calculating the Scale Factor, use the whole value of the number to be displayed, for example, 50.0 minutes, the Desired Readout in this case is 500. Do not use decimal points in the Desired Readout when calculating the scale factor.*

For calculated SF values less than 59,999

If the Scale Factor is a value less than 59,999, it can be entered directly into the meter as the Scale Factor and the Scale Multiplier can be left at 1.

For calculated SF values greater than 59,999

If the Scale Factor is a value over 59,999 (maximum value), the Scale Multiplier must be used to reduce the calculated Scale Factor value until it is less than 59,999. The Scale Multiplier divides the calculated Scale Factor value by 1, 10, 100 and 1000, thus reducing the calculated value accordingly. Select the appropriate Scale Multiplier value that allows the Scale Factor to be a value under 59,999. Both the Scale Factor and Scale Multiplier can then be entered into the meter.

Example 1 (6 Digit):

DR = 150 minutes

$$\text{PPS} = \frac{\text{450 RPM x 60 PPR}}{60}$$

PPS = 450

SF = DR x PPS

SF = 150 x 450

SF = 67,500

Since the SF value is greater than 59,999, the SM will be needed to reduce the calculated value to value less than 59,999. Using the SM of 10, the 67,500 value is divide by 10, reducing the SF to a value of 6750. The meter can be programmed for a SF of 6750 and a SM of 10.

Example 2 (5 Digit):

DR = 2 hours and 23 minutes (2-23)

$$\text{PPS} = \frac{\text{138 RPM x 100 PPR}}{60}$$

PPS = 230

To calculate the Scale Factor for a 5 Digit application, first convert the DR to its base units.

DR = 2 (hours) x 60 + 23

DR = 120 + 23

DR = 143 minutes

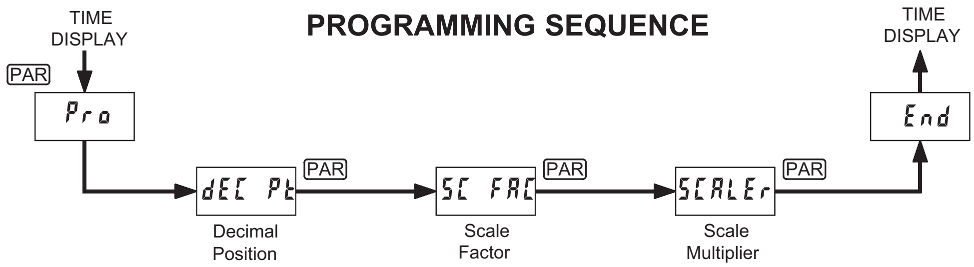
SF = DR x PPS

SF = 143 x 230

SF = 32,890

Since the SF value is less than 59,999, it can be entered directly as the SF and the SM will be 1. *Note: When programmed for the 5 Digit mode, the meter will convert the D.R. back to the hours and minutes format.*

6.0 Programming the Meter



The Process Time Indicator has three programmable parameters which are entered in the sequence shown above, using the front panel push buttons.

Before programming, please refer to the section on Scaling the Meter to determine the Decimal Position, Scale Factor and Scale Multiplier to use for the specific application.

Note: Programming mode can be locked out with the Program Disable DIP switch. With the switch in the Disabled (up) position the meter will not enter programming mode. Refer to the section on DIP switch setup.

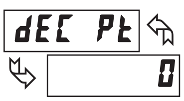
PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING PARAMETERS

In programming mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

DECIMAL POSITION (6-digit version only)

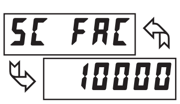


0 0.0 0.00 0.000

This parameter selects the decimal point position on the display. The selection is used when calculating the Scale Factor. This parameter only appears when the meter is configured for the conventional (6-digit) display.

Press the arrow keys (▲ or ▼) to sequence through the selection list until the desired selection is shown. Press the **PAR** key to save the displayed selection and advance to the next parameter.

SCALE FACTOR



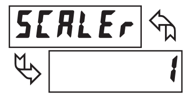
00001 to 59999

The Scale Factor is used in combination with the Scale Multiplier to obtain the desired process time readout. (See details on Scaling the Meter.)

The Scale Factor is displayed as a five-digit value with one selected digit flashing (initially digit 5). Press the ▲ (up arrow) key to increment the value of the selected (flashing) digit. Holding the ▲ key automatically scrolls the value of the selected digit.

Press the ▼ (down arrow) key to select the next digit position to the right. Use the ▲ key to increment the value of this digit to the desired number. Press the ▼ key again to select the next digit to be changed. Repeat the "select and set" sequence until all digits are displaying the desired Scale Factor value. Press the **PAR** key to save the displayed value and advance to the next parameter. Holding the ▼ key automatically scrolls through each digit position.

SCALE MULTIPLIER



1 10 100 1000

The Scale Multiplier is used in combination with the Scale Factor to obtain the desired process time readout. (See details on Scaling the Meter.)

Press the arrow keys (▲ or ▼) to sequence through the selection list until the desired selection is displayed. Press the **PAR** key to save the selection and exit programming mode.

PROGRAMMING MODE EXIT

The meter exits Programming Mode when the **PAR** key is pressed to save the Scale Multiplier selection. The meter briefly displays End upon exiting Programming Mode. All programmed selections are now transferred to the non-volatile memory and the meter returns to the Process Time display.

(If power loss occurs during programming mode, verify parameter changes and reprogram, if necessary, when power is restored.)

PROGRAMMING MODE TIME OUT

The Programming Mode has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the Process Time display. When automatic timeout occurs, any changes that were made to the parameter currently being programmed, will not be saved.

FACTORY SETTINGS

The factory settings for the programming parameters are shown above in the alternating display illustrations. The factory settings can be easily restored by removing power from the meter, and then pressing and holding the **PAR** key while power is reapplied. The meter displays rESEt until the **PAR** key is released. The normal power-up sequence then resumes, with the factory settings loaded and saved in non-volatile memory.

Note: The Program Disable DIP switch must be in the Enabled (down) position to allow loading factory settings. See section on DIP switch setup.

C

This page intentionally left blank.

TIMERS

D

The Trusted Source for
Innovative Control Solutions

QUICK Specs

	Timers			
	TIMER	TIMER W/CONTROL		
	CUB7T	CUB5T	C48T	PAXTM
				
Description	1/32 DIN Miniature Timer	Timer with Output Option Card Capability	1/16 DIN Timer with Control	1/8 DIN Timer with Output Option Card Capability
Dimensions (Height) x (Width)	28 mm (H) x 51 mm (W)	39 mm (H) x 75mm (W)	49 mm (H) x 49 mm (W)	50 mm (H) x 97mm (W)
Display	8 Digit, .35" (9mm) Reflective, Green and Red Backlight LCD	8 Digit, .46" (12mm) Reflective, Green and Red Backlight LCD	2 x 6 Digit, Main Display .3" (7mm) Sec. Display .2" (5mm) Reflective and Backlight LCD	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity
Input	Switch Contact, NPN O. C. or Voltage 10 V to 300 VAC or DC	Switch Contact, NPN O. C. or Voltage 9 V to 28 VDC	Switch Contact, NPN O. C., PNP O. C., or VCME through VCMH	Switch Contact, NPN O. C., PNP O. C., or VCME through VCMH
Time Ranges	.001, .01, .1 and 1 Second .1 and 1 Minute .01, .1 and 1 Hour Hour: Minutes: Seconds	.001, .01, .1 and 1 Second .01, .1 and 1 Minute .01, .1 and 1 Hour .01, .1 and 1 Min/Sec .01, .1 and 1Hr/Min Hours/Minutes/Seconds Days/Hours/Minutes	.001, .01, .1 and 1 Second .001, .01, .1 and 1 Minute Min/Sec Min/Sec/Tenth Hr/Min/Sec Hr/Min/Tenth Hr/Min/Hun	.001, .01, .1 and 1 Second .001, .01, .1 and 1 Minute .001, .01, .1 and 1 Hour Minutes/.001, .01, .1, 1 Sec Hours/.001, .01, .1, 1 Min Hours/Minutes/Seconds
Reset	Front Panel, Remote	Front Panel, Remote	Front Panel, Remote, Automatic	Front Panel, Remote, Automatic
Setpoint Capability	No	Single Form C Relay Dual Sinking	Single or Dual Form A Current Sinking	Dual Form C Quad Form A Quad Sinking Quad Sourcing
Communications	No	RS232 RS485	RS485	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8
Other Features/ Options	No	Programmable User Inputs	Programmable User Inputs and Front Buttons	Programmable User Inputs and Front Buttons, Cycle Counting Capability
Power Source	3 Volt Lithium Battery, Backlighting 9 - 28 VDC @ 35 mA	9 to 28 VDC	85 to 250 VAC 11 to 14 VDC 24 VAC	85 to 250 VAC 11 to 36 VDC 24 VAC
Page Number	*	Page 181	Page 194	Page 199

*See website for product information.

QUICK Specs

Timers

	TIMER W/CONTROL	
	PAXCK	LIBT
		
Description	1/8 DIN Real Time Clock with Output Option Card Capability	Timer with Control
Dimensions (Height)x(Width)	50 mm (H) x 97mm (W)	72 mm (H) x 72 mm (W)
Display	6 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	4 Digit, .4" (10mm) LED 4 Digit, .5" (13mm) LCD
Input	Switch Contact, NPN O. C., PNP O. C., or VCME through VCMH	Switch Contact, NPN O. C., PNP O. C., or VCME through VCMH
Time Ranges	.001, .01, .1 and 1 Second .001, .01, .1 and 1 Minute .001, .01, .1 and 1 Hour Minutes/.001, .01, .1, 1 Sec Hours/.001, .01, .1, 1 Min Hours/Minutes/Seconds Days/Hours/Minutes	.01, .1 and 1 Second .01, .1 and 1 Minute .01, .1 and 1 Hour Minutes/Seconds Hours/Minutes
Reset	Front Panel, Remote, Automatic	Front Panel, Remote, Automatic
Setpoint Capability	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Single or Dual Form C, Solid State
Communications	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	No
Other Features/ Options	Programmable User Inputs and Front Buttons, Cycle Counting Capability	No
Power Source	85 to 250 VAC 11 to 36 VDC 24 VAC	115/230 VAC 11 to 14 VDC
Page Number	Page 224	*

*See website for product information.

D

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **CUBT**	■ Display: .2" (5 mm) Reflective LCD ■ Power Source: 115/230 VAC, 10 to 28 VDC, 10 to 28 VAC	 **C48T**	■ Display: 2 x 6, Main Display .3" (7 mm) Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC
 **LNXT**	■ Display: .3" (8 mm) Reflective LCD ■ Power Source: 115/230 VAC, 11 to 14 VDC, 21.5 to 30 VAC	 **C48T**	■ Display: 2 x 6, Main Display .3" (7 mm) Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC **Panel Cut-Out Dimension Differences**
 **LIBT**	■ Display: 4 Digit, .4" (10 mm) LED OR .5" (13 mm) LCD ■ Power Source: 115/230 VAC, 11 to 14 VDC	 **C48T**	■ Display: 2 x 6, Main Display .3" (7 mm) Secondary Display .2" (5 mm) Reflective LCD ■ Power Source: 85 to 250 VAC, 11 to 36 VDC **Panel Cut-Out Dimension Differences**

Note: Refer to the current product literature, as some differences may exist.

D

MODEL CUB5T - MINIATURE ELECTRONIC PRESET TIMER AND CYCLE COUNTER

C UL US LISTED
IND. CONT. EQ.
51EB

- LCD, REFLECTIVE OR RED/GREEN LED BACKLIGHTING
- 0.46" (11.7 mm) HIGH DIGITS
- 7-DIGIT BI-DIRECTIONAL TIMING CAPABILITY
- 6-DIGIT CYCLE COUNTING CAPABILITY
- OPTIONAL RELAY OUTPUT MODULE
- OPTIONAL SERIAL COMMUNICATIONS MODULE (RS232 or RS485)
- SELECTABLE TIMER RANGES AND OPERATING MODES
- ELAPSED TIMER AND PRESET TIMER FUNCTIONALITY
- DISPLAY COLOR CHANGE CAPABILITY AT PRESET OUTPUT
- OPERATES FROM 9 TO 28 VDC POWER SOURCE
- NEMA 4X/IP65 SEALED FRONT BEZEL

D

GENERAL DESCRIPTION

The CUB5T provides the ultimate in timer flexibility, from its complete user programming to the optional relay output and serial communications capability. The meter functions as an Elapsed Timer or Preset Timer. It also has a built-in Cycle Counter. The display can be toggled either manually or automatically between the Timer and Cycle Counter values. With eight different input operating modes and 18 selectable timer ranges, the meter can be programmed for a wide variety of timing applications.

The CUB5T has an LCD display with 0.46" (11.7 mm) high digits. The LCD is available in two versions, reflective (CUB5TR00) and backlight (CUB5TB00). The backlight version is user selectable for red or green backlighting with variable display intensity.

The Timer has two signal inputs and eight input operating modes. These modes provide level active or edge triggered start/stop operation. A Display Hold mode will display the elapsed time for one cycle, while the next cycle continues timing internally. The Timer Reset modes will automatically reset the timer value when a time start edge is applied to the input. This allows sequential timing cycles without having to manually reset the Timer.

In addition to the Timer inputs, a programmable User Input is available to perform a variety of meter functions. All inputs are current sinking (active low) and accept a variety of logic and open-collector output signal sources. Relay and switch contacts can also be used as signal sources, when the software input debounce filter is enabled.

The capability of the CUB5T can be easily expanded with the addition of a field installable option module. When the CUB5RLY0 relay output module is added, the meter becomes a Preset Timer. The Setpoint Output can be assigned to the Timer or Cycle Counter values, and configured to suit a variety of control and alarm requirements. Serial communications capability for RS232 or RS485 is added with a serial option module (CUB5COM).

The CUB5T can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5T. The MLPS is powered from an 85 to 250 VAC source and provides up to 400 mA to drive the meter and sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

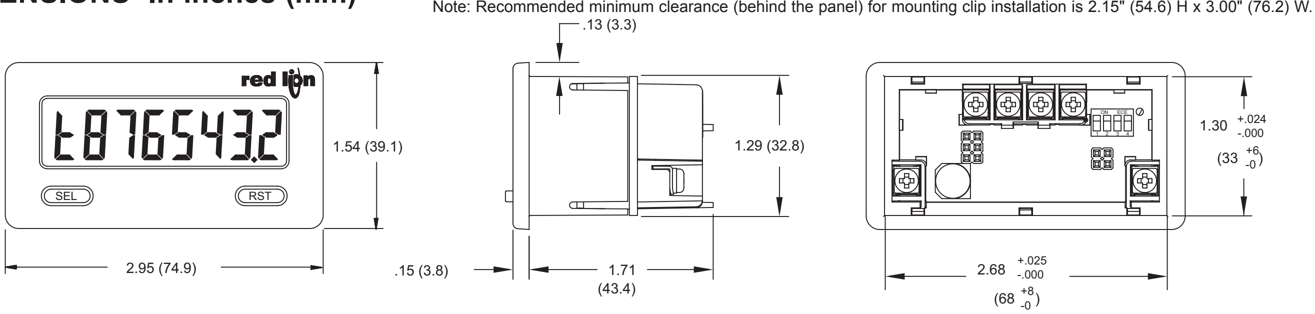
Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5TR	Preset Timer and Cycle Counter with Reflective Display	CUB5TR00
	CUB5TB	Preset Timer and Cycle Counter with Backlight Display	CUB5TB00
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 8 digit LCD 0.46" (11.7 mm) high digits
   CUB5TR00: Reflective LCD with full viewing angle
   CUB5TB00: Selectable transmissive red or green backlight LED with viewing angle optimized. Display color change capability at preset when using a relay module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or a Class 2 or SELV rated power supply.

MODEL NUMBER	DISPLAY COLOR	INPUT CURRENT WITHOUT CUB5RLY0	INPUT CURRENT WITH CUB5RLY0
CUB5TR00	---	10 mA	30 mA
CUB5TB00	Red (max intensity)	85 mA	115 mA
CUB5TB00	Green (max intensity)	95 mA	125 mA

3. **TIMER DISPLAY**: 7-digits
   Display Designator: “t” to the left side of the display
   Display Range: 0 to 9999999
   Overflow/Underflow Indication: Display flashes “t OUEr”
   Minimum Digit Resolution: 0.001 Sec.
   Maximum Single Digit Resolution: 1 Hr.
   Timing Accuracy: ±0.01%
4. **CYCLE COUNTER DISPLAY**: 6-digits, may be disabled if not used
   Display Designator: “C” to the left side of the display
   Display Range: 0 to 999999
   Overflow/Underflow Indication: Display flashes “C OUEr”
   Maximum Count Rate:
   All Count Sources except Input B: 10 Hz
   Input B Count Source:
   With Timer Input Filter ON: 10 Hz
   With Timer Input Filter OFF: 500 Hz
5. **TIMER SIGNAL INPUTS (INP A and INP B)**
   Logic Inputs, Current Sinking (active low)
   Input A:
   Internal 7.8KΩ pull-up resistor to +9 to 28 VDC
   Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
   Input B:
   Internal 10KΩ pull-up resistor to +9 to 28 VDC
   Trigger levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Inputs A and B:
   Timer Input Pulse Width: 1 msec min.
   Timer Start/Stop Response Time: 1 msec max.
   Filter: Software filtering provided for relay or switch contact debounce. Filter enabled or disabled through programming. If enabled, results in 50 msec start/stop response time for successive pulses applied to the same input terminal.
6. **USER INPUT (USR)**: Programmable function input
   Logic Input, Current Sinking (active low)
   Internal 10KΩ pull-up resistor to +9 to 28 VDC
   Trigger levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and timer/counter values when power is removed.
8. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
9. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range for CUB5TR00: -35 to 75°C
   Operating Temperature Range for CUB5TB00 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

   Storage Temperature: -35 to 85°C
   Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 500 Hz, in X, Y, Z direction for 1.5 hours, 5 g.
   Shock According to IEC 68-2-27: Operational 40 g, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
10. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File #E179259, UL61010A-1, CSA 22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Outdoor Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Report #E179259-V01-S02
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:

Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m

Emissions:

Emissions	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
Refer to EMC Installation Guidelines for additional information.

11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
12. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5T meters can be fitted with optional relay card and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations
Response Time:
Turn On Time: 4 msec max.
Turn Off Time: 4 msec max.
Time Accuracy: ± 0.01%

WARNING: Disconnect all power to the meter before installing Plug-in card.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38400
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable. 2 msec min. or 50 msec min.

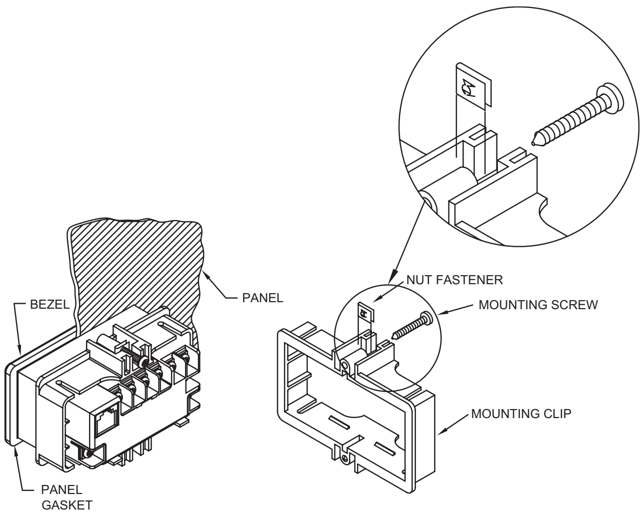
RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38400
Data Format: 7/8 bits; odd, even, or no parity

1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



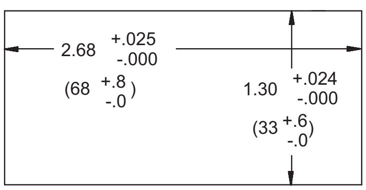
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



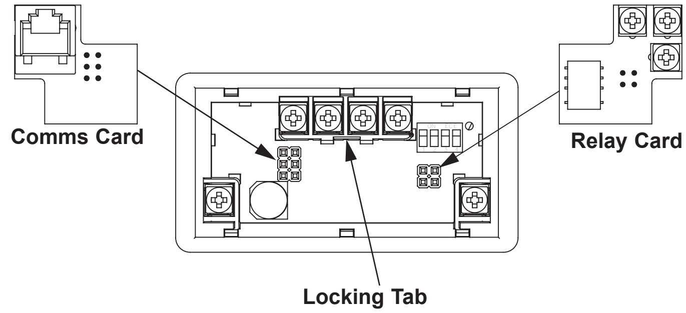
2.0 DIP Switches

The DIP switches on the main circuit board are not used with the CUB5T and must be left in the factory set position (all down). Setting any switch to the up position may cause improper operation of the meter.

3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter after the rear cover is removed

WARNING: Disconnect all power to the meter before installing Plug-in Card.



CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

4.0 Wiring the Meter

D

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

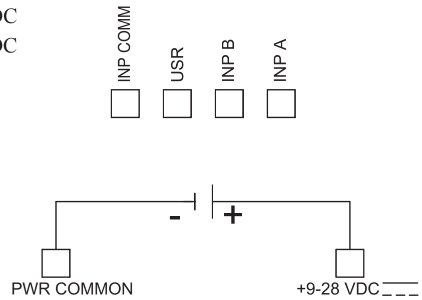
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

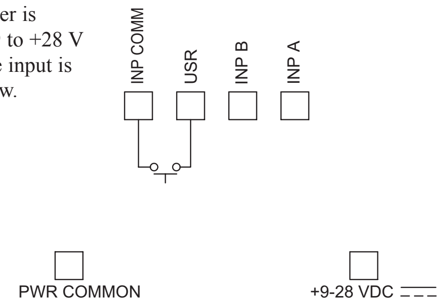


4.2 USER INPUT WIRING

Sinking Logic

INP COMM
USR
} Connect external switching device between the User Input terminal and Input Common.

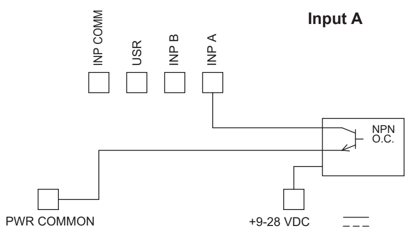
The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low.



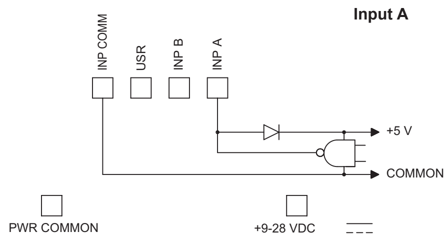
4.3 INPUT WIRING

CAUTION: Power input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the power input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth ground; and the common of the plug-in cards with respect to input common.

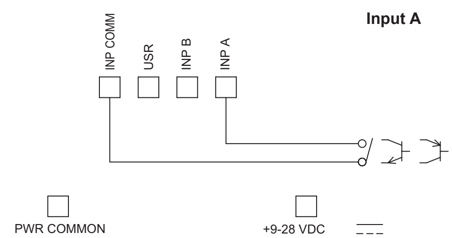
Current Sinking Output



Interfacing With TTL



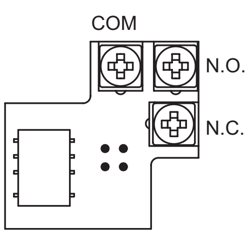
Switch or Isolated Transistor; Current Sink



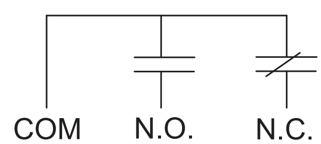
D

4.4 SETPOINT (OUTPUT) WIRING

SETPOINT RELAY PLUG-IN CARD

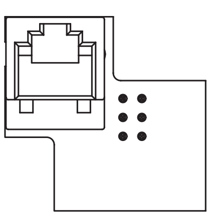


ELECTRICAL CONNECTIONS

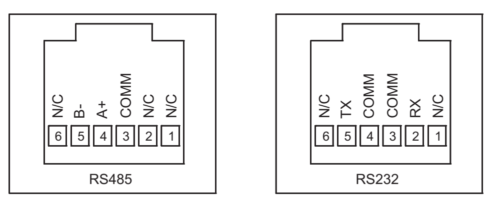


4.5 SERIAL COMMUNICATION WIRING

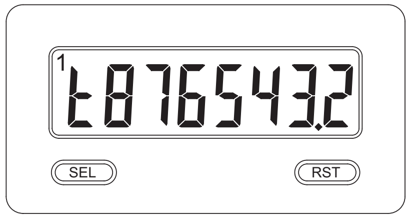
SERIAL COMMUNICATIONS PLUG-IN CARD



RJ11 CONNECTOR PIN OUTS



5.0 Reviewing the Front Buttons and Display



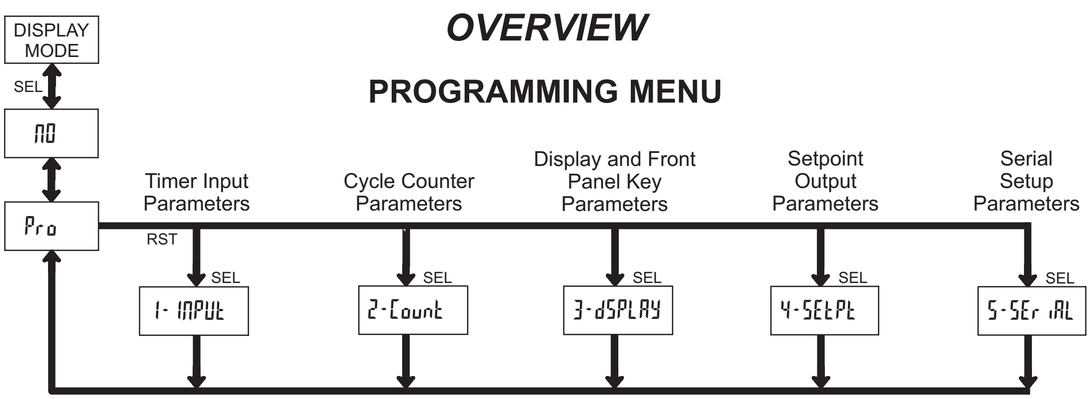
KEY	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Select display (timer or cycle counter)	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Reset value(s) per Front Panel Reset setting		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

"t" - To the left of the display is the timer value.
"C" - To the left of the display is the cycle counter value.
"1" - To the upper left of the display indicates the setpoint status.

If display scroll is enabled, the display will toggle automatically every four seconds between the timer and cycle counter values.

6.0 Programming the Meter



D

PROGRAMMING MODE ENTRY (SEL KEY)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** key. If it is not accessible, then it is locked by either a security code, or a hardware lock (See Module 3).

MODULE ENTRY (SEL & RST KEYS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** key is used to select the desired module. The displayed module is entered by pressing the **SEL** key.

MODULE MENU (SEL KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** key is used to move through the selections/values for that parameter. Pressing the **SEL** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** key to access the value. The right hand most digit will begin to flash. Pressing the **RST** key again increments the digit by one or the user can hold the **RST** key and the digit will automatically scroll. The **SEL** key will advance to the next digit. Pressing and holding the **SEL** key will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL KEY)

The Programming Mode is exited by pressing the **SEL** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

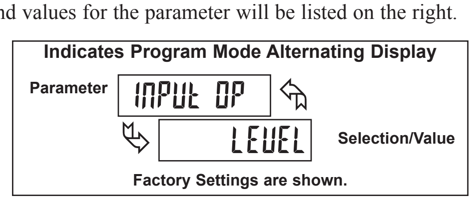
FACTORY SETTINGS

Factory Settings may be completely restored in Module 3. This is useful when encountering programming problems.

Pressing the **RST** key on power-up will load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - TIMER INPUT PARAMETERS (1- INPUt)

PARAMETER MENU

1- INPUt → SEL → Pro

RANGE	INPUt OP	FILtEr	t-dir	t-Strt	t-StOP	t-FLASH	Run P-UP	RSt P-UP	USEr INP	USEr ASN
Timer Range	Timer Input Operation	Timer Input Filter	Timing Direction	Timer Start Value	Timer Stop Value	Flash Timer Annunciator	Timer Run State At Power-up	Timer Reset At Power-up	User Input Function	User Input Assignment

TIMER RANGE

RANGE
SSSSSSS

18 TIMER RANGE SELECTIONS

(S = SEC; M = MIN; H = HR; d = DAY)

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
SECONDS		
SSSSSSS	9999999	1 SEC
SSSSSS.S	999999.9	0.1 SEC
SSSSS.SS	99999.99	0.01 SEC
SSSS.SSS	9999.999	0.001 SEC
MINUTES		
MMMMMMM	9999999	1 MIN
MMMMMM.M	999999.9	0.1 MIN
MMMMM.MM	99999.99	0.01 MIN
HOURS		
HHHHHHH	9999999	1 HR
HHHHHH.H	999999.9	0.1 HR
HHHHH.HH	99999.99	0.01 HR

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
MINUTES/SECONDS		
MMMMM.SS	99999.59	1 SEC
MMMM.SS.S	9999.59.9	0.1 SEC
MMM.SS.SS	999.59.99	0.01 SEC
HOURS/MINUTES		
HHHHH.MM	99999.59	1 MIN
HHHH.MM.M	9999.59.9	0.1 MIN
HHH.MM.MM	999.59.99	0.01 MIN
HOURS/MINUTES/SECONDS		
HHH.MM.SS	999.59.59	1 SEC
DAYS/HOURS/MINUTES		
dddHH.MM	999.23.59	1 MIN

TIMER INPUT OPERATION

INPUt OP
LEVEL

LEVEL EdGE-1 EdGE-2 HOLd-2
LEU rSt Ed-1 rSt Ed-2 rSt HOLd rSt

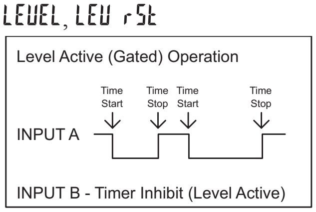
This parameter determines how the Timer Input Signals affect the Run/Stop status of the Timer. Timing diagrams are shown below for level active and edge triggered (1-input or 2-input) operation. For single input modes (Input A only), Input B provides a level active Timer Inhibit function. In the Display Hold mode, the timer display value remains held and only updates when a Timer Start (Input A) or Timer Stop (Input B) edge occurs.

The timer reset (rSt) operating modes are identical to the other modes in the diagrams, except the timer display value is reset at the Time Start edges.

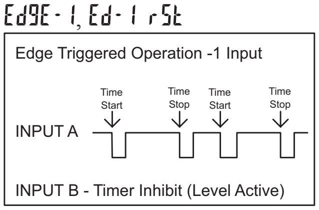
The Timer can also be stopped at a Timer Stop Value or at Setpoint output activation or deactivation. This type of Stop condition is cleared when a Timer Reset occurs, or another start edge is applied on the timer input.

For Reset Modes (rSt), the timer is reset at Time Start edge.

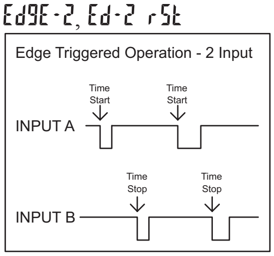
LEVEL, LEU rSt



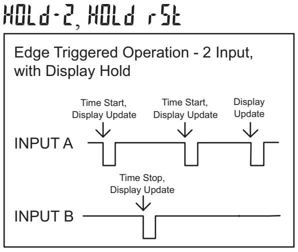
EdGE-1, Ed-1 rSt



EdGE-2, Ed-2 rSt



HOLd-2, HOLd rSt



TIMER INPUT FILTER

FILtEr
On

On OFF

Provides a 50 msec software debounce for the Timer Inputs (A and B). Select On when using relays or switch contacts as a signal source.

TIMING DIRECTION

t-dir
UP

UP dn

Bi-directional timing capability. Select the timing direction desired for the application.

TIMER START VALUE

t-Strt
0000000

0000000 to 9999999

The Timer returns to this value whenever a Timer Reset occurs. The value is entered in the same display format as the Timer Range selected. Non-zero values are normally used for "timing down" applications, but they can also provide an offset value when timing up.

TIMER STOP VALUE

t-StOP
NO

NO YES

The Timer stops when this value is reached regardless of the signal levels on the timer inputs. Selecting YES displays a sub-menu where the Stop Value is entered in the same display format as the Timer Range selected. This stop condition is cleared when a Timer Reset occurs or another start edge is applied on the timer input. Select NO if a Stop Value is not desired.

StOP UAL
0000000

0000000 to 9999999

FLASH TIMER ANNUNCIATOR

t-FLASH
YES

NO YES

Select YES to have the timer annunciator (t) flash when the timer is running.

TIMER RUN STATE AT POWER-UP

Run P-UP
StOP

StOP SAUE

Determines the Run/Stop state of the Timer at Power-up. This parameter does not apply to LEVEL Input Operation.

StOP - Timer Stopped at power-up, regardless of prior Run/Stop state
SAUE - Timer assumes the Run/Stop state it was in prior to power-down

D

TIMER RESET AT POWER-UP

RSt P-UP
YES

NO YES

The Timer can be programmed to Reset at each meter power-up.

USER INPUT FUNCTION

USEr INP
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
Pro Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
d-SELECt	Display Select (Edge triggered)	Toggle display with each activation.
rESEt	Maintained Reset	Level active reset of the selected value(s).
d-HOLd	Display Hold	Freeze display for the selected value(s) while allowing time or counts to accumulate internally.
HOLd-rSt	Hold and Reset	Edge triggered reset of the selected value(s) after storing the time or count.

USER INPUT FUNCTION (Cont'd)

DISPLAY	MODE	DESCRIPTION
Inhibit	Inhibit	Inhibit timing or counting for the selected value(s).
d-LEVEL	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation. (backlight version only)
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
Prnt-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the selected value(s).
rSt OUt	Reset Output	Edge triggered deactivation of the Setpoint Output.

USER INPUT ASSIGNMENT

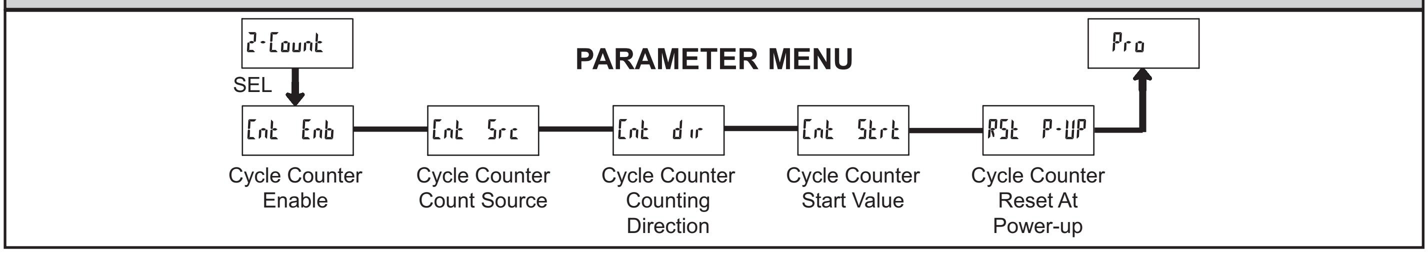
USEr ASN
t-VALUE

t-VALUE
C-VALUE
both t-C

The User Input Assignment only applies if the cycle counter is enabled and a selection of reset, display hold, hold and reset, inhibit, or print and reset is selected in the User Input Function menu.

D

6.2 MODULE 2 - CYCLE COUNTER PARAMETERS (2-Count)



CYCLE COUNTER ENABLE

Cnt Enb
YES

NO YES

When set to NO, the remaining Cycle Counter parameters are not accessible.

CYCLE COUNTER COUNT SOURCE

Cnt Src
t-rESEt

INPUt b OUt-ON
USr INP OUt-OFF
t-rESEt

This parameter selects the source from which the Cycle Counter derives counts. The Timer Reset (t-rESEt) selection generates a count when either a manual or automatic timer reset occurs (See Module 4 for programming Automatic Reset). The Input B (INPUt b) selection generates a count each time Input B is activated. This selection overrides the timer inhibit function of Input B, when the timer is programmed for Level or Edge-1 operating mode (See Module 1 for Timer Input Operating Modes).

The User Input (USr INP) selection generates a count each time the User Input is activated. When selected as the count source, the User Input can still be set to perform a User Function described in Module 1. In this case, the Cycle Counter will count the number of times the selected User Function occurred.

The Output ON/OFF selections generate a count when the Setpoint output either activates or deactivates. These selections will only generate counts when an optional Setpoint module is installed.

CYCLE COUNTER COUNTING DIRECTION

Cnt dir
UP

UP dn

Bi-directional counting capability. Select the counting direction desired for the application.

CYCLE COUNTER START VALUE

Cnt Strt
000000

000000 to 999999

The Cycle Counter returns to this value whenever a Counter Reset occurs. Non-zero values are normally used for "down counting" applications, but can also provide an offset value when counting up.

CYCLE COUNTER RESET AT POWER-UP

RSt P-UP
NO

NO YES

The Cycle Counter can be programmed to Reset at each meter power-up.

6.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSPLAY)

PARAMETER MENU

3-dSPLAY

SEL ↓

Backlight Unit Only

SEL Enb	rSt Enb	d-ScroLL	d-COLOr	d-LEVEL	Pro CodE	FACt SEt	→ Pro
Front Panel Display Select	Front Panel Reset Enable	Display Scroll Enable	Display Color	Display Intensity Level	Programming Security Code	Load Factory Default Settings	

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL Enb

YES

YES NO

The YES selection allows the **SEL** button to toggle between the timer and cycle counter displays.

FRONT PANEL RESET ENABLE (RST)

rSt Enb

YES

YES NO both t-C
NO t-VALUE dSPLAY
C-VALUE

The YES selection allows the **RST** button to reset the selected value(s). The shaded selections only appear if the cycle counter is enabled.

DISPLAY SCROLL ENABLE

d-ScroLL

NO

YES NO

The YES selection allows the display to automatically scroll between the timer and cycle counter values. The scroll rate is about every 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

d-COLOr

rEd

rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEVEL

5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

Pro CodE

000

0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (Pro Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values and Timer Stop value to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the Pro CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the Pro CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
not Pro Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at Pro CodE prompt *
		100-999	Pro CodE prompt	With correct code entry at Pro CodE prompt *
Pro Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	Pro CodE prompt	With correct code entry at Pro CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

LOAD FACTORY DEFAULT SETTINGS

FACt SEt

NO

NO YES

The YES selection will return the meter to the factory default settings. The meter will display rESEt and then return to Pro, at which time all settings have been changed.

Pressing the **RST** key on power-up will load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

D

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SEtPt)

4-SEtPt SEL

PARAMETER MENU

SPt ASn	SPt ACt	SPt On	SPt OFF	SPt tOUt	StOP-t	AUtO rSt	SPt rSt	Ch-COLOr (Backlight Unit Only)	SPt P-UP	Pro
Setpoint Assignment	Setpoint Output Action	Setpoint On	Setpoint Off	Setpoint Output Time-out	Stop Timer	Timer/Counter Auto Reset	Setpoint Output Reset with Display Reset	Change Display Color with Setpoint Output State	Setpoint Output Power-up State	

The Setpoint Output Parameters are only active when the optional relay module is installed in the meter. Some parameters will not appear depending on the Setpoint Assignment and Setpoint Output Action selected.

SETPOINT ASSIGNMENT

SPt ASn — t-VALUE

t-VALUE C-VALUE

Select the display for Setpoint assignment.

SETPOINT OUTPUT ACTION

SPt ACt — LAtCH

LAtCH
t-OUt
On-OFF

This parameter selects the action of the Setpoint output as shown below.

SPT ACTION	DESCRIPTION	OUTPUT ACTIVATES	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	When Time or Count = Setpoint On value	At Manual Reset (if SPt rSt = YES)
t-OUt	Timed Output Mode	When Time or Count = Setpoint On value	After Setpoint Output Time-Out
On-OFF	On-Off Output Mode	When Time or Count = Setpoint On value	When Time or Count = Setpoint Off value

SETPOINT ON

SPt On — VALUE

VALUE
t-Strt
t-StOP

This parameter determines when the Setpoint output will activate. The output can activate at a programmed Setpoint Value or can be set to activate when the Timer starts (t-Strt) or stops (t-StOP).

Selecting VALUE displays a sub-menu where the Setpoint Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

SPt VAL — 0000100

0000000 to 9999999

SETPOINT OFF

SPt OFF — VALUE

VALUE
t-Strt
t-StOP

The Setpoint Off parameter only appears if the Setpoint Action is set to On-Off Output mode (On-OFF). In this mode, the Setpoint OFF parameter determines when the Setpoint Output will deactivate. The output can be programmed to deactivate at a Setpoint Off Value or can be set to deactivate when the Timer starts (t-Strt) or stops (t-StOP).

Selecting VALUE displays a sub-menu where the Setpoint Off Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

SPOF VAL — 0000200

0000000 to 9999999

SETPOINT OUTPUT TIME-OUT

SPt tOUt — 00.01.00

00.00.01 to 99.59.99

This parameter is only active if the Setpoint Action is set to Timed Output mode (t-OUt). Enter the time duration the Setpoint Output will remain ON once it is activated. This value is always entered in minutes, seconds, and hundredths of seconds format. The maximum value is 99 minutes 59.99 seconds.

STOP TIMER

StOP-t — nO

nO
Out-On
Out-OFF

Stops the Timer when the Setpoint output activates (Out-On) or deactivates (Out-OFF). Select nO if the output should not affect the Timer Run/Stop status.

The Timer Stop condition is cleared when a Timer Reset occurs, or a Time Start edge is applied on the Timer input.

TIMER/COUNTER AUTO RESET

AUtO rSt — nO

nO
Out-On
Out-OFF

Automatically resets the Setpoint Assigned display value when the Setpoint Output activates (Out-On) or deactivates (Out-OFF). Select nO if the output should not cause a display reset.

SETPOINT OUTPUT RESET WITH DISPLAY RESET

SPt rSt — YES

YES nO

Select YES to have the Setpoint Output deactivate (reset) when the Setpoint Assigned display resets. Reset can occur by the **RST** button or the User Input, if programmed for that function. Select nO if the Setpoint output should not reset when the display resets.

CHANGE DISPLAY COLOR w/SETPOINT OUTPUT STATE

Ch-COLOr — nO

nO YES

This parameter enables the backlight CUB5T to switch the display color when the Setpoint output activates. When the output deactivates, the display color will revert to the normal operating mode color. This parameter is only active for the backlight version.

SETPOINT OUTPUT POWER-UP STATE

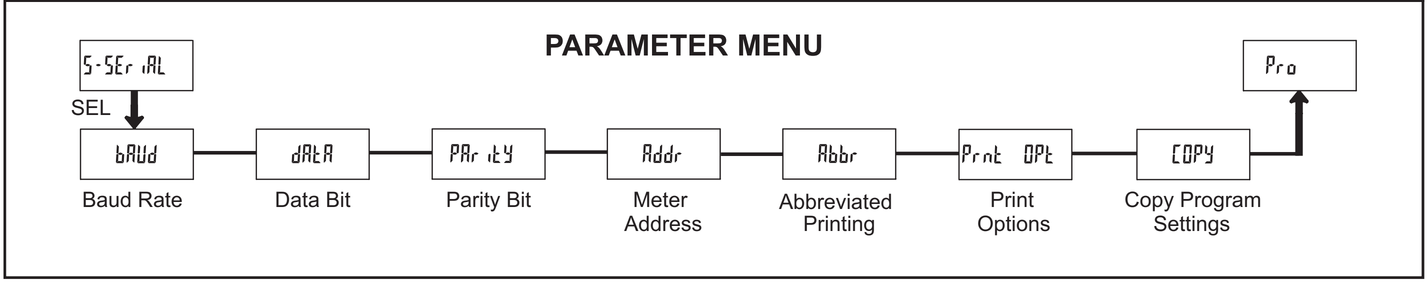
SPt P-UP — OFF

OFF
On
SAVE

SAVE will restore the output to the same state it was at before the meter was powered down. On will activate the output at power up. OFF will deactivate the output at power up. This parameter is not active when the Setpoint Action is selected for timed output mode.

D

6.5 MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SEr iAL)



Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the CUB5T with those of the host computer or other serial device. The Serial Setup Parameters are only accessible when an optional RS232 or RS485 serial communications module is installed in the meter.

This section replaces the bulletin shipped with the RS232 and RS485 serial communications plug-in cards. Discard the separate bulletin when using those serial plug-in cards with the CUB5T.

BAUD RATE

bAUd — 9600

300 1200 4800 19200
600 2400 9600 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA — 7-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr itY — Odd

nO Odd EVEn

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to nO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr — 00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr — nO

nO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select nO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS

Prnt OPt — nO

nO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as nO will not be sent.

The "Print All" (Prnt ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, the Cycle Counter and Cycle Counter Start values will only be sent when the Cycle Counter is enabled. If disabled, these parameters are inactive and will not be transmitted. Likewise, the Setpoint parameters will not be sent unless an optional setpoint card is installed in the meter.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
t-VALUE	Timer	YES	TMR
C-VALUE	Cycle Counter	nO	CNT
t-Strt	Timer Start	nO	TST
t-StOP	Timer Stop	nO	TSP
Cnt Strt	Counter Start	nO	CST
SPt On	Setpoint ON	nO	SPT
SPt OFF	Setpoint OFF	nO	SOF
SPt tOUt	Setpoint Time-out	nO	STO

D

Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a value or the output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences in meter response time when using the * and $ terminating characters.

Register Identification Chart

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Timer	TMR	T, V, R	7 digit, per Timer Range
B	Cycle Counter	CNT	T, V, R	6 digit
C	Timer Start	TST	T, V	7 digit, per Timer Range
D	Timer Stop	TSP	T, V	7 digit, per Timer Range
E	Counter Start	CST	T, V	6 digit
F	Setpoint ON (Reset Output)	SPT	T, V, R	per Setpoint Assignment, same as Timer or Counter
G	Setpoint OFF	SOF	T, V	per Setpoint Assignment, same as Timer or Counter
H	Setpoint Time-out	STO	T, V	6 digit, mm.ss.ss format

Command String Examples:

1. Node address = 17, Write 350 to the Setpoint On value
   String: N17VF350$
2. Node address = 5, Read Timer value, response time of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint output
   String: RF*
4. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to Transmit Details listed in the Register Identification Chart. Leading zeros are ignored. The meter ignores any decimal point and conforms the number to the appropriate display format. (For example: The Timer range is set for tenths of a second and 25 is written to the Timer Start register. The value of the register is now 2.5 seconds. In this case, write a value of 250 to equal 25.0 seconds).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 9 bytes for number and three bytes for decimal points
19	<CR> (carriage return)
20	<LF> (line feed)
21	<SP>* (Space)
22	<CR>* (carriage return)
23	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 18) is 12 characters long. When a display overflow exists for a requested timer or cycle counter value, an * (used as an overflow character) replaces a space in byte 7. Byte 8 is always a space.

The remaining ten positions of this field consist of seven positions for the requested value with decimal points positioned for the selected timer range. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 9 bytes for number and three bytes for decimal points
13	<CR> (carriage return)
14	<LF> (line feed)
15	<SP>* (Space)
16	<CR>* (carriage return)
17	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register mnemonic, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Cycle Counter = 875
   17 CNT 875 <CR><LF>
2. Node address = 0, full field response, Setpoint On value = 250.5
   SPT 250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint On value= 250, last line of block print
   250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

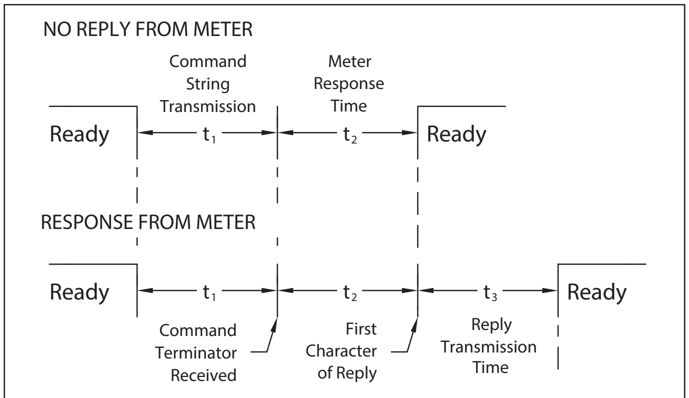
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

$$t_3 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



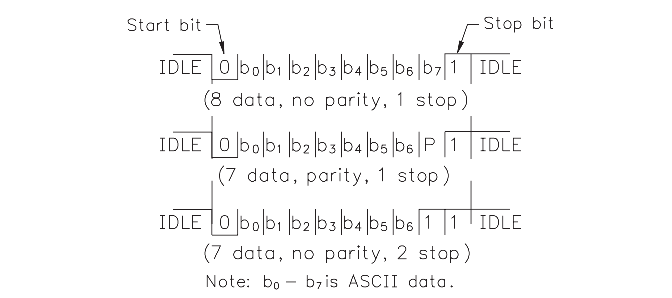
Timing Diagram Figure

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The CUB5T meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

C48T SERIES - 1/16 DIN TIMERS

MODEL C48TS - SINGLE PRESET
MODEL C48TD - DUAL PRESET

- *LCD, 7 SEGMENT, 2 LINE, 6 DIGIT DISPLAY, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE MODELS WITH RED TOP LINE AND GREEN BOTTOM LINE BACKLIGHTING*
- *SOLID STATE AND RELAY OUTPUT MODELS*
- *FIELD REPLACEABLE RELAY OUTPUT BOARDS*
- *STATUS INDICATORS FOR OUTPUTS*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *PROGRAMMABLE USER INPUTS AND FRONT PANEL FUNCTION KEY*
- *PARAMETER SECURITY VIA PROGRAMMABLE OPERATOR ACCESS PRIVILEGES AND PROTECTED VALUE MENU*
- *HORIZONTAL OR VERTICAL STACKING OF MULTIPLE UNITS*
- *85 to 250 VAC or 18 to 36 VDC/24 VAC POWERED UNITS*
- *RS485 SERIAL COMMUNICATIONS OPTION*
- *CHOICE OF NUMERIC DATA ENTRY MODES*

UL Recognized Component, File # E137808

DESCRIPTION

The Model C48 Timer is available in Single or Dual Preset models. The C48T features a 7 segment, 2 line by 6 digit reflective or backlit LCD display. For the backlit versions, the main display line is red and shows the timer value. The smaller secondary display line is green, and can be used to view the preset values or output time values.

The C48 timer can be configured for a variety of different operating modes to meet most timing application requirements. Twelve timing ranges are available from thousandths of a second to hours and minutes. Decimal Points are used to separate the time units (hours, minutes, seconds). Timing can be cumulative or can reset and start upon each power cycle. “On Delay” or “Off Delay”, “Single Shot”, “Repetitive auto cycling” modes are all supported.

The Timer can also be configured to Continue or Stop timing upon reaching Preset. The display can be programmed to stop at the preset value (Reset to Zero mode) or zero (Reset to Preset mode), or automatically reset to zero or preset and hold. Once stopped, the timer can be restarted by manually resetting it, or it can be programmed to restart when power is reapplied.

The C48 Timer has a Run/Stop Input, 3 programmable User Inputs, and a programmable front panel function key. The Run/Stop and User Inputs can be configured as sinking (active low) or sourcing (active high) inputs via a single plug jumper. The user inputs and the front panel function key can be configured to provide a variety of functions.

Four front panel push-buttons are used for programming the operating modes and data values, changing the viewed display, and performing user programmable functions, e.g. reset, etc. The C48T can be configured for one of two numeric data entry methods, digit entry or automatic scrolling. The digit entry method allows for the selection and incrementing of digits individually. The automatic scrolling method allows for the progressive change of one through all digit positions by pressing and holding the “up” or “down” button.

The Dual Preset models are available with solid-state or Relay outputs. The Single Preset model has a solid-state and relay output in parallel. All solid-state outputs are available in a choice of NPN current sinking or PNP current sourcing, open-collector transistor outputs. All relay output boards are field replaceable.

The optional RS-485 serial communication interface provides two-way communication between a C48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each C48 on the line can be programmed from 0 to 99. Data from the C48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFC48, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

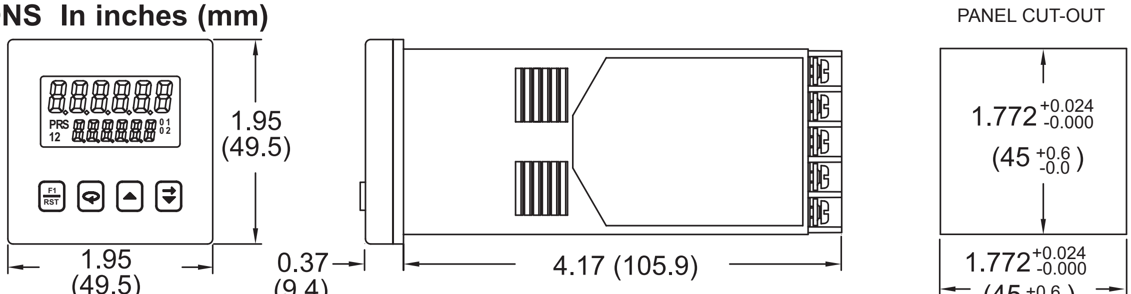
The unit is constructed of a lightweight, high impact plastic case with a textured front panel and a clear display window. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the C48 Timers extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **DISPLAY:** 2 Line by 6 digit LCD display; Positive image reflective or negative image transmissive with red (top line) and green (bottom line) backlighting.
   Main Display: 0.3" (7.62 mm) high digits
   Secondary Display: 0.2" (5.08 mm) high digits
   Annunciators:
      Value: PRS, 1, and 2
      Output: 01 and 02
2. **POWER REQUIREMENTS:**
   AC Versions (C48CXXX0X):
      AC Power: 85 to 250 VAC, 50/60 Hz, 9 VA max.
      DC Power: 11 to 14 VDC @ 150 mA max. (Non PNP output models)
      Note: Models with PNP current sourcing outputs must be powered from AC.
   DC Versions (C48CXXX1X):
      CONTINUOUS:
         DC Power: 18 to 36 VDC; 5.5 W max.
         AC Power: 24 VAC ±10%; 50/60 Hz; 7 VA max.
         Note: The +10% tolerance range on AC input voltage must be strictly adhered to. DO NOT EXCEED 26.4 VAC.
      PEAK (START-UP CURRENT):
         AC or DC Power: 500 mA peak start-up current for 10 msec max.

   DC OUT (V_{SRC} IN) - Terminal 10
   For units which do not have PNP current sourcing outputs, this terminal provides a DC output for sensor power (+12 VDC ±15%). The maximum sensor current is 100 mA.
   For units with PNP current sourcing outputs, this terminal serves a dual purpose depending on the application's PNP output voltage level and current requirements.
      1. The terminal may be used as a +12 VDC output for sensor power. In this case, the PNP output voltage level will be +12 VDC (±15%). A maximum of 100 mA is available for the combination of sensor current and PNP output sourcing current.
      2. If a higher PNP output voltage level or additional output sourcing current is desired, an external DC supply may be connected between the "DC OUT (V_{SRC} IN)" and "COMM." terminals. This supply will determine the PNP output voltage level, and must be in the range of +13 to +30 VDC.
      An external DC supply can also provide the additional output sourcing current required in applications where two or more PNP outputs are "ON" simultaneously. However, the maximum current rating of 100 mA per individual output must not be exceeded, regardless of external supply capacity.
3. **MEMORY:** Nonvolatile E^2PROM retains all programmable parameters and timer values.
4. **SENSOR POWER:** +12 VDC (± 15%) @ 100 mA max.
5. **INPUTS:** Run/Stop, Usr. In1, Usr In2, and Usr. In3.
   Configurable as current sinking (active low) or current sourcing (active high) inputs via a single plug jumper.
   Current Sinking (active low): V_{IL} = 1.5 VDC max, 22 KΩ pull-up to 5 VDC.
   Current Sourcing (active high): V_{IH} = 3.5 VDC min., V_{IN} max = 30 VDC; 22 KΩ pull-down.
   Run/Stop Response Time: 250 µsec max.
   User Input Response Time: 5 msec max.
6. **TIME ACCURACY**: ± 0.01%
7. **OUTPUTS:** (Output type and quantity are model dependent)
   Solid-State:
      NPN Open Collector: I_{SNK} = 100 mA max. @ V_{OL} = 1.1 VDC max; V_{OH} = 30 VDC max.
      PNP Open Collector: I_{SRC} = 100 mA max.(See note); V_{OH} = 12 VDC ±15% (using internal supply); V_{OH} = 13 to 30 VDC (using external supply).
      Note: The internal supply of the C48T can provide a total of 100 mA for the combination of sensor current and PNP output sourcing current. The supply voltage is +12 VDC (±15%), which will be the PNP output voltage level when using only the internal supply.
      If additional PNP output sourcing current or a higher output voltage level is desired, an external DC supply may be connected between the "DC Out/In" and "Comm." terminals. This supply will determine the PNP output voltage level, and must be in the range of +13 to +30 VDC.
      An external supply can provide the additional output sourcing current required in applications where two or more outputs are "ON" simultaneously. However, the maximum rating of 100 mA per individual output must not be exceeded, regardless of external supply capacity.
   Relay: Form A contact, Rating = 5 A @ 250 VAC, 30 VDC (resistive load), 1/10 HP @ 120 VAC (inductive load)
      Relay Life Expectancy: 100,000 cycles min. at max. load rating
   Programmable Timed Output(s): User selectable output time resolution
      0.01 Second Resolution: 0.01 to 99.99 seconds, ± 0.01% + 10 msec max.
      0.1 Second Resolution: 0.1 to 999.9 Seconds, ± 0.01% + 100 msec max.
8. **RS485 SERIAL COMMUNICATIONS (Optional)**: Up to 32 units can be connected.
   Baud Rate: Programmable from 1200 to 9600 baud
   Address: Programmable from 0 to 99
   Data Format: 10 Bit Frame, 1 start bit, 7 or 8 data bits, 1 or No Parity bit, and 1 stop bit
   Parity: Programmable for Odd (7 data bits), Even (7 data bits), or None (8 data bits)
9. **CERTIFICATIONS AND COMPLIANCES**:
   UL Recognized Component, File #E137808
      Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Simulation of cordless telephone	ENV50204	Level 3; 10 V/m
		900 MHz ± 5 MHz
		200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A

   Notes:
   AC VERSIONS
   1. A power line filter, RLC#LFIL0000 or equivalent, was installed when the unit was DC powered.
   DC VERSIONS
      To insure compliance with the EMC standards listed above, do not connect any wires from the terminal(s) labeled "COMM." to the "DC-" supply terminal (12), when powering the unit from a DC supply.
   Refer to EMC Installation Guidelines section of the manual for additional information.
10. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0°C to 50°C
   Storage Temperature: -40°C to 70°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C.
   Altitude: Up to 2000 meters
11. **ELECTRICAL CONNECTION**: Wire clamping screw terminals.
12. **CONSTRUCTION**: Black plastic case with collar style panel latch. The panel latch can be installed for horizontal or vertical stacking. Black plastic textured bezel with clear display viewing window. Unit assembly with circuit boards can be removed from the case without removing the case from the panel or disconnecting the wiring. This unit is rated for NEMA 4X/IP65 indoor use. Installation Category II, Pollution Degree 2.
13. **WEIGHT**: 6.0 oz. (170 g)

SINGLE PRESET MODELS

The C48TS offers a choice of twelve timing ranges with eighteen different operating modes. The unit has a solid-state output that operates in parallel with a relay output. The solid-state output is available as an NPN or PNP open collector transistor.

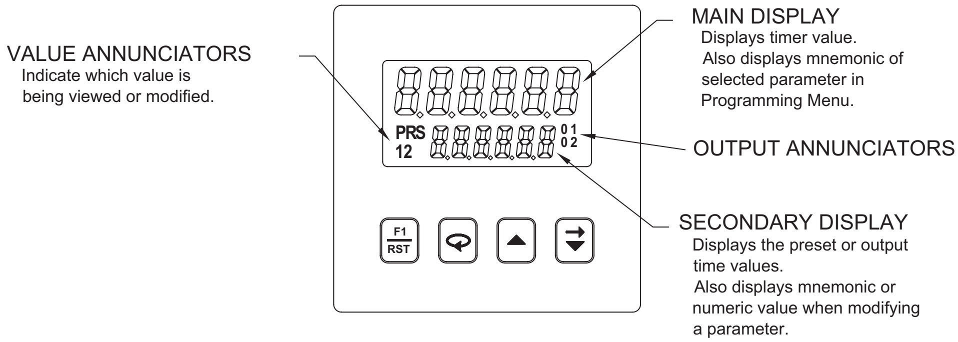
DUAL PRESET MODELS

The C48TD offers a choice of twelve timing ranges with 42 operating modes. The unit is available with solid-state or relay outputs. The solid-state outputs are available as NPN or PNP open collector transistors.

FRONT PANEL FEATURES

The C48 Timer features a dual line display. In the normal operating mode (main display), the timer value is shown on the top line and preset or output time values are shown on the bottom line. The Presets or Output time values can be programmed to be viewable only, viewable and changeable, or locked (not viewable) from the main display.

In the normal operating mode, the presets and output time values are accessible providing that these values are not programmed for ‘L’ocked. Values that are accessible (changeable) can be changed immediately when viewed in the secondary display.



USER INTERFACE/PROGRAMMING MODES

The operating modes of the C48T are programmed using the front panel keypad. To enter the programming menu, the key is pushed and held for 2 seconds. Within the programming menu, the key is used to sequence through the list of programming parameters.

PROGRAMMING MENU

DISPLAY	PARAMETER DESCRIPTION
EntrY	- Digit or Auto Scrolling Data Entry Mode
trAnGE	- Timer Range Modes (See Table on following page)
OPEr	- Timer Operating Modes (See Table on following page)
rStPuP	- Reset at Power up
Ac PrS	- Accessibility of Preset Values
PrESEt	- Preset 1 and 2 Values
P1trAc	- P1 Track P2 (C48TD only)
Ac Out	- Accessibility of Output Time Values
OutrES	- Output Resolution
OutPut	- Output 1 and 2 Time Values
rEUOut	- Reverse Output/Relay Logic
rEUAnu	- Reverse Output Annunciator Logic
OutPuP	- Power up Output State
USr In1	- User Input 1
USr In2	- User Input 2
USr In3	- User Input 3
USr F1	- User F1 Key
CodE	- Programming/Protected Parameter Menu Code
ScroLL	- Scroll Display
SErSEt	- Serial Baud Rate and Parity Settings (RS485 option only)
SErAdr	- Serial Unit Address (RS485 option only)
SErAbr	- Abbreviate Serial Mnemonics (RS485 option only)
PrnOPt	- Print Options (RS485 option only)
PrnrSt	- Print and Reset Time Value (RS485 option only)
FAcSEt	- Load Factory Default Settings

D

FRONT PANEL KEYPAD

F1/RST
- Performs user Programmed Function

- Cycles through secondary displays.
- Enters Programming Mode or Protected Value Menu when pushed and held for 2 seconds.
- Scrolls through programming displays.
- Enters Data Values.

- Selects next available mode in programming mode.
- Increments digit in Digit Entry mode.
- Increments value in Auto Scrolling entry mode.

- Selects Data Entry mode for displayed data values.
- Selects Digit to right when in Digit Entry mode.
- Decrements value in Auto Scrolling entry mode.

Program Security/Operator Accessible Values

The Program Disable Plug Jumper, Programmable Code Value, User Input (programmed for Program Disable), and the Accessible value parameter settings provide various levels of security against unauthorized programming changes. The accessible value parameters provide individual access or locking of each value.

Protected Value Menu

The Protected Value Menu allows access to selected presets and timed output values without having them viewable or changeable from the main display. To enter the protected menu, the key is pressed and held, and a programmed code value is entered.

Timer Range Modes - trAnGE

The timer can be configured to operate in one of 12 time ranges. The table below shows the various ranges available with the time resolution of each range.

MODE	RANGE	RESOLUTION
SEC.000	999.999 Seconds	0.001 sec
SEC.00	9999.99 Seconds	0.01 sec
SEC.0	99999.9 Seconds	0.1 sec
SEC	999999 Seconds	1 sec
n.000	999.999 Minutes	0.001 min
n.00	9999.99 Minutes	0.01 min
n.0	99999.9 Minutes	0.1 min
n.SEC	9999.59 Minutes.Seconds	1 sec
n.SEC.0	999.59.0 Minutes.Seconds.0	0.1 sec
hn.SEC	99.59.59 Hours.Minutes.Seconds	1 sec
hn.00	99.59.99 Hours.Minutes.00	0.01 min
hn.0	999.59.9 Hours.Minutes.0	0.1 min

Programmable Operating Modes - OPEr

These modes determine the operational characteristics of the timer. In the tables, 01 and 02 refer to Output 1 and Output 2 respectively.

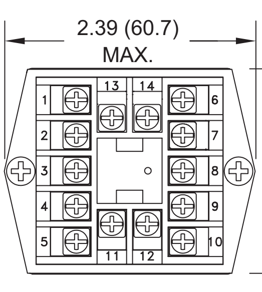
SINGLE PRESET OPERATING MODES	
1 - Manual Reset to Zero, Latched Output	10 - Stop Timer at 01, Manual Reset to Zero, Timed Output
2 - Manual Reset to Zero, Timed Output	11 - Stop Timer at 01, Manual Reset to Preset, Latched Output
3 - Manual Reset to Preset, Latched Output	12 - Stop Timer at 01, Manual Reset to Preset, Timed Output
4 - Manual Reset to Preset, Timed Output	13 - Stop Timer at 01, Auto Reset to Zero, Latched Output
5 - Auto Reset to Zero, Timed Output	14 - Stop Timer at 01, Auto Reset to Zero, Timed Output
6 - Auto Reset to Preset, Timed Output	15 - Stop Timer at 01, Auto Reset to Preset, Latched Output
7 - Auto Reset to Zero at 01 End, Timed Output	16 - Stop Timer at 01, Auto Reset to Preset, Timed Output
8 - Auto Reset to Preset at 01 End, Timed Output	17 - Stop Timer at 01, Auto Reset to Zero at 01 End, Timed Output
9 - Stop Timer at 01, Manual Reset to Zero, Latched Output	18 - Stop Timer at 01, Auto Reset to Preset at 01 End, Timed Output

DUAL PRESET OPERATING MODES	
1 - Manual Reset to Zero, Latched Outputs	22 - Stop Timer at 02, Manual Reset to Zero, 01 off at 02, 02 Latched
2 - Manual Reset to Zero, 01 Timed, 02 Latched	23 - Stop Timer at 02, Manual Reset to Zero, 01 off at 02, 02 Timed
3 - Manual Reset to Zero, 01 and 02 Timed	24 - Stop Timer at 02, Manual Reset to Preset 2, Latched Outputs
4 - Manual Reset to Zero, 01 off at 02, 02 Latched	25 - Stop Timer at 02, Manual Reset to Preset 2, 01 Timed, 02 Latched
5 - Manual Reset to Zero, 01 off at 02, 02 Timed	26 - Stop Timer at 02, Manual Reset to Preset 2, 01 and 02 Timed
6 - Manual Reset to Preset 2, Latched Outputs	27 - Stop Timer at 02, Manual Reset to Preset 2, 01 off at 02, 02 Latched
7 - Manual Reset to Preset 2, 01 Timed, 02 Latched	28 - Stop Timer at 02, Manual Reset to Preset 2, 01 off at 02, 02 Timed
8 - Manual Reset to Preset 2, 01 and 02 Timed	29 - Stop Timer at 02, Auto Reset to Zero, Latched Outputs
9 - Manual Reset to Preset 2, 01 off at 02, 02 Latched	30 - Stop Timer at 02, Auto Reset to Zero, 01 Timed, 02 Latched
10 - Manual Reset to Preset 2, 01 off at 02, 02 Timed	31 - Stop Timer at 02, Auto Reset to Zero, 01 and 02 Timed
11 - Auto Reset to Zero, 01 and 02 Timed	32 - Stop Timer at 02, Auto Reset to Zero, 01 off at 02, 02 Latched
12 - Auto Reset to Zero, 01 off at 02, 02 Timed	33 - Stop Timer at 02, Auto Reset to Zero, 01 off at 02, 02 Timed
13 - Auto Reset to Preset 2, 01 and 02 Timed	34 - Stop Timer at 02, Auto Reset to Preset 2, Latched Outputs
14 - Auto Reset to Preset 2, 01 off at 02, 02 Timed	35 - Stop Timer at 02, Auto Reset to Preset 2, 01 Timed, 02 Latched
15 - Auto Reset to Zero at 02 End, 01 and 02 Timed	36 - Stop Timer at 02, Auto Reset to Preset 2, 01 and 02 Timed
16 - Auto Reset to Zero at 02 End, 01 off at 02, 02 Timed	37 - Stop Timer at 02, Auto Reset to Preset 2, 01 off at 02, 02 Latched
17 - Auto Reset to Preset 2 at 02 End, 01 and 02 Timed	38 - Stop Timer at 02, Auto Reset to Preset 2, 01 off at 02, 02 Timed
18 - Auto Reset to Preset 2 at 02 End, 01 off at 02, 02 Timed	39 - Stop Timer at 02, Auto Reset to Zero at 02 End, 01 and 02 Timed
19 - Stop Timer at 02, Manual Reset to Zero, Latched Outputs	40 - Stop Timer at 02, Auto Reset to Zero at 02 End, 01 off at 02, 02 Timed
20 - Stop Timer at 02, Manual Reset to Zero, 01 Timed, 02 Latched	41 - Stop Timer at 02, Auto Reset to Preset 2 at 02 End, 01 and 02 Timed
21 - Stop Timer at 02, Manual Reset to Zero, 01 and 02 Timed	42 - Stop Timer at 02, Auto Reset to Preset 2 at 02 End, 01 off at 02, 02 Timed

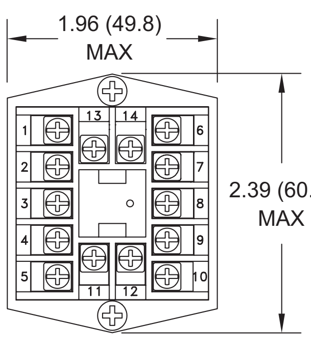
MULTIPLE UNIT STACKING

The C48T is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of the units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

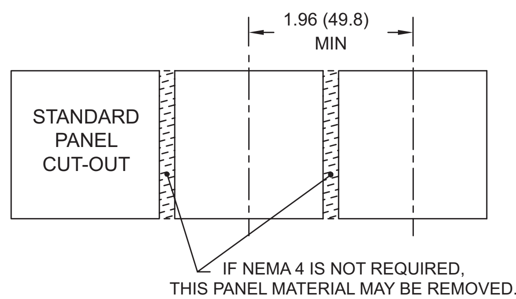


PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING



PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

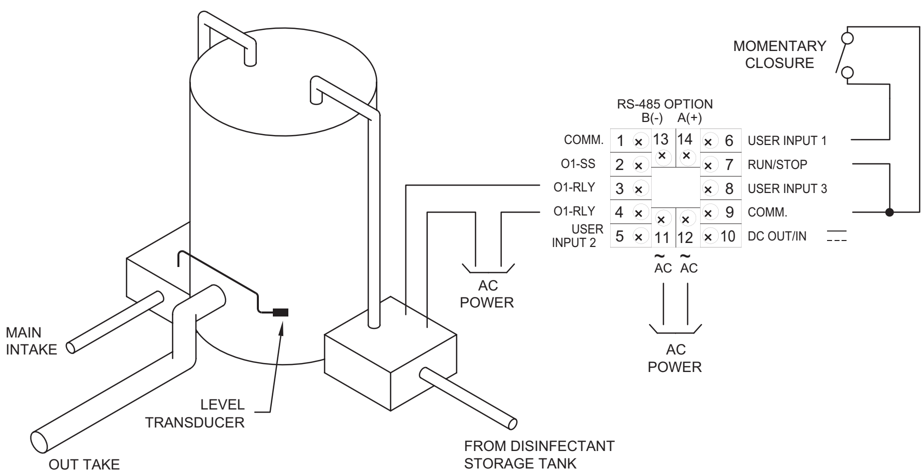
PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING.
HORIZONTAL ARRANGEMENT SHOWN.



ONE SHOT TIMING CYCLE

Proper wash down mixture for a food processing plant is an important factor in maintaining the clean environment required. A disinfectant solution is added to the mixing/holding tank used for the wash down cycle. When the holding tank is near empty, a level transducer activates the filler pump. A C48TS is used to turn on the disinfectant solution pump for a preprogrammed amount of time during the filling process of the holding tank.

When the filler pump starts, a momentary contact closure activates User Input 1, resetting the C48 Timer. The timer begins the timing cycle since the run terminal is connected to common. The normally open relay contacts close at the timer reset signal activating the disinfectant solution pump. When the programmed preset is reached, timing stops and the relay deactivates, turning off the pump controlling the disinfectant solution. The C48 Timer's preset cycle time may be changed according to the manufacturer's concentration level of the disinfectant.



PROGRAMMING

EntrY	Auto Sc
trAnGE	nSEC (min & sec)
OPEr	09
rStP.uP	no
Ac PrS	-Y (yes)
PrESEt	xxxx.xx
rEUOut	-Y (yes)
rEUAnu	-n (no)
OutP.uP	-F (off)
USr In1	rSt-E
USr In2	Pro.d iS
USr In3	ChGdSP
USrF1	rSt-E
CodE	xxxx
ScroLL	no

D

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	* NPN O.C. OUTPUT(S)	RELAY OUTPUT(S)	RS485	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
					18-36 VDC/24VAC	85 to 250 VAC
C48T	1 Preset Timer, Reflective LCD	Yes	Yes	No	C48TS013	C48TS003
	1 Preset Timer, Backlit LCD	Yes	Yes	No	C48TS113	C48TS103
	2 Preset Timer, Reflective LCD	No	Yes	No	C48TD012	C48TD002
	2 Preset Timer, Reflective LCD	No	Yes	Yes	C48TD017	C48TD007
	2 Preset Timer, Reflective LCD	Yes	No	Yes	N/A	C48TD005
	2 Preset Timer, Backlit LCD	No	Yes	No	C48TD112	C48TD102
	2 Preset Timer, Backlit LCD	No	Yes	Yes	C48TD117	C48TD107
	2 Preset Timer, Backlit LCD	Yes	No	Yes	N/A	C48TD105

* PNP O.C. output(s) versions are available, contact the factory.

RELAY OUTPUT BOARDS

MODEL NO.	DESCRIPTION	NPN O.C. OUTPUT	PNP O.C. OUTPUT	RELAY OUTPUT(S)	PART NUMBER
RBC48	Single Preset	Yes	No	Yes	RBC48001
	Dual Preset	No	No	Yes	RBC48003

ACCESSORIES

MODEL	DESCRIPTION	PART NUMBER
SFC48	PC Configuration Software for Windows 3.x and 95 (3.5"disk) (for RS-485 Models)	SFC48

MODEL PAX-1/8 DIN PRESET TIMER (PAXTM) & REAL-TIME CLOCK (PAXCK)

c UL US LISTED
IND. CONT. EQ.
51EB

- *6-DIGIT 0.56" RED SUNLIGHT READABLE DISPLAY*
- *4 SEPARATE DISPLAYS (Timer, Counter, Real-Time Clock, and Date)*
- *CYCLE COUNTING CAPABILITY*
- *PROGRAMMABLE FUNCTION KEYS/USER INPUTS*
- *FOUR SETPOINT ALARM OUTPUTS (W/Plug-in card)*
- *COMMUNICATIONS AND BUS CAPABILITIES (W/Plug-in card)*
- *BUS CAPABILITIES: DEVICENET, MODBUS and PROFIBUS-DP*
- *CRIMSON® PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The PAXTM (PAX® Timer) and PAXCK (PAX® Clock/Timer) offer many features and performance capabilities to suit a wide range of industrial applications. Both can function as an Elapsed Timer or Preset Timer, while the PAXCK also offers Real-Time Clock with Date capability. The Plug-in option cards allow the opportunity to configure the meter for the present application, while providing easy upgrades for future needs.

Both units can function as an Elapsed Time Indicator. By using two separate signal inputs and 23 selectable timer ranges, the meters can be programmed to meet most any timing application. With the addition of a Plug-in Setpoint card, they can easily become a dual or quad output preset timer.

The PAXCK can also operate as a Real-Time Clock (RTC), with the Real-Time Clock Card already installed. The meter is capable of displaying time in 12 or 24-hour time formats. The 12-hour format can be displayed in hours and minutes, with or without an AM/PM indication or in hours, minutes, and seconds. The 24-hour format can be displayed in hours and minutes or in hours, minutes, and seconds. The PAXCK is also capable of a calendar display in which the day, month and/or year can be displayed. The meter will recognize leap years, and can automatically adjust for Daylight Savings Time. The Real-Time Clock has the ability to externally synchronize with other PAXCK meters to provide a uniform display network throughout the plant.

If the application calls for both a Preset Timer and a Real-Time Clock at the same time, the PAXCK can handle this requirement as well. The meter provides up to four different displays, accessed via front panel push buttons or external inputs. The displays are Timer (TMR), which displays the current timer value; Count (CNT), which displays the current cycle counter value; Date (DAT), which displays the current programmed date; and Real-Time Clock, which displays the current time. A battery-backed Real-Time Clock plug-in card is provided with the PAXCK. This card, which includes a lithium coin-cell battery, will maintain the time and date when main power is removed.

The meters accept inputs from a variety of sources including switch contacts and outputs from CMOS or TTL circuits. The input can be configured to trigger on the edge or level of the incoming pulse. Internal jumpers are available to allow the selection for sinking inputs (active low) or sourcing inputs (active high).

The front panel keys and three user inputs are programmable to perform various meter functions. One of the functions includes exchanging parameter lists, allowing for two separate listings of setpoint values, timer start/stop values, counter start/stop values and RTC daily on and off values.

The meters can have up to four setpoint outputs, determined by the optional plug-in cards. The setpoint plug-in cards provide dual FORM-C relays (5A), quad FORM-A relays (3A) or either quad sinking or quad sourcing open collector logic outputs. The outputs can be assigned to the timer, counter, RTC date, and RTC time. The outputs can also be independently configured to suit a variety of control and alarm requirements.

Plug-in cards can also provide serial communications. These include RS232, RS485, Modbus, DeviceNet, and Profibus-DP. Display values, setpoint alarm values and setpoint states can be controlled through serial communications. With the RS232 or RS485 communication card installed, it is possible to configure the meter using a Windows® based program. The meter configuration data can be saved to a file for later recall.

Once the meters have been initially configured, the parameter list may be locked out from further modification entirely, or the setpoint, timer start/stop values, counter start/stop values, RTC time SET, and Display Intensity can be made accessible. This lockout is possible through a security code or user input.

The meters have been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

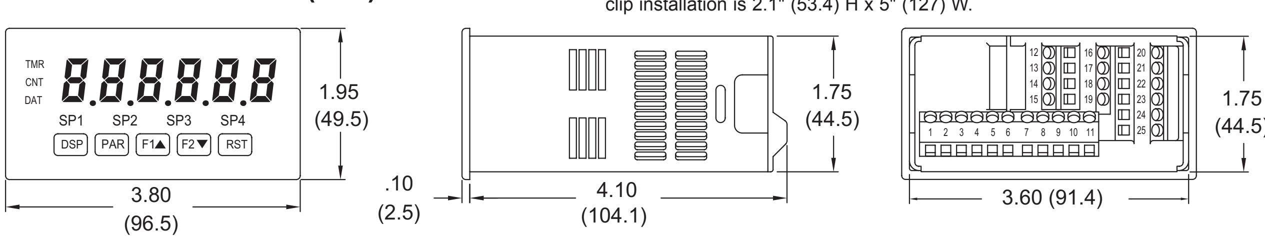


Table Of Contents

Ordering Information

Meter Part Numbers

PAX				0

CK - Timer/Real Time Clock
TM - Timer

0 - Red, Sunlight Readable Display
1 - Green Display

0 - 85 to 250 VAC
1 - 11 to 36 VDC, 24 VAC

D

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXRTC	Real-Time Clock Card (Replacement Only)	PAXRTC00
Accessories	SFCRD *	Crimson PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200

*Crimson® software is available for download from http://www.redlion.net/

General Meter Specifications

1. **DISPLAY**: 6 digit, 0.56" (14.2 mm) red sunlight readable or standard green LED
2. **POWER**:
   AC Versions (PAXCK000, PAXTM000):
   AC Power: 85 to 250 VAC, 50/60 Hz, 18 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs. (300 V working)
   DC Versions (PAXCK010, PAXTM010):
   DC Power: 11 to 36 VDC, 14 W
   (Derate operating temperature to 40°C if operating <15 VDC and three Plug-in cards are installed)
   AC Power: 24 VAC, ± 10%, 50/60 Hz, 15 VA
   Isolation: 500 Vrms for 1 min. to all inputs and outputs (50 V working)
3. **SENSOR POWER**: 12 VDC, ±10%, 100 mA max. Short circuit protected.
4. **ANNUNCIATORS**:

TMR -Timer Display	SP1 -Setpoint 1 Output
CNT -Cycle Counter Display	SP2 -Setpoint 2 Output
DAT -Real-Time Clock Date Display	SP3 -Setpoint 3 Output
-Real-Time Clock Time Display	SP4 -Setpoint 4 Output

5. **KEYPAD**: 3 programmable function keys, 5 keys total.
6. **TIMER DISPLAY**:
   Timer Range: 23 Selectable Ranges
   Timing Accuracy: ± 0.01%
   Minimum Digit Resolution: 0.001 Sec.
   Maximum Least Significant Digit Resolution: 1 Hr.
   Maximum Display: 999999
7. **CYCLE COUNTER DISPLAY**:
   Counter Range: 0 to 999999
   Digit Resolution: 1 cycle
   Maximum Count Rate: 50 Hz
8. **REAL-TIME/DATE DISPLAY (PAXCK)**:
   Real-Time Display: 5 display formats
   Hr/Min/Sec (12 or 24 Hr. format); Hr/Min (24 Hr.); Hr/Min (12 Hr. with or without AM/PM indication)
   Date Display: 7 display formats
   Month/Day or Day/Month (numeric or 3-letter Month format); Month/Day/Year or Day/Month/Year (all numeric);
   Day of Week/Day (3-letter Day of Week format)
9. **REAL-TIME CLOCK CARD**: Field replaceable plug-in card
   Time Accuracy: ± 5 secs./Month (1 min./year) with end-user calibration
   Battery: Lithium 2025 coin cell
   Battery Life Expectancy: 10 yrs. typical
   Synchronization Interface: Two-wire multi-drop network (RS485 hardware), 32 units max., operates up to 4000 ft.
   Isolation To Timer & User Input Commons: 500 Vrms for 1 min.
   Working Voltage: 50 V. Not isolated from all other commons.
10. **TIMER INPUTS A and B**:
    Logic inputs configurable as Current Sinking (active low) or Current Sourcing (active high) via a single plug jumper.
    Current Sinking (active low): V_{IL} = 0.9 V max., 22KΩ pull-up to +12 VDC.
    Current Sourcing (active high): V_{IH} = 3.6 V min., 22KΩ pull-down, Max. Continuous Input: 30 VDC.
    Timer Input Pulse Width: 1 msec min.
    Timer Start/Stop Response Time: 1 msec max.
    Filter: Software filtering provided for switch contact debounce. Filter enabled or disabled through programming.
    If enabled, filter results in 50 msec start/stop response time for successive pulses on the same input terminal.
11. **USER INPUTS**: Three programmable user inputs
    Logic inputs configurable as Current Sinking (active low) or Current Sourcing (active high) through a single plug jumper.
    Current Sinking (active low): V_{IL} = 0.9 V max., 22KΩ pull-up to +12 VDC.
    Current Sourcing (active high): V_{IH} = 3.6 V min., 22KΩ pull-down, Max. Continuous Input: 30 VDC.
    Isolation To Timer Input Common: Not isolated
    Response Time: 10 msec
12. **MEMORY**: Non-volatile E^2PROM retains all programming parameters and display values.
13. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50°C (0 to 45°C with all three plug-in cards installed)
    Storage Temperature Range: -40 to 60°C
    Operating and Storage Humidity: 0 to 85% max. RH non-condensing
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
    Shock According to IEC 68-2-27: Operational 25 g (10g relay), 11 msec in 3 directions.
    Altitude: Up to 2000 meters
14. **CERTIFICATIONS AND COMPLIANCE**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Certificate # US/8843A/UL
    CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (face only), IEC 529
    IP20 Enclosure rating (rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms 150 KHz - 80 MHz
Emissions to EN 50081-1		
RF interference	EN 55022	Enclosure class B Power mains class B

Note:
Refer to the EMC Installation Guidelines section for more information.

15. **CONNECTIONS**: High compression, cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
16. **CONSTRUCTION**: This meter is rated for NEMA 4X/IP65 outoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
17. **WEIGHT**: 10.1 oz. (286 g)

D

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Real-Time Clock Card (PAXRTC). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via RLCPro, a Windows® based program, the RS232 or RS485 Cards must be used.

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC40 - Modbus (Terminal)
PAXCDC20 - RS232 Serial (Terminal)	PAXCDC4C - Modbus (Connector)
PAXCDC2C - RS232 Serial (Connector)	PAXCDC50 - Profibus-DP

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 300 to 19,200
Parity: No, Odd or Even
Bus Address: Selectable 0 to 99, Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 2 to 50 msec or 50 to 100 msec (RS485)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

MODBUS CARD

Type: RS485; RTU and ASCII MODBUS modes
Isolation To Sensor & User Input Commons: 500 Vrms for 1 minute. Working Voltage: 50 V. Not isolated from all other commons.
Baud Rates: 300 to 38,400.
Data: 7/8 bits
Parity: No, Odd, or Even
Addresses: 1 to 247.
Transmit Delay: Programmable; See Transmit Delay explanation.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 126, set by the master over the network. Address stored in non-volatile memory.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

The Crimson® software is a Windows® based program that allows configuration of the PAX® meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. A PAX® serial plug-in card is required to program the meter using the software.

SETPOINT CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Timer & User Input Commons: 2300 Vrms for 1 min. Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @120 VAC, inductive load
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads
Response Time: 5 msec. nominal with 3 msec. nominal release
Timed Output Accuracy: ±0.01% -10 msec.

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Timer & User Input Commons: 2300 Vrms for 1 min. Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 250 VAC or 30 VDC (resistive load), 1/10 HP @ 120 VAC, inductive load
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads
Response Time: 5 msec. nominal with 3 msec. nominal release
Timed Output Accuracy: ±0.01% -10 msec.

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Timer & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V
Response Time: 400 µsec. nominal with 2 msec. nominal turnoff
Timed Output Accuracy: ±0.01% -10 msec.

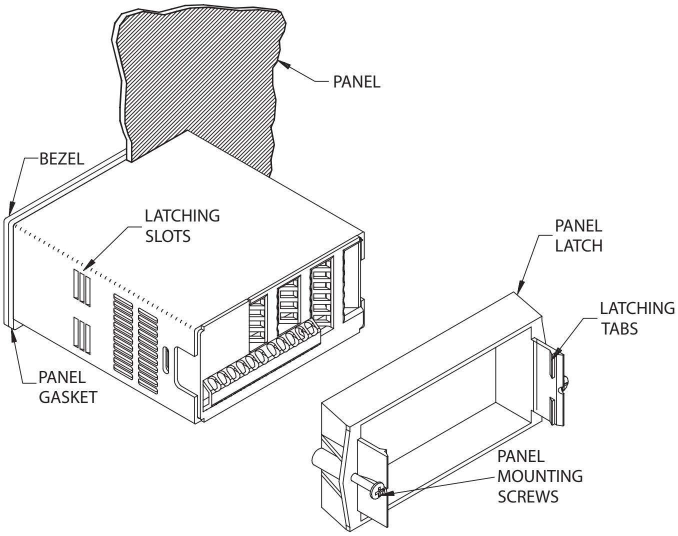
QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Timer & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 24 VDC ± 10% , 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output
Response Time: 400 µsec. nominal with 2 msec. nominal turnoff
Timed Output Accuracy: ±0.01% -10 msec.

1.0 Installing the Meter

Installation

The meter meets NEMA 4X/IP65 requirements for indoor use when properly installed. The meter is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the meter. Slide the panel gasket over the rear of the meter to the back of the bezel.



The meter should be installed fully assembled. Insert the meter into the panel cutout.

While holding the meter in place, push the panel latch over the rear of the meter so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the meter is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

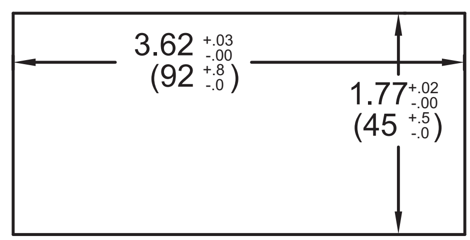
Installation Environment

The meter should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the meter near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the meter.

PANEL CUT-OUT



2.0 Setting the Jumpers

To access the jumpers, remove the meter base from the meter case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

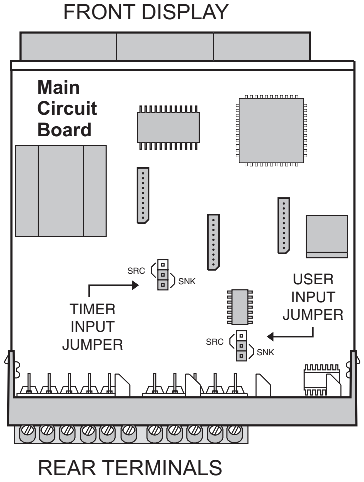
Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

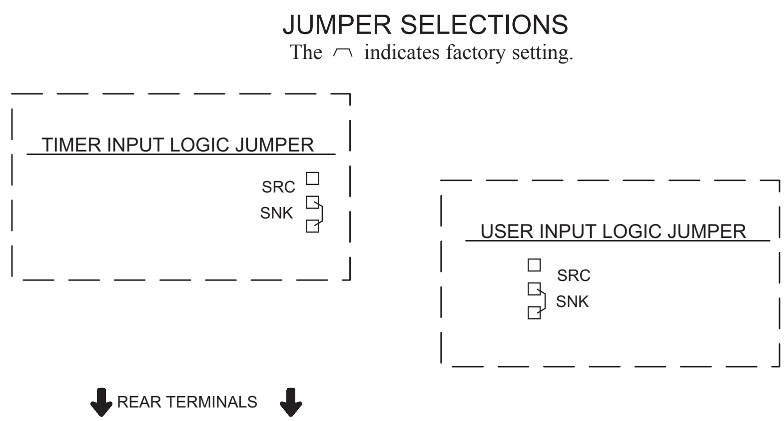
Timer Input Logic Jumper

One jumper is used for the logic state of both timer inputs. Select the proper position to match the input being used.

User Input Logic Jumper

One jumper is used for the logic state of all user inputs. If the user inputs are not used, it is not necessary to check or move this jumper.

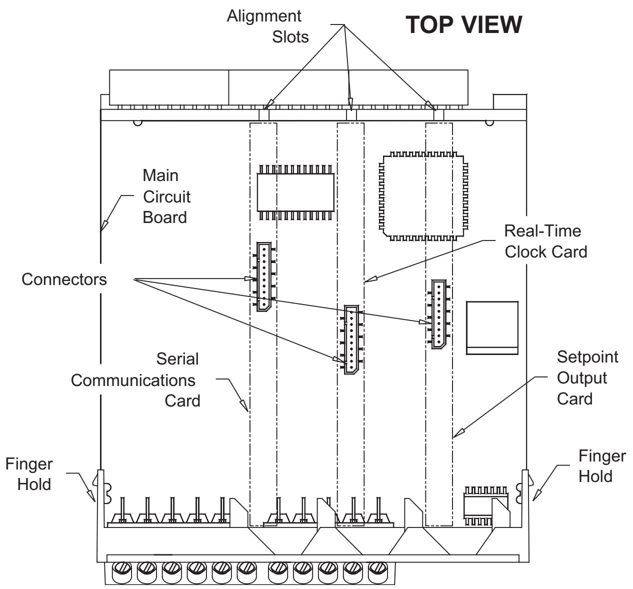




3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The Plug-in cards have many unique functions when used with the meters.

CAUTION: The Plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

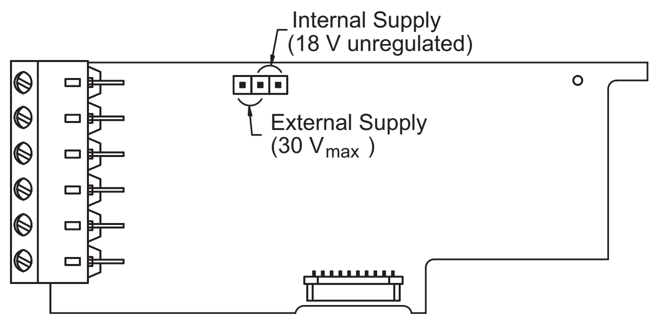


To Install:

1. With the case open, locate the Plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.*
2. Install the Plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the Plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the Plug-in card label to the bottom side of the meter. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.

Quad Sourcing Open Collector Output Card Supply Select

* If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

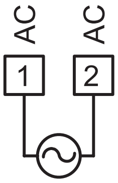
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

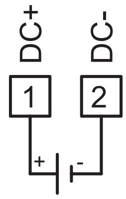
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

4.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC



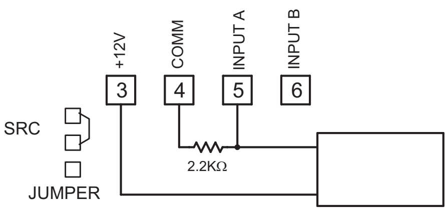
DC Power
Terminal 1: +VDC
Terminal 2: -VDC



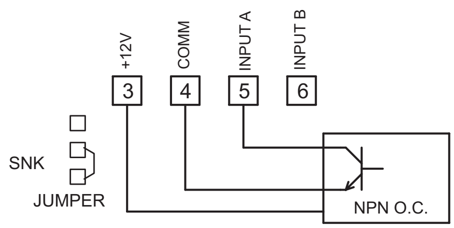
4.2 TIMER INPUT WIRING

Before connecting the wires, the Timer Input logic jumper should be verified for proper position.

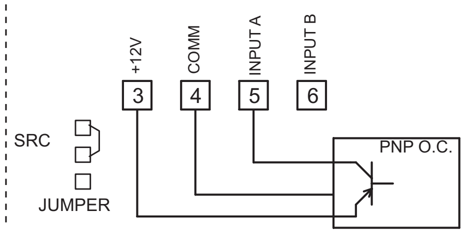
Two Wire Proximity, Current Source



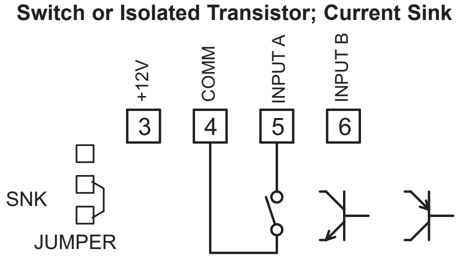
Current Sinking Output



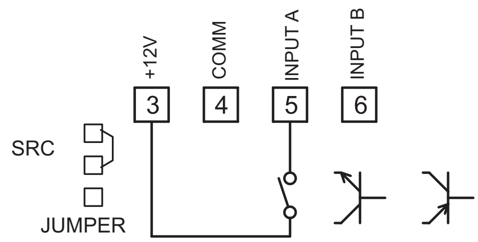
Current Sourcing Output



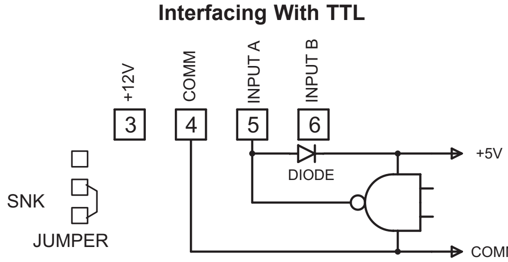
Switch or Isolated Transistor; Current Sink



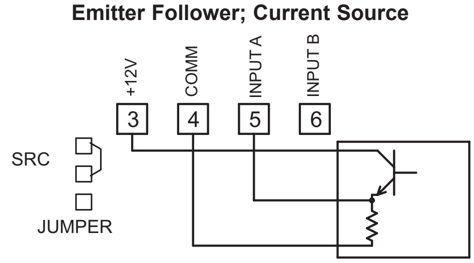
Switch or Isolated Transistor; Current Source



Interfacing With TTL



Emitter Follower; Current Source



CAUTION*: Timer Input common is NOT isolated from User Input common. In order to preserve the safety of the meter application, the timer input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the User Input Common with respect to earth ground; and the common of the isolated plug-in cards with respect to input common.*

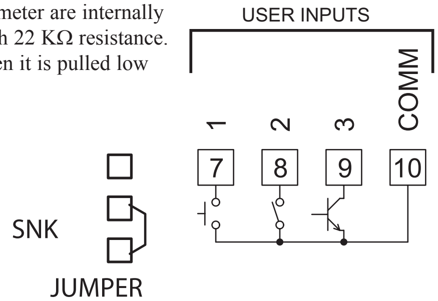
4.3 USER INPUT WIRING

Before connecting the wires, the Timer Input logic jumper should be verified for proper position. When the user input is configured for cycle count, in module 4, the count input should be wired between terminals 7 & 10.

Sinking Logic

Terminals 7-9 } Connect external switching device between the
Terminal 10 } appropriate User Input terminal and User Comm.

The user inputs of the meter are internally pulled up to +12 V with 22 KΩ resistance. The input is active when it is pulled low (<0 .9 V).

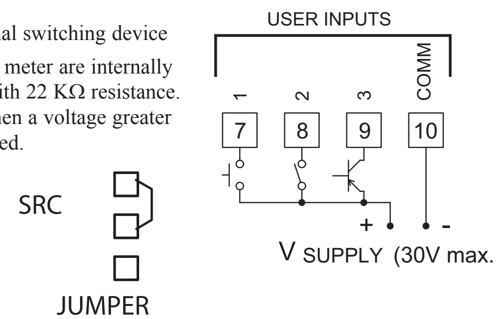


Sourcing Logic

Terminals 7-9:
+ VDC through external switching device

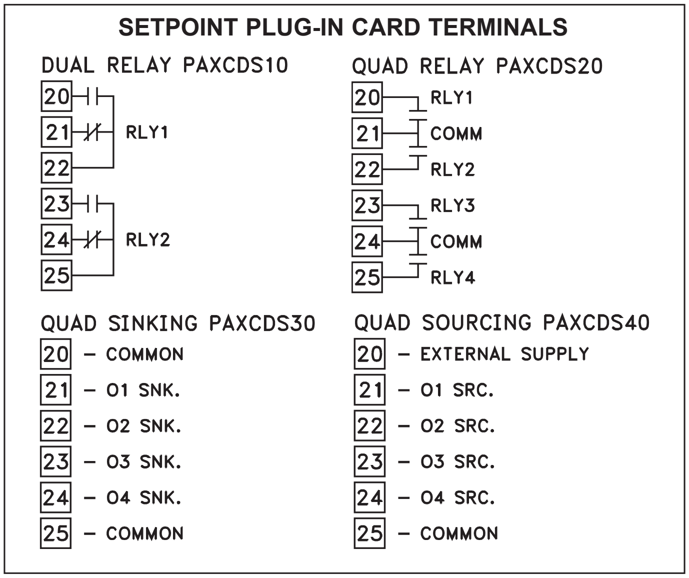
Terminal 10:
-VDC through external switching device

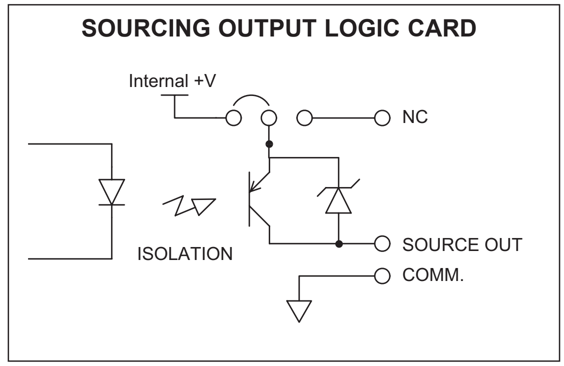
The user inputs of the meter are internally pulled down to 0 V with 22 KΩ resistance. The input is active when a voltage greater than 3.6 VDC is applied.

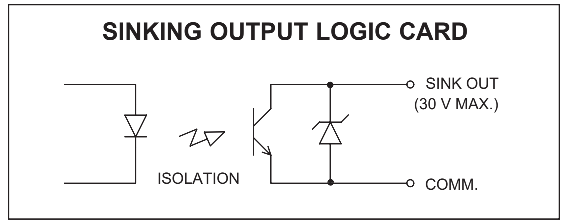


D

4.4 SETPOINT (ALARMS) WIRING



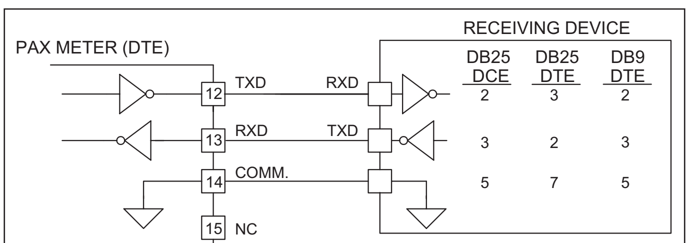




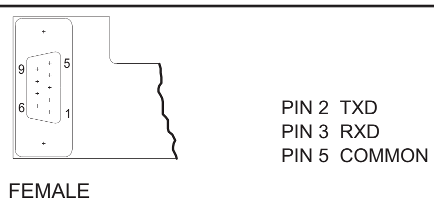
4.5 SERIAL COMMUNICATION WIRING

D

RS232 Communications



Terminal Block Connection Figure



Extended Comms Connection Figure

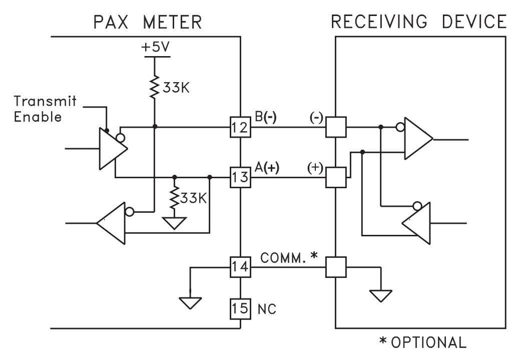
RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The PAX emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function.

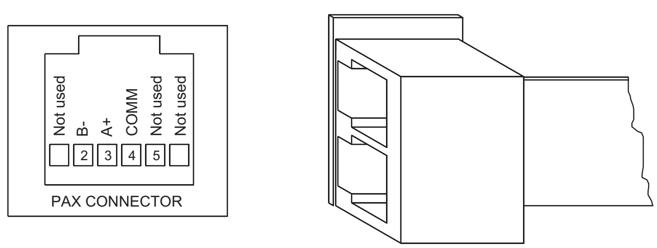
As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is "busy". The receiving device asserts that it is busy by setting the RXD line to a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.

RS485 Communications

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the PAX is limited to 19.2k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



Terminal Block Connection Figure

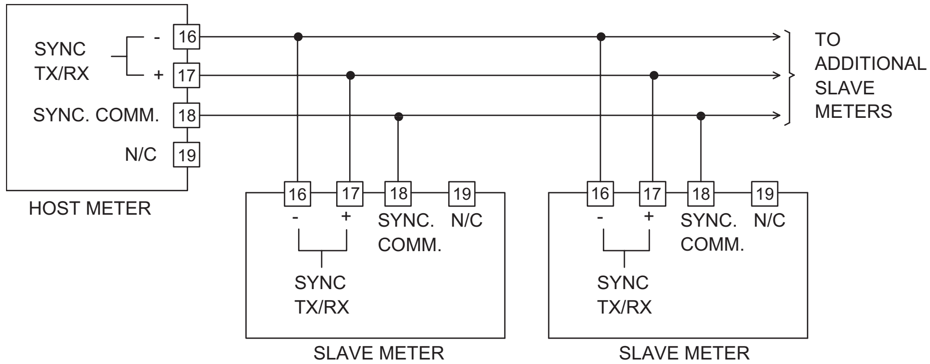


Extended Comms Connection Figure

4.6 REAL-TIME CLOCK WIRING (PAXCK)

Time synchronization between multiple PAXCK meters can be accomplished through a hardware interface on the Real-Time Clock option card. This RS485 type interface allows connection of up to 32 PAXCK meters in a two-wire multidrop network, at distances up to 4000 ft.

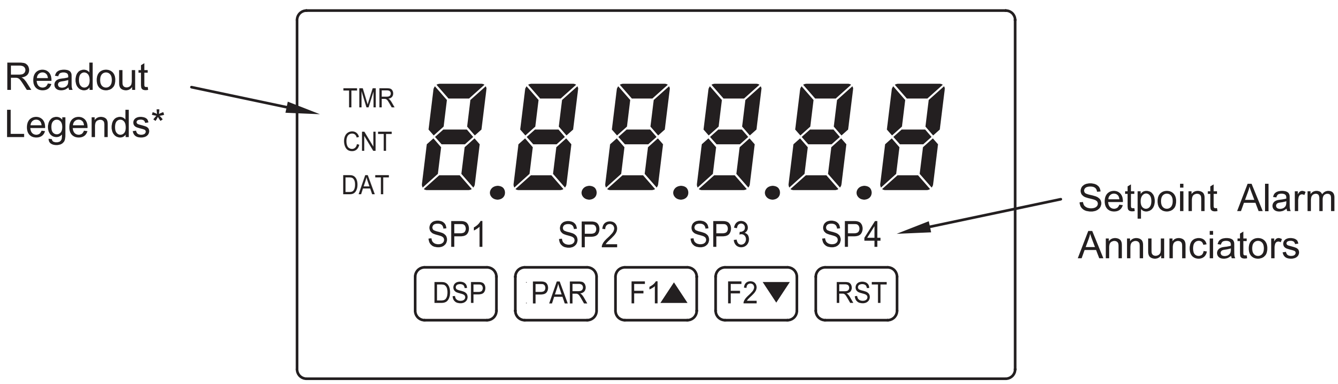
In a synchronization network, one PAXCK meter is programmed as the Host, while all other meters are programmed as Slaves. Once every hour, the Host meter outputs a time synchronization pulse onto the network. Upon receiving the synchronization pulse, each Slave meter automatically adjusts the minutes and seconds of its RTC Time setting to synchronize with the Host.



Real-Time Clock Synchronization Figure

5.0 Reviewing the Front Buttons and Display

D



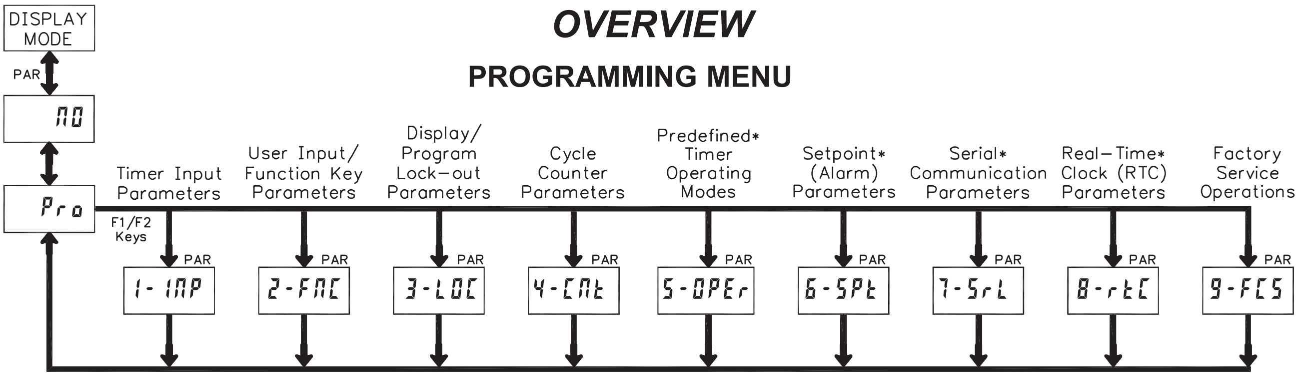
KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through Timer, Cycle Counter, Date, and Time	Exit programming and return to Display Mode
PAR	Access Programming Mode	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1 **	Increment selected parameter value or selections
F2▼	Function key 2; hold for 3 seconds for Second Function 2 **	Decrement selected parameter value or selections
RST	Reset (Function key) ***	Selects digit location in parameter values

* Cycle counter and Real-Time Clock displays are locked out in Factory Settings.
** Factory setting for the F1 and F2 keys is NO mode.
*** Factory setting for the RST key is dr5t-E (Reset Display)

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



* Only accessible with appropriate plug-in card.

D

DISPLAY MODE

The meter normally operates in the Display Mode. In this mode, the meter displays can be viewed consecutively by pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown; Timer (TMR), Cycle Counter (CNT), or Date (DAT). The Time Display for the Real-Time Clock is shown with no annunciator. Any of these displays can be locked from view through programming. (See Module 3.)

PROGRAMMING MODE

Two programming modes are available.

Full Programming Mode permits all parameters to be viewed and modified. Upon entering this mode, the front panel keys change to Programming Mode operations. This mode should not be entered while a process is running, since the meter timing functions and User Input response may not operate properly while in Full Programming Mode.

Quick Programming Mode permits only certain parameters to be viewed and/or modified. When entering this mode, the front panel keys change to Programming Mode operations, and all meter functions continue to operate properly. Quick Programming Mode is configured in Module 3. The Display Intensity Level "d-LEV" parameter is only available in the Quick Programming Mode when the security code is non-zero. For a description, see Module 9—Factory Service Operations. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming Mode.

PROGRAMMING TIPS

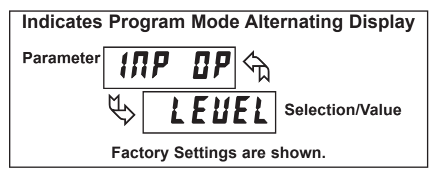
The Programming Menu is organized into nine modules. (See above.) These modules group together parameters that are related in function. It is recommended to begin programming with Module 1 and proceed through each module in sequence. Note that Modules 5 through 8 are only accessible when the appropriate plug-in option card is installed. If lost or confused while programming, press the **DSP** key to exit programming mode and start over. When programming is complete, it is recommended to record the meter settings on the Parameter Value Chart and lock-out parameter programming with a User Input or lock-out code. (See Modules 2 and 3 for lock-out details.)

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point if encountering programming problems. Throughout the module description sections which follow, the factory setting for each parameter is shown below the parameter display. In addition, all factory settings are listed on the Parameter Value Chart following the programming section.

ALTERNATING SELECTION DISPLAY

In the module description sections which follow, the dual display with arrows appears for each programming parameter. This is used to illustrate the display alternating between the parameter (top display) and the parameter's Factory Setting (bottom display). In most cases, selections or value ranges for the parameter will be listed on the right.



STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (PAR KEY)

The Programming Mode is entered by pressing the **PAR** key. If this mode is not accessible, then meter programming is locked by either a security code or a hardware lock. (See Modules 2 and 3 for programming lock-out details.)

MODULE ENTRY (ARROW & PAR KEYS)

Upon entering the Programming Mode, the display alternates between Pro and the present module (initially NO). The arrow keys (**F1▲** and **F2▼**) are used to select the desired module, which is then entered by pressing the **PAR** key.

PARAMETER (MODULE) MENU (PAR KEY)

Each module has a separate parameter menu. These menus are shown at the start of each module description section which follows. The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. From this point, programming may continue by selecting and entering additional modules. (See **MODULE ENTRY** above.)

PARAMETER SELECTION ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the parameter and the present selection or value for that parameter. For parameters which have a list of selections, the arrow keys (**F1▲** and **F2▼**) are used to sequence through the list until the desired selection is displayed. Pressing the **PAR** key stores and activates the displayed selection, and also advances the meter to the next parameter.

NUMERICAL VALUE ENTRY (ARROW, RST & PAR KEYS)

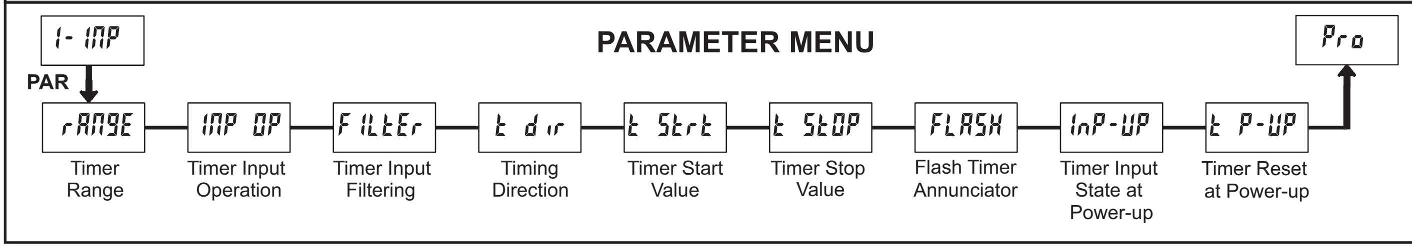
For parameters which require a numerical value entry, the arrow keys can be used to increment or decrement the display to the desired value. When an arrow key is pressed and held, the display automatically scrolls up or scrolls down. The longer the key is held, the faster the display scrolls.

In addition, the **RST** key can be used in combination with the arrow keys to enter numerical values. The **RST** key is pressed to select a specific digit to be changed, which blinks when selected. Once a digit is selected, the arrow keys are used to increment or decrement that digit to the desired number. The **RST** key is then pressed again to select the next digit to be changed. This "select and set" sequence is repeated until each digit is displaying the proper number. Pressing the **PAR** key stores and activates the displayed value, and also advances the meter to the next parameter.

PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pro NO)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro NO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

6.1 MODULE 1 - TIMER INPUT PARAMETERS (1- INP)



Module 1 is the programming module for the Timer Input Parameters. In the Display Mode, the TMR annunciator indicates the Timer display is currently being shown. An **EXCHANGE PARAMETER LISTS** feature, which includes the Timer Start and Timer Stop Values, is explained in Module 2.

TIMER RANGE

rANGE
SSSSSS

23 TIMER RANGE SELECTIONS

(S = SEC; M = MIN; H = HR; d = DAY)

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
SECONDS		
SSSSSS	999999	1 SEC
SSSSS.S	99999.9	0.1 SEC
SSSS.SS	9999.99	0.01 SEC
SSS.SSS	999.999	0.001 SEC
MINUTES		
MMMMMM	999999	1 MIN
MMMMM.M	99999.9	0.1 MIN
MMMM.MM	9999.99	0.01 MIN
MMM.MMM	999.999	0.001 MIN
HOURS		
HHHHHH	999999	1 HR
HHHHH.H	99999.9	0.1 HR
HHHH.HH	9999.99	0.01 HR
HHH.HHH	999.999	0.001 HR

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
MINUTES/SECONDS		
MMMM.SS	9999.59	1 SEC
MMM.SS.S	999.59.9	0.1 SEC
MM.SS.SS	99.59.99	0.01 SEC
M.SS.SSS	9.59.999	0.001 SEC
HOURS/MINUTES		
HHHH.MM	9999.59	1 MIN
HHH.MM.M	999.59.9	0.1 MIN
HH.MM.MM	99.59.99	0.01 MIN
H.MM.MMM	9.59.999	0.001 MIN
HOURS/MINUTES/SECONDS		
HH.MM.SS	99.59.59	1 SEC
H.MM.SS.S	9.59.59.9	0.1 SEC
DAYS/HOURS/MINUTES		
dd.HH.MM	99.23.59	1 MIN

TIMER INPUT OPERATION

INP OP
LEVEL

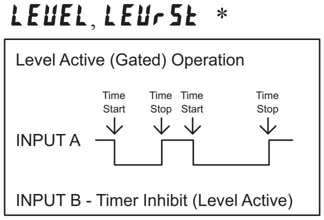
LEVEL   EdGE-1   EdGE-2   HoLd-2
LEVrSt   EdrS-1   EdrS-2   HrSt-2

This parameter determines how the Timer Input Signals affect the "Run/Stop" status of the Timer. The timing diagrams below reflect a Sinking input setup (active low). A Sourcing input setup (active high) is available through plug jumper selection (see Section 2.0). In this case, the logic levels of the timing diagrams would be inverted.

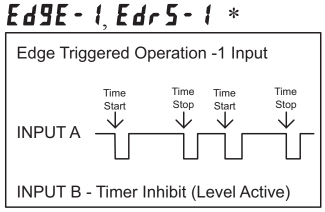
The Timer can also be stopped using a Timer Stop Value or a Setpoint. This type of Stop condition is cleared when a Timer Reset occurs, or another start edge is applied.

For LEVEL and EdGE-1 operation, Input B provides a level active Timer Inhibit function. This function is also available through a User Input (see Module 2). Timing diagrams are shown below for "LEVEL" through "HoLd-2" modes. The "LEVrSt" through "HrSt-2" modes are identical except the timer display value is also reset at "Time Start" edges. In the "HoLd-2" and "HrSt-2" modes, the timer display value remains held and only updates when a Timer Start (Input A) or Timer Stop (Input B) edge occurs.

LEVEL, LEVrSt *

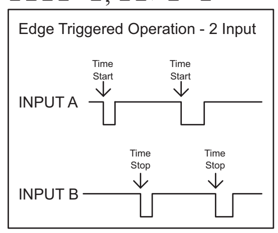


EdGE-1, EdrS-1 *

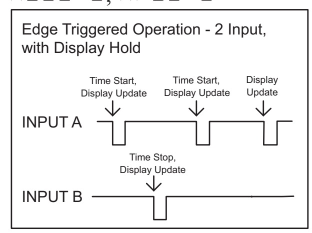


* - *Timer is reset at Time Start edge.*

EdGE-2, EdrS-2 *



HoLd-2, HrSt-2 *



* - *Timer is reset at Time Start edge.*

TIMER INPUT FILTERING

FILtEr
On

On   OFF

Provides a 50 msec debounce for the Timer Inputs (A and B). Select On when using relays or switch contacts as a signal source.

TIMING DIRECTION

t dir
UP

UP   dn

Timing direction can be reversed through a User Input. (See Module 2.)

TIMER START VALUE

t Strt
000000

000000 to 999999

The Timer returns to this value whenever a Timer Reset occurs. The value is entered in the same display format as the Timer Range selected. Non-zero values are normally used for "timing down" applications, but they can also provide an "offset" value when timing up.

TIMER STOP VALUE

t StOP
NO

NO   YES

The Timer stops when this value is reached, regardless of the signal levels on the Timer Inputs. Selecting YES will display the VALUE sub-menu where the Stop Value can be set or changed. The Stop Value is entered in the same display format as the Timer Range selected. This Stop condition is cleared when a Timer Reset occurs. Select NO if a Stop Value is not being used.

VALUE
000000

000000 to 999999

D

FLASH TIMER ANNUNCIATOR

FLASH
NO

NO t-rUN t-StOP

This parameter allows the Timer annunciator (TMR) to flash when the Timer is running or stopped/inhibited. Select NO if a flashing indicator is not desired.

TIMER RESET AT POWER-UP

t P-UP
NO

NO YES

The Timer can be programmed to Reset at each meter power-up.

TIMER INPUT STATE AT POWER-UP

InP-UP
StOP

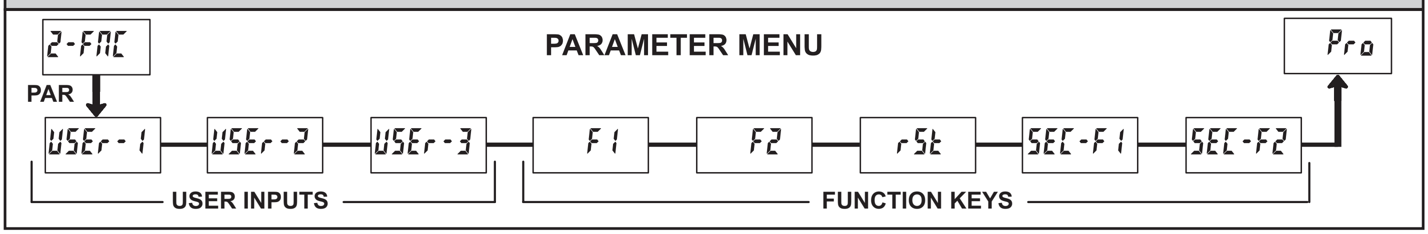
StOP SAUE

Determines the “Run/Stop” State of the Timer at Power-up. This parameter does not apply to LEUEL timer input operation.

StOP - Timer Stopped at power-up, regardless of prior run/stop state

SAUE - Timer assumes the same run/stop state it was in prior to power-down

6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)



D

Module 2 is the programming module for the rear terminal User Inputs and front panel Function Keys.

Three rear terminal User Inputs are individually programmable to perform specific meter control functions. While in the Display Mode, the function is executed when the User Input transitions to the active state. Refer to the User Input specifications for active state response times. Certain User Input functions are disabled in “Full” Programming Mode. User Inputs should be programmed while in the inactive state.

Three front panel Function Keys, **F1**, **F2** and **RST**, are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed when the key is pressed. Holding the **F1** or **F2** Function Keys for three seconds executes a secondary function. It is possible to program a secondary function without a primary function. The front panel key functions are disabled in both Programming Modes.

In most cases, if more than one User Input and/or Function Key is programmed for the same function, the maintained (level active) functions will be performed while at least one of those User Inputs or Function Keys are activated. The momentary (edge triggered) functions are performed every time any of those User Inputs or Function Keys transition to the active state.

Some functions have a sublist of parameters, which appears when **PAR** is pressed at the listed function. A sublist provides yes/no selection for Display Values or Setpoints which pertain to the programmed function. The function will only be performed on the parameters entered as YES in the sublist. If a User Input or Function Key is configured for a function with a sublist, then that sublist will need to be scrolled through each time, in order to access any parameters for the User Inputs or Function Keys which follow.

NO FUNCTION

USEr-1
NO

F1
NO

With this selection, NO function is performed. This is the factory setting for all user inputs and function keys except the Reset (**RST**) Key.

PROGRAMMING MODE LOCK-OUT

USEr-1
PLOC

Programming Mode is locked-out, as long as activated (maintained action). In Module 3, certain parameters can be setup where they are still accessible during Programming Mode Lock-out. A security code can be configured to allow complete programming access during User Input lock-out. This parameter does not apply to the function keys. Program only one user input for this function.

EXCHANGE PARAMETER LISTS

USEr-1
LISt

F1
LISt

Two lists of parameter entries are available for the Timer/Counter Start and Stop Values; Setpoint On/Off and Time-Out Values; and Setpoint Daily On/Off Occurrence (for Real-Time Clock option). The two lists are named LISt-A and LISt-b. If a User Input is used to select the list, then LISt-A is selected when the User Input is in the inactive state and LISt-b is selected when the User Input is in the active state (maintained action). If a front panel Function Key is used to select the list, then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed or when entering any Programming Mode.

To program the values for LISt-A and LISt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the Timer/Counter Start and Stop Values (t Strt, t StOP, C Strt, C StOP), and if applicable, the Setpoint On/Off and Time-Out Values (SP-1, SP-2, SP-3, SP-4, SPOF-1, SPOF-2, SPOF-3, SPOF-4, tOUt-1, tOUt-2, tOUt-3, tOUt-4), and the Setpoint Daily On/Off Occurrence (d ON-1, d ON-2, d ON-3, d ON-4, dOFF-1, dOFF-2, dOFF-3, dOFF-4). If any other parameters are changed, the other list values must be reprogrammed. Program only one user input for this function.

Note: *When downloading the Crimson® program containing List A/B, make sure that both the software and meter have the same list active. The active list in the Crimson® program is the one being displayed in Input Setup and/or Setpoint Alarms category.*

DISPLAY SELECT (Level Active)

USEr-1 → dSEL-L

When active (maintained action), the meter continuously scrolls through all displays that are not "locked-out" in the Display mode. (See Module 3 for Display Lock-out details.) A sub-menu provides Scrolling Speed selection.

SPEEd → 2.5 SEC   2.5 SEC   5 SEC

DISPLAY SELECT (Edge Triggered)

USEr-1 → dSEL-E

When activated (momentary action), the meter advances to the next display that is not "locked-out" in the Display mode. (See Module 3 for Display Lock-out details.)

DISPLAY RESET (Level Active)

USEr-1 → drSt-L   F1 → drSt-L

When active (maintained action), the meter continually resets only the currently shown display. If the RTC Time or Date is displayed, this function applies to the ***Outputs*** assigned to the RTC, and does not Reset the actual RTC Time or Date display. (See Module 6 for details on Output Assignment and Output Reset with Display Reset.)

DISPLAY RESET (Edge Triggered)

USEr-1 → drSt-E   F1 → drSt-E

When activated (momentary action), the meter resets ***only*** the currently shown display. This is the factory setting for the Reset (**RST**) key. If the RTC Time or Date is displayed, this function applies to the ***Outputs*** assigned to the RTC, and does not Reset the actual RTC Time or Date display. (See Module 6 for details on Output Assignment and Output Reset with Display Reset.)

MAINTAINED RESET (Level Active)

USEr-1 → rSt-L   F1 → rSt-L

When active (maintained action), the meter continually resets the displays entered as YES in the sublist. The sublist appears when the **PAR** key is pressed. This function does not apply to the RTC Time or Date displays.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

MOMENTARY RESET (Edge Triggered)

USEr-1 → rSt-E   F1 → rSt-E

When activated (momentary action), the meter resets the displays entered as YES in the sublist. Function does not apply to RTC Time or Date displays.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

DISPLAY HOLD (Level Active)

USEr-1 → d-HOLd   F1 → d-HOLd

When active (maintained action), the meter "freezes" the display values entered as YES in the sublist, while normal meter operation continues internally. Program only one user input for this function.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO
rtC-d	RTC Date	NO
rtC-t	RTC Time	NO

DISPLAY HOLD and RESET (Level Active Reset)

USEr-1 → HrSt-L   F1 → HrSt-L

When activated, the meter "freezes" the display values entered as YES in the sublist, before performing an internal ***Maintained Reset*** on the selected displays. This function does not apply to the RTC Time or Date displays.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

DISPLAY HOLD and RESET (Edge Triggered Reset)

USEr-1 → HrSt-E   F1 → HrSt-E

When activated, the meter "freezes" the display values entered as YES in the sublist, before performing an internal ***Momentary Reset*** on the selected displays. This function does not apply to the RTC Time or Date displays. Program only one user input for this function.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

D

INHIBIT (Level Active)

USEr-1 → INHIbt   F1 → INHIbt

When active (maintained action), timing and counting ceases for the displays entered as YES in the sublist. The inhibit function is not a t Strt or t StOP event in Setpoint programming. This function does not apply to RTC Time or Date displays. Program only one user input for this function.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

CHANGE DIRECTION (Level Active)

USEr-1 → Ch-dir   F1 → Ch-dir

When active (maintained action), the timing or counting direction for the display entered as YES in the sublist, will be reversed from the direction set by the Timing Direction (t-dir) and/or Counting Direction (C-dir) parameters in Modules 1 and 4. (Program only one User Input per display for this function.) This function does not apply to RTC Time or Date displays.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

CHANGE DISPLAY INTENSITY LEVEL

USEr-1 → d-LEV   F1 → d-LEV

When activated (momentary action), the display intensity changes to the next intensity level (of 4). The four levels correspond to Display Intensity Level (d-LEV) settings of 0, 3, 8 & 15. The intensity level, when changed via the User Input/Function Key, is not retained at power-down, unless Quick Programming or Full Programming mode is entered and exited. The unit will power-up at the last saved intensity level.

Note: The next two parameters only appear when an RS232 or RS485 Serial Communications Card is installed in the meter.

PRINT REQUEST

USEr-1 → Print   F1 → Print

When activated, the meter issues a block print through the serial port. The specific values transmitted during a print request are selected with the Print Options parameter in Module 7. For User Inputs (level active), the meter transmits blocks repeatedly as long as the input is active. For Function Keys, (edge triggered) only one block is transmitted per key press.

PRINT REQUEST and RESET (Edge Triggered)

USEr-1 → Pr-rSt   F1 → Pr-rSt

When activated (momentary action), the meter first issues a block print through the serial port, and then performs a ***Momentary Reset*** on the displays entered as YES in the sublist. The specific values transmitted in the print block are selected with the Print Options parameter in Module 7. Only one transmit and reset occurs per User Input activation or Function Key press.

DISPLAY	DESCRIPTION	FACTORY
t-dSP	Timer	NO
C-dSP	Cycle Counter	NO

Note: The remaining parameters only appear when a Setpoint Card is installed in the meter.

OUTPUT HOLD (Level Active)

USEr-1 → O-HOLd   F1 → O-HOLd

When active (maintained action), the meter "holds" (maintains) the present output state for all Setpoints entered as YES in the sublist. Does not apply to Output Set and Reset User Inputs. Program only one user input for this function.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

OUTPUT SET (Level Active)

USEr-1 → OSEt-L   F1 → OSEt-L

When activated (maintained action), the meter continually activates the output for all Setpoints entered as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

OUTPUT SET (Edge Triggered)

USEr-1 → OSEt-E   F1 → OSEt-E

When activated (momentary action), the meter activates the output for all Setpoints entered as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

OUTPUT RESET (Level Active)

USEr-1 → OrSt-L   F1 → OrSt-L

When activated (maintained action), the meter continually deactivates the output for all Setpoints entered as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

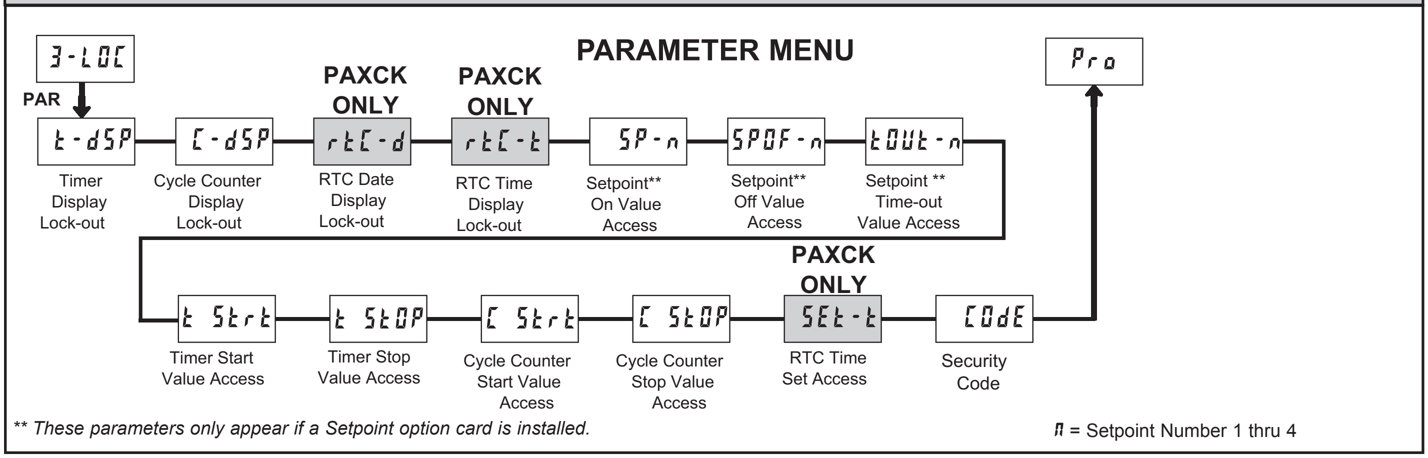
OUTPUT RESET (Edge Triggered)

USEr-1 → OrSt-E   F1 → OrSt-E

When activated (momentary action), the meter deactivates the output for all Setpoints entered as YES in the sublist.

DISPLAY	DESCRIPTION	FACTORY
SP-1	Setpoint 1	NO
SP-2	Setpoint 2	NO
SP-3	Setpoint 3	NO
SP-4	Setpoint 4	NO

6.3 MODULE 3 - DISPLAY AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)



Module 3 is the programming module for setting the Display Lock-out Parameters and the "Quick Programming Mode" Value Access Parameters. In the Quick Programming mode, after the PROGRAM LOCKOUT PARAMETERS and before the Security Code (COdE), a Display Intensity Level (d-LEU) parameter is available when the security code is non-zero. It allows the display intensity to be set to 1 of 16 levels (0-15).

DISPLAY LOCK-OUT PARAMETERS

When operating in the Display Mode, the meter displays can be viewed consecutively by repeatedly pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown. Timer (TMR), Cycle Counter (CNT), or Date (DAT). The Time Display for the Real-Time Clock is shown with no annunciator. Any of these displays can be locked from view with the DISPLAY LOCK-OUT parameters. Using these parameters, each display can be programmed for "Read" or "Lock" defined as follows:

SELECTION	DISPLAY	DESCRIPTION
Read	rEd	Visible in Display Mode
Lock	LOC	Not visible in Display Mode

TIMER DISPLAY LOCK-OUT
CYCLE COUNTER DISPLAY LOCK-OUT
PAXCK: REAL-TIME CLOCK DATE/TIME DISPLAY LOCK-OUT *

t-dSP rEd   C-dSP LOC   rtC-d LOC   rtC-t LOC

These displays can be programmed for rEd or LOC. When a particular meter function is not used, the Display Lock-out should be set to LOC for that display.

PROGRAM LOCK-OUT PARAMETERS (VALUE ACCESS)

"Full" Programming Mode permits all parameters to be viewed and modified. This programming mode can be locked with a Security Code and/or a User Input. When locked, and the **PAR** key is pressed, the meter enters a Quick Programming Mode. In this mode, access to Setpoint Values, Timer & Cycle Counter Start/Stop Values, and Time Setting for the Real-Time Clock can be programmed for "Read", "Enter", or "Lock" defined as follows:

SELECTION	DISPLAY	DESCRIPTION
Read	rEd	Visible, not changeable, in Quick Programming Mode
Enter	Ent	Visible and changeable in Quick Programming Mode
Lock	LOC	Not visible in Quick Programming Mode

SETPOINT 1 to 4 VALUE ACCESS ** (n = 1 thru 4)

SP-n LOC   SPOF-n LOC   tOUt-n LOC

Setpoint Values for SP1 thru SP4 can be programmed for rEd, Ent, or LOC. SPOF-n and tOUt-n are only displayed when they apply to the Setpoint Action (ACt-n) programmed for that particular Setpoint. (See Module 6 for details.)

TIMER & CYCLE COUNTER START/STOP VALUE ACCESS

t Strt LOC   t StOP LOC   C Strt LOC   C StOP LOC

Timer & Counter Start/Stop Values can be programmed for rEd, Ent, or LOC.

PAXCK: REAL-TIME CLOCK TIME SETTING ACCESS

SEt-t LOC   Ent LOC

This parameter can be programmed for Ent or LOC. Selecting Ent allows setting or changing the RTC Time in Quick Programming mode.

SECURITY CODE

COdE 000   000 to 255

Entry of a non-zero value will cause the COdE prompt to appear when trying to access the "Full" Programming Mode. Access will only be allowed after entering a matching security code or the universal unlock code of 222. With this lock-out, a User Input would not have to be used for the Program Lock-out function. Note however, the Security Code lock-out is overridden when an User Input, configured for Program Lock-out (PLOC), is not active (See Chart.)

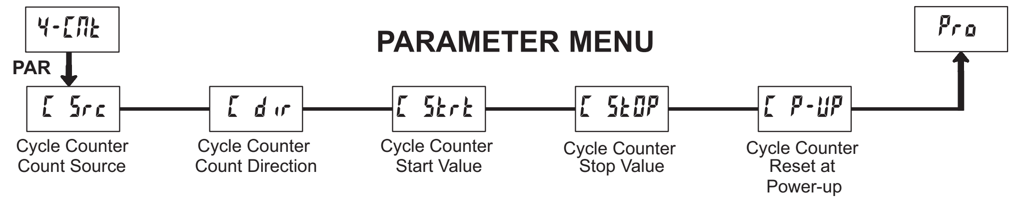
PROGRAMMING MODE ACCESS

SECURITY CODE	USER INPUT SELECTION	USER INPUT STATE	MODE WHEN "PAR" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
0	not PLOC	———	Full Programming	Immediate access
not 0	not PLOC	———	Quick Programming	After Quick Programming with correct Security code entry
not 0	PLOC	Active	Quick Programming	After Quick Programming with correct Security code entry
not 0	PLOC	Not Active	Full Programming	Immediate access
0	PLOC	Active	Quick Programming	No access
0	PLOC	Not Active	Full Programming	Immediate access

Throughout this bulletin, Programming Mode (without Quick in front) always refers to "Full" Programming.

D

6.4 MODULE 4 - CYCLE COUNTER PARAMETERS (4-CNt)



Module 4 is the programming module for the Cycle Counter Parameters. In the Display Mode, the CNT annunciator indicates the Cycle Counter display is currently being shown. An **EXCHANGE PARAMETER LISTS** feature, which includes the Cycle Counter Start and Stop Values, is explained in Module 2.

CYCLE COUNTER COUNT SOURCE

C Src
NONE

NONE USEr-1 t-rSt
O1-ON O1-OFF O2-ON O2-OFF
O3-ON O3-OFF O4-ON O4-OFF

This parameter selects the source from which a count is added to or subtracted from the Cycle Counter. Select NONE if the Cycle Counter is not being used, which will exit the module and bypass the remaining parameters.

When USEr-1 is selected, a count is generated each time the User 1 Input is activated. When selected as the count source, User Input 1 can still be programmed to perform a User Function described in Module 2, if desired. In this case, the Cycle Counter would be counting the number of times the particular User Function occurred.

The Timer Reset (t-rSt) selection generates a count when either a manual or automatic reset occurs. (See Module 6 for programming Automatic Resets.)

The Output ON/OFF selections generate a count when the chosen output either activates or deactivates. These selections only appear when a Setpoint Card is installed. O3 and O4 selections only appear for Quad Setpoint cards.

D

CYCLE COUNTER COUNTING DIRECTION

C dir
UP

UP dN

Counting direction can be reversed through a User Input. (See Module 2.)

CYCLE COUNTER START VALUE

C Strt
000000

000000 to 999999

The Cycle Counter returns to this value whenever a Cycle Counter Reset occurs. Non-zero values are normally used for "down counting" applications, but they can also provide an "offset" value when counting up.

CYCLE COUNTER STOP VALUE

CStOP
NO

NO YES

The Cycle Counter stops counting when this value is reached, regardless of the operation of the Timer. Selecting YES will display the VALUE sub-menu where the Stop Value can be set or changed. The Stop condition is cleared when a Cycle Counter Reset occurs. Select NO if a Stop Value is not used.

VALUE
000000

000000 to 999999

CYCLE COUNTER RESET AT POWER-UP

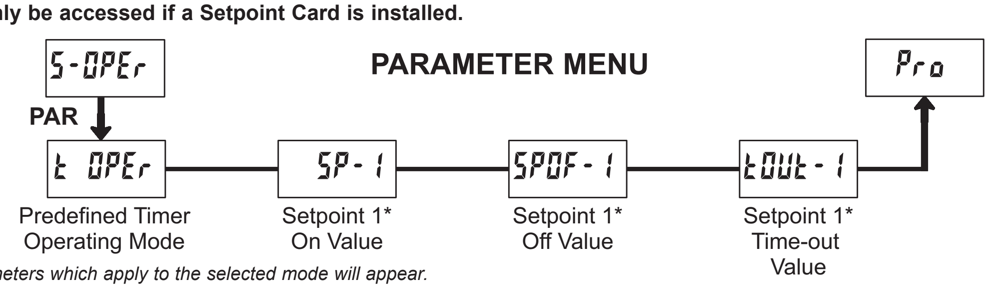
C P-UP
NO

NO YES

The Cycle Counter can be programmed to Reset at each meter power-up.

6.5 MODULE 5 - TIMER OPERATING MODES (5-OPEr)

This module can only be accessed if a Setpoint Card is installed.



** Only the value parameters which apply to the selected mode will appear.*

PREDEFINED TIMER OPERATING MODE

t OPEr
NO

- ON-dLY - On-Delay Timing
- OF-dLY - Off-Delay Timing
- rEPEAt - Repeat Cycle Timing
- dLY INt - On-Delay/Interval Timing
- INt-L - Interval Timing (Level Triggered)
- INt-E - Interval Timing (Edge Triggered)

This parameter is used to select Predefined Operating Modes for the Timer. These modes cover a variety of timing applications frequently encountered in industrial control processes. When using a Predefined mode, the operator needs only to set the actual Setpoint On/Off or Time-out values for the particular application. However, each programming parameter will still be accessible, in order to make modifications to the predefined settings if desired.

The Predefined modes control the activation and deactivation of Output 1, in relation to Start and Reset signals applied to the Timer inputs. (See timing diagrams which follow.) When a selection other than NO is chosen, the parameters for Setpoint 1 (SP-1) in Module 6 are automatically configured to implement the selected operating mode. For some modes, parameters in Modules 1 and 2 are also automatically configured to properly implement the predefined mode. Refer to the chart shown with the timing diagrams for the specific parameters loaded for each predefined mode. Also, note the specific external wiring or plug jumper settings required for some modes.

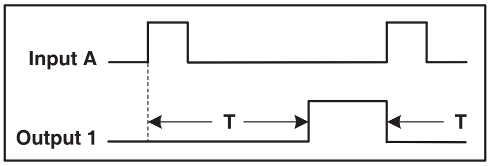
The Setpoint On/Off or Time-out values for the specific application should be entered directly in Module 5 after selecting the operating mode. Only the value parameters which apply to the selected mode are displayed. These values can also be entered through Module 6, Setpoint (Alarm) Parameters, if desired.

Select NO if not using a Predefined Operating Mode, in which case Setpoint parameters must all be individually programmed for the particular application.

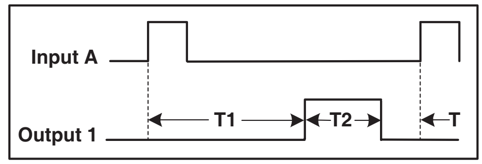
Timing Diagrams for Predefined Timer Operating Modes

***NOTE**: Input A is shown as a Sourcing input (active high). If a Sinking input (active low) is used, the logic levels for Input A would be inverted.*

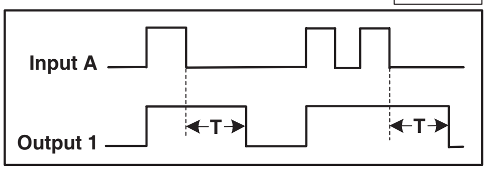
On-Delay Timing ON-dLY



On-Delay / Interval Timing dLY INt

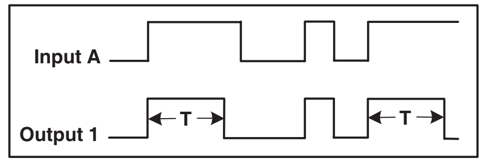


Off-Delay Timing OF-dLY



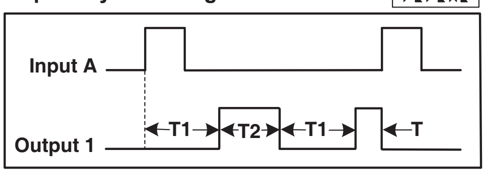
The input signal must be wired to both the Input A and User Input 1 terminals. The Timer Input plug jumper and the User Input plug jumper must both be set to the same position (either both SNK or both SRC).

Interval Timing (Level triggered) INt-L

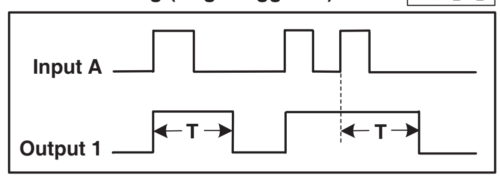


The input signal must be wired to both the Input A and User Input 1 terminals. The Timer Input plug jumper and the User Input plug jumper must be set to opposite positions (one SNK, one SRC) and the Input signal must be a current sinking type (i.e. pulls input to common).

Repeat Cycle Timing rEPEAt



Interval Timing (Edge triggered) INt-E



D

Parameter Settings for Predefined Timer Operating Modes

MODULE 1 - Timer Input Parameters (1-INP)

DISPLAY	PARAMETER	ON-dLY	OF-dLY	rEPEAt	dLY INt	INt-L	INt-E
INP OP	Timer Input Operation	EdrS-2	EdrS-2	EdrS-2	EdrS-2	LEUrSt	EdrS-2

MODULE 2 - User Input Parameters (2-FNC)

DISPLAY	PARAMETER	ON-dLY	OF-dLY	rEPEAt	dLY INt	INt-L	INt-E
USEr-1	User Input 1	N/A	rSt-L	N/A	N/A	OrSt-E	N/A
rSt	Reset Key	NO	NO	NO	NO	(SP1-YES) NO	NO

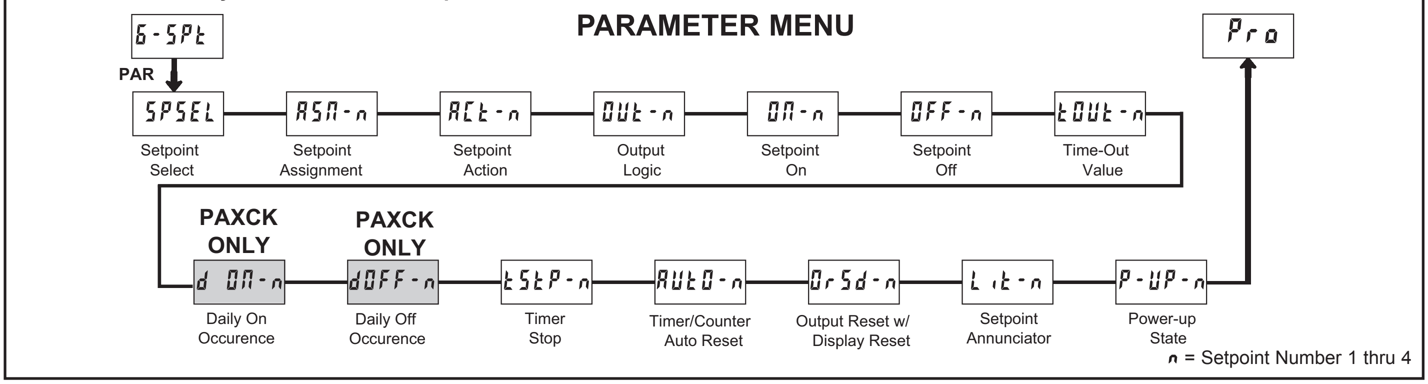
MODULE 6 - Setpoint Parameters (6-SPt)

DISPLAY	PARAMETER	ON-dLY	OF-dLY	rEPEAt	dLY INt	INt-L	INt-E
SPSEL	Setpoint Select	SP-1	SP-1	SP-1	SP-1	SP-1	SP-1
ASN-1	Setpoint Assignment	t-dSP	t-dSP	t-dSP	t-dSP	t-dSP	t-dSP
ACt-1	Setpoint Action	LAtCH	ON-OFF	ON-OFF	t-OUt	ON-OFF	t-OUt
OUt-1	Output Logic	NOr	NOr	NOr	NOr	NOr	NOr
ON-1	Setpoint On	UALUE	t-Strt	UALUE	UALUE	t-Strt	t-Strt
SP-1	Setpoint On Value	T*	N/A	T1*	T1*	N/A	N/A
OFF-1	Setpoint Off	N/A	UALUE	UALUE	N/A	UALUE	N/A
SPOF-1	Setpoint Off Value	N/A	T*	T2*	N/A	T*	N/A
tOUt-1	Time-out Value	N/A	N/A	N/A	T2*	N/A	T*
tStP-1	Timer Stop	NO	O-OFF	NO	O-OFF	O-OFF	O-OFF
AUtO-1	Timer/Counter Auto Reset	NO	NO	O-OFF	NO	NO	NO
OrSd-1	Output Reset w/display Reset	NO	NO	NO	NO	NO	NO
L it-1	Setpoint Annunciator	NOr	NOr	NOr	NOr	NOr	NOr
P-UP-1	Power-up State	OFF	OFF	OFF	OFF	OFF	OFF

** Refer to timing diagrams. These parameters are the actual Setpoint On/Off or Time-Out values set by the user for the specific application.*

6.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPt)

This module can only be accessed if a Setpoint Card is installed.



Module 6 is the programming module for the Setpoint (Alarm) Output Parameters. This programming module can only be accessed if a Setpoint card is installed. Depending on the card installed, there will be two or four Setpoint outputs available. The Setpoint Assignment and Setpoint Action parameters determine the applicable Setpoint features, and dictate which subsequent parameters will appear for the Setpoint being programmed.

This section of the bulletin replaces the bulletin shipped with the Dual and Quad Setpoint plug-in cards. Discard the separate bulletin when using Setpoint plug-in cards with the PAXCK and PAXTM.

D

SETPOINT SELECT

SPSEL
NO

NO SP-1 SP-2
SP-3 SP-4

Select the Setpoint (alarm) output to be programmed. This provides access to the parameters for that particular Setpoint. The "n" in the following parameter displays, reflects the chosen Setpoint number (1 thru 4). After the chosen Setpoint is programmed, the display returns to SPSEL NO. Select the next Setpoint to be programmed and continue this sequence for each Setpoint. Select NO to exit the module. SP-3 and SP-4 apply to Quad Setpoint cards only.

SETPOINT ASSIGNMENT

ASN-n
NONE

NONE t-dSP C-dSP rtC-d rtC-t

Select the meter display to which the Setpoint is assigned: Timer (t-dSP), Cycle Counter (C-dSP), Real-Time Clock Date display (rtC-d) or Real-Time Clock Time display (rtC-t). *(The rtC-d and rtC-t selections only appear if a Real-Time Clock option card is installed.)*

By selecting NONE, the Setpoint is not assigned to a specific display. However, the output can still be activated (set) and deactivated (reset) by various "events". Such events include the Timer starting or stopping, or another Setpoint output turning On or Off. The output can also be set and reset through a User Input function or through serial communications.

SETPOINT ACTION

ACt-n
LAtCH

LAtCH t-OUt ON-OFF

This parameter determines the mode for output ***deactivation*** as shown below. Output ***activation*** is controlled by the **SETPOINT ON** parameter setting.

DISPLAY	DESCRIPTION	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	At Reset (Manual or Automatic)
t-OUt	Timed Output Mode	After "Time-Out Value" Elapses
ON-OFF	On-Off Output Mode	Based on "Setpoint Off" Setting

The t-OUt and ON-OFF selections are not available when Setpoint is assigned to rtC-d.

OUTPUT LOGIC

OUt-n
NOr

NOr rEU

Normal Output Logic (NOr) turns the output "on" when activated and "off" when deactivated. Reverse Output Logic (rEU) turns the output "off" when activated and "on" when deactivated.

SETPOINT ON

ON-n
UALUE

UALUE t-Strt t-StOP
01-ON 01-OFF 02-ON 02-OFF
03-ON 03-OFF 04-ON 04-OFF

This parameter determines when the Setpoint output will activate. Output activation can occur at a specific Setpoint Value (UALUE) or can be triggered by various "events", as shown in the parameter list. Such events include the Timer starting (t-Strt) or stopping (t-StOP), or by the action (event) that causes another Setpoint output to turn On or Off. When programmed for an event, the Setpoint must not be used as the Setpoint On event for another Setpoint.

Selecting UALUE displays a sub-menu where the Setpoint value is entered. The Setpoint value is based on the meter display to which the Setpoint is assigned (ASN-n). When assigned to the Timer or Cycle Counter, the Setpoint value is entered in the same format as the assigned display. When assigned to the Real-Time Clock Date Display (rtC-d), the date value is entered in month.day.year format (nn.dd.yy). When assigned to the Real-Time Clock Time Display (rtC-t), the Setpoint value is always entered in HH-NNP format (Hours-Minutes with AM/PM selection). In Setpoint One-shot mode (See Daily On Occurrence), the One-shot Setpoint is enabled (armed) by scrolling the AM/PM digit until the 2nd digit decimal point is lit.

SP-n
000000

000000 to 999999

SETPOINT OFF

OFF-n
UALUE

UALUE t-Strt t-StOP
01-ON 01-OFF 02-ON 02-OFF
03-ON 03-OFF 04-ON 04-OFF

The Setpoint Off parameter only appears when the Setpoint Action (ACt-n) is programmed for On-Off Output mode (ON-OFF). In this mode, this parameter determines when the Setpoint output will deactivate. Output deactivation can occur at a specific Setpoint Off Value (UALUE) or can be triggered by various "events", as shown in the parameter list. Such events include the Timer starting (t-Strt) or stopping (t-StOP), or by the action (event) that causes another Setpoint output to turn On or Off. When programmed for an event, the Setpoint must not be used as the Setpoint Off event for another Setpoint.

Selecting UALUE will display a sub-menu where the Setpoint Off value is entered. The Setpoint Off value is based on the meter display to which the Setpoint is assigned (ASN-n). When assigned to the Timer or Cycle Counter, the value is entered in the same format as the assigned display. When assigned to the Real-Time Clock Date Display (rtC-d), the date value is entered in month. day.year format (nn.dd.yy). When assigned to the Real-Time Clock Time Display (rtC-t), the value is always entered in HH-NNP format (Hours-Minutes with AM/PM selection).

SPOF-n
000100

000000 to 999999

TIME-OUT VALUE

tOUt-n
00.01.00

00.00.02 to 99.59.99

The Time-Out Value only appears when the Setpoint Action (ACt-n) is programmed for Timed Output mode (t-OUt). In this mode, the Time-Out Value is the Setpoint Output time duration, from activation to deactivation. This value is always entered in minutes, seconds, and hundredths of seconds format. The maximum Time-Out Value is 99 minutes 59.99 seconds.

PAXCK: DAILY ON OCCURRENCE

d On-n
NO

NO YES

This parameter only appears when the Setpoint is assigned (ASN-n) to the Real-Time Clock Time display (rtC-t). This parameter determines the days of the week when the Setpoint output will activate.

Selecting YES displays a sublist for choosing the days of the week. On all days entered as YES in the sublist, the output will activate. On all days entered as NO, the output will not activate. The output activation is repetitive, and will occur every week on the chosen day(s).

DISPLAY	DESCRIPTION	FACTORY
Sun	Sunday	NO
Mon	Monday	YES
tuE	Tuesday	YES
WEd	Wednesday	YES
thu	Thursday	YES
Fri	Friday	YES
SAt	Saturday	NO

Setpoint One-Shot Mode

If all days are set to NO, the Setpoint will operate in "One-shot" mode. When a One-shot setpoint is enabled (armed), the setpoint output will activate at the set time and disable itself from activating again. To enable or re-enable a one-shot alarm, go to the Setpoint value entry display and press the Up or Dn key repeatedly while the AM/PM digit is selected (flashing). When the 2nd digit decimal point is lit, the Setpoint is enabled. The Setpoint enable status is saved at power-down. The enable state of the Setpoint is not affected or changed when the Parameter List is exchanged.

The setpoint will turn off (de-activate) as programmed per the Setpoint Action selected. If On-OFF mode is selected, program all the Daily Off days to YES to have the Setpoint turn off at the next Daily Off Occurrence. The One-shot status can also be viewed or set from the Setpoint Off value entry display.

PAXCK: DAILY OFF OCCURRENCE

dOFF-n
NO

NO YES

This parameter only appears when the Setpoint is assigned (ASN-n) to the Real-Time Clock Time display (rtC-t) and when the Setpoint Action (ACt-n) is programmed for On-Off Output mode (On-OFF). In this mode, this parameter determines the days of the week when the Setpoint output will deactivate.

Selecting YES displays a sublist for choosing the days of the week. On all days entered as YES in the sublist, the output will deactivate. On all days entered as NO, the output will not deactivate. The output deactivation is repetitive, and will occur every week on the chosen day(s).

DISPLAY	DESCRIPTION	FACTORY
Sun	Sunday	NO
Mon	Monday	YES
tuE	Tuesday	YES
WEd	Wednesday	YES
thu	Thursday	YES
Fri	Friday	YES
SAt	Saturday	NO

TIMER STOP

tStP-n
NO

NO O-ON O-OFF

Timer stops when the Setpoint output activates (O-ON) or deactivates (O-OFF). Select NO if the output should not affect the Timer Run/Stop status.

Stopping the Timer as a result of this parameter does not constitute a t-StOP condition (event) for the Setpoint On or Setpoint Off parameters.

TIMER/COUNTER AUTO RESET

AUtO-n
NO

NO O-ON O-OFF

When the Setpoint output activates (O-ON) or deactivates (O-OFF), the meter automatically resets the Setpoint Assignment display (ASN-n). Select NO if the Setpoint output should not cause the assigned display to reset. Does not apply to manual activations or deactivations by user input, function key, or serial communications.

OUTPUT RESET WITH DISPLAY RESET

OrSd-n
NO

NO YES

When YES is selected, the Setpoint output will reset when the Setpoint Assignment display (ASN-n) resets. Select NO if the Setpoint output should not reset when the assigned display resets.

D

SETPOINT ANNUNCIATOR

L it-n
NOr

NOr rEV FLASH OFF

This parameter controls the illumination of the LED annunciator for the corresponding Setpoint output (SPn) as follows:

Normal (NOr) – Annunciator displayed when output is "on" (activated)
Reverse (rEV) – Annunciator displayed when output is "off" (deactivated)
Flash (FLASH) – Annunciator and display flashes when output is "on" (activated)
Off (OFF) – Annunciator disabled

SETPOINT POWER-UP STATE

P-UP-n
OFF

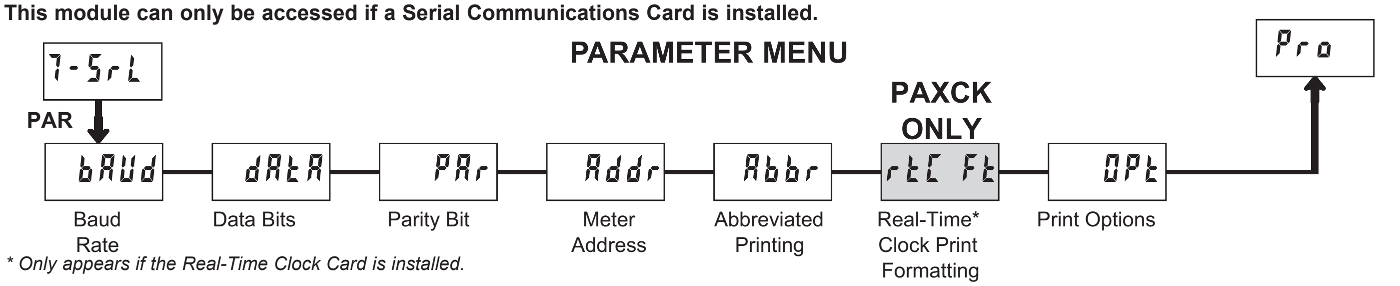
OFF ON SAVE

Determines the on/off state of the Setpoint output at power-up. Regardless of output logic setting (normal or reverse).

OFF – Deactivates the Setpoint output at power-up
ON – Activates the Setpoint output at power-up
SAVE – Restores the output to the state it was in prior to power-down

6.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL)

This module can only be accessed if a Serial Communications Card is installed.



** Only appears if the Real-Time Clock Card is installed.*

Module 7 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the PAX with those of the host computer or other serial device, such as a terminal or printer. This programming module can only be accessed if an RS232 or RS485 Serial Communications card is installed.

This section also includes an explanation of the commands and formatting required for communicating with the PAX. In order to establish serial communications, the user must have host software that can send and receive ASCII characters. Red Lion's Crimson® software can be used for configuring the PAX. (See ordering information.) For serial hardware and wiring details, refer to section 4.5 Serial Communication Wiring.

This section of the PAXTM/CK bulletin replaces the bulletin shipped with the RS232 and RS485 serial communications plug-in cards. Discard the separate bulletin when using those serial plug-in cards with the PAXTM/CK. Also, this section does NOT apply to the DeviceNet, Modbus, or Profibus-DP communication cards. For details on the operation of the Fieldbus cards, refer to the bulletin shipped with each card.

D

BAUD RATE

bAUd
9600

300 600 1200 2400
4800 9600 19200

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value at which all the serial equipment are capable of transmitting and receiving data.

DATA BITS

dAtA
7

7 8

Select either 7- or 8-bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr
Odd

nO Odd EUEn

This parameter only appears when the Data Bits parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to nO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr
00

00 to 99

Enter the serial meter (node) address. With a single meter, an address is not needed and a value of zero can be used. With multiple meters (RS485 applications), a unique 2 digit address number must be assigned to each meter.

Addresses 98 and 99 are reserved to configure a unit as a serial real-time clock master. See Serial Real-time Clock Master Adressing.

ABBREVIATED PRINTING

Abbr
nO

nO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value (T) command or a Block Print Request (P) command. Select nO for a Full print transmission, which consists of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting affects all the parameters selected in the **PRINT OPTIONS**. (Note: If the meter address is 00, the address will not be sent during a Full transmission.)

PAXCK: REAL-TIME CLOCK PRINT FORMATTING

rtC Ft
YES

nO YES

This parameter determines the formatting of the Real-Time Clock (RTC) values transmitted from the meter in response to a Transmit Value (T) command or a Block Print Request (P) command. This parameter appears only when a Real-Time Clock plug-in option card is installed.

When YES is selected, RTC values are formatted as per the RTC Time and Date Display Formats programmed in Module 8. The Day of Week value is sent as a character string.

When nO is selected, the meter sends the RTC values as numeric data only. This selection allows the RTC values to be recognized by the Red Lion HMI products. RTC Time/Date units are separated by a ".". The Day is sent as a single number as shown below.

TIME - Hours (24-Hr. format), Minutes, Seconds (HHMMSS)
DATE - Month, Day, Year (mmddyy)
DAY - 1 = Sunday thru 7 = Saturday

PRINT OPTIONS

OPt
nO

This parameter selects the meter values transmitted in response to a Print Request. A Print Request is sometimes referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the block print. All parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as nO will not be sent.

DISPLAY	PARAMETER	FACTORY	MNEMONIC
t-dSP	Timer	YES	TMR
C-dSP	Cycle Counter	nO	CNT
rtC-d	RTC Date*	nO	DAT
rtC-t	RTC Time*	nO	TIM
SPnt	Setpoint Values*	nO	SP1 SP2 SP3 SP4
SPntOF	Setpoint Off/Time-Out Values*	nO	SO1 SO2 SO3 SO4
StrStP	Timer/Cnt Start & Stop Values	nO	TST TSP CST CSP

* *These values are plug-in card dependent.*

SERIAL RTC MASTER ADDRESSING

A meter, having software code version 2.3 or greater, with a Real Time Clock Card and an RS485 Serial Communication Card installed, can act as a Serial RTC Master, when programmed with meter address 98 or 99. With this feature, whenever the Master meter's time, date or day is changed, through quick or main programming, it will transmit and make the same change to the other PAXCK's on the RS485 bus. Only one meter should be configured as Master. This Master, with address 98 or 99, should also be programmed as the "Host" in module 8-rtc under Clock Synchronization. With it programmed as Host, the other PAXCK Slaves will update hours, minutes and seconds to the Host once an hour and the Real-Time Clock Wiring (terminals 16-18) will not be necessary.

Meter addresses 98 and 99 are distinguished as follows:With address 98, the meter will transmit the change to all meters on the RS485 bus addressed as "0". This is useful when using both newer or older software code version meters, or when another master (computer, operator interface) is not being used.

With address 99, the meter will transmit the change to all, software code version 2.3 or greater, meters on the RS485 bus using a global broadcast address suffix. This is useful when it is necessary to have unique or other than 0 serial meter addresses or when having a computer or operator interface connected.

SENDING SERIAL COMMANDS AND DATA

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by the command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character.
V	Value change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character
P	Block Print Request (read)	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. The address suffix , "?" is the global broadcast address specifier. A command string that is sent with N? prefix will be accepted by all PAXCKs on the RS485 network (software code version 2.3 or greater). This is useful for setting all meters to the current time, date or day that may have unique meter addresses on a bus. It is important not to send (P)rint or (T)ransmit commands using N? prefix, as it will result in multiple meters responding at the same time. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print the options. If constructing a value change command (writing data), the numeric data is sent next.
4. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

*Note: On a change value command (V), if the command string is terminated with the * character, all values are stored in E^2PROM memory. Values are not stored if the $ terminator is used.*

Register Identification Chart

ID	VALUE DESCRIPTION	REGISTER NAME [1]	COMMAND [2]	TRANSMIT DETAILS [3]
A	Timer Value	TMR	T, V, R	6 digit
B	Cycle Counter Value	CNT	T, V, R	6 digit
C	RTC Time Value	TIM	T, V	6 digit
D	RTC Date Value	DAT	T, V	6 digit
E	Setpoint 1	SP1	T, V, R	6 digit
F	Setpoint 2	SP2	T, V, R	6 digit
G	Setpoint 3	SP3	T, V, R	6 digit
H	Setpoint 4	SP4	T, V, R	6 digit
I	Setpoint 1 Off Value	SO1	T, V	6 digit
J	Setpoint 2 Off Value	SO2	T, V	5 digit
K	Setpoint 3 Off Value	SO3	T, V	6 digit
L	Setpoint 4 Off Value	SO4	T, V	6 digit
M	Timer Start Value	TST	T, V	6 digit
O	Cycle Counter Start Value	CST	T, V	6 digit
Q	Timer Stop Value	TSP	T, V	6 digit
S	Cycle Counter Stop Value	CSP	T, V	6 digit
U	Auto/Man Register	MMR	T, V	0 - auto, 1 - manual
W	Day of Week Value	DAY	T, V	1 = Sun....7 = Sat
X	Setpoint Register	SOR	T, V	0 - not active, 1 - active

1. Register Names are also used as Register Mnemonics during full transmission.
2. The registers associated with the P command are set up in Print Options (Module 7).
3. Unless otherwise specified, the Transmit Details apply to both T and V Commands.

D

Command String Examples:

1. Address = 17, Write 350 to Setpoint 1
   String: N17VE350$
2. Address = 5, Cycle Counter value, response time of 50 to 100 msec. min.
   String: N05TB*
3. Address = 0, Reset Timer value
   String: RA*

Transmitting Data To the Meter

Numeric data sent to the meter must be limited to Transmit Details listed in the Register Identification Chart. Leading zeros are ignored. The meter ignores any decimal point and conforms the number to the scaled resolution. (ie. The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

For RTC Time [C] and Date [D] Value:

Time - 24 Hours, Minutes, Seconds (HHMMSS)
Ex: 083000 = 8:30 AM, 144500 = 2:45 PM

Date - Month, Day, Year (mmddyy)
Ex: 123101 = December 31, 2001

Day - 1 = Sunday through 7 = Saturday
EX: 3 = Tuesday

Notes:
1. *Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.*
2. *The date and day must be set separately.*

Transmitting Data From the Meter

Data is transmitted from the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response is established in Module 7.

Full Transmission (Abbr = NO)

BYTE	DESCRIPTION
1, 2	2 byte Node (Meter) Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte numeric data field: 6 bytes for number, up to 3 for decimal points.
19	<CR> (Carriage return)
20	<LF> (Line feed)
21	<SP> (Space)✰
22	<CR> (Carriage return)✰
23	<LF> (Line feed)✰

✰ *These characters only appear in the last line of a block print.*

The first two characters transmitted are the unit address. If the address assigned is 0, two spaces are substituted. A space follows the unit address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (decimal points are loaded depending on timer range selected). The data is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with <CR> and <LF>. When a block print is finished, an extra <SP>, <CR>, and <LF> are used to provide separation between the transmissions.

Abbreviated Transmission (Abbr = YES)

BYTE	DESCRIPTION
1-12	12 byte data field, 6 bytes for number, up to 3 bytes for decimal points.
13	<CR> (Carriage return)
14	<LF> (Line feed)
15	<SP> (Space)✰
16	<CR> (Carriage return)✰
17	<LF> (Line feed)✰

✰ *These characters only appear in the last line of a block print.*

The abbreviated response suppresses the address and register mnemonics, leaving only the numeric part of the response.

Note: Transmissions are formatted to match the way the parameter is displayed. This includes setpoints.

Example: SP1 assigned to RTC. RTC format = 12:00 P.
SP1 printout = 12:00 P.

Note: When communicating with a Red Lion Controls HMI unit, set rtC Ft in programming module 7 (serial) to NO. This formats the RTC parameters to:
Time - 24 Hours, Minutes, Seconds
Date - Month, Day, Year
Day - 1 = Sunday through 7 = Saturday
Decimal points are substituted for all punctuation.

Meter Response Examples:

1. Address = 17, full field response, Cycle Counter = 875
   17 CNT 875 <CR><LF>
2. Address = 0, full field response, Setpoint 2 = 250.5
   SP2 250.5<CR><LF>
3. Address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint output. In Manual Mode (1) the outputs are defined by the registers SOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

U abcd
d = SP4
c = SP3
b = SP2
a = SP1

Example: VU0011 places SP3 and SP4 in manual.

Setpoint Output Register (SOR) ID: X

This register is used to view or change the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A "0" in the setpoint location means the output is inactive and a "1" means the output is active. The output logic parameter in Module 6 will affect the active logic state.

X abcd
d = SP4
c = SP3
b = SP2
a = SP1

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change.

Example: VX10* will result in output 1 active and output 2 inactive.

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

Refer to the Timing Diagrams below. At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*, $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 times the # of characters) / baud rate

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time window of 50 msec. minimum and 100 msec. maximum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time window (t_2) of 2 msec. minimum and 50 msec. maximum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

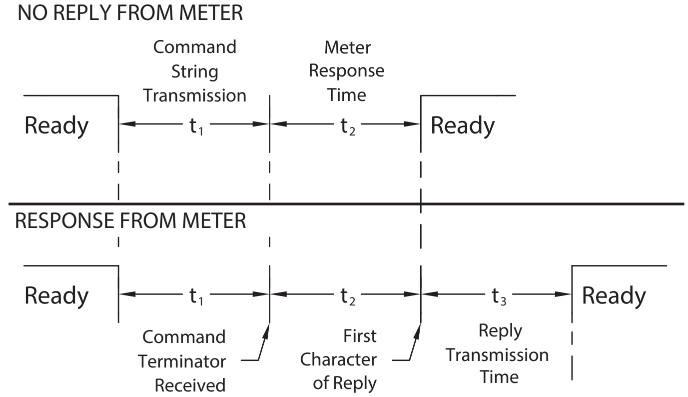
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

t_3 = (10 times the # of characters) / baud rate

SERIAL TIMING

COMMAND	COMMENT	PROCESS TIME (t_2)
R	Reset	2-50 msec.
V	Write	100-200 msec.
T	Transmit	2-50 msec. for $
		50-100 msec. for *
P	Print	2-50 msec. for $
		50-100 msec. for *

Timing Diagrams



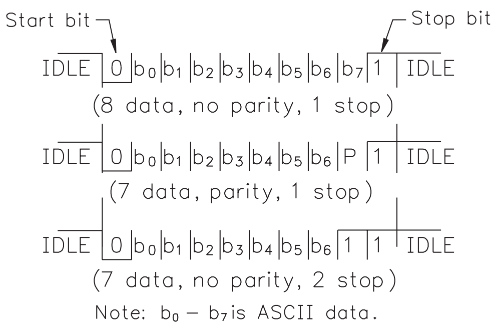
COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -25 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +25 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters. Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

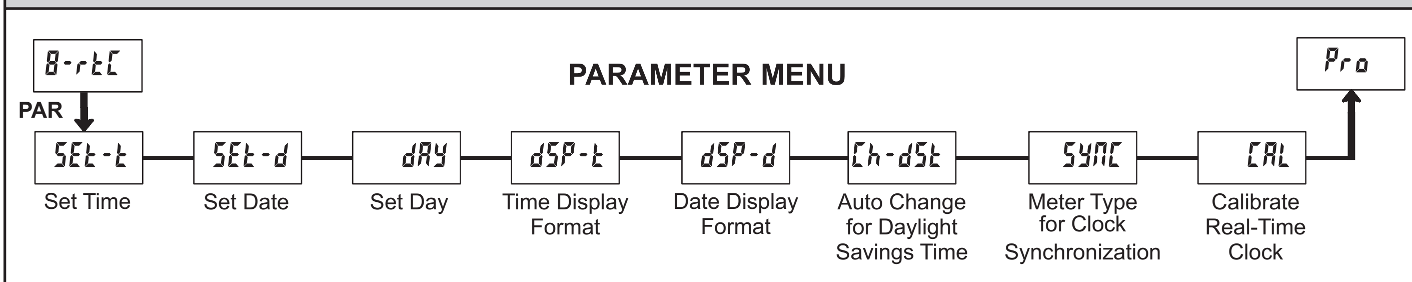
After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX.

D

6.8 MODULE 8 - REAL-TIME CLOCK PARAMETERS (8-rtC) - PAXCK



Module 8 is the programming module for the Real-Time Clock (RTC) Date and Time Parameters. In the Display Mode, the DAT annunciator indicates the RTC Date is currently being shown. The RTC Time display is shown with no annunciator. This programming module can only be accessed if a Real-Time Clock card is installed.

SET TIME

SEt-t
nO

nO YES

This parameter sets the Time for the Real-Time Clock. Selecting YES will display the sub-menu where the Time can be set or changed. The RTC Time is entered in "Hours-Minutes", 12-hour format, with AM/PM indication. When the **PAR** key is pressed, the new Time is entered and begins running. The "Seconds" always start from 00 when the Time is entered. Select nO to advance to the next parameter without changing the Time.

HH-nnP
12-00A

HOURS-MINUTES Am/Pm

SET DATE

SEt-d
nO

nO YES

This parameter sets the Date for the Real-Time Clock. Selecting YES will display the sub-menu where the Date can be set or changed. The RTC Date is entered in "Month.Day.Year" format (two-digit values). When the **PAR** key is pressed, the new Date is entered. Select nO to advance to the next parameter without changing the Date.

nn.dd.YY
01.01.01

MONTH.DAY.YEAR

SET DAY

dAY
Sun

Sun Mon tuE WEd
thu Fri SAt

Set the Day of the week for the Real-Time Clock.

TIME DISPLAY FORMAT

dSP-t — 12-59P 12-59 23-59 12.59.59 23.59.59

12-59P

Select the format in which the Real-Time Clock Time will be displayed. The format selections depict the *range* for the RTC Time display, and DO NOT represent the *current* RTC Time. When the meter is operating in the Display Mode, the RTC Time display is shown with no annunciator.

DATE DISPLAY FORMAT

dSP-d — 12-31 31-12 12.31.99 31.12.99 JAN-31 31-JAN Sun-31

12-31

Select the format in which the Real-Time Clock Date will be displayed. The format selections depict the *range* for the RTC Date display, and DO NOT represent the *current* RTC Date. When the meter is operating in the Display Mode, the RTC Date display is indicated by the DAT annunciator.

AUTO CHANGE FOR DAYLIGHT SAVINGS TIME

Ch-dSt — NO YES

NO

Selecting YES allows the meter to automatically adjust the RTC Time for Daylight Savings Time. (Adjustment dates are U.S.A. standard only.) Avoid setpoints that occur during adjustment (Sundays 1 to 3 AM).

METER TYPE FOR CLOCK SYNCHRONIZATION

SYNC — SLAVE HOSt

SLAVE

Time synchronization between multiple PAXCK meters can be accomplished through a hardware interface on the Real-Time Clock option card. This RS485 type interface allows connection of up to 32 PAXCK meters in a two-wire multidrop network, at distances up to 4000 ft. (See Section 4.6, Real-Time Clock Wiring).

In a Synchronization network, one PAXCK meter is programmed as the Host (HOSt), while all other meters are programmed as Slaves (SLAVE). Once every hour (at 30 min. past the hour), the Host meter outputs a time synchronization pulse onto the network. Upon receiving the synchronization pulse, each Slave meter automatically adjusts the Minutes and Seconds of its RTC Time setting to synchronize with the Host. *Synchronization, using the Real-Time Clock Wiring, adjusts the Minutes and Seconds only, and does* ***not*** *change the Hours, AM/PM, Day or Date settings in the Slave meter's RTC.*

Full-time synchronization (hours, minutes and seconds) is possible for PAXCKs that are connected in an RS485 network (RS485 Serial Option cards required). In this configuration, one meter is designated as the Serial RTC Master by setting the meter's address as 98 or 99 (see Serial Real-time Clock Addressing in Master Module 7). Every hour (at 30 min past the hour), the Serial RTC Master / Host will transmit the full time (Hours, minutes, seconds) to all meters through the RS485 serial card wiring network. The time, date, or day will also be transmitted and updated in the Slaves when changed in the programming of the Serial RTC Master. Only one meter should be configured as Master and that meter should also be configured as the Host.

CALIBRATE REAL-TIME CLOCK

CAL — NO YES

NO

*** NOTE: DO NOT ADJUST TRIM CAP ON RTC CARD!**

The Real-Time Clock circuit uses a crystal controlled oscillator for high accuracy timekeeping. The oscillator is factory calibrated* and optimized for 25°C ambient temperature operation. Since the PAXCK is designed to operate over a wide temperature range, and since the accuracy of a crystal oscillator varies with ambient temperature, some drift in the RTC time may be observed over an extended period. This is primarily seen in high or low temperature installations. To compensate for the wide operating temperature range, a calibration or "Offset" value can be entered, which effectively slows down or speeds up the clock to maintain accurate timekeeping.

To calibrate the RTC, install the meter in its normal operating environment, and set the time based on a known accurate reference (such as the WWV broadcast or the Atomic Clock reference which is available via the internet). After 30 days of normal operation, compare the RTC time to the reference, and note the amount of time gained or lost. Refer to the tables on the next page for the proper Offset value to enter, given the amount of time drift observed.

OFFSEt — 00 to 63

00

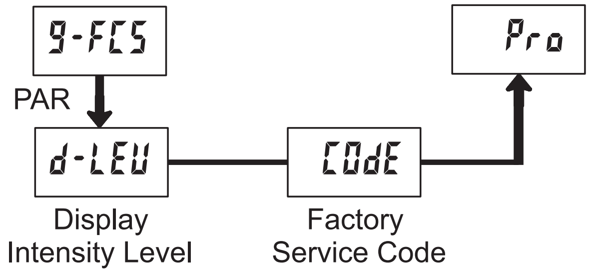
Selecting YES for the CAL parameter displays the OFFSEt sub-menu where the present Offset value can be viewed or changed. The tables below show the value to enter, given the amount of time gained or lost in a 30-day period.

Values 00 and 32 provide no Offset, and are not shown in the tables.

IF RTC CLOCK GAINED TIME: USE VALUE FROM THIS TABLE			
SECONDS GAINED IN 30 DAYS	ENTER THIS OFFSET VALUE	SECONDS GAINED IN 30 DAYS	ENTER THIS OFFSET VALUE
5	01	90	17
11	02	95	18
16	03	100	19
21	04	105	20
26	05	111	21
32	06	116	22
37	07	121	23
42	08	127	24
47	09	132	25
53	10	137	26
58	11	142	27
63	12	148	28
69	13	153	29
74	14	158	30
79	15	163	31
84	16		

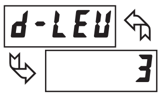
IF RTC CLOCK LOST TIME: USE VALUE FROM THIS TABLE			
SECONDS LOST IN 30 DAYS	ENTER THIS OFFSET VALUE	SECONDS LOST IN 30 DAYS	ENTER THIS OFFSET VALUE
11	33	179	49
21	34	190	50
32	35	200	51
42	36	211	52
53	37	221	53
63	38	232	54
74	39	243	55
84	40	253	56
95	41	264	57
105	42	274	58
116	43	285	59
127	44	295	60
137	45	306	61
148	46	316	62
158	47	327	63
169	48		

6.9 MODULE 9 - FACTORY SERVICE OPERATIONS (9-FCS)



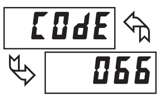
PARAMETER MENU

DISPLAY INTENSITY LEVEL



Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in Quick Programming Mode when enabled.

RESTORE FACTORY DEFAULTS



Use the **RST** and/or arrow keys to display CODE 066 and press **PAR**. The meter will display rESEt and then returns to CODE 050. Press **DSP** key to return to the Display Mode. This will overwrite all programmed user settings with the Factory Default Settings shown in the Parameter Value Chart. For the PAXCK, the Time and Date stored in the Real-Time Clock, as well as the RTC Claibration Offset value, are NOT overwritten by this parameter. However, the Time and Date Display Formats will revert back to the Factory Default Settings.

TROUBLESHOOTING

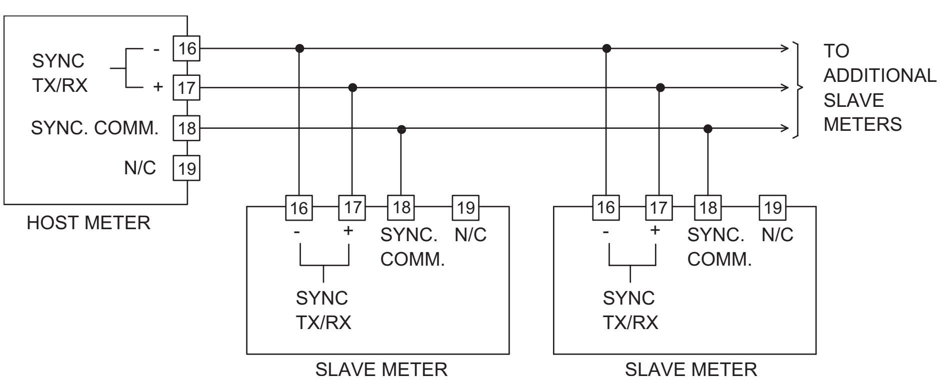
For further assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	REMEDIES
NO DISPLAY	**CHECK**: Power level, power connections
PROGRAMMING LOCKED-OUT	**CHECK**: User input set for program lock-out function is in Active state **ENTER**: Security code requested
CERTAIN DISPLAYS ARE LOCKED-OUT	**CHECK**: Display Lock-out programming in Module 3
MODULES or PARAMETERS NOT ACCESSIBLE	**CHECK**: Corresponding plug-in card installation, Program Lock-out/ Value Access parameter programming in Module 3
TIMER NOT RUNNING	**CHECK**: Input wiring, Timer plug jumper setting, Timer input programming in Module 1, input signal level, Timer Inhibited by Input B or a user input
USER INPUT NOT WORKING PROPERLY	**CHECK**: User input wiring, user input plug jumper setting, user input signal level, user input programming in Module 2
OUTPUTS NOT WORKING PROPERLY	**CHECK**: Setpoint plug-in card installation, wiring, Setpoint programming in Module 6
REAL-TIME CLOCK NOT WORKING PROPERLY	**CHECK**: RTC plug-in card installation, RTC programming in Module 8, check for proper battery installation, replace battery. **DO NOT ADJUST TRIM CAP ON RTC CARD!**
SERIAL COMMUNICATIONS NOT WORKING	**CHECK**: Serial plug-in card installation, Serial wiring, Serial settings in Module 7, host settings
ERROR CODE (Err 1-4)	**PRESS**: Reset key (If unable to clear, contact factory.)

Shaded areas are model dependent.

PAXCK Application

A big application request has always been for Real-Time Clocks to display time throughout the plant. The challenge has been to keep all the various clock locations synchronized with the right time. With the new PAXCK Timer/Real-Time Clock this problem is history. The clocks can be provided in three different sizes, the PAXCK (0.56 inch LEDs), the LPAXCK (1.5 inch LEDs), or the EPAX (4 inch LEDs). You can mix and match any number of the two versions, up to a maximum of 32 units. Simply select one of the units in the system as the host and the balance are programmed as slaves. The host will send out a synchronization pulse every hour to correct the time on any clock unit wired in the system.



Real-Time Clock Synchronization Network

MODEL PAXCK - 1/8 DIN REAL-TIME CLOCK

This is a brief overview of the PAXCK. For complete specifications and programming information, see the **PAX 1/8 DIN Preset Timer (PAXTM) & Real-time Clock (PAXCK) Bulletin** starting on **page 199**.

c UL US LISTED
IND. CONT. EQ.
51EB

- *6-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *4 SEPARATE DISPLAYS (Timer, Counter, Real-Time Clock, and Date)*
- *CYCLE COUNTING CAPABILITY*
- *PROGRAMMABLE FUNCTION KEYS/USER INPUTS*
- *FOUR SETPOINT ALARM OUTPUTS (W/Plug-in card)*
- *COMMUNICATIONS AND BUS CAPABILITIES (W/Plug-in card)*
- *BUS CAPABILITIES: DEVICENET, MODBUS and PROFIBUS-DP*
- *CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

D

PAXCK SPECIFICATIONS

4. **ANNUNCIATORS**:

TMR -Timer Display	SP1 -Setpoint 1 Output
CNT -Cycle Counter Display	SP2 -Setpoint 2 Output
DAT -Real-Time Clock Date Display	SP3 -Setpoint 3 Output
-Real-Time Clock Time Display	SP4 -Setpoint 4 Output

REAL-TIME/DATE DISPLAY (PAXCK):
Real-Time Display: 5 display formats
Hr/Min/Sec (12 or 24 Hr. format); Hr/Min (24 Hr.); Hr/Min (12 Hr. with or without AM/PM indication)
Date Display: 7 display formats
Month/Day or Day/Month (numeric or 3-letter Month format); Month/Day/Year or Day/Month/Year (all numeric);
Day of Week/Day (3-letter Day of Week format)

REAL-TIME CLOCK CARD: Field replaceable plug-in card
Time Accuracy: ± 5 secs./Month (1 min./year) with end-user calibration
Battery: Lithium 2025 coin cell
Battery Life Expectancy: 10 yrs. typical
Synchronization Interface: Two-wire multi-drop network (RS485 hardware), 32 units max., operates up to 4000 ft.
Isolation To Timer & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not isolated from all other commons.

TIMER INPUTS A and B:
Logic inputs configurable as Current Sinking (active low) or Current Sourcing (active high) via a single plug jumper.
Current Sinking (active low): V_{IL} = 0.9 V max., 22KΩ pull-up to +12 VDC.
Current Sourcing (active high): V_{IH} = 3.6 V min., 22KΩ pull-down, Max. Continuous Input: 30 VDC.
Timer Input Pulse Width: 1 msec min.
Timer Start/Stop Response Time: 1 msec max.
Filter: Software filtering provided for switch contact debounce. Filter enabled or disabled through programming.
If enabled, filter results in 50 msec start/stop response time for successive pulses on the same input terminal.

DIGITAL PANEL METERS

The Trusted Source for

Innovative Control Solutions

E

QUICK Specs

Digital Panel Meters

	VOLT/CURRENT			UNIVERSAL
	CUB4V / I	CUB5V / I	PAXLV / I	PAXLA
				
Description	Miniature DC Volt/Current Meter	DC Volt/Current Meter with Output Option Card Capability	1/8 DIN, AC or DC Volt/Current Meter	1/8 DIN, DC Volt/Current/Process Meter with Setpoint Card Capability
Dimensions (Height) x (Width)	39mm (H) x 75mm (W)	39mm (H) x 75mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)
Display	3 1/2 Digit, .6" (15mm) Reflective, Green and Red Backlight LCD	5 Digit, .48" (12mm) Reflective, Green and Red Backlight LCD	3 1/2 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Red LED
Input Ranges	Current (CUB4I) 0 to 199.9 µA DC through 199.9 mA DC Voltage (CUB4V) 0 to 199.9 mV DC through 199.9 VDC	Current (CUB5I) 0 to 200 µA DC through 200 mA DC Voltage (CUB5V) 0 to 200 mV DC through 200 VDC	Current (PAXLI) (AC or DC) 0 to 199.9 µA through 1.999 A Voltage(PAXLV) (AC or DC) 0 to 1.999 mV DC through 300 VDC	Current: 0 to 200 µA through 200 mA DC Voltage: 0 to 200 mV through 200 VDC Process: 4 to 20 mA and 0 to 10 VDC
Zero/Offset	Zero Based	Zero Based	Zero Based	Non Zero Based
Setpoint Capability*	No	Single Form C Relay Dual Sinking	No	Dual Form C Relays
Communication Capability	No	RS232 RS485	No	No
Other Features/ Options	No	User Input Min/Max Memory Custom Units Indicator	Custom Units Overlay	User Input Excitation Custom Units Overlay Min/Max Memory
Power Source	9 to 28 VDC	9 to 28 VDC	115/230 VAC	50 to 250 VAC 21.6 to 250 VDC
Page Number	*	Page 233/244	Page 255	Page 273

* Field Installable Option Card

E

QUICK Specs

Digital Panel Meters

	VOLT/CURRENT		UNIVERSAL	
	PAXLIT	**PAXLHV**	**DP5D**	**PAXD**
				
Description	1/8 DIN, 5 amp AC Current Meter	1/8 DIN, AC Voltage Monitor	1/8 DIN, Universal DC Meter	1/8 DIN, Universal DC Meter with Output Option Card Capability
Dimensions (Height) x (Width)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)
Display	3 1/2 Digit, .56" (14mm) Red LED	3 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity
Input Ranges	0 to 5 A AC	0 to 600 VAC	Current +/-200 µA DC to +/-2 A DC Voltage +/-200 mV DC to +/-300 VDC	Current +/-200 µA DC to +/-2 A DC Voltage +/-200 mV DC to +/-300 VDC Resistance 100 Ohm to 10K Ohm
Zero/Offset	Zero Based	Zero Based	Non Zero Based	Non Zero Based
Setpoint Capability*	No	Yes	No	Form C Relay (Dual) Form A Relay (Quad) Solid State Outputs (Quad)
Communication Capability	No	No	No	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8
Other Features/ Options	Custom Units Overlay	Custom Units Overlay	Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay
Power Source	115/230 VAC	115/230 VAC	85 to 250 VAC or 11 to 36 VDC	85 to 250 VAC or 11 to 36 VDC
Page Number	Page 262	Page 268	Page 283	Page 301

* Field Installable Option Card

E

QUICK Specs

Digital Panel Meters

	UNIVERSAL	VOLT/CURRENT	PROCESS	
	PAX2A	PAXH	CUB4CL / LP	CUB5P
				
Description	1/8 DIN Dual Line Process Signal, DC Voltage, DC Current Meter With Output Option Card Capability	1/8 DIN, AC True RMS Voltage and Current Meter with Output Option Card Capability	Miniature Current Loop and Loop Powered Meters	DC Process meter with Output Option Card Capability
Dimensions (Height) x (Width)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	39mm (H) x 75mm (W)	39mm (H) x 75mm (W)
Display	Top Line: 6 Digit, .71" (18mm) Tri-color Backlight Bottom Line: 9 Digit, .35" (9mm) Green Backlight	5 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	3 1/2 Digit, .6" (15mm) Reflective, Green and Red Backlight LCD	5 Digit, .48" (12mm) Reflective, Green and Red Backlight LCD
Input Ranges	Current +250 µA DC to +2 A DC Voltage +250 mV DC to +200 VDC	Current +200 µA AC to +5 A AC Voltage +200 mV AC to +300 VAC	Current Loop Dual Range 4 to 20 mA DC or 10 to 50 mA DC	0 to 10 VDC 4 to 20 mA DC or 10 to 50 mA DC
Zero/Offset	Non Zero Based	Non Zero Based	Non Zero Based	Non Zero Based
Setpoint Capability*	Yes	Yes	No	Single Form C Relay Dual Sinking
Communication Capability	RS232 or RS485 Modbus DeviceNet Profibus	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	No	RS232 RS485
Other Features/ Options	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Display	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay	No	User Input Min/Max Memory Custom Units Indicator
Power Source	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC or 11 to 36 VDC	9 to 28 VDC (CUB4CL) Derives Operating Power from Current Loop 3 Volts Max. (CUB4LP)	9 to 28 VDC
Page Number	Page 332	Page 362	Page 363	Page 367

* Field Installable Option Card

E

QUICK Specs

Digital Panel Meters

PROCESS

	PAXLCL	PAXLPV	DP5P	PAXP
				
Description	1/8 DIN, Current Loop Meter	1/8 DIN, Process Volt Meter	1/8 DIN, Process Meter	1/8 DIN, Process Meter with Output Option Card Capability
Dimensions (Height)x(Width)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)
Display	3 1/2 Digit, .56" (14mm) Red LED	3 1/2 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity
Input Ranges	Current Loop Dual Range 4 to 20 mA DC or 10 to 50 mA DC	Process Volt 1 to 5 VDC	Process Current/Voltage 0 to 20 mA DC or 0 to 10 VDC	Process Current/Voltage 0 to 20 mA DC or 0 to 10 VDC
Zero/Offset	Non Zero Based	Non Zero Based	Non Zero Based	Non Zero Based
Setpoint Capability*	No	No	No	Form C Relay (Dual) Form A Relay (Quad) Solid State Outputs (Quad)
Communication Capability	No	No	No	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8
Other Features/ Options	Custom Units Overlay, Excitation	Custom Units Overlay, Excitation	Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay
Power Source	85 to 250 VAC	85 to 250 VAC	85 to 250 VAC or 11 to 36 VDC	85 to 250 VAC or 11 to 36 VDC
Page Number	Page 378	Page 386	Page 394	Page 395

* Field Installable Option Card

E

QUICK Specs

Digital Panel Meters

	PROCESS	STRAIN GAGE		
	PAXDP	PAXLSG	PAXS	PAX2S
				
Description	1/8 DIN, Dual Input Process Meter with Output Option Card Capability	1/8 DIN, Strain Gage Meter	1/8 DIN, Strain Gage Meter with Output Option Card Capability	1/8 DIN, Dual Line Strain Gage Meter with Output Option Card Capability
Dimensions (Height) x (Width)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)	50mm (H) x 97mm (W)
Display	5 Digit, .56" (14mm) Sunlight Readable Red LED, Adjustable Intensity	3 1/2 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .71" (18mm) Tri-color Backlight Bottom Line: 9 Digit, .35" (9mm) Green Backlight
Input Ranges	Dual Inputs Process Current/Voltage 0 to 20 mA DC/0 to 10 VDC	Single-ended or Differential Input 0 to 10 mV through 1.999 A	+/- 24 mV DC or +/- 240 mV DC	+/- 24 mV DC or +/- 240 mV DC
Zero/Offset	Non Zero Based	Non Zero Based	Non Zero Based	Non Zero Based
Setpoint Capability*	Form C Relay (Dual) Form A Relay (Quad) Solid State Outputs (Quad)	No	Form C Relay (Dual) Form A Relay (Quad) Solid State Outputs (Quad)	Form C Relay (Dual) Form A Relay (Quad) Solid State Outputs (Quad)
Communication Capability	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	No	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 RS485 Modbus DeviceNet Profibus
Other Features/ Options	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay	Custom Units Overlay Excitation,	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Overlay	Analog Output*, Tare, Min/Max Memory, Integrator/Totalizer, Linearizer, Excitation, Custom Units Display
Power Source	85 to 250 VAC or 18 to 36 VDC	115/230 VAC	85 to 250 VAC or 11 to 36 VDC	50 to 250 VAC 21.6 to 250 VDC
Page Number	Page 396	Page 424	Page 432	Page 462

* Field Installable Option Card

E

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **CUBID / CUBVD**	■ Display: 3 1/2 Digit, .35" (9 mm) Reflective LCD ■ Power Source: 5 VDC or 7 to 28 VDC ■ Measurement: DC Current or Voltage	 **CUB5I / CUB5V**	■ Display: 5 Digit, .48" (12 mm) Reflective LCD ■ Power Source: 9 to 28 VDC ■ Measurement: DC Current or Voltage
 **LPPI**	■ Display: 3 1/2 Digit, .35" (9 mm) Reflective LCD ■ Power Source: Loop Powered ■ Measurement: Current Loop	 **CUB4LP**	■ Display: 3 1/2 Digit, .6" (15 mm) Reflective LCD ■ Power Source: Loop Powered ■ Measurement: Current Loop
 **APLI / APLV**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: AC or DC Current and Voltage	 **PAXLI / PAXLV**	■ Display: 3 1/2 Digit, .56" (14 mm) Reflective LCD ■ Power Source: 115/230 VAC ■ Measurement: AC or DC Current and Voltage
 **APLIT / APLHV**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: 5 Amp AC Current/ 600 VAC	 **PAXLIT / PAXLHV**	■ Display: 3 1/2 Digit (PAXLIT); 3 Digit (PAXLHV), .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: 5 Amp AC/600 VAC **Panel Cut-Out Dimension Differences**
 **APLCL / APLPV**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: Current Loop/ Process Volt	 **PAXLCL / PAXLPV**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: Current Loop/Process Volt **Panel Cut-Out Dimension Differences**
 **APLSG**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: Strain Gage	 **PAXLSG**	■ Display: 3 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: Strain Gage **Panel Cut-Out Dimension Differences**
 **IMP**	■ Display: 4 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: Process Signals	 **PAXP**	■ Display: 5 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC, 11 to 36 VDC, 24 VAC ■ Measurement: Process Signals ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **IMD**	■ Display: 4 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: DC Current and Voltage	 **PAXD**	■ Display: 5 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC, 11 to 36 VDC, 24 VAC ■ Measurement: DC Current and Voltage ■ Requires Appropriate Option Card **Panel Cut-Out Dimensions Differences**
 **IMH**	■ Display: 4 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: 5 Amp AC	 **PAXH**	■ Display: 5 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC, 11 to 36 VDC, 24 VAC ■ Measurement: AC Current and Voltage ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**
 **IMS**	■ Display: 4 1/2 Digit, .56" (14 mm) Red LED ■ Power Source: 115/230 VAC ■ Measurement: Strain Gage	 **PAXS**	■ Display: 5 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC, 11 to 36 VDC, 24 VAC ■ Measurement: Strain Gage ■ Requires Appropriate Option Card **Panel Cut-Out Dimension Differences**

Note: Refer to the current product literature, as some differences may exist.

E

This page intentionally left blank.

MODEL CUB5V - MINIATURE ELECTRONIC 5-DIGIT DC VOLTMETER

C UL US LISTED
IND. CONT. EQ.
51EB

- *FOUR SELECTABLE D.C. RANGES*
  0 to 200 mV, 2 V, 20 V, 200 V
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR RED/GREEN LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARDS*
- *OPTIONAL SERIAL COMMUNICATIONS CARDS (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5V accepts a DC Voltage input signal and provides a display in the desired unit of measure. The meter also features minimum and maximum display capture, display offset, units indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

VOLTAGE

The CUB5V is the DC Volt meter. It features 4 voltage input ranges, that are selected by the user via a programming jumper and software input range selection. The ranges consist of following: 0 to 200 mV, 2 V, 20 V, 200 V. Users should select the appropriate voltage range that covers their maximum input.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

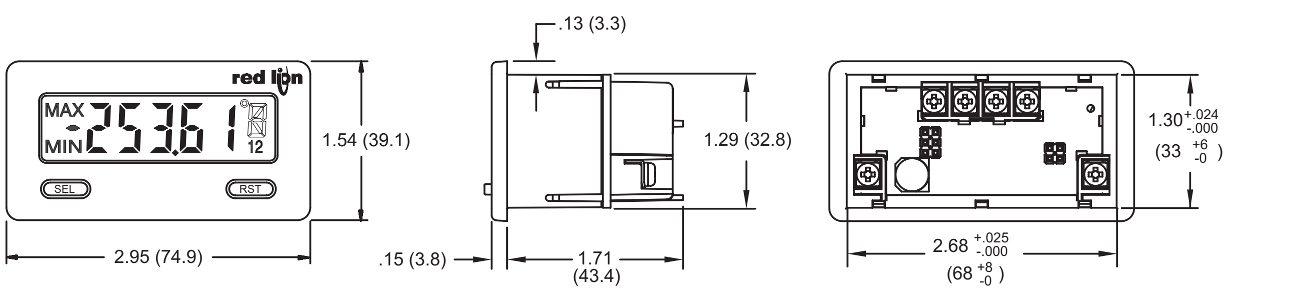
CAUTION: Risk of Danger.
Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5V	DC Volt Meter with reflective display	CUB5VR00
		DC Volt Meter with backlight display	CUB5VB00
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPRO	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson 2 PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net/

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5VR00: Reflective LCD with full viewing angle
   CUB5VB00: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5VR00	---	10 mA	40 mA
CUB5VB00	Red (max intensity)	85 mA	115 mA
CUB5VB00	Green (max intensity)	95 mA	125 mA

3. **INPUT RANGES**: Jumper Selectable
   D.C. Voltages: 200 mV, 2 V, 20 V, 200 V
4. **SIGNAL INPUTS**:

INPUT RANGE	ACCURACY @23 °C, less than 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 mVDC	0.1% of span	1.027 MΩ	75 VDC	10 µV	70 ppm / °C
2 VDC	0.1% of span	1.027 MΩ	75 VDC	.1 mV	70 ppm / °C
20 VDC	0.1% of span	1.027 MΩ	250 VDC	1 mV	70 ppm / °C
200 VDC	0.1% of span	1.027 MΩ	250 VDC	10 mV	70 ppm / °C

5. **OVERRANGE RATINGS, PROTECTION & INDICATION:**
   9 to 28 VDC power circuit is not isolated from the signal circuit.
   Input Overrange Indication: "OLOL".
   Input Underrange Indication: "ULUL".
   Display Overrange/Underrange Indication: ".....”/“-....."
6. **A/D CONVERTER**: 16 bit resolution
7. **RESPONSE TIME:**
   Display: 500 msec min.
   Output: 800 msec max (with input filter setting of 0)
8. **NORMAL MODE REJECTION:** 60 dB 50/60 Hz
9. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
10. **CONNECTIONS**: Wire clamping screw terminals
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 5 inch-lbs (0.565 N-m) max.
11. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
13. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5VR00: -35 to 75°C
    Operating Temperature Range for CUB5VB00 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85°C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g.
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
14. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    IEC/EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E179259
    UL Listed: File #E137808
    Type 4X Outdoor Enclosure rating (Face only)
    IP65 Enclosure rating (Face only)
    IP20 Enclosure rating (Rear of unit)
    Refer to EMC Installation Guidelines for additional information.
15. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

Note: Measurement errors may occur if signal input common is shared with another circuit common (ie, serial common, Dual Sinking Output option card, or Power Supply common) on multiple units.

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

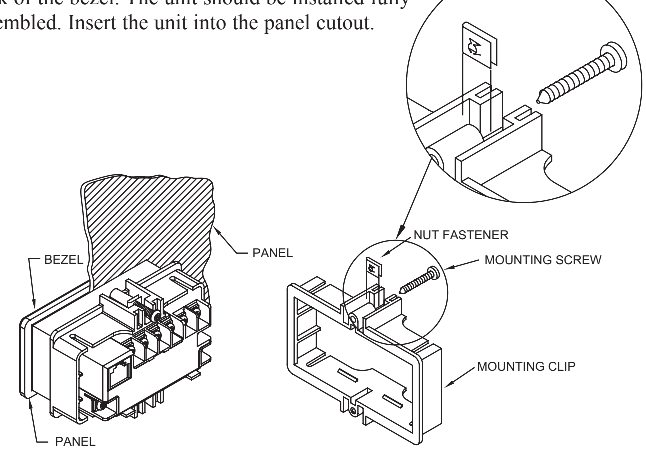
USB PROGRAMMING CARD

Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



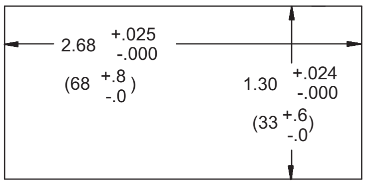
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 Setting the Jumpers

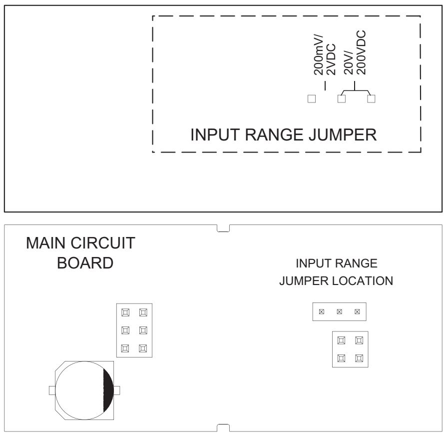
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum input to avoid overloads. To access the jumper, remove the rear cover of the meter.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

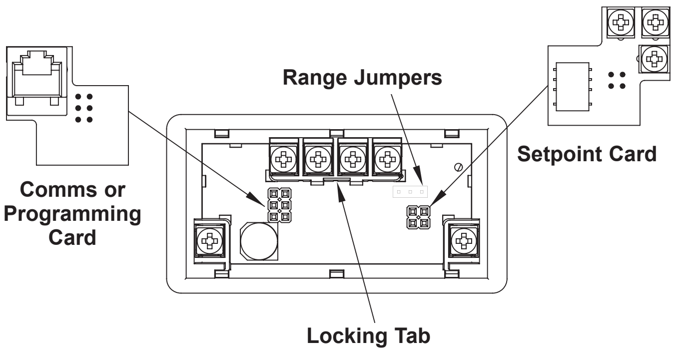
REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.



3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter



CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

E

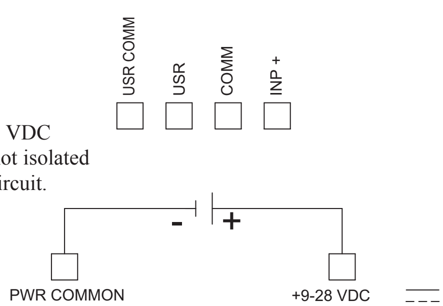
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

CAUTION: 9 to 28 VDC power circuit is not isolated from the signal circuit.

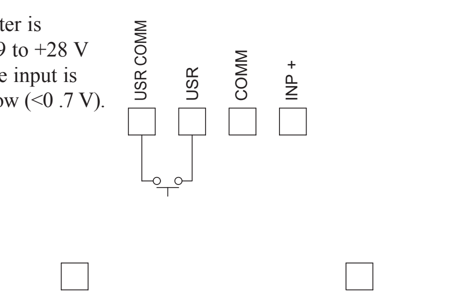


4.2 USER INPUT WIRING

Sinking Logic

USR COMM } Connect external switching device between the
USR } User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).

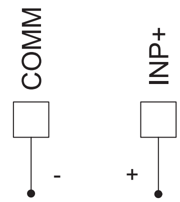


4.3 INPUT WIRING

CAUTION: Power input common is NOT isolated from user and input commons. In order to preserve the safety of the meter application, the power input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the signal or user inputs and input common terminals. Appropriate considerations must then be given to the potential of the user and input commons with respect to earth ground; and the common of the plug-in cards with respect to input common.

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

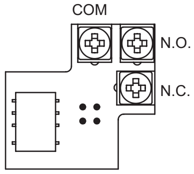
Voltage Signal (self powered)



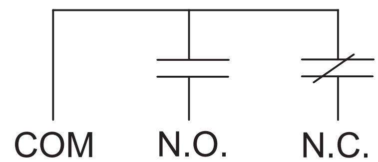
JUMPER POSITION	MAX INPUT VOLTAGE
200 mV / 2 VDC	75 VDC
20V / 200 VDC	250 VDC

4.4 SETPOINT (OUTPUT) WIRING

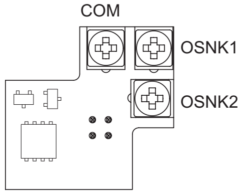
SINGLE SETPOINT RELAY PLUG-IN CARD



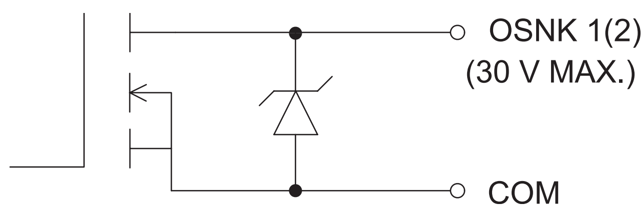
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



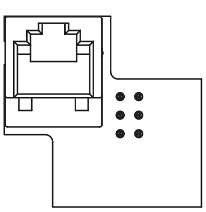
ELECTRICAL CONNECTIONS

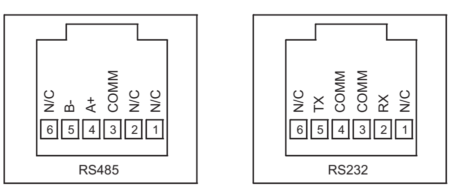


Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

4.5 SERIAL COMMUNICATION WIRING

SERIAL COMMUNICATIONS PLUG-IN CARD

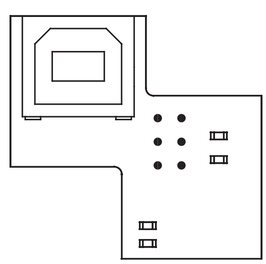




RJ11 CONNECTOR PIN OUTS

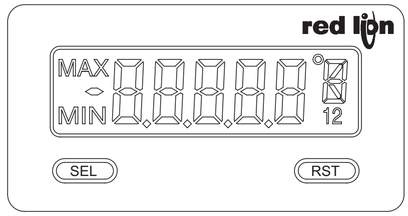
4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



E

5.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN/MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

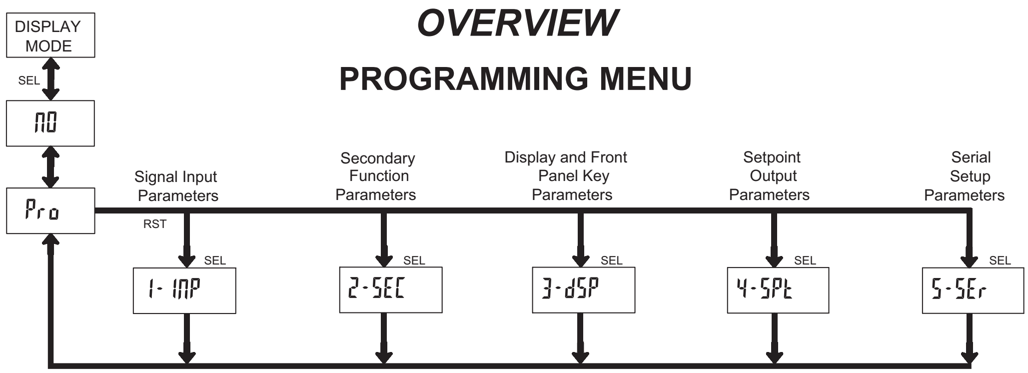
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



E

PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro nO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro nO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

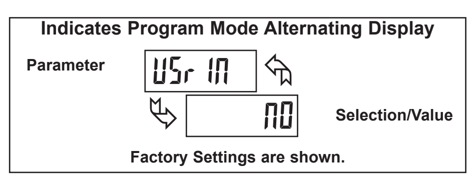
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU

1-INP → SEL → Pro

rANGE	dECPt	OFSEt	FILtr	bANd	StYLE	INP 1	dSP 1	INP 2	dSP 2	USr IN	U-ASN
Input Range	Display Decimal Point	Display Offset Value	Filter Setting	Filter Band	Scaling Style	Input Value for Scaling Point 1	Display Value For Scaling Point 1	Input Value for Scaling Point 2	Display Value For Scaling Point 2	User Input Function	User Input Assignment

CUB5V INPUT RANGE

rANGE
200u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
0.2u	200.00 mV	20u	20.000 V
2u	2.0000 V	200u	200.00 V

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt
0

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dSP1 and dSP2 parameters and setpoint values.

DISPLAY OFFSET VALUE

OFSEt
0.00

-19999 to 19999

The display can be corrected with an offset value. This can be used to compensate for signal variations or sensor errors. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the effects of offset.

FILTER SETTING

FILtr
1

0 1 2 3

If the displayed value is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bANd
10

0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

SCALING STYLE

StYLE
kEY

kEY APLY

If Input Values and corresponding Display Values are known, the Key-in (kEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INP 1
0.00

0 to 29999

For Key-in (kEY) style, enter the first Input Value using the front panel buttons. (The Input Range selection sets the decimal location for the Input Value).

For Apply (APLY) style, the meter shows the previously stored Input Value. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 1

dSP 1
0.00

-19999 to 99999

Enter the first Display Value by using the front panel buttons. This is the same for kEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

INP 2
100.00

0 to 29999

For Key-in (kEY) style, enter the known second Input Value using the front panel buttons.

For Apply (APLY) style, the meter shows the previously stored Input Value for Scaling Point 2. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2
100.00

-19999 to 99999

Enter the second Display Value by using the front panel buttons. This is the same for kEY and APLY scaling styles.

General Notes on Scaling

1. When using the Apply (APLY) scaling style, input values for scaling points must be confined to the signal input limits of the selected range.
2. The same Input Value should not correspond to more than one Display Value. (Example: 10 V can not equal 0 and 10.)
3. For input levels beyond the programmed Input Values, the meter extends the Display Value by calculating the slope from the two coordinate pairs (INP1 / dSP1 & INP2 / dSP2).

E

USER INPUT FUNCTION

USr IN
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
ZErO	Zero Input (Edge triggered)	Zero the Input Display value causing Display Reading to be Offset.
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Pr int	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN
dSP

HI HI-LO
LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → SEL → HI-En — HI-t — LO-En — LO-t — FCS — CodE → Pro

HI-En	HI-t	LO-En	LO-t	FCS	CodE
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations

MAX DISPLAY ENABLE

HI-En
NO

NO YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
NO

NO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS
NO

NO YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **SEL** button to exit the module.

VIEW VERSION DISPLAY

CodE
50

Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **SEL** button to exit the module.

CALIBRATION

CodE
48

The CUB5V uses stored voltage calibration values to provide accurate voltage measurements. Over time, the electrical characteristics of the components inside the meter will slowly change, with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5V involves an input voltage calibration, which should only be performed by individuals experienced in calibrating electronic equipment. Allow a 30 minute warm up before performing any calibration related procedures. The following procedures should be performed at an ambient temperature of 15 to 35°C (59 to 95°F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5V.

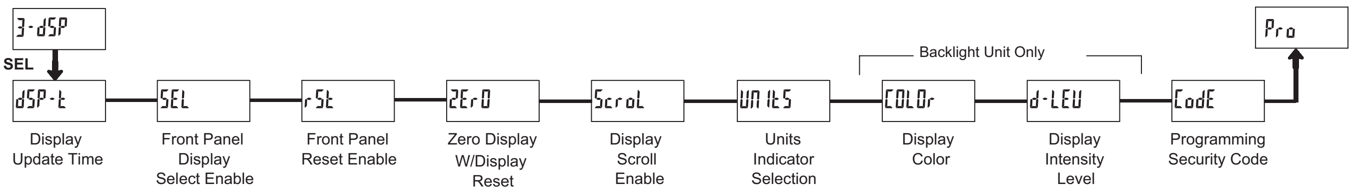
Voltage Calibration

1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the INP+ (positive) and COMM (negative) terminals of the CUB5V. Set the output of the voltage source to zero.
2. With the display at CodE 48, press and hold the **SEL** button for 2 seconds. Unit will display CAL NO.
3. Press the **RST** button to select the range to be calibrated.
4. Press the **SEL** button. Display reads 0.0u.
5. With the voltage source set to zero (or a dead short applied to the input), press **SEL**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, apply full-scale input signal for the range. (Note: For 200V range, apply 100V as indicated on the display.) Press **SEL**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL NO, press the **SEL** button to exit calibration.

E

6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t
1

0.5   1   2   seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES   NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

NO   LO   dSP
HI   HI-LO

This selection allows the **RST** button to reset the selected value(s).

ZERO DISPLAY WITH DISPLAY RESET

ZErO
NO

YES   NO

This parameter enables the **RST** button or user input to zero the input display value, causing the display reading to be offset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.

DISPLAY SCROLL ENABLE

ScroL
NO

YES   NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS INDICATOR SELECTION

UnItS
OFF

OFF   LISt   SEGS

This parameter activates the Units Indicator on the display. There are two methods of selecting the Indicator. List will present a group of Units preprogrammed into the meter. Segments allows the user to choose which of the segments should light.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr
rEd

rEd   Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

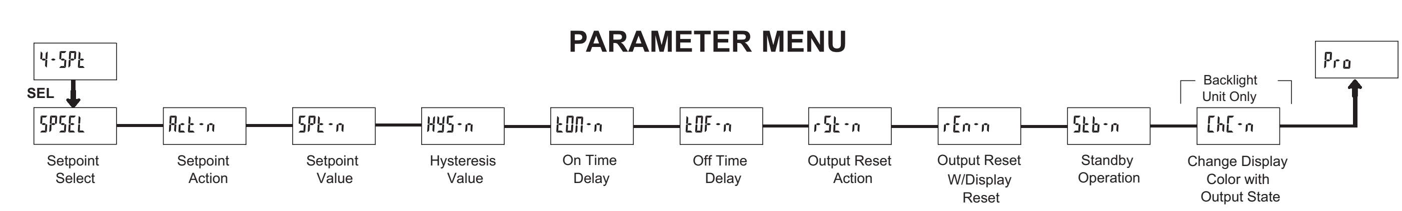
Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

E

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL ⇦ NO

NO SP-1 SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2 ⇦ NO

YES NO

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

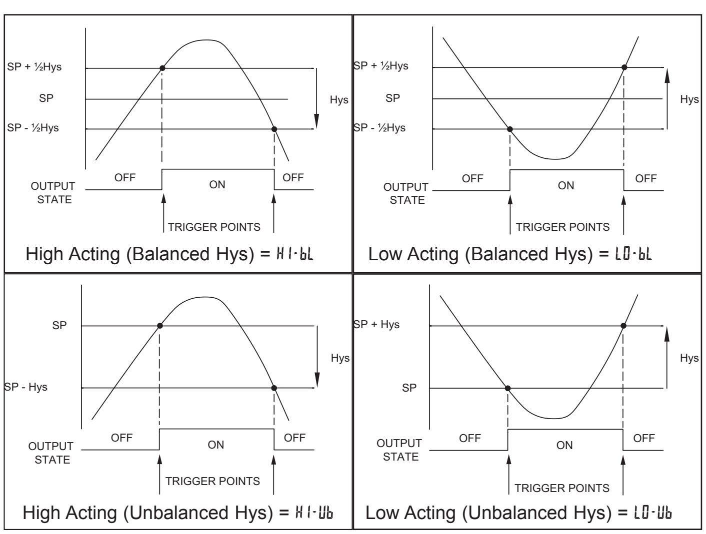
SETPOINT ACTION

Act-n ⇦ HI-Ub

HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL = High Acting, with balanced hysteresis
LO-bL = Low Acting, with balanced hysteresis
HI-Ub = High Acting, with unbalanced hysteresis
LO-Ub = Low Acting, with unbalanced hysteresis



High Acting (Balanced Hys) = HI-bL
Low Acting (Balanced Hys) = LO-bL
High Acting (Unbalanced Hys) = HI-Ub
Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n ⇦ 10000

-19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n ⇦ 2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n ⇦ 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n ⇦ 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n ⇦ Auto

Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

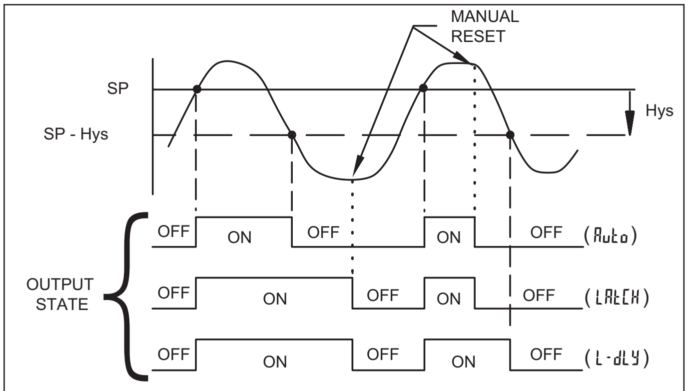
Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST**

E

button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n YES NO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n NO NO YES

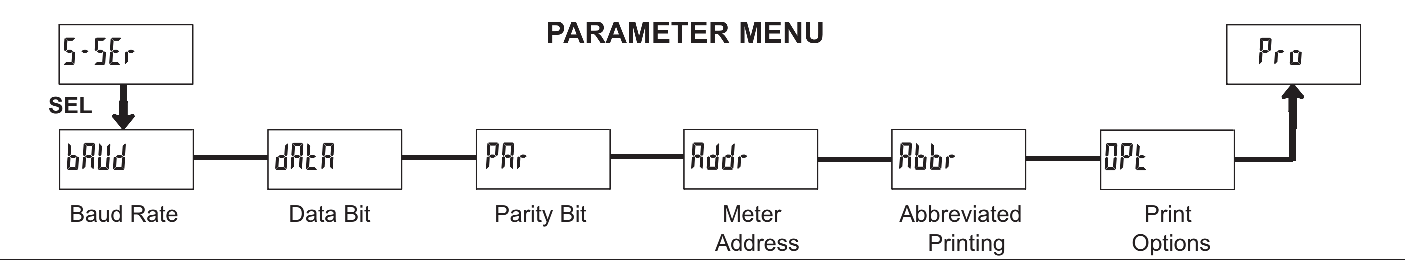
When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n NO NO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communication/programming cards is installed in the meter.

Refer to the CUB5COM bulletin for details on CUB5 RS232 or RS485 serial communications.

Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

MODEL CUB5I - MINIATURE ELECTRONIC 5-DIGIT DC CURRENT METER

C UL US LISTED
IND. CONT. EQ.
51EB

- *FOUR SELECTABLE D.C. RANGES*
  200 µA, 2 mA, 20 mA, 200 mA
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR RED/GREEN LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATIONS CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5I accepts a DC Current input signal and provides a display in the desired unit of measure. The meter also features minimum and maximum display capture, display offset, units indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

CURRENT

The CUB5I is the DC Current meter. It features 4 current input ranges, that are selected by the user via a programming jumper and software input range selection. The ranges consist of following: 200 µA, 2 mA, 20 mA, or 200 mA. Users should select the appropriate current range that covers their maximum signal input.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

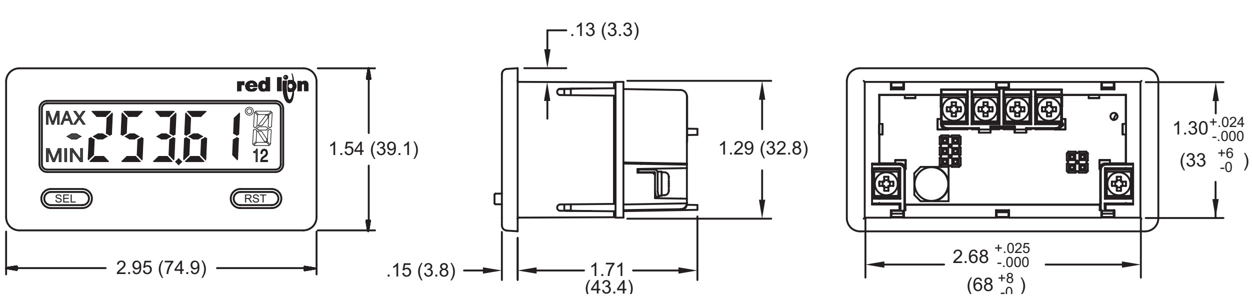
CAUTION: Risk of Danger. Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



Ordering Information

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5I	DC Current Meter with Reflective Display	CUB5IR00
		DC Current Meter with Backlight Display	CUB5IB00
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output Card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net

General Meter Specifications

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5IR00: Reflective LCD with full viewing angle
   CUB5IB00: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5IR00	---	10 mA	40 mA
CUB5IB00	Red (max intensity)	85 mA	115 mA
CUB5IB00	Green (max intensity)	95 mA	125 mA

3. **INPUT RANGES**: Jumper Selectable
   D.C. Currents: 200 µA, 2 mA, 20 mA, or 200 mA
4. **SIGNAL INPUTS:**

INPUT RANGE	ACCURACY @23 °C, less than 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 µA	0.1% of span	1.111 KΩ	15 mA	10 nA	70 ppm / °C
2 mA	0.1% of span	111 Ω	50 mA	0.1 µA	70 ppm / °C
20 mA	0.1% of span	11 Ω	150 mA	1 µA	70 ppm / °C
200 mA	0.1% of span	1 Ω	500 mA	10 µA	70 ppm / °C

5. **OVERRANGE RATINGS, PROTECTION & INDICATION:**
   9 to 28 VDC power circuit is not isolated from the signal circuit.
   Input Overrange Indication: "OLOL".
   Input Underrange Indication: "ULUL".
   Display Overrange/Underrange Indication: "....."/"-....."
6. **RESPONSE TIME:**
   Display: 500 msec min.
   Output: 800 msec max (with input filter setting of 0)
7. **NORMAL MODE REJECTION:** 60 dB 50/60 Hz
8. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
9. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5IR00: -35 to 75°C
    Operating Temperature Range for CUB5IB00 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85°C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
11. **CONNECTIONS**: Wire clamping screw terminals
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 5 inch-lbs (0.565 N-m) max.
12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
13. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    IEC/EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E179259
    UL Listed: File #E137808
    Type 4X Outdoor Enclosure rating (Face only)
    IP65 Enclosure rating (Face only)
    IP20 Enclosure rating (Rear of unit)
    Refer to EMC Installation Guidelines for additional information.
14. **WEIGHT**: 3.2 oz (100 g)

E

OPTIONAL PLUG-IN CARDS

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

Note*: Measurement errors may occur if signal input common is shared with another circuit common (ie, serial common, Dual Sinking Output option card, or Power Supply common) on multiple units.*

SINGLE RELAY CARD
Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD
Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD
Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD
Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

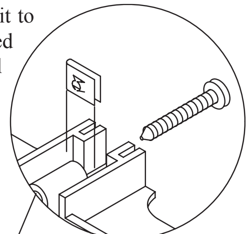
USB PROGRAMMING CARD
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

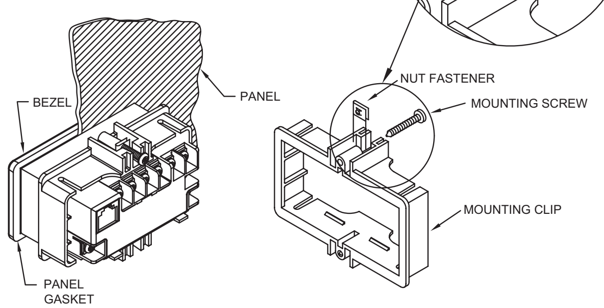
1.0 INSTALLING THE METER

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.



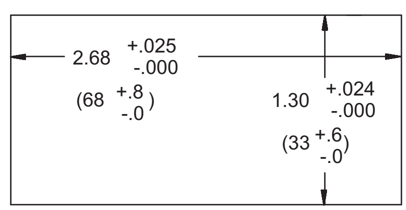


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 SETTING THE JUMPERS

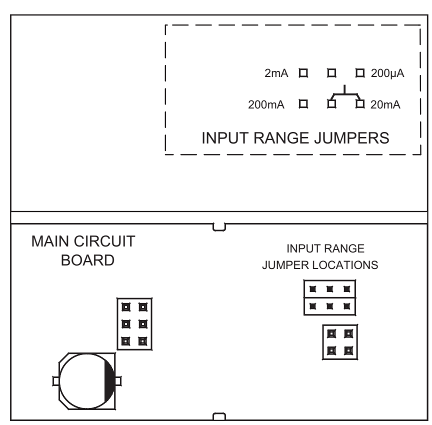
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum signal input to avoid overloads. To access the jumper, remove the rear cover of the meter.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

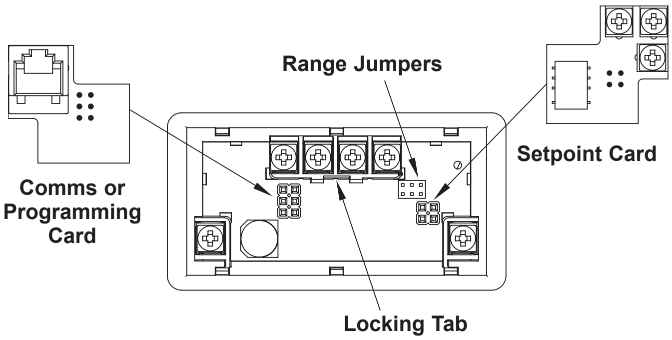
REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.



3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter



CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place**.**

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

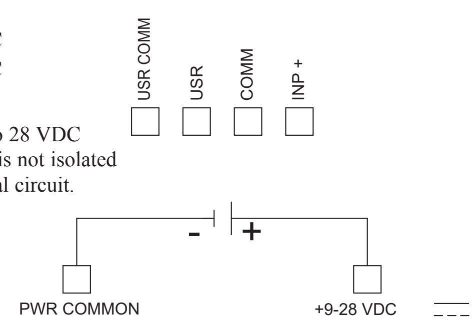
Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

CAUTION: 9 to 28 VDC power circuit is not isolated from the signal circuit.

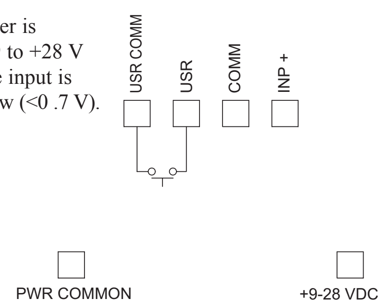


4.2 USER INPUT WIRING

Sinking Logic

USR COMM
USR
} Connect external switching device between the User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).



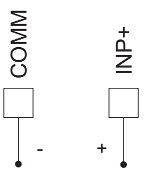
E

4.3 INPUT WIRING

CAUTION: Power input common is NOT isolated from user and input commons. In order to preserve the safety of the meter application, the power input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the signal or user inputs and input common terminals. Appropriate considerations must then be given to the potential of the user and input commons with respect to earth ground; and the common of the plug-in cards with respect to input common.

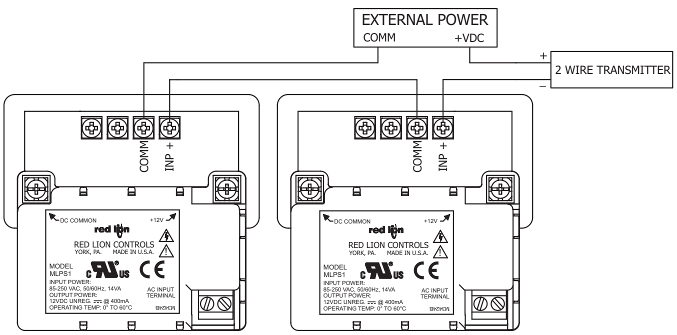
Before connecting signal wires, the Input Range Jumper should be verified for proper position.

Input Signal (self powered)

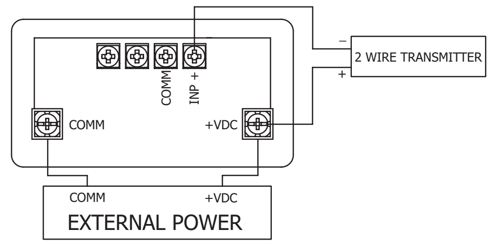


JUMPER POSITION	MAX INPUT CURRENT
200 µA	15 mA
2 mA	50 mA
20 mA	150 mA
200 mA	500 mA

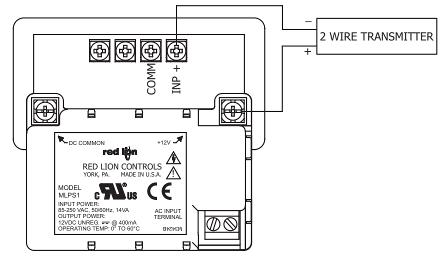
Series Loop (must use separate supply for sensor power and each CUB5)



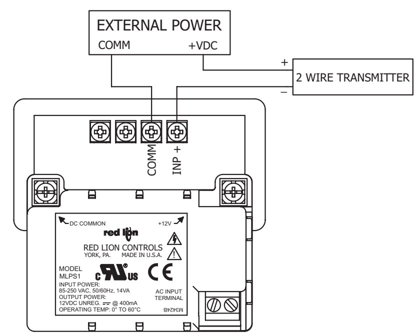
2 Wire With External Power



2 Wire With MLPS Power Supply

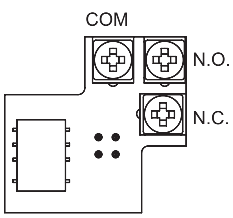


2 Wire With Separate Sensor And CUB5 Power

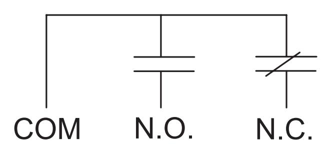


4.4 SETPOINT (OUTPUT) WIRING

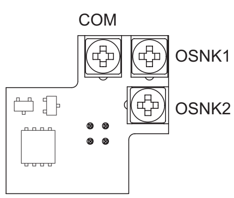
SINGLE SETPOINT RELAY PLUG-IN CARD

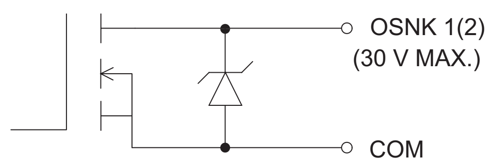


ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



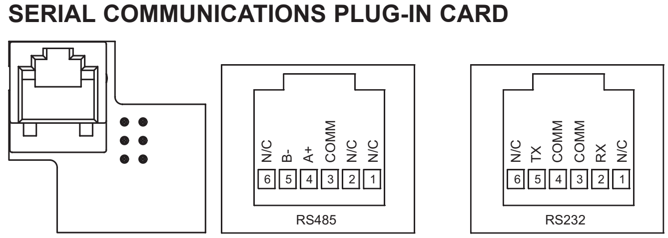


ELECTRICAL CONNECTIONS

Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

4.5 SERIAL COMMUNICATION WIRING

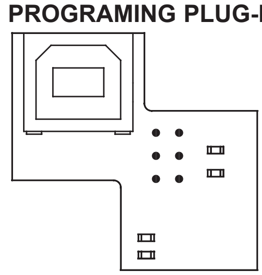
SERIAL COMMUNICATIONS PLUG-IN CARD



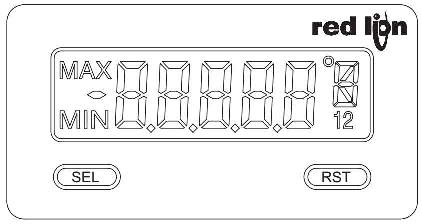
RJ11 CONNECTOR PIN OUTS

4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



5.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN/MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

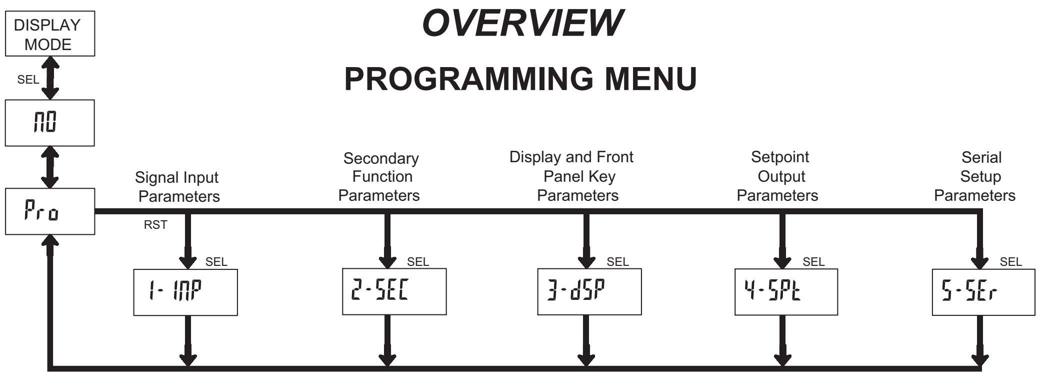
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



E

PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

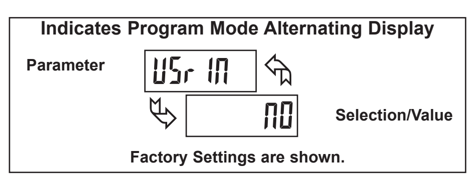
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU

1-INP → SEL → rANGE (Input Range) → dECPt (Display Decimal Point) → OFSEt (Display Offset Value) → FILtr (Filter Setting) → bANd (Filter Band) → StYLE (Scaling Style) → INP 1 (Input Value for Scaling Point 1) → dSP 1 (Display Value For Scaling Point 1) → INP 2 (Input Value for Scaling Point 2) → dSP 2 (Display Value For Scaling Point 2) → USr IN (User Input Function) → U-ASN (User Input Assignment) → Pro

CUB5I INPUT RANGE

rANGE → 0.02A

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
200uA	200.00 µA	0.02A	20.000 mA
0.002A	2.0000 mA	0.2A	200.00 mA

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt → 0.000

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dSP1 and dSP2 parameters and setpoint values.

DISPLAY OFFSET VALUE

OFSEt → 0.000

-19999 to 19999

The display can be corrected with an offset value. This can be used to compensate for signal variations or sensor errors. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the effects of offset.

FILTER SETTING

FILtr → 1

0 1 2 3

If the displayed value is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bANd → 10

0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

SCALING STYLE

StYLE → KEY

KEY APLY

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INP 1 → 0.000

0 to 29999

For Key-in (KEY) style, enter the first Input Value using the front panel buttons. (The Input Range selection sets the decimal location for the Input Value).

For Apply (APLY) style, the meter shows the previously stored Input Value. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 1

dSP 1 → 0.000

-19999 to 99999

Enter the first Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

INP 2 → 10.000

0 to 29999

For Key-in (KEY) style, enter the known second Input Value using the front panel buttons.

For Apply (APLY) style, the meter shows the previously stored Input Value for Scaling Point 2. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2 → 10.000

-19999 to 99999

Enter the second Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles.

General Notes on Scaling

1. When using the Apply (APLY) scaling style, input values for scaling points must be confined to the range limits shown.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 20.)
3. For input levels beyond the programmed Input Values, the meter extends the Display Value by calculating the slope from the two coordinate pairs (INP1 / dSP1 & INP2 / dSP2).

E

USER INPUT FUNCTION

USr IN
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
ZErO	Zero Input (Edge triggered)	Zero the Input Display value causing Display Reading to be Offset.
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Pr int	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN
dSP

HI HI-LO
LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → SEL → HI-En → HI-t → LO-En → LO-t → FCS → CodE → Pro

HI-En	HI-t	LO-En	LO-t	FCS	CodE
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations

MAX DISPLAY ENABLE

HI-En
NO

NO YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
NO

NO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS
NO

NO YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **SEL** button to exit the module.

VIEW VERSION DISPLAY

CodE
50

Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **SEL** button to exit the module.

CALIBRATION

CodE
48

The CUB5I uses stored current calibration values to provide accurate current measurements. Over time, the electrical characteristics of the components inside the CUB5I will slowly change with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5I involves a current calibration which should only be performed by individuals experienced in calibrating electronic equipment. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5I.

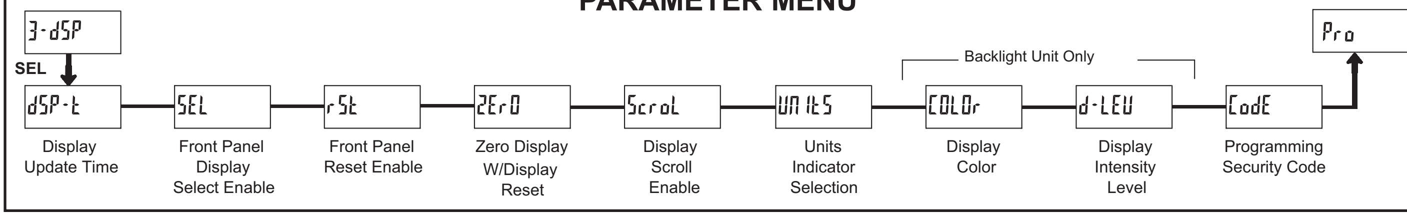
Current Calibration

1. Connect the negative lead of a precision DC current source with an accuracy of 0.01% or better to the COMM terminal. Leave the positive lead of the DC current source unconnected.
2. With the display at CodE 48, press and hold the **SEL** button for 2 seconds. Unit will display CAL NO
3. Press the **RST** button to select the range to be calibrated.
4. Press the **SEL** button. Display reads 0.0A
5. With the positive lead of the DC current source unconnected, press **SEL**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, connect the positive lead of the DC current source to INP+ and apply full-scale input signal for the range. (Note: For 200 mA range, apply 100 mA as indicated on the display.)
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL NO, press the **SEL** button to exit calibration.

E

6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t → 1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL → YES

YES NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt → dSP

NO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

ZERO DISPLAY WITH DISPLAY RESET

ZEr0 → NO

YES NO

This parameter enables the **RST** button or user input to zero the input display value, causing the display reading to be offset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.

DISPLAY SCROLL ENABLE

Scrol → NO

YES NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS INDICATOR SELECTION

UnItS → OFF

OFF LISt SEGS

This parameter activates the Units Indicator on the display. There are two methods of selecting the Indicator. List will present a group of Units preprogrammed into the meter. Segments allows the user to choose which of the segments should light.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr → rEd

rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU → 5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE → 000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

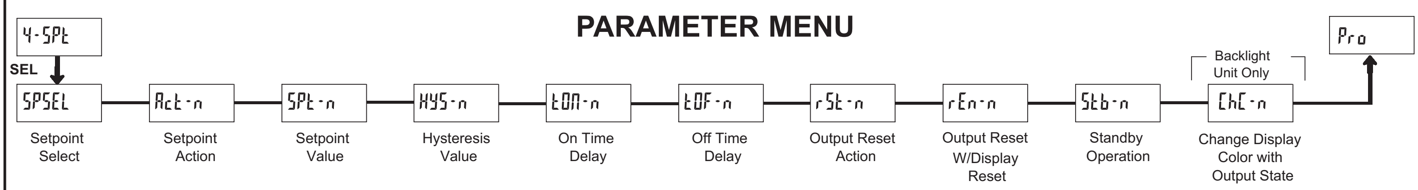
Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

E

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL
nO

nO SP-1 SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select nO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2
nO

YES nO

Select YES to enable Setpoint 2 and access the setup parameters. If nO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

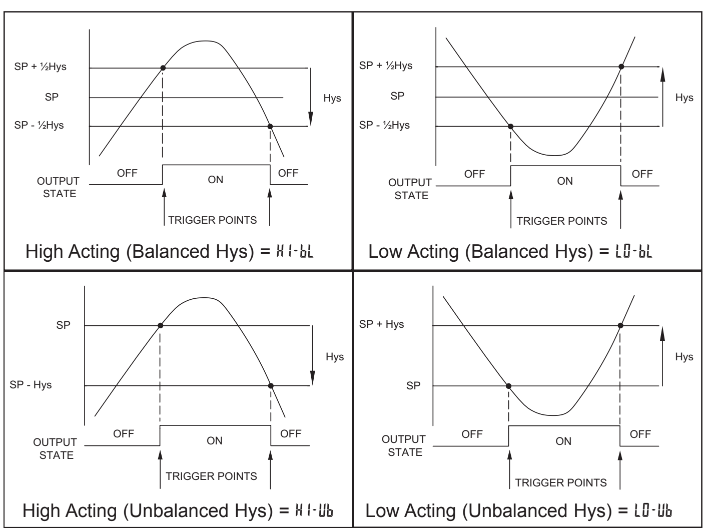
SETPOINT ACTION

Act-n
HI-Ub

HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL	=	High Acting, with balanced hysteresis
LO-bL	=	Low Acting, with balanced hysteresis
HI-Ub	=	High Acting, with unbalanced hysteresis
LO-Ub	=	Low Acting, with unbalanced hysteresis



High Acting (Balanced Hys) = HI-bL

Low Acting (Balanced Hys) = LO-bL

High Acting (Unbalanced Hys) = HI-Ub

Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n
10000

-19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n
2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n
0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n
0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n
Auto

Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

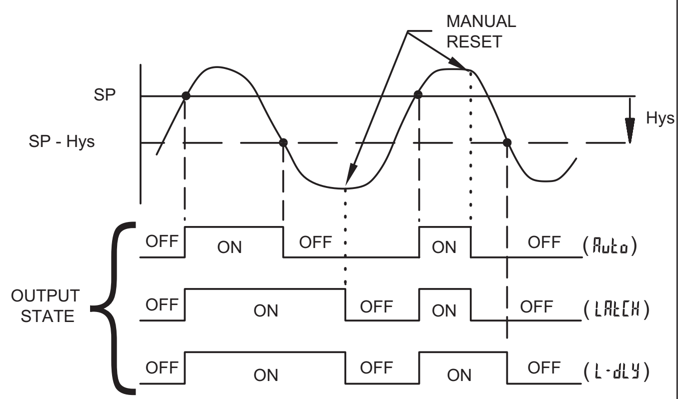
Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST**

E

button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n YES

nO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n nO

nO YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

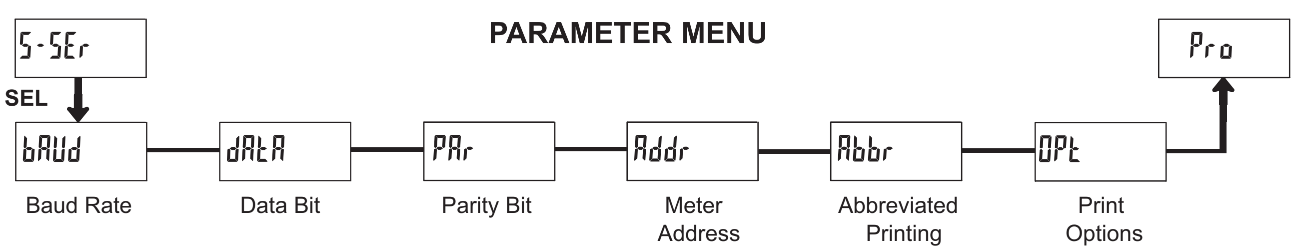
CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n nO

nO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - Serial Setup Parameters (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

MODEL PAXLI - PAX LITE CURRENT METERS &
MODEL PAXLV - PAX LITE VOLTMETERS

c UL US LISTED
IND. CONT. EQ.
51EB

- *FOUR MULTI-RANGE UNITS COVER:*
  199.9 µA to 1.999 A *, 199.9 mV (AC or DC)
  1.999 V to 300 V (AC or DC)
- *3 1/2-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAY W/ POLARITY*
- *BUILT-IN SCALING PROVISIONS*
- *SELECTABLE DECIMAL POINT LOCATION*
- *AUTO ZEROING CIRCUITS*
- *OVER-RANGE INDICATION*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*

* Accessory Shunts Available For Higher Current Ranges.

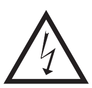
GENERAL DESCRIPTION

PAX Lite Current and Volt Meters are premium quality instruments designed for tough industrial applications. With multi-range capability, built-in provision for scaling, and DIP switch selectable decimal points, these meters offer the ultimate in application flexibility. Four models cover your voltage and current indicator needs. The meter can provide direct readout from pressure, speed or flow transducers, or any other variable that can be translated to voltage or current. The built-in scaling allows the display to be scaled to the desired engineering unit.

The 3 ½ -digit bi-polar display (minus sign displayed when current or voltage is negative) features a 0.56" high, 7-segment LEDs for easy reading. The meter is also available with custom units label capability. Using the PAX label kit (PAXLBK30), the selected label is installed behind the panel, keeping it safe from washdown or other environmental conditions. A DIP switch is used to control the backlight for the units label.

The meters have a NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, allowing the meter to provide a tough yet reliable application solution.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.



CAUTION: Risk of electric shock.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**, (CAT I):
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II. (See IEC 664 & IEC 61010)

INSTALLATION CATEGORY (overvoltage category) **II**, (CAT II):
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III. (See IEC 664 & IEC 61010)

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

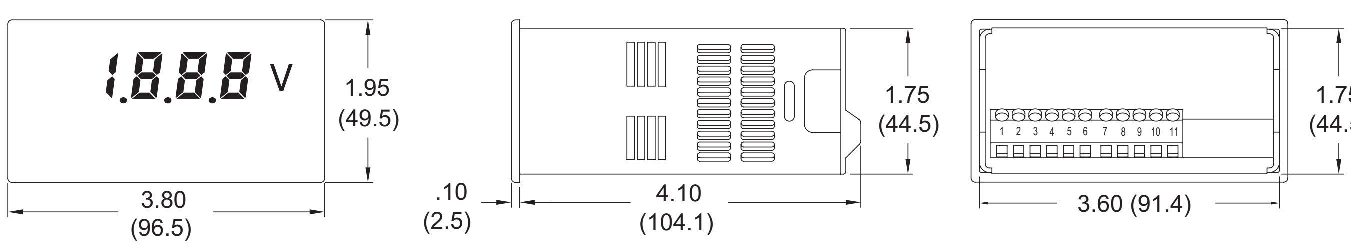


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL			0	0

I - Current Input
V - Voltage Input

A - AC Input
D - DC Input

Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	PAXLBK	Units Label Kit Accessory	PAXLBK30
	APSCM	10 Amp DC Current Shunt	APSCM010
		100 Amp DC Current Shunt	APSCM100

E

General Meter Specifications

1. **DISPLAY**: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED, (-) minus sign displayed when current or voltage is negative. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **POWER**: 115/230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA.
   Isolation: 2300 Vrms for 1 min. between input and supply
   Working Voltage: 300 V max. , CAT II
3. **INPUT RANGES/RESOLUTION**: (Selectable by jumper connections.):

AC Voltmeters	AC Current Meters	DC Voltmeters	DC Current Meters
0-1.999 V/1 mV	0-199.9 µA/0.1 µA	±1.999 V/1 mV	±199.9 µA/0.1 µA
0-19.99 V/10 mV	0-1.999 mA/1 µA	±19.99 V/10 mV	±1.999 mA/1 µA
0-199.9 V/100 mV	0-19.99 mA/10 µA	±199.9 V/100 mV	±19.99 mA/10 µA
0-300 V/1 V	0-199.9 mA/100 µA	±300 V/1 V	±199.9 mA/100 µA
	0-1.999 A/1 mA		±1.999 A/1 mA
	0-199.9 mV/100 µV		±199.9 mV/100 µV

   Input Impedance:
   Voltage: All ranges1MΩ
   Current:

199.9 µA	1000.1 KΩ
1.999 mA	100.1 Ω
19.99 mA	10.1 Ω
199.9 mA	1.1 Ω
1.999 A	0.1 Ω

   Working Voltage: 300 V max., CAT II
4. **ACCURACY**:
   AC Voltmeters: ±(0.1% of Reading + 3 digits) (45-500 Hz)
   AC Current Meters (45-500 Hz):
   199.9 µA/199.9 mV, 1.999 mA, 19.99 mA: ±(0.1% of Reading + 3 digits)
   199.9 mA: ±(0.15% of Reading + 3 digits)
   1 A: ±(0.5% of Reading + 3 digits)
   DC Voltmeters: ±(0.1% of Reading + 1 digit)
   DC Current Meters:
   199.9 µA/199.9 mV, 1.999 mA, 19.99 mA: ±(0.1% of Reading + 1 digit)
   199.9 mA: ±(0.15% of Reading + 1 digit)
   1.999 A: ±(0.5% of Reading + 1 digit)
   Note: Any individual range may be recalibrated (scaled) to 0.1% accuracy with appropriate calibration equipment.
5. **OVER-RANGE INDICATION**: on all modes is indicated by blanking 3 least significant digits.
6. **MAX. VOLTAGE ON LOWEST INPUT RANGE**: 75 VAC or DC (Both voltmeters and current meters).
7. **MAX. VOLTAGE ON TERMINAL BLOCK**: 300 VAC or DC (Both voltmeters and current meters).
8. **MAX. CURRENTS (FOR CURRENT METERS)**:
   199.9 µA through 19.99 mA: 10 times max. range current
   199.9 mA: 1 A
   1.999 A: 3 A
   Caution: In circuits where fault currents can exceed the maximum shunt current, a fast-blow fuse should be installed in series with the input signal. Otherwise, a slow blow 10 amp fuse is recommended that will allow for start-up over current situations, while still protecting the instrument.
9. **TEMPERATURE COEFFICIENTS**:

Current meters	Voltmeters
DC: ±100 PPM/°C	DC: ±75 PPM/°C
AC: ±200 PPM/°C	AC: ±150 PPM/°C

10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature: 0° to 60 °C
    Storage Temperature: -40° to 80 °C
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Altitude: Up to 2000 meters
11. **RESPONSE TIME TO STEP CHANGE INPUT**: 1 sec. nominal
12. **READING RATE**: 2.5 readings/sec., nominal
13. **NORMAL MODE REJECTION**: 50 dB 50/60 Hz (DC units only)
14. **COMMON MODE REJECTION**: 110 dB DC or 50/60 Hz (DC units only)
15. **COMMON MODE VOLTAGE (COMM. TO EARTH)**: 350 volt peak
16. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report #04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    ELECTROMAGNETIC COMPATIBILITY:
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle; 40 % variation
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

17. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
18. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
19. **WEIGHT**: 0.65 lbs. (0.24 Kg)

E

Accessories

UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled by a DIP switch.

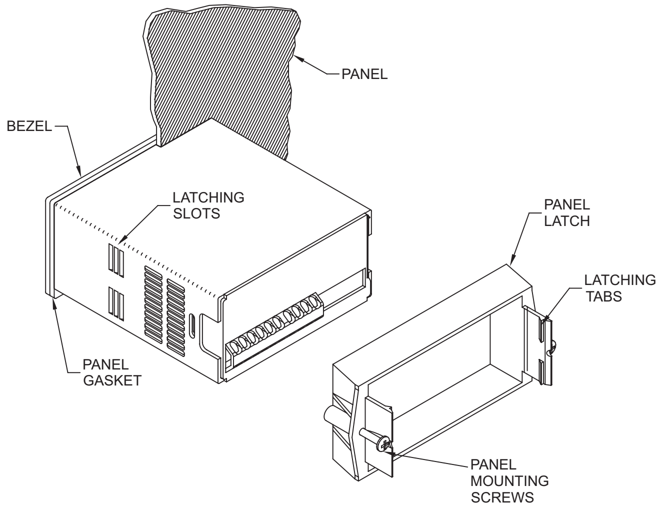
EXTERNAL CURRENT SHUNTS (APSCM)

To measure DC current signals greater than 2 ADC, a shunt must be used. The APSCM010 current shunt converts a maximum 10 ADC signal into 100.0 mV. The APSCM100 current shunt converts a maximum 100 ADC signal into 100.0 mV. The continuous current through the shunt is limited to 115% of the rating.

1.0 INSTALLING THE METER

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

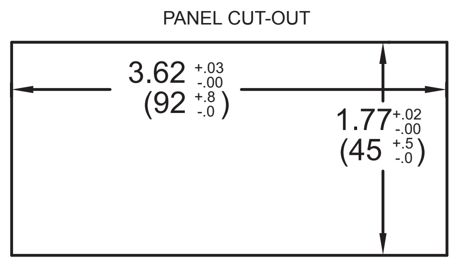


While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.



2.0 SETTING THE JUMPERS AND SWITCHES

The meter has an input jumper and switches, which must be checked and/or changed prior to applying power. To access the input jumper and switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Power Selection Switch

Caution: Insure the AC power selection switch is set for the proper voltage before powering the meter. The meter is shipped from the factory in the 230 VAC position.

Input Range Jumper

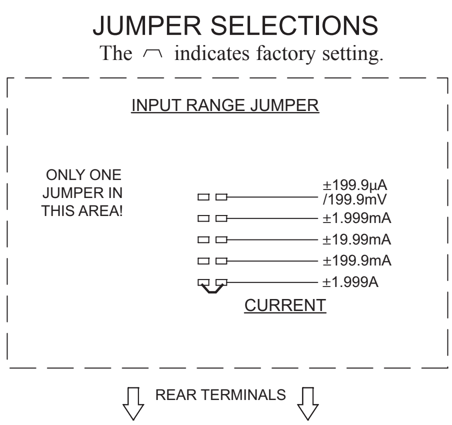
A jumper is used for selection of the voltage or current input range. Select the proper input range that will be high enough to avoid input signal overload. It is important that only one jumper position is used at a time. Avoid placing a jumper across two different input ranges.

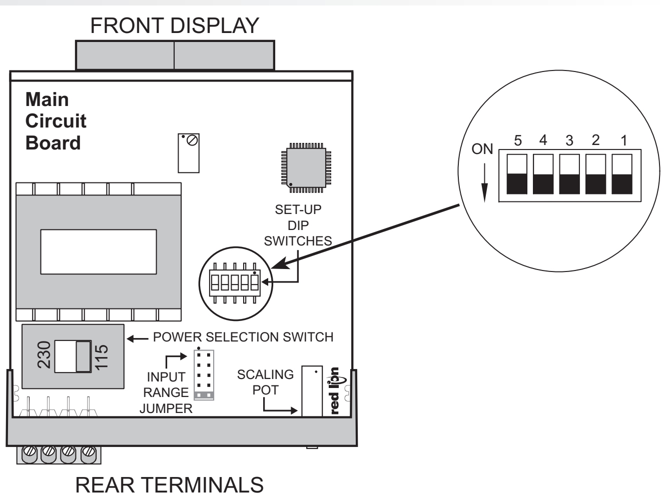
Set-Up DIP Switches

A DIP switch is located inside the meter. It is used for the selection of decimal points, backlight annunciator, and scaling. Selecting the "ON" position enables the function.

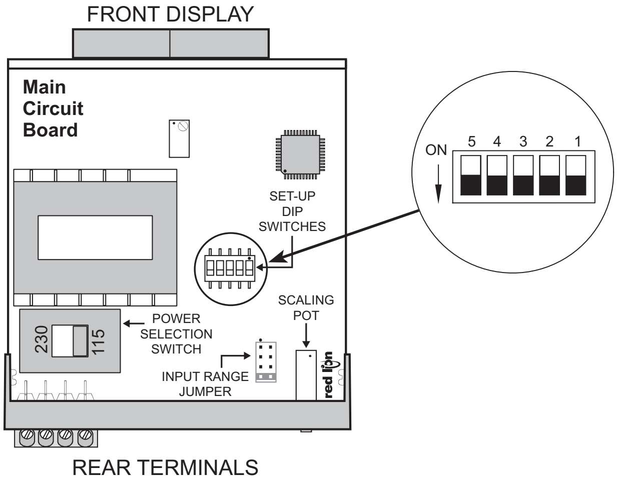
SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label
5	Enables the Scaling Pot

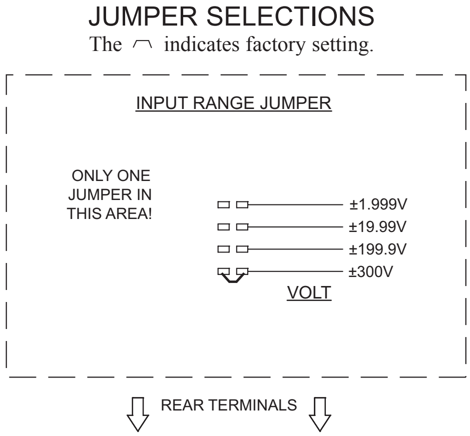
PAXLI Jumper Selection





PAXLV Jumper Selection





3.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

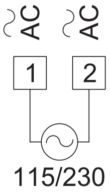
E

3.1 POWER WIRING

AC Power

Terminal 1: VAC

Terminal 2: VAC



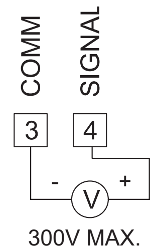
3.2 INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

PAXLV
Voltage Signal (self powered)

Terminal 4: + Volts DC/AC

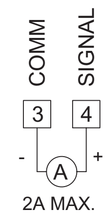
Terminal 3: - Volts DC/AC



PAXLI
Current Signal (self powered)

Terminal 4: + Amps DC/AC

Terminal 3: - Amps DC/AC



4.0 SCALING THE METER

PAXLV

DIRECT VOLTMETER READOUT

When the application requires direct voltmeter readout, the Scale Switch should remain in the “OFF” position. The Input Range Jumper is set to the voltage range being applied. It is possible to select a range higher than being applied to get lower resolution. The Decimal Point switches are set to resolution of the selected Input Range Jumper.

SCALING VOLTMETER READOUT

In many industrial applications, a voltmeter is required to display a reading in terms of PSI, RPM, or some other unit of measure. The signal voltage being measured can be generated by a transducer that senses the variations and delivers a linear output voltage. To provide the desired readout at the specified voltage, the voltmeter must be scaled.

Place the Scale Switch in the “ON” position. This enables the Scale Potentiometer which is accessible from the back of the meter. (Enabling the Scale Potentiometer does NOT affect the calibration of the meter.) Place the Decimal Point Switches to the proper location. To properly set the Input Range Jumper, the Division Factor must be determined by first using the below formula. After the Division Factor is calculated, use the Division Factor Range Selection Chart to choose the proper Input Range Jumper setting. Apply the meter power and the voltage signal. Adjust the Scale Potentiometer to the desired value.

This scaling only effects the span. There is no offset scaling. This means that only zero voltage can display a value of zero.

DIVISION FACTOR FORMULA:

$$\frac{\text{VT x D.D.P.}}{\text{D.R.}} = \text{D.F.}$$

WHERE:

VT	=	Maximum Transducer Output
D.D.P	=	Display Decimal Point
D.F.	=	Division Factor
D.R.	=	Desired Reading

D.D.P.			
0.000	=	1	The Display Decimal Point
00.00	=	10	(D.D.P.) is determined by
000.0	=	100	the desired decimal point
0000	=	1000	placement in the readout.

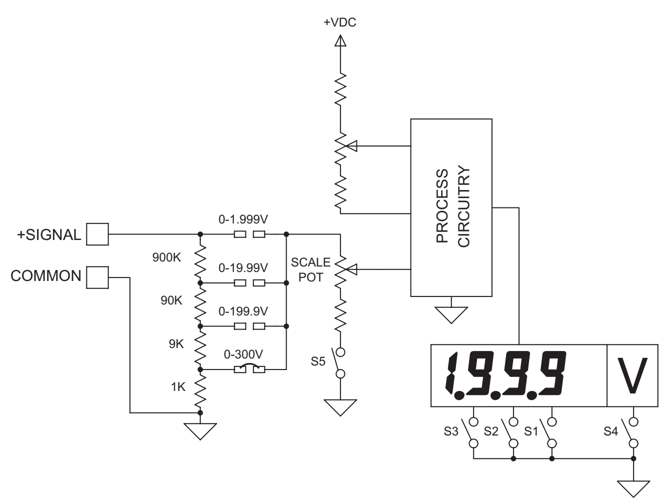
After the Division Factor for the application has been calculated, the proper voltage range jumper can be selected. Use the “Division Factor Range Selection Chart” to choose the proper jumper setting.

DIVISION FACTOR RANGE SELECTION CHART

D.F.	Use Input Position
0.1 to 1.2	Pos 1: 0-1.999 VDC
1.2 to 10.5	Pos 2: 0-19.99
10.5 to 100.5	Pos 3: 0-199.9
100.5 to 1300	Pos 4: 0-300

Note: Only one voltage jumper should be selected. Install the jumper before the voltage signal is applied.

BLOCK DIAGRAM PAXLV



EXAMPLE: A relative humidity transducer delivers a 7.0 VDC voltage at a relative humidity of 75%.

$$\text{D.F.} = \frac{\text{VT x D.D.P.}}{\text{D.R.}} = \frac{7.0 \text{ x } 1000}{75} = 93.3$$

This Division Factor is between 10.5 and 100.5, therefore jumper position 3 (199.9 V) is selected. The Scaling Potentiometer is then adjusted for the desired readout at a known relative humidity.

E

DIRECT CURRENT METER READOUT

When the application requires direct current meter readout, the Scale Switch should remain in the "OFF" position. The Input Range Jumper is set to the current range being applied. It is possible to select a range higher than being applied to get lower resolution. The Decimal Point switches are set to resolution of the selected Input Range Jumper.

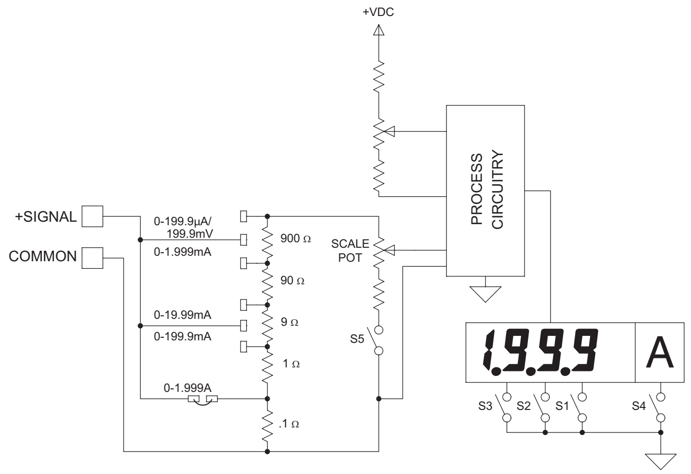
SCALING CURRENT METER READOUT

In many industrial applications, a current meter is required to display a reading in terms of PSI, RPM, or some other unit of measure. The signal voltage being measured can be generated by a transducer that senses the variations and delivers a linear output voltage. To provide the desired readout at the specified current, the current meter must be scaled.

Place the Scale Switch in the "ON" position. This enables the Scale Potentiometer which is accessible from the back of the meter. (Enabling the Scale Potentiometer does NOT affect the calibration of the meter.) Place the Decimal Point Switches to the proper location. The Input Range Jumper is set to the current range being applied. Apply the meter power and the current signal. Adjust the Scale Potentiometer to the desired value. Scaling to obtain a numerical readout higher than the normal value of the current can also be accomplished, in most cases, by selecting a lower current range. However, the maximum current for the range must not be exceeded. (See Specifications for maximum input currents.)

This scaling only effects the span. There is no offset scaling. This means that only zero amps can display a value of zero.

BLOCK DIAGRAM PAXLI



EXAMPLE: The Pax Current Meter has been connected to measure a circuit current to 120.0 mA maximum. However, in this application, the display is to indicate percent of load current with 120.0 mA equivalent to 100.0 percent. The scale potentiometer is adjusted to reduce the normal 120.0 mA signal input display reading of 120.0 to indicate the desired reading of 100.0 on the display. Scaling to obtain a numerical readout higher than the normal value of the current can also be accomplished in most cases by selecting a lower current range. However, the maximum current for the range must not be exceeded. *(See Specifications for maximum input currents.)*

5.0 TROUBLESHOOTING

PROBLEM	REMEDIES
NO DISPLAY	**CHECK**: Power switch and line voltage
INCORRECT DISPLAY	**CHECK**: Input jumper position **CHECK**: Scaling adjustment pot DIP switch position **ADJUST**: Scaling pot **VERIFY**: Input Signal
OVER-RANGE INDICATION	**CHECK**: Input jumper position **VERIFY**: Input signal

For further assistance, contact technical support at the appropriate company numbers listed.

6.0 CALIBRATION

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed by enabling the scale pot DIP switch. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment.

Input Calibration

WARNING*: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.*

Before starting, verify that the Input Range Jumper is set for the range to be calibrated. Also verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter.

Then perform the following procedure:

1. Place jumper in 2 V range (PAXLV) or 2 mA range (PAXLI).
2. Set the DIP switch off to disable the scaling pot.
3. Apply half scale input signal.
4. Adjust calibration potentiometer as necessary for the display to read 1000 (ignore decimal point).
5. Apply zero signal and ensure display reads zero.
6. Apply full scale signal and ensure display reads 1999.

Note: Any individual range may be recalibrated (scaled) to 0.1% accuracy with appropriate calibration equipment.

MODEL PAXLIT - PAX LITE 5 AMP AC CURRENT METER

- *5 AMP AC CURRENT INPUT**
- *3 1/2-DIGIT, 0.56" (14.2 mm) HIGH LED RED DISPLAY*
- *SELECTABLE DECIMAL POINT LOCATION*
- *BUILT-IN SCALING PROVISIONS*
- *OVER-RANGE INDICATION*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*

* Accessory Shunts Available For Higher Current Ranges.

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

PAXLIT 5 Amp AC Current Meter provides the capability of measuring large AC currents. The internal current shunt in the PAXLIT can measure up to 5 Amps AC current directly. Using an external current transformer, AC currents of up to 1,999 Amps can be measured and displayed.

The PAXLIT can be scaled, using the scaling potentiometer, to display between 200 and 1999 when measuring full scale current. Using the DIP switch selectable decimal points, the display can be customized for direct readout for practically any application.

The 3½-digit bi-polar display (minus sign displayed when current is negative) features a 0.56" high, 7-segment LEDs for easy reading. The meter is also available with custom units label capability. Using the PAX label kit (PAXLBK30), the selected label is installed behind the panel, keeping it safe from washdown or other environmental conditions. A DIP switch is used to control the backlight for the units label.

The meters have a NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, allowing the meter to provide a tough yet reliable application solution.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**, (CAT I):
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II. (See IEC 664 & IEC 61010)

INSTALLATION CATEGORY (overvoltage category) **II**, (CAT II):
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III. (See IEC 664 & IEC 61010)

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

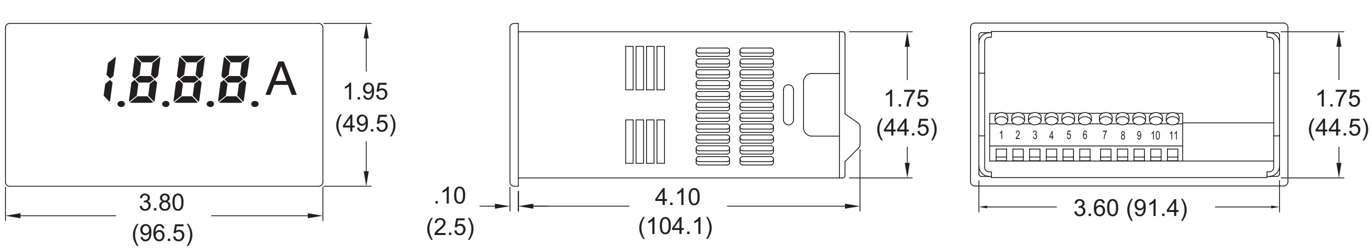


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	IT	0	0

IT - 5 Amp Current Meter

E

Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	PAXLBK	Units Label Kit Accessory	PAXLBK30
	CT	50:5 Amp Current Transformer	CT005050
		200:5 Amp Current Transformer	CT020050

General Meter Specifications

1. **DISPLAY**: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **POWER**: 115/230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA.
   Isolation: 2300 Vrms for 1 min. between input and supply
   Working Voltage: 300 V max., CAT II
3. **SIGNAL INPUT**:
   Range: 0 to 5 Amps AC @ 45 to 400 Hz
   Resolution: 2.5 mA
   Working Voltage: 300 V max., CAT II
4. **ACCURACY**: ±(0.5% of reading + 5 digits).
5. **OVER-RANGE INDICATION**: is indicated by blanking 3 least significant digits.
6. **MAX SHUNT CURRENT**: 50 Amps for 1 sec.; 8 Amps continuous.
   Caution: In circuits where fault currents can exceed the maximum shunt current, a fast-blow fuse should be installed in series with the input signal. Otherwise, a slow blow 8 Amp fuse is recommended that will allow for start-up over current situations, while still protecting the instrument.
7. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature: 0° to 60 °C
   Storage Temperature: -40° to 80 °C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g's.
   Shock According to IEC 68-2-27: Operational 30g's, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
8. **RESPONSE TIME TO STEP CHANGE INPUT**: 1 sec. nominal
9. **READING RATE**: 2.5 readings/sec., nominal
10. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4X Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Report # 04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529

   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle; 40 % variation
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

11. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 4.5 inch-lbs (0.51 N-m) max.
12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
13. **WEIGHT**: 0.65 lbs. (0.24 Kg)

Accessories

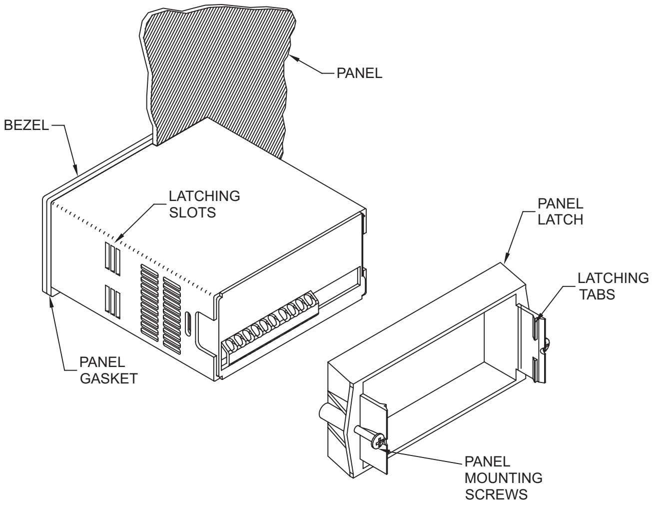
UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled by a DIP switch.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

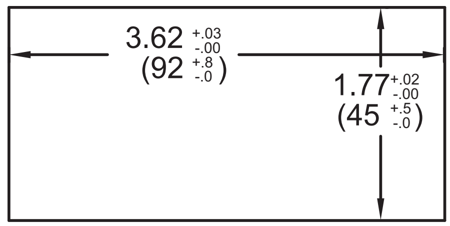


While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.



2.0 Setting the Switches

The meter has switches, which must be checked and/or changed prior to applying power. To access the switch, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

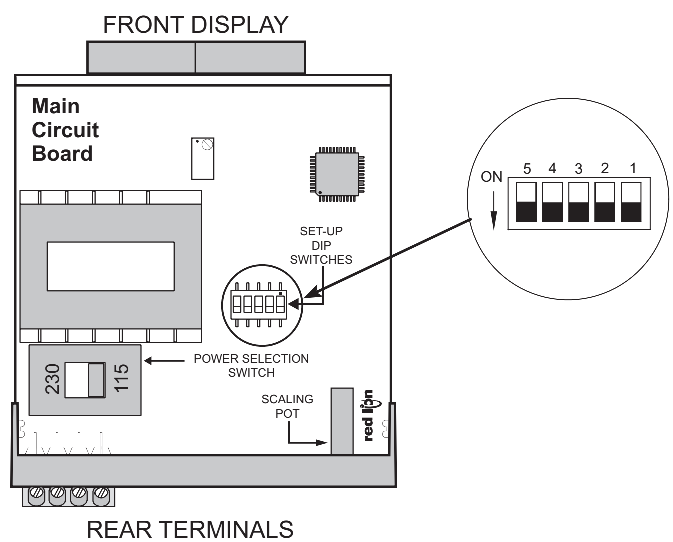
Power Selection Switch

Caution: Insure the AC power selection switch is set for the proper voltage before powering the meter. The meter is shipped from the factory in the 230 VAC position.

Set-Up DIP Switches

A DIP switch is located inside the meter. It is used for the selection of decimal points, backlight annunciator, and scaling. Selecting the "ON" position enables the function.

SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label
5	Enables the Scaling Pot



E

3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

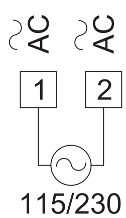
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   - Ferrite Suppression Cores for signal and control cables:
     - Fair-Rite # 0443167251 (RLC #FCOR0000)
     - TDK # ZCAT3035-1330A
     - Steward #28B2029-0A0
   - Line Filters for input power cables:
     - Schaffner # FN610-1/07 (RLC #LFIL0000)
     - Schaffner # FN670-1.8/07
     - Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

3.1 POWER WIRING

AC Power

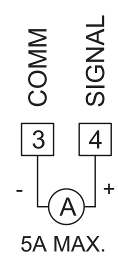
Terminal 1: VAC
Terminal 2: VAC



3.2 INPUT SIGNAL WIRING

Current Signal (self powered)

Terminal 4: + Amps AC
Terminal 3: - Amps AC



4.0 Scaling the Meter

FACTORY SCALING

The meter is calibrated from the factory for 5 Amps AC current input to show 1999. This scaling will be used when the Scale Switch is in the "OFF" position.

SCALING READOUT

Place the Scale Switch in the "ON" position. This enables the Scale Potentiometer which is accessible from the back of the meter. (Enabling the Scale Potentiometer does NOT affect the calibration of the meter.) Place the Decimal Point Switches to the proper location. Apply the meter power and the current signal. Adjust the Scale Potentiometer to the desired value.

This scaling only effects the span. There is no offset scaling. This means that only zero current can display a value of zero.

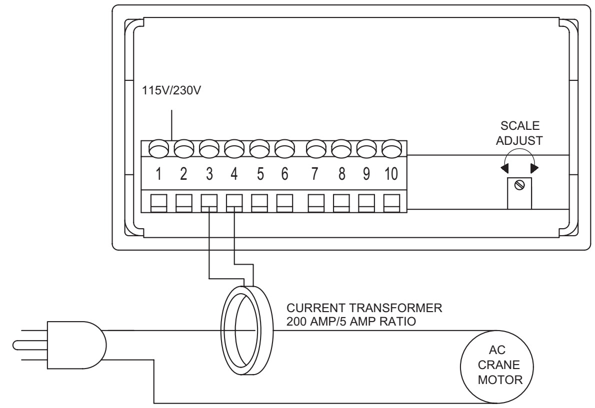
At 5 Amps AC current input, the display can be scaled from 1999 down to 200 by using the scaling potentiometer. For display values below 200, turn on the appropriate Decimal Point Switch and then adjust the potentiometer to achieve the desired display value. Example: A customer wants to display 50 Amps because he is using a 50:5 CT. In this case, he must turn DIP switch 1 on for a decimal point and DIP switch 5 on for scaling. Then apply the 5 Amp signal and turn the scaling pot until 50.0 is shown on the display.

5.0 Application

MOTOR CURRENT MEASUREMENT USING A CURRENT TRANSFORMER

The PAXLIT 5 Amp AC Current Meter is configured by simply connecting the “COMM.” (Terminal 3) and the “5AMP” (Terminal 4) to the external current transformer. The current carrying wire to be sensed is passed through the center of the current transformer. The resolution of the display, in this case, is 0.1 Amp, therefore, “Switch #1” is selected.

The meter is now ready to be scaled. The installer has access to a calibrated portable digital current meter capable of measuring the motor current. Scaling will be accomplished by adjusting the scaling pot on the PAXLIT meter to agree with the portable digital current meter. The operator turns on the AC motor and lifts a large weight to load the motor. The installer then simply adjusts the scaling adjustment, located at the rear of the unit, until the display is equal to the value indicated on the portable current meter. The meter will now indicate the load current of the motor precisely.



CAUTION: It is recommended that the current transformer be internally protected or that a voltage clamping circuit be provided, preventing dangerous high voltage across the CT secondary windings in case of accidental opening of the secondary output leads when the primary is energized.

In order to prevent risk of electric shock ensure CT is installed according to local NEC regulations for installation of current instrument transformers.

6.0 Troubleshooting

PROBLEM	REMEDIES
NO DISPLAY	**CHECK**: Power switch and line voltage
INCORRECT DISPLAY	**CHECK**: Scaling adjustment pot DIP switch position **ADJUST**: Scaling pot **VERIFY**: Input Signal
OVER-RANGE INDICATION	**VERIFY**: Input signal

For further assistance, contact technical support at the appropriate company numbers listed.

E

7.0 Calibration

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed by enabling the scale pot DIP switch. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every two years), it should only be performed by qualified technicians using appropriate equipment.

Input Calibration

***WARNING**: Calibration of this meter requires a signal source with an accuracy of 0.05% or better and an external meter with an accuracy of 0.005% or better.*

Before starting, verfiy that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter.

Then perform the following procedure:

1. Set the DIP switch off to disable the scaling pot.
2. Apply half scale input signal.
3. Adjust calibration potentiometer as necessary for the display to read 1000 (ignore decimal point)
4. Apply zero signal and ensure display reads zero.
5. Apply full scale signal and ensure display reads 1999.

MODEL PAXLHV - PAX LITE AC VOLTAGE MONITOR

- *3-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAY*
- *AUTO ZEROING CIRCUIT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*
- *UP TO 600 VAC MAX*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The Model PAXLHV is designed for AC voltage monitoring. The half-wave rectified input signal is calibrated to indicate the RMS value of a pure sinusoidal wave-form. The front bezel meets NEMA 4X/IP65 requirements when properly installed.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

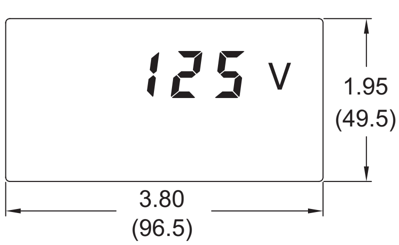
DEFINITION OF TERMS

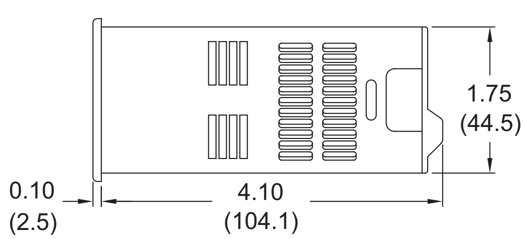
INSTALLATION CATEGORY (overvoltage category) **I**:
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II.

INSTALLATION CATEGORY (overvoltage category) **II**:
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.





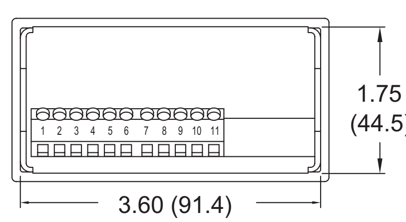


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	HV	0	0

HV - AC Voltage Input

E

Accessories Part Number

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

General Meter Specifications

1. **DISPLAY**: 3-digit, 0.56" (14.2 mm) high character, 7-segment Red LED
2. **POWER**: 115 or 230 VAC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA. Installation Category II, Pollution Degree 2.
   Isolation: 2300 Vrms for 1 min. to input
   Working Voltage: 300 V max., CAT II
3. **ACCURACY**: At 23°C, 85% R.H.; ±(0.1% of Reading + 2 digits)
4. **INPUT IMPEDANCE**: 1 MΩ
5. **INPUT RANGE**: 0 to 600 VAC max. @ 45 to 500 Hz. Installation Category I
6. **RESOLUTION**: 1 VAC
7. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0° to 60°C
   Storage Temperature Range: -40° to 80°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
   Temperature Coefficient: ±150 PPM/°C
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
   Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
   Altitude: Up to 2000 meters
8. **READING RATE**: 400 msec., nominal
9. **RESPONSE TIME**: 1 sec. nominal for a step change input.
10. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories Inc.
    UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report #04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529

    ELECTROMAGNETIC COMPATIBILITY:
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle; 40 % variation
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

11. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel Gasket and mounting clip included.
13. **WEIGHT**: 0.65 lbs. (0.24 Kg)

Accessories

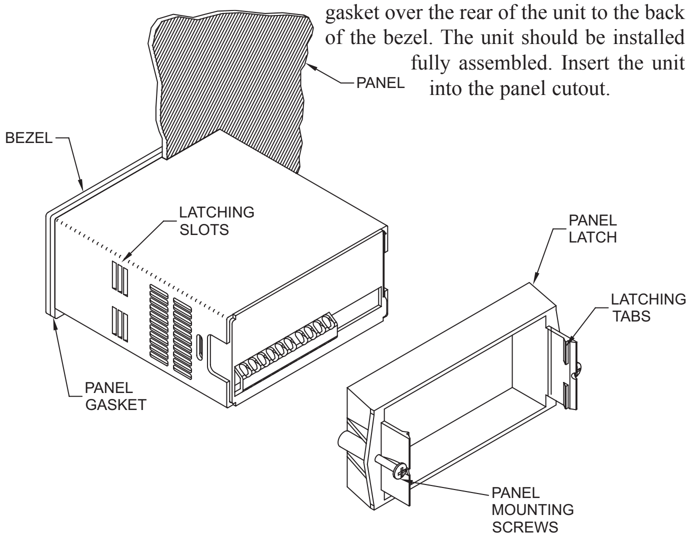
UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled by a DIP switch.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



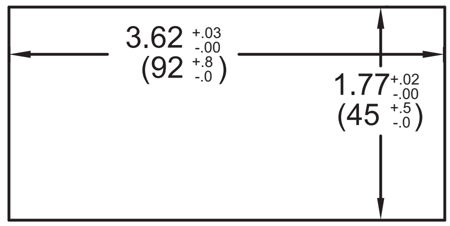
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

PANEL CUT-OUT



2.0 Setting the Switches

The meter has a switch, which must be checked and/or changed prior to applying power. To access the switch, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

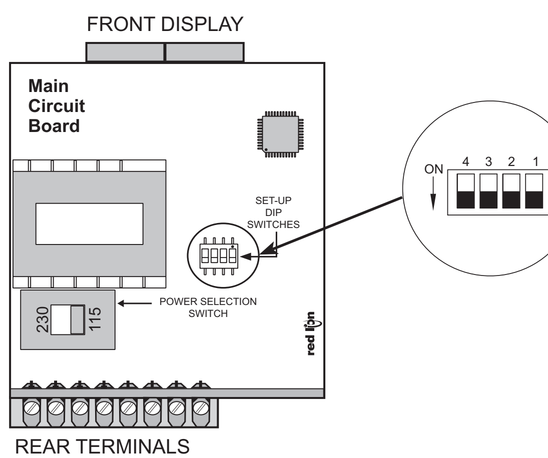
Power Selection Switch

Caution: Insure the AC power selection switch is set for the proper voltage before powering-up the meter. The meter is shipped from the factory in the 230 VAC position.

Set-Up DIP Switches

A DIP switch is located inside the meter. It is used for the selection of decimal points and backlight annunciator. Selecting the "ON" position enables the function.

SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label



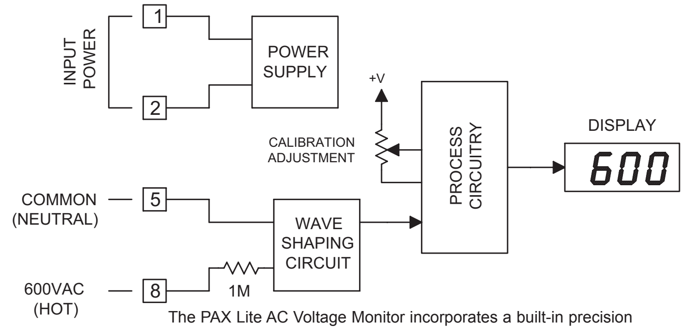
E

3.0 Wiring the Meter

WIRING OVERVIEW

All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. As depicted in the drawing of the Model PAXLHV, all connections are made on the terminal block located at the rear of the unit.

BLOCK DIAGRAM



The PAX Lite AC Voltage Monitor incorporates a built-in precision voltage divider that provides direct measurement from 0 to 600 VAC.

EMC INSTALLATION GUIDELINES

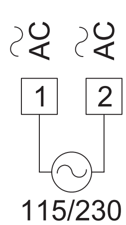
Although this meter is designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, that is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the meter is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VB3
      Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

3.1 POWER WIRING

Primary AC power is connected to terminal 1 and 2 *(Marked AC Power, located on the left-hand side of the terminal block)*. For best results, the AC power should be relatively “Clean” and within the specified ±10% variation limit. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

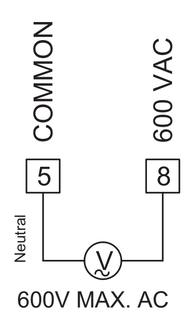
AC Power
Terminal 1: VAC
Terminal 2: VAC



3.2 INPUT SIGNAL WIRING

Input connections are made on terminal 5 and 8. When powering the PAXLHV with the same voltage that is being measured, terminal 5 (COMM.) should be connected to neutral for the most stable reading on the display. If an unstable display results from measuring a voltage that is isolated from the supply voltage, reversing the supply voltage connections may correct this condition.

Voltage Input
Terminal 5: Common
Terminal 8: 600 VAC



MODEL PAXLA - PAX LITE DC VOLT/CURRENT/PROCESS METER

c UL US LISTED
IND. CONT. EQ.
51EB

For Model No. PAXLA0U0 Only

- *5 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE SCALING AND DECIMAL POINTS*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAY*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNIT OVERLAY W/ BACKLIGHT*
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*

GENERAL DESCRIPTION

The PAXLA is a versatile meter available as a DC volt, current, or process meter with scaling and dual Form C relay outputs. The meter is programmed through the front panel buttons and the use of jumpers. The RST Key will also function as a front panel display reset.

Once the front panel programming is complete, the buttons can be disabled by a user input setting. The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXLA	Volt/Current/Process Meter with Dual Relay Output	PAXLA000
	UL Listed Volt/Current/Process Meter with Dual Relay Output	PAXLA0U0
PAXLBK	Unit Label Kit Accessory	PAXLBK10

SPECIFICATIONS

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) intensity adjustable Red LED (-19999 to 99999)
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 12 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs
   DC POWER: 21.6 to 250 VDC, 6 W
   DC Out: +24 VDC @ 100 mA if input voltage is greater than 50 VAC/VDC
   +24 VDC @ 50 mA if input voltage is less than 50 VDC
3. **INPUT RANGES**: Jumper Selectable
   D.C. Voltages: 200 mV, 2 V, 20 V, 200 V, 10 V

INPUT RANGE	ACCURACY @ 23 °C LESS THAN 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 mV	0.1% of span	1.033 MΩ	75 VDC	10 µV	70 ppm /°C
2 V	0.1% of span	1.033 MΩ	75 VDC	0.1 mV	70 ppm /°C
20 V	0.1% of span	1.033 MΩ	250 VDC	1 mV	70 ppm /°C
200 V	0.1% of span	1.033 MΩ	250 VDC	10 mV	70 ppm /°C
10 V	0.1% of span	538 KΩ	75 V	1 mV	70 ppm /°C

D.C. Currents: 200 µA, 2 mA, 20 mA, 200 mA

INPUT RANGE	ACCURACY @ 23 °C LESS THAN 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 µA	0.1% of span	1.111 KΩ	15 mA	10 nA	70 ppm /°C
2 mA	0.1% of span	111 Ω	50 mA	0.1 µA	70 ppm /°C
20 mA	0.1% of span	11 Ω	150 mA	1 µA	70 ppm /°C
200 mA	0.1% of span	1 Ω	500 mA	10 µA	70 ppm /°C

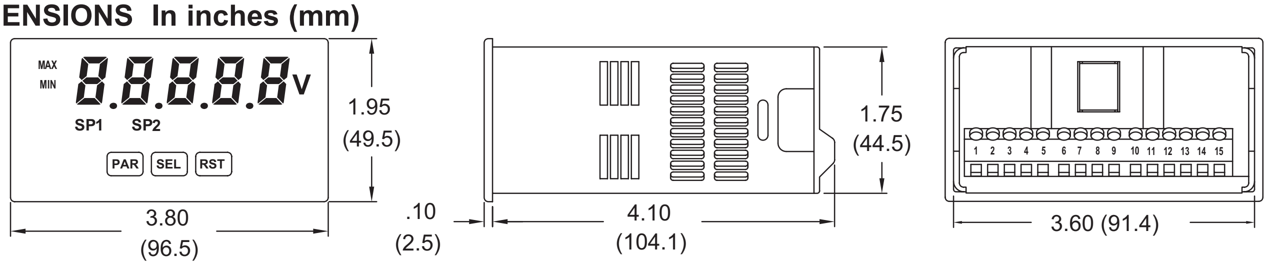
D.C. Process: 4 to 20 mA, 1 to 5 VDC, 0/1 to 10 VDC

INPUT RANGE	SELECT RANGE
4 - 20 mA	Use the 20 mA range
1 - 5 VDC	Use the 10V range
1 - 10 VDC	Use the 10V range

4. **OVERRANGE/UNDERRANGE INDICATION:**
   Input Overrange Indication: "OLOL".
   Input Underrange Indication: "ULUL".
   Display Overrange/Underrange Indication: "….."/"-….."
5. **A/D CONVERTER:** 16 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: 20 readings/sec.
   Display update: 500 msec min.

E

DIMENSIONS In inches (mm)



7. **USER INPUT**:
User Input: Software selectable pull-up (24.7 KΩ) or pull-down resistor (20 KΩ) that determines active high or active low input logic.
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 5 msec typ.; 100 msec debounce (activation and release)

8. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters when power is removed.

9. **OUTPUT**:
Type: Dual FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100,000 minimum operations
Response Time:
Turn On Time: 4 msec max.
Turn Off Time: 4 msec max.

10. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 50 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g's.
Shock According to IEC 68-2-27: Operational 30 g (10g relay), 11 msec in 3 directions.
Altitude: Up to 2,000 meters

11. **CONNECTIONS**: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gage: 30-14 AWG copper wire
Torque: 4.5 inch-lbs (0.51 N-m) max.

12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

13. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
Type 4X Enclosure rating (Face only), UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
IP20 Enclosure rating (Rear of unit), IEC 529
For Model No. PAXLA0U0 Only: UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class A

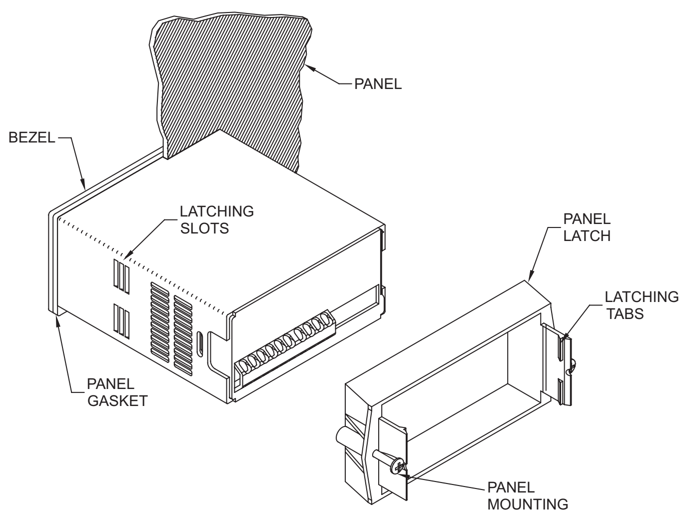
Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

14. **WEIGHT**: 10.4 oz. (295 g)

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

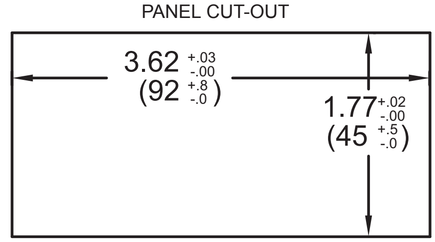
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



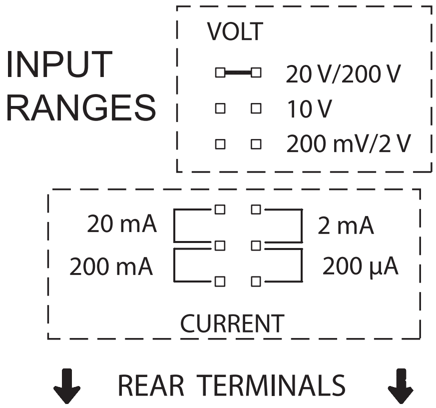
2.0 Setting the Jumpers

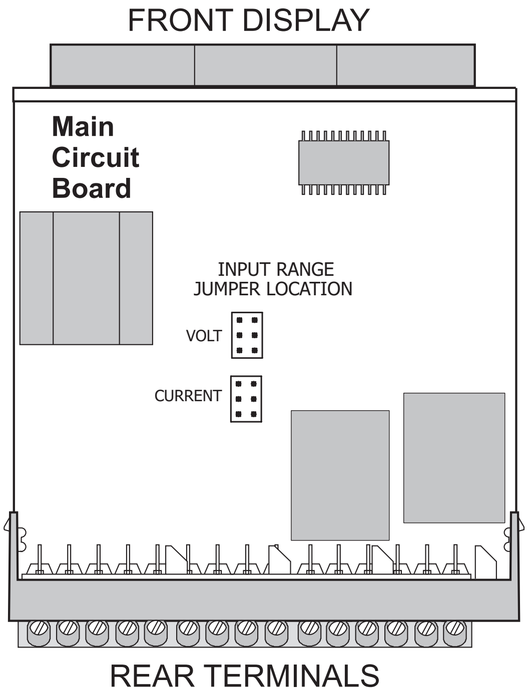
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum signal input to avoid overloads.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start on the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.





3.0 Wiring the Meter

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

WIRING OVERVIEW

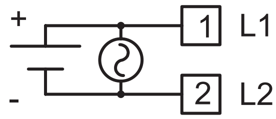
Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

E

3.1 POWER WIRING

Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -



DC Out Power
Terminal 3: + 24 VDC OUT
Terminal 4: Common

3.2 USER INPUT WIRING

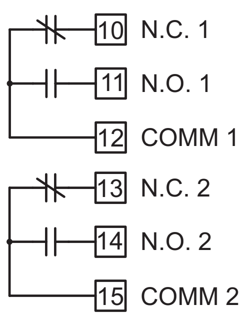
Terminal 8: User Input
Terminal 9: User Comm

Sinking Logic

Sourcing Logic

3.3 SETPOINT (OUTPUT) WIRING

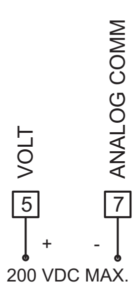
Terminal 10: NC 1
Terminal 11: NO 1
Terminal 12: Relay 1 Common
Terminal 13: NC 2
Terminal 14: NO 2
Terminal 15: Relay 2 Common



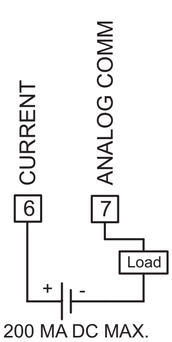
3.4 INPUT SIGNAL WIRING

CAUTION: Analog common is NOT isolated from user input common. In order to preserve the safety of the meter application, the Analog and DC power common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Input and Input Common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground. Always connect the analog signal common to terminal 7.

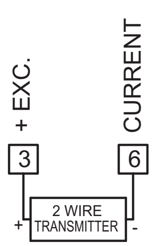
Voltage Signal (self powered)
Terminal 5: +VDC
Terminal 7: -VDC



Current Signal (self powered)
Terminal 6: +ADC
Terminal 7: -ADC

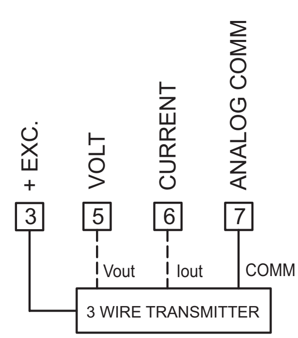


Current Signal (2 wire requiring excitation)
Terminal 3: +EXC
Terminal 6: +ADC

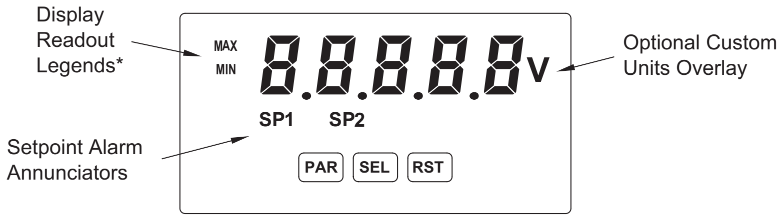


Current Signal (3 wire requiring excitation)
Terminal 6: +ADC (signal)
Terminal 7: -ADC (common)
Terminal 3: +EXC

Voltage Signal (3 wire requiring excitation)
Terminal 5: +VDC (signal)
Terminal 7: -VDC (common)
Terminal 3: +EXC



4.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL	Index display through selected displays	Advance through selection list/select digit position in parameter value
RST	Resets display	Increment selected digit of parameter value

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

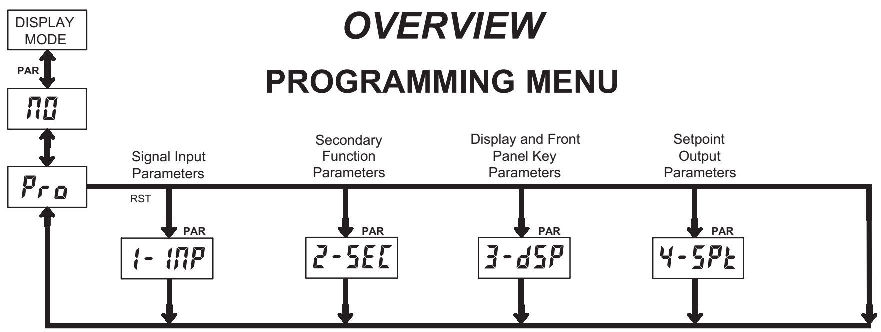
"SP1" - Below the display indicates setpoint 1 output activated.
"SP2" - Below the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** button. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL & PAR BUTTONS)

The Programming Menu is organized into four modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL** button is used to select the desired module. The displayed module is entered by pressing the **PAR** button.

MODULE MENU (PAR BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL** and **RST** buttons are used to move through the selections/values for that parameter. Pressing the **PAR** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST** button increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will select the next digit to the left. Pressing the **PAR** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR BUTTON)

The Programming Mode is exited by pressing the **PAR** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

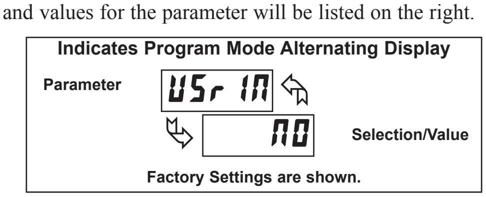
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



E

5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU

1-INP (PAR) → Pro

rANGE	dECPt	OFSEt	FILtr	bANd	StYLE	INP 1	dSP 1	INP 2	dSP 2	USr IN	U-ASN	U-Act
Input Range	Display Decimal Point	Display Offset Value	Filter Setting	Filter Band	Scaling Style	Input Value for Scaling Point 1	Display Value For Scaling Point 1	Input Value for Scaling Point 2	Display Value For Scaling Point 2	User Input Function	User Input Assignment	User Input Active Level

INPUT RANGE

rANGE
200u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
200uA	200.00 µA	0.02A	20.000 mA
0.002A	2.0000 mA	0.2A	200.00 mA
0.2u	200.00 mV	20u	20.000 V
2u	2.0000 V	200u	200.00 V
10u	10.000 V		

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt
0.00

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dSP1 and dSP2 parameters and setpoint values and offset value..

DISPLAY OFFSET VALUE

OFSEt
0.00

-19999 to 19999

The display can be corrected with an offset value. This can be used to compensate for signal variations or sensor errors. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the effects of offset. The decimal point follows the dECPt selection.

FILTER SETTING

FILtr
1

0 1 2 3

If the displayed value is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bANd
10

0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

SCALING STYLE

StYLE
KEY

KEY APLY

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INP 1
0.00

0 to 29999

For Key-in (KEY) style, enter the first Input Value using the front panel buttons. (The Input Range selection sets the decimal location for the Input Value).

For Apply (APLY) style, the meter shows the previously stored Input Value. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 1

dSP 1
0.00

-19999 to 99999

Enter the first Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

INP 2
100.00

0 to 29999

For Key-in (KEY) style, enter the known second Input Value using the front panel buttons.

For Apply (APLY) style, the meter shows the previously stored Input Value for Scaling Point 2. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2
100.00

-19999 to 99999

Enter the second Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

General Notes on Scaling

1. When using the Apply (APLY) scaling style, input values for scaling points must be confined to the range limits shown.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 20.)
3. For input levels beyond the programmed Input Values, the meter extends the Display Value by calculating the slope from the two coordinate pairs (INP1 / dSP1 & INP2 / dSP2).

E

USER INPUT FUNCTION

USr IN

NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
ZErO	Zero Input (Edge triggered)	Zero the Input Display value causing Display Reading to be Offset.
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEV	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation.
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN

dSP

HI   HI-LO
LO   dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, or display hold is selected in the User Input Function menu.

USER INPUT ACTIVE LEVEL

U-Act

LO

HI   LO

Select whether the user input is configured as active low or active high.

5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → PAR → HI-En (Max Display Enable) — HI-t (Max Capture Delay Time) — LO-En (Min Display Enable) — LO-t (Min Capture Delay TIme) — FCS (Factory Service Operations) — CodE (Access Code For Service Operations) → Pro

MAX DISPLAY ENABLE

HI-En

NO

NO   YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t

2.0

0.0 to 999.9 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En

NO

NO   YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t

2.0

0.0 to 999.9 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS

NO

NO   YES

Select YES to perform any of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE

66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** button to exit the module.

VIEW MODEL AND VERSION DISPLAY

CodE

50

Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** button to exit the module.

CALIBRATION

CodE

48

The PAXLA uses stored calibration values to provide accurate measurements. Over time, the electrical characteristics of the components inside the PAXLA will slowly change with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the PAXLA involves a calibration which should only be performed by individuals experienced in calibrating electronic equipment. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the PAXLA.

E

Current Calibration

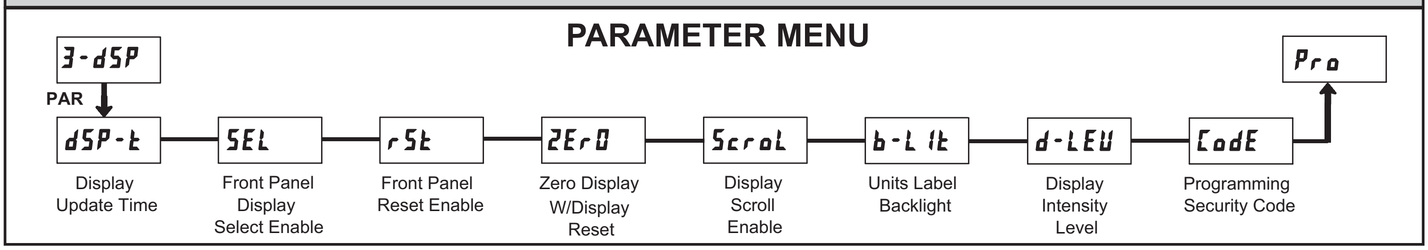
1. Connect the negative lead of a precision DC current source with an accuracy of 0.01% or better to the COMM terminal. Leave the positive lead of the DC current source unconnected.
2. With the display at CodE 48, press the **PAR** button. Unit will display CAL nO
3. Press the **RST** button to select the range to be calibrated.
4. Press the **PAR** button. Display reads 0.0A
5. With the positive lead of the DC current source unconnected, press **PAR**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, connect the positive lead of the DC current source to the current input and apply full-scale input signal for the range. (Note: For 200 mA range, apply 100 mA as indicated on the display.) Press **PAR**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL nO, press the **PAR** button to exit calibration.

Voltage Calibration

1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the volt input and COMM terminals of the PAXLA. Set the output of the voltage source to zero.
2. With the display at CodE 48, press the **PAR** button. Unit will display CAL nO.
3. Press the **RST** button to select the range to be calibrated.
4. Press the **PAR** button. Display reads 0.0u.
5. With the voltage source set to zero (or a dead short applied to the input), press **PAR**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, apply full-scale input signal for the range. (Note: For 200V range, apply 100V as indicated on the display.) Press **PAR**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL nO, press the **PAR** button to exit calibration

5.3 MODULE 3 - Display and Front Panel Button Parameters (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t
1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES nO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

nO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

ZERO DISPLAY WITH DISPLAY RESET

ZErO
nO

YES nO

This parameter enables the **RST** button or user input to zero the input display value, causing the display reading to be offset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.

DISPLAY SCROLL ENABLE

ScroL
nO

YES nO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS LABEL BACKLIGHT*

b-LIt
OFF

On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays which can be installed in to the meter's bezel display assembly. The backlight for these custom units is activated by this parameter.

DISPLAY INTENSITY LEVEL

d-LEU
3

1 to 3

Enter the desired Display Intensity Level (1-3). The display will actively dim or brighten as levels are changed.

E

PROGRAMMING SECURITY CODE

CodE ↰ **000** to **999**
↳ **000**

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (**P-Loc**) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

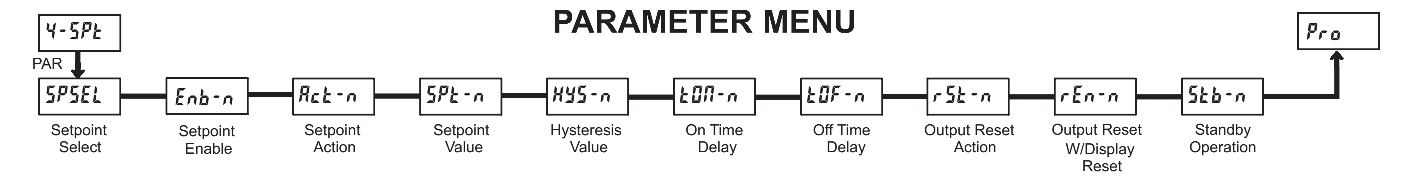
Programming a Security Code other than 0, requires this code to be entered at the **CodE** prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the **CodE** prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not **P-Loc**	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at **CodE** prompt *
		100-999	**CodE** prompt	With correct code entry at **CodE** prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	**CodE** prompt	With correct code entry at **CodE** prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

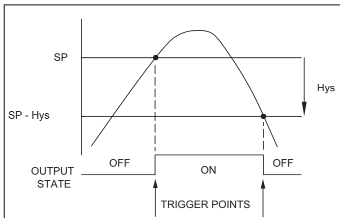
PARAMETER MENU



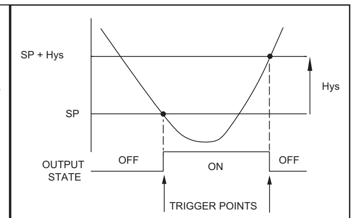
SETPOINT SELECT

SPSEL ↰ **NO** **SP-1** **SP-2**
↳ **NO**

Enter the setpoint (output) to be programmed. The **n** in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to **SPSEL**. Repeat steps for each setpoint to be programmed. Select **NO** to exit the module.



High Acting (Unbalanced Hys) = **HI-Ub**



Low Acting (Unbalanced Hys) = **LO-Ub**

SETPOINT ENABLE

Enb-n ↰ **YES** **NO**
↳ **NO**

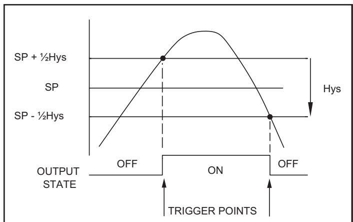
Select **YES** to enable Setpoint **n** and access the setup parameters. If **NO** is selected, the unit returns to **SPSEL** and Setpoint **n** is disabled.

SETPOINT ACTION

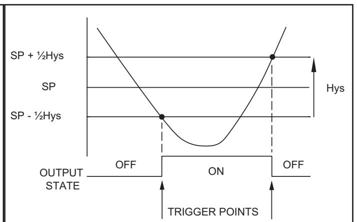
Act-n ↰ **HI-bL** **LO-bL** **HI-Ub** **LO-Ub**
↳ **HI-Ub**

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

- **HI-bL** = High Acting, with balanced hysteresis
- **LO-bL** = Low Acting, with balanced hysteresis
- **HI-Ub** = High Acting, with unbalanced hysteresis
- **LO-Ub** = Low Acting, with unbalanced hysteresis



High Acting (Balanced Hys) = **HI-bL**



Low Acting (Balanced Hys) = **LO-bL**

SETPOINT VALUE

SPt-n ↰ **-19999** to **99999**
↳ **00100**

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n ↰ **1** to **59999**
↳ **2**

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

E

ON TIME DELAY

tON-n
0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n
0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n
Auto

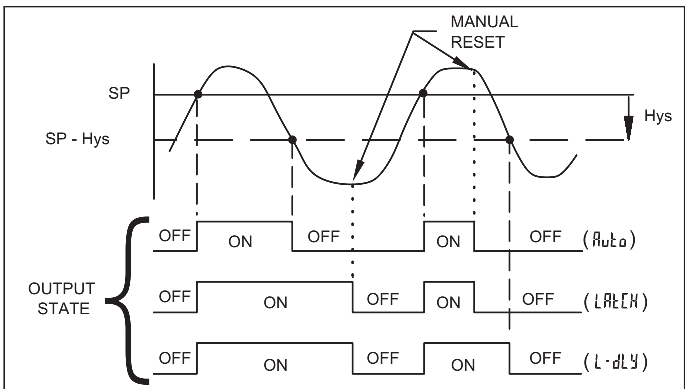
Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n
YES

NO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n
NO

NO YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

E

MODEL DP5 – 1/8 DIN ANALOG INPUT PANEL METERS

- PROCESS, VOLTAGE, CURRENT, AND TEMPERATURE INPUTS
- 5-DIGIT 0.56" HIGH LED DISPLAY
- PROGRAMMABLE FUNCTION KEYS/USER INPUT
- 9 DIGIT TOTALIZER (INTEGRATOR) WITH BATCHING
- OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT
- NEMA 4X/IP65 SEALED FRONT BEZEL

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The DP5 Panel Meters offer many features and performance capabilities to suit a wide range of industrial applications. These meters are available in three different models to handle various analog inputs, including DC Voltage/Current, Process, and Temperature Inputs. Refer to pages 4 and 5 for the details on the specific models.

The meters provide a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow, calculate service intervals of motors or pumps, etc. The totalizer can also accumulate batch weighing operations.

Once the meters have been initially configured, the parameter list may be locked out from further modification.

The meters have been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

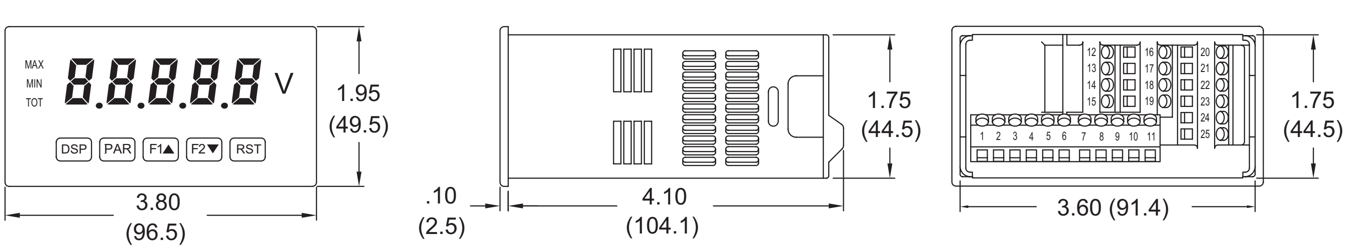


Table Of Contents

Ordering Information

Meter Part Numbers

DP5		0			0

D - DC Volt/Current Input
P - Process Input
T - Thermocouple and RTD Input

0 - Red LED Display

0 - 85 to 250 VAC
1 - 11 to 36 VDC, 24 VAC

Accessories Part Number

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory (Not required for DP5T)	PAXLBK10

E

General Meter Specifications

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) red LED, (-19999 to 99999)
2. **POWER**:
   AC Versions:
      AC Power: 85 to 250 VAC, 50/60 Hz, 10 VA
      Isolation: 2300 Vrms for 1 min. to all inputs.
   DC Versions:
      DC Power: 11 to 36 VDC, 11 W
      AC Power: 24 VAC, ± 10%, 50/60 Hz, 10 VA
      Isolation: 500 Vrms for 1 min. to all inputs (50 V working).
3. **ANNUNCIATORS**:
   MAX - maximum readout selected
   MIN - minimum readout selected
   TOT - totalizer readout selected, flashes when total overflows
   Units Label - optional units label backlight
4. **KEYPAD**: 3 programmable function keys, 5 keys total
5. **A/D CONVERTER**: 16 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: 10 readings/sec.
   Step response: 200 msec. max. to within 99% of final readout value
      (digital filter and internal zero correction disabled)
      700 msec. max. (digital filter disabled, internal zero correction enabled)
   Display update rate: 1 to 10 updates/sec.
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   DP5T: "OPEN" - Appears when open sensor is detected.
   DP5T: "SHrt" - Appears when shorted sensor is detected *(RTD only)*
   ". . . ." - Appears when display values exceed + display range.
   "- . . ." - Appears when display values exceed - display range.
8. **INPUT CAPABILITIES**: See specific product specifications, pages 4-5
9. **EXCITATION POWER**: See specific product specifications, pages 4-5
10. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode: > 60 dB @ 50 or 60 Hz ±1%, digital filter off
    Common Mode: >100 dB, DC to 120 Hz
11. **USER INPUT**: One software defined user input
    Max. Continuous Input: 30 VDC
    Isolation To Sensor Input Common: Not isolated. Do not tie commons together.
    Response Time : 50 msec. max.
    Logic State: Jumper selectable for sink/source logic

INPUT STATE	SINKING INPUTS 22 KΩ pull-up to +5 V	SOURCING INPUTS 22 KΩ pull-down
Active	V_{IN} < 0.9 VDC	V_{IN} > 3.6 VDC
Inactive	V_{IN} > 3.6 VDC	V_{IN} < 0.9 VDC

12. **TOTALIZER**:
    Time Base: second, minute, hour, or day
    Time Accuracy: 0.01% typical
    Decimal Point: 0 to 0.0000
    Scale Factor: 0.001 to 65.000
    Low Signal Cut-out: -19,999 to 99,999
    Total: 9 digits, display alternates between high order and low order readouts
13. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters and display values.
14. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50°C
    Storage Temperature Range: -40 to 60°C
    Operating and Storage Humidity: 0 to 85% max. RH non-condensing
    Altitude: Up to 2000 meters
15. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
       UL Recognized Component, File #E179259, UL61010-1, CSA C22.2 No. 61010-1
          DP5T Only: File # E156876, UL873, CSA C22.2 No. 24
          Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
       UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
          LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
       Type 4X Enclosure rating (Face only), UL50
       IECEE CB Scheme Test Certificate #US/8843A/UL
          CB Scheme Test Report #04ME11209-20041018
             Issued by Underwriters Laboratories, Inc.
          IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part I
          IP65 Enclosure rating (Face only), IEC 529
          IP20 Enclosure rating (Rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m [1] 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms 150 KHz - 80 MHz
Simulation of cordless telephones	ENV 50204	Level 3; 10 V/m 900 MHz ±5 MHz 200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A Power mains class A

Notes:
1. Self-recoverable loss of performance during EMI disturbance at 10 V/m:
   Measurement input signal may deviate during EMI disturbance.
   For operation without loss of performance:
      Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent)
      I/O and power cables are routed in metal conduit connected to earth ground.
Refer to EMC Installation Guidelines section of the bulletin for additional information.

16. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
17. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
18. **WEIGHT**: 7 oz. (200 g)

MODEL DP5D - UNIVERSAL DC INPUT

- FOUR VOLTAGE RANGES (300 VDC Max)
- FIVE CURRENT RANGES (2A DC Max)
- 24 VDC TRANSMITTER POWER

DP5D SPECIFICATIONS

INPUT RANGES:

INPUT RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
±200 μADC	0.03% of reading +0.03 μA	0.12% of reading +0.04μA	1.11 Kohm	15 mA	10 nA
±2 mADC	0.03% of reading +0.3 μA	0.12% of reading +0.4 μA	111 ohm	50 mA	0.1 μA
±20 mADC	0.03% of reading +3μA	0.12% of reading +4 μA	11.1 ohm	150 mA	1 μA
±200 mADC	0.05% of reading +30 μA	0.15% of reading +40 μA	1.1 ohm	500 mA	10 μA
±2 ADC	0.5% of reading +0.3 mA	0.7% of reading +0.4 mA	0.1 ohm	3 A	0.1 mA
±200 mVDC	0.03% of reading +30 μV	0.12% of reading +40 μV	1.066 Mohm	100 V	10 μV
±2 VDC	0.03% of reading +0.3 mV	0.12% of reading +0.4 mV	1.066 Mohm	300 V	0.1 mV
±20 VDC	0.03% of reading +3 mV	0.12% of reading +4 mV	1.066 Mohm	300 V	1 mV
±300 VDC	0.05% of reading +30 mV	0.15% of reading +40 mV	1.066 Mohm	300 V	10 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85%RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.

E

- DUAL RANGE INPUT (20 mA or 10 VDC)
- 24 VDC TRANSMITTER POWER

DP5P SPECIFICATIONS

SENSOR INPUTS:

INPUT (RANGE)	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	DISPLAY RESOLUTION
20 mA (-2 to 26 mA)	0.03% of reading +2 μA	0.12% of reading +3 μA	20 ohm	150 mA	1 μA
10 VDC (-1 to 13 VDC)	0.03% of reading +2 mV	0.12% of reading +3 mV	500 Kohm	300 V	1 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85%RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.

MODEL DP5T - THERMOCOUPLE AND RTD INPUT

- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *TIME-TEMPERATURE INTEGRATOR*

DP5T SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degree
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200°C is a function of temperature, ranging from 1°C at -200°C and degrading to 7°C at -270°C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)
Direct mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Direct 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Direct 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

ACCESSORIES

UNITS LABEL KIT (PAXLBK) - Not required for DP5T

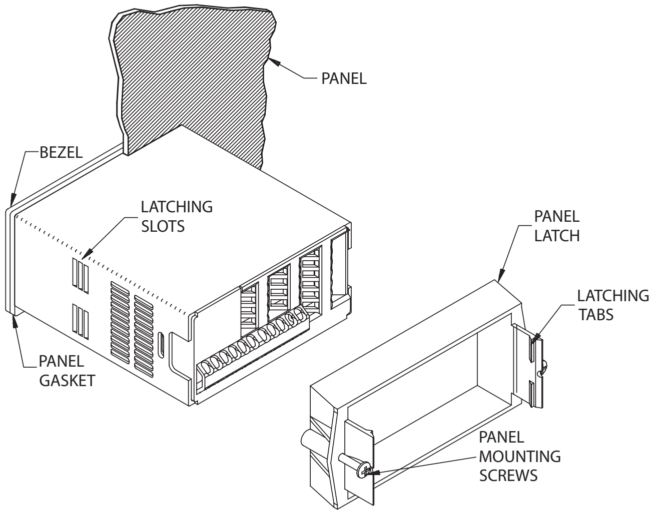
Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each DP5T meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

1.0 Installing The Meter

Installation

The DP5 meets NEMA 4X/IP65 requirements for indoor use when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

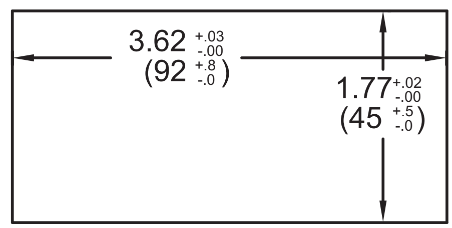
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Jumpers

The meter can have up to two jumpers that must be checked and / or changed prior to applying power. The two jumpers are: Input Range and User Input Logic. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

User Input Logic Jumper

This jumper selects the logic state of the user input. If the user input is not used, it is not necessary to check or move this jumper.

E

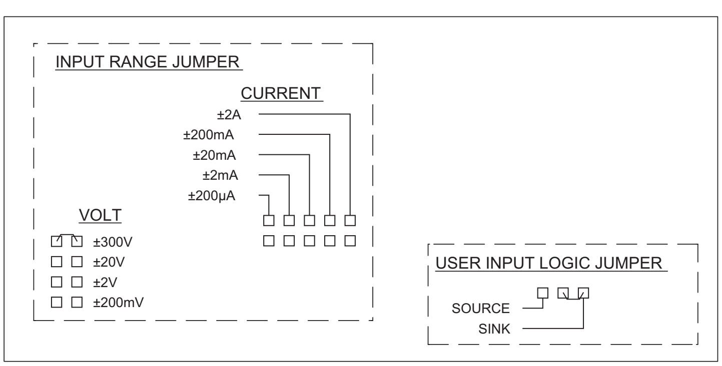
DP5D Jumper Selection

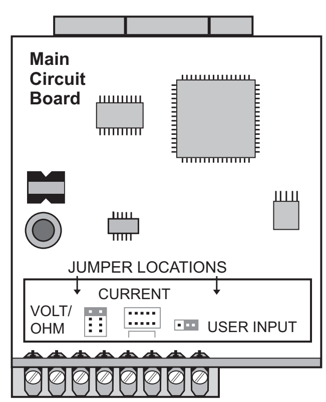
Input Range Jumper

One jumper is used for voltage or current input ranges. Select the proper input range high enough to avoid input signal overload. Only one jumper is allowed in this area. Do not have a jumper in both the voltage and current ranges at the same time. Avoid placing the jumper across two ranges.

JUMPER SELECTIONS

The ⌒ indicates factory setting.

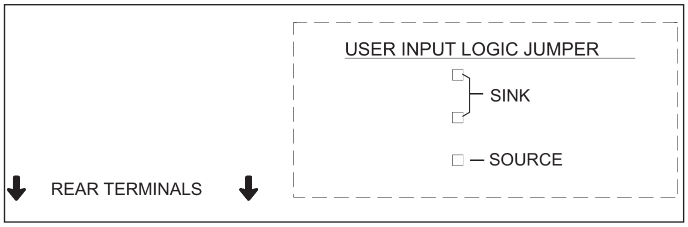


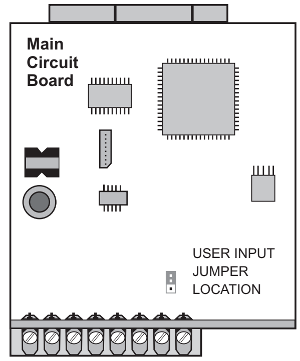


DP5P Jumper Selection

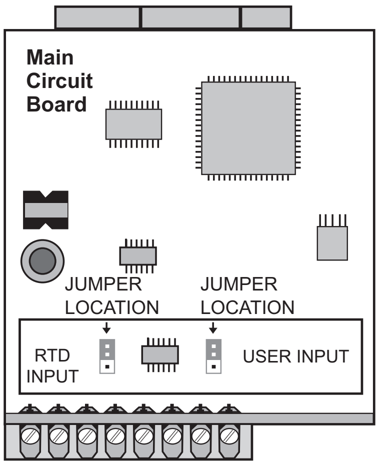
JUMPER SELECTIONS

The ⌒ indicates factory setting.





DP5T Jumper Selection

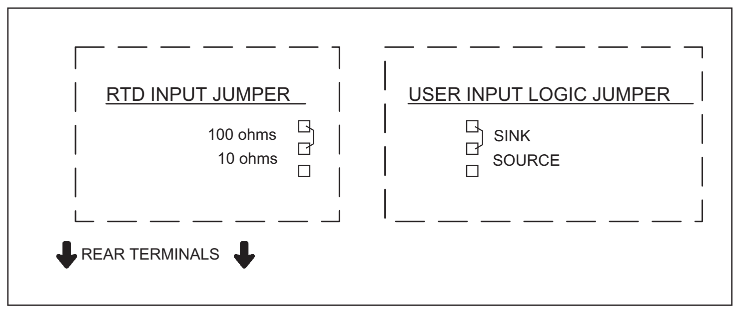


RTD Input Jumper

One jumper is used for RTD input ranges. Select the proper range to match the RTD probe being used. It is not necessary to remove this jumper when not using RTD probes.

JUMPER SELECTIONS

The ⌒ indicates factory setting.



3.0 WIRING THE METER

E

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

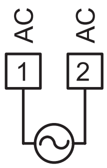
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations.Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

3.1 POWER WIRING

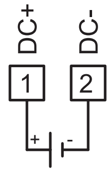
AC Power

Terminal 1: VAC
Terminal 2: VAC



DC Power

Terminal 1: +VDC
Terminal 2: -VDC



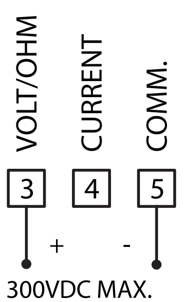
3.2 INPUT SIGNAL WIRING

DP5D INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

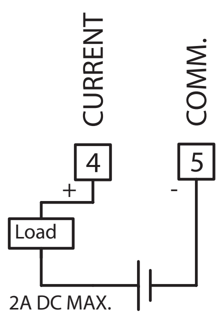
Voltage Signal (self powered)

Terminal 3: +VDC
Terminal 5: -VDC



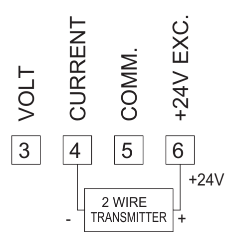
Current Signal (self powered)

Terminal 4: +ADC
Terminal 5: -ADC



Current Signal (2 wire requiring excitation)

Terminal 4: -ADC
Terminal 6: +ADC

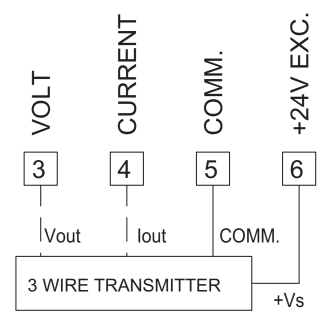


Current Signal (3 wire requiring excitation)

Terminal 4: +ADC (signal)
Terminal 5: -ADC (common)
Terminal 6: +Volt supply

Voltage Signal (3 wire requiring excitation)

Terminal 3: +VDC (signal)
Terminal 5: -VDC (common)
Terminal 6: +Volt supply

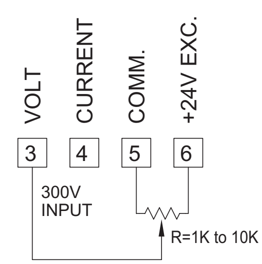


CAUTION: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Input and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common.

Potentiometer Signal (3 wire requiring excitation)

Terminal 3: Wiper
Terminal 5: Low end of pot.
Terminal 6: High end of pot.
Input Range Jumper: 300 Volt
Module 1 Input Range: 300 Volt

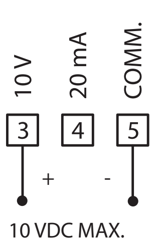
Note: The Apply signal scaling style should be used because the signal will be in volts.



DP5P INPUT SIGNAL WIRING

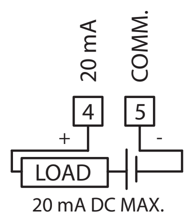
Voltage Signal (self powered)

Terminal 3: +VDC
Terminal 5: -VDC



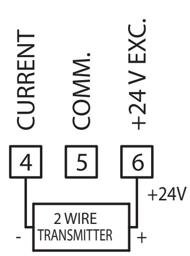
Current Signal (self powered)

Terminal 4: +ADC
Terminal 5: -ADC



Current Signal (2 wire requiring excitation)

Terminal 4: -ADC
Terminal 6: +ADC

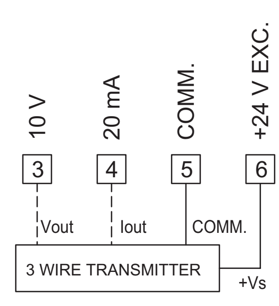


Current Signal (3 wire requiring excitation)

Terminal 4: +ADC (signal)
Terminal 5: -ADC (common)
Terminal 6: +Volt supply

Voltage Signal (3 wire requiring excitation)

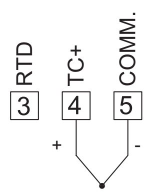
Terminal 3: +VDC (signal)
Terminal 5: -VDC (common)
Terminal 6: +Volt supply



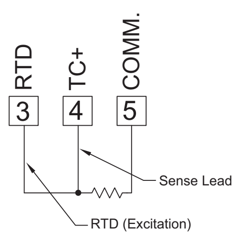
CAUTION: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Input and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common.

DP5T INPUT SIGNAL WIRING

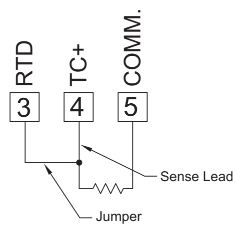
Thermocouple



3-Wire RTD



2-Wire RTD



***CAUTION**: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Input and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common.*

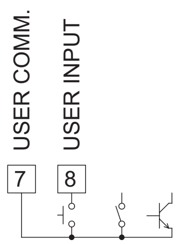
3.3 USER INPUT WIRING

Before connecting the wires, the User Input Logic Jumper should be verified for proper position. If not using the User Input then skip this section.

Sinking Logic

Terminal 8: } Connect external switching device between the
Terminal 7: } User Input terminal and User Comm.

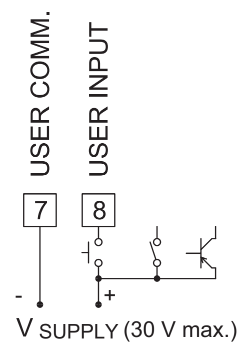
In this logic, the user input of the meter is internally pulled up to +5 V with 22 K resistance. The input is active when it is pulled low (<0 .9 V).



Sourcing Logic

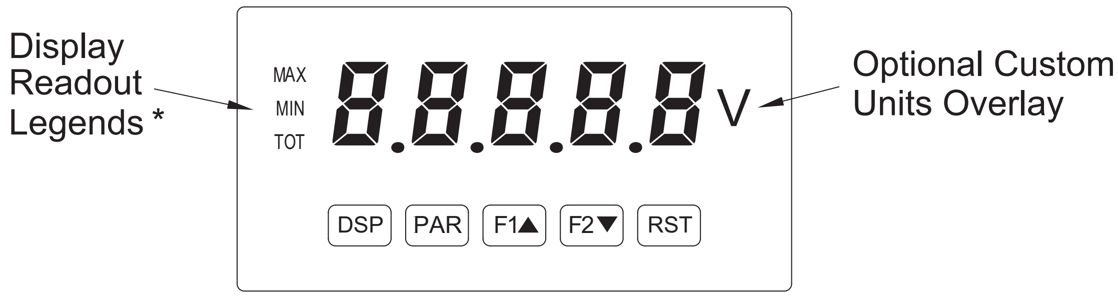
Terminal 8: + VDC thru external switching device
Terminal 7: -VDC thru external switching device

In this logic, the user input of the meter is internally pulled down to 0 V with 22 K resistance. The input is active when a voltage greater than 3.6 VDC is applied.



E

4.0 Reviewing the Front Buttons and Display



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through max/min/total/input readouts	Quit programming and return to display mode
PAR	Access parameter list	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1**	Increment selected parameter value
F2▼	Function key 2; hold for 3 seconds for Second Function 2**	Decrement selected parameter value
RST	Reset (Function key)**	Hold with F1▲, F2▼ to scroll value by x1000

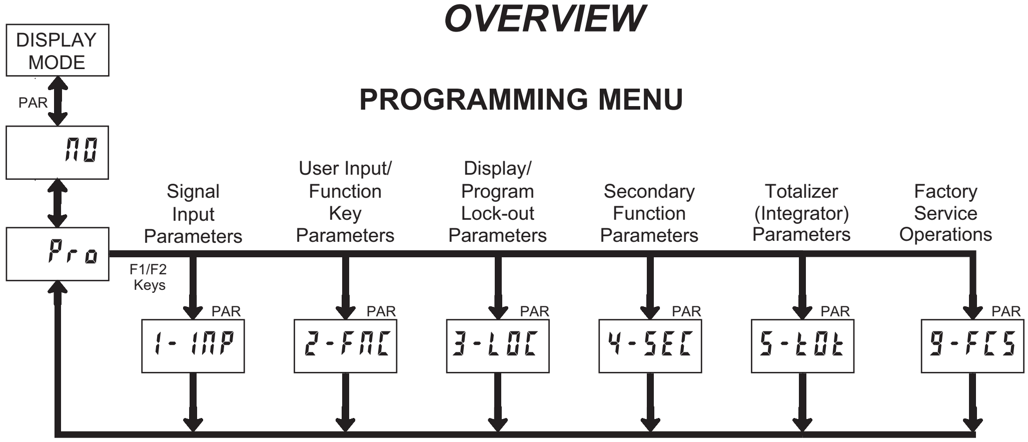
* Display Readout Legends may be locked out in Factory Settings.

** Factory setting for the F1, F2, and RST keys is NO mode.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



DISPLAY MODE

The meter normally operates in the Display Mode. In this mode, the meter displays can be viewed consecutively by pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown; Max Value (MAX), Min Value (MIN), or Totalizer Value (TOT). Each of these displays can be locked from view through programming. (See Module 3) The Input Display Value is shown with no annunciator.

PROGRAMMING MODE

Two programming modes are available.

Full Programming Mode permits all parameters to be viewed and modified. Upon entering this mode, the front panel keys change to Programming Mode operations. This mode should not be entered while a process is running, since the meter functions and User Input response may not operate properly while in Full Programming Mode.

Quick Programming Mode permits only certain parameters to be viewed and/or modified. When entering this mode, the front panel keys change to Programming Mode operations, and all meter functions continue to operate properly. Quick Programming Mode is configured in Module 3. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming Mode.

E

PROGRAMMING TIPS

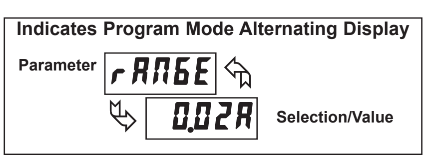
The Programming Menu is organized into nine modules (See above). These modules group together parameters that are related in function. It is recommended to begin programming with Module 1 and proceed through each module in sequence. If lost or confused while programming, press the **DSP** key to exit programming mode and start over. When programming is complete, it is recommended to record the meter settings on the Parameter Value Chart and lock-out parameter programming with a User Input or lock-out code. (See Modules 2 and 3 for lock-out details.)

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point if encountering programming problems. Throughout the module description sections which follow, the factory setting for each parameter is shown below the parameter display. In addition, all factory settings are listed on the Parameter Value Chart following the programming section.

ALTERNATING SELECTION DISPLAY

In the module description sections which follow, the dual display with arrows appears for each programming parameter. This is used to illustrate the display alternating between the parameter (top display) and the parameter's Factory Setting (bottom display). In most cases, selections or value ranges for the parameter will be listed on the right.



STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (PAR KEY)

The Programming Mode is entered by pressing the **PAR** key. If this mode is not accessible, then meter programming is locked by either a security code or a hardware lock. (See Modules 2 and 3 for programming lock-out details.)

MODULE ENTRY (ARROW & PAR KEYS)

Upon entering the Programming Mode, the display alternates between Pro and the present module (initially nO). The arrow keys (**F1▲** and **F2▼**) are used to select the desired module, which is then entered by pressing the **PAR** key.

PARAMETER (MODULE) MENU (PAR KEY)

Each module has a separate parameter menu. These menus are shown at the start of each module description section which follows. The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro nO. From this point, programming may continue by selecting and entering additional modules. (See **MODULE ENTRY** above.)

PARAMETER SELECTION ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the parameter and the present selection or value for that parameter. For parameters which have a list of selections, the arrow keys (**F1▲** and **F2▼**) are used to sequence through the list until the desired selection is displayed. Pressing the **PAR** key stores and activates the displayed selection, and also advances the meter to the next parameter.

NUMERICAL VALUE ENTRY (ARROW, RST & PAR KEYS)

For parameters which require a numerical value entry, the arrow keys can be used to increment or decrement the display to the desired value. When an arrow key is pressed and held, the display automatically scrolls up or scrolls down. The longer the key is held, the faster the display scrolls.

The **RST** key can be used in combination with the arrow keys to enter large numerical values, when the **RST** key is pressed along with an arrow key, the display scrolls by 1000's. Pressing the **PAR** key stores and activates the displayed value, and also advances the meter to the next parameter.

PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pro nO)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro nO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU

1-INP → PAR → rANGE — dECPt — round — FILtr — bANd — StYLE — INP x — dSP x → Pro

rANGE	dECPt	round	FILtr	bANd	StYLE	INP x	dSP x
Input Range	Display Decimal Point	Display Rounding	Filter Setting	Filter Band	Scaling Style	Input x Value	Display x Value

DP5T PARAMETER MENU

1-INP → PAR → tYPE — SCALE — dECPt — round — OFFSt — FILtr — bANd → Pro

tYPE	SCALE	dECPt	round	OFFSt	FILtr	bANd
Input Type	Temperature Scale	Display Decimal Point	Display Rounding	Display Offset	Filter Setting	Filter Band

Refer to the appropriate Input Range for the selected meter. Use only one Input Range, then proceed to Display Decimal Point.

DP5D INPUT RANGE

rANGE
300u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
200uA	±200.00 µA	0.2u	±200.00 mV
0.002A	±2.0000 mA	2u	±2.0000 V
0.02A	±20.000 mA	20u	±20.000 V
0.2A	±200.00 mA	300u	±300.00 V
2A	±2.0000 A		

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DP5P INPUT RANGE

rANGE
0.02A

SELECTION	RANGE RESOLUTION
0.02A	±20.000 mA
10u	±10.000 V

Select the input range that corresponds to the external signal.

DP5T INPUT TYPE

tYPE
tc-J

SELECTION	TYPE	SELECTION	TYPE
tc-t	T TC	tc-c	C TC
tc-E	E TC	Pt385	RTD platinum 385
tc-J	J TC	Pt392	RTD platinum 392
tc-K	K TC	Ni672	RTD nickel 672
tc-r	R TC	Cu427	RTD copper 10 Ω
tc-S	S TC	ULt	Direct mV range
tc-b	B TC	rES-H	Direct ohms range high
tc-n	N TC	rES-L	Direct ohms range low

Select the input type that corresponds to the input sensor. For RTD types, check the RTD Input Jumper for matching selection. For sensor verification and testing, use the direct readout modes.

TEMPERATURE SCALE

SCALE
°F

°F °C

Select the temperature scale. This selection applies for Input, MAX, MIN, and TOT displays. This does not change the user installed Custom Units Overlay display. If changed, those parameters that relate to the temperature scale should be checked.

DISPLAY DECIMAL POINT

dECPt
0

0 0.0 0.00 0.000 0.0000

These selections are not available for DP5T.

Select the decimal point location for the Input, **MAX** and **MIN** displays. (The **TOT** display decimal point is a separate parameter.) This selection also affects round, dSP1 and dSP2 parameters.

DISPLAY ROUNDING*

round
1

1 2 5
10 20 50 100

These bottom selections are not available for DP5T.

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, etc.) are not automatically adjusted to this display rounding selection.

DP5T: TEMPERATURE DISPLAY OFFSET*

OFFSt
0

-19999 to 99999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the affects of offset.

E

FILTER SETTING*

FILtr
1.0

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND*

bAnd
10

0.0 to 25.0 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the digital filter permanently engaged.

The remaining parameters in Module 1 do not apply to the DP5T.

SCALING STYLE

StYLE
KEY

KEY key-in data
APLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used. After using the Apply (APLY) scaling style, this parameter will default back to KEY but the scaling values will be shown from the previous applied method.

INPUT VALUE FOR SCALING POINT 1

InP 1
0.00

- 19999 to 99999

For Key-in (KEY), enter the known first Input Value by using the arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (APLY), apply the input signal to the meter, adjust the signal source externally until the desired Input Value appears. In either method, press the **PAR** key to enter the value being displayed. The **DSP** key can be pressed without changing the previously stored InP 1 value in the APLY style.

Note: APLY style - Pressing the **RST** *key will advance the display to the next scaling display point without storing the input value.*

DISPLAY VALUE FOR SCALING POINT 1

dSP 1
0.00

- 19999 to 99999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

InP 2
100.00

- 19999 to 99999

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (APLY), adjust the signal source externally until the next desired Input Value appears.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2
100.00

- 19999 to 99999

Enter the second coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles.

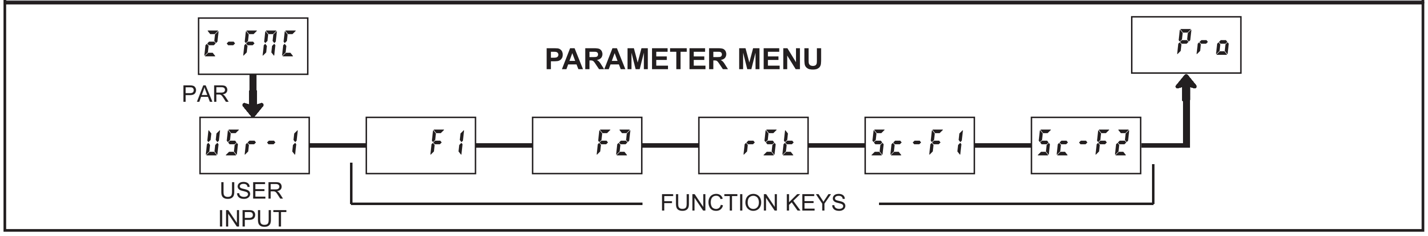
General Notes on Scaling

1. Input Values for scaling points should be confined to the limits of the Input Range.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 10.)
   This is referred to as read out jumps (vertical scaled segments).
3. The same Display Value can correspond to more than one Input Value. (Example: 0 mA and 20 mA can equal 10.)
   This is referred to as readout dead zones (horizontal scaled segments).
4. The maximum scaled Display Value spread between range maximum and minimum is limited to 65,535. For example using +20 mA range the maximum +20 mA can be scaled to is 32,767 with 0 mA being 0 and Display Rounding of 1. (Decimal points are ignored.) The other half of 65,535 is for the lower half of the range 0 to -20 mA even if it is not used. With Display Rounding of 2, +20 mA can be scaled for (32,767 x 2 =) 65,535 but with even Input Display values shown.
5. For input levels beyond the first programmed Input Value, the meter extends the Display Value by calculating the slope from the first two coordinate pairs (InP 1 / dSP 1 & InP2 / dSP2). If InP 1 = 4 mA and dSP 1 = 0, then 0 mA would be some negative Display Value. The calculations stop at the limits of the Input Range.
6. For input levels beyond the last programmed Input Value, the meter extends the Display Value by calculating the slope from the two sequential coordinate pairs. The calculations stop at the limits of the Input Range.

E

* *Factory Setting can be used without affecting basic start-up.*

5.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)



The user input is programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state.

The front panel function keys are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if the user input and/or one of the function keys is programmed for the same function, the maintained (level trigger) actions will be performed while the user input or at least one of the function keys are activated. The momentary (edge trigger) actions will be performed every time the user input or function keys transition to the active state.

Note*: In the following explanations, not all selections are available for both the user input and front panel function keys. Alternating displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection.* USr-1 *will represent the user input.* F1 *will represent all five function keys.*

NO FUNCTION

USr-1 / NO   F1 / NO

No function is performed if activated. This is the factory setting for the user input and all function keys. No function can be selected without affecting basic start-up.

PROGRAMMING MODE LOCK-OUT

USr-1 / PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USr-1 / rEL   F1 / rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Offset Value and is automatically stored as the new Display Offset Value (OFFSt). If another Zero (tare) Display is performed, the display will again change to zero and the Display reading will shift accordingly.

RELATIVE/ABSOLUTE DISPLAY

USr-1 / d-rEL   F1 / d-rEL

This function will switch the Input Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input Display will normally show the Relative unless switched by this function. Regardless of the display selected, all meter functions continue to operate based on relative values. The Absolute is a gross value (based on Module 1 **DSP** and **INP** entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative display. AbS (absolute) or rEL (relative) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USr-1 / d-HLd

The shown display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USr-1 / A-HLd

The meter disables processing the input and holds all display contents as long as activated (maintained action).

SYNCHRONIZE METER READING

USr-1 / SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USr-1 / bAt   F1 / bAt

The Input Display value is one time added (batched) to the Totalizer at transition to activate (momentary action). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden.

SELECT TOTALIZER DISPLAY

USr-1 / d-tot

The Totalizer display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Totalizer continues to function independent of being displayed.

E

RESET TOTALIZER

USr-1 → rtot1 F1 → r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USr-1 → rtot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USr-1 → E-tot

The Totalizer continues to operate as long as activated (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USr-1 → d-HI

The Maximum display is selected as long as activated (maintained action). When the user input is released, the Input Display returns. The **DSP** key overrides the active user input. The Maximum continues to function independent of being displayed.

RESET MAXIMUM

F1 → r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MAXIMUM DISPLAY

USr-1 → r-HI

When activated (momentary action), the Maximum value is set to the present Input Display value. Maximum continues from that value while active (maintained action). When the user input is released, Maximum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Maximum function.

SELECT MINIMUM DISPLAY

USr-1 → d-Lo

The Minimum display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Minimum continues to function independent of being displayed.

RESET MINIMUM

F1 → r-Lo

When activated (momentary action), rESEt flashes and the Minimum reading is set to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MINIMUM DISPLAY

USr-1 → r-Lo

When activated (momentary action), the Minimum value is set to the present Input Display value. Minimum continues from that value while active (maintained action). When the user input is released, Minimum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Minimum function.

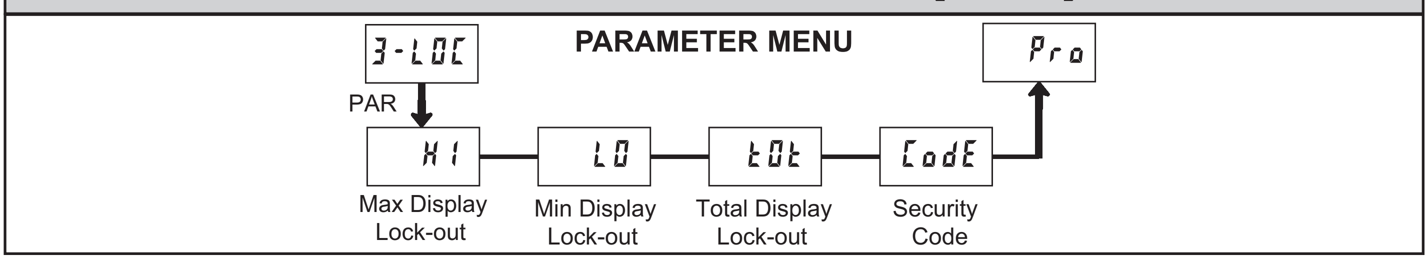
RESET MAXIMUM AND MINIMUM

USr-1 → r-HL F1 → r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

E

5.3 MODULE 3 - DISPLAY AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)



MAXIMUM DISPLAY LOCK-OUT*
MINIMUM DISPLAY LOCK-OUT*
TOTALIZER DISPLAY LOCK-OUT*

HI → LOC LO → LOC tOt → LOC

These displays can be programmed for LOC or rEd. When programmed for LOC, the display will not be shown when the **DSP** key is pressed regardless of Program Lock-out status. It is suggested to lock-out the display if it is not needed. The associated function will continue to operate even if its display is locked-out.

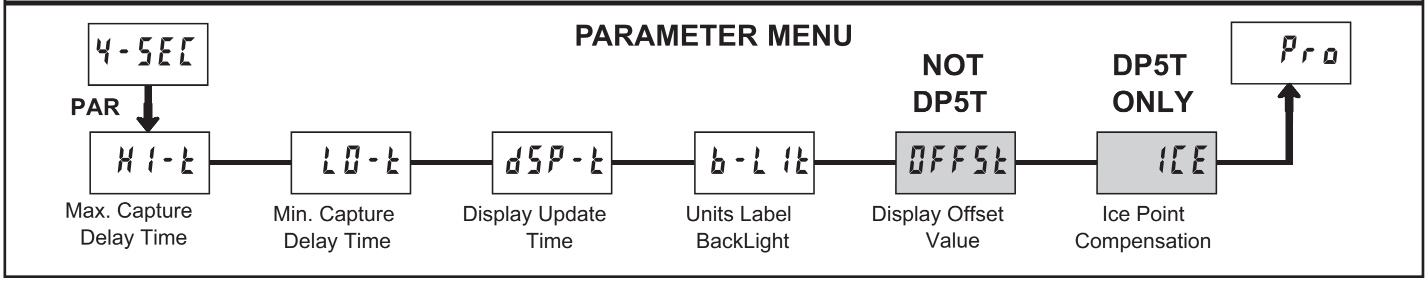
PROGRAM MODE SECURITY CODE*

CodE → 0 0 to 250

By entering any non-zero value, the prompt CodE 0 will appear when trying to access the Program Mode. Access will only be allowed after entering a matching security code or universal code of 222. With this lock-out, a user input would not have to be configured for Program Lock-out. However, this lock-out is overridden by an inactive user input configured for Program Lock-out.

* *Factory Setting can be used without affecting basic start-up.*

5.4 MODULE 4 - SECONDARY FUNCTION PARAMETERS (4-SEC)



MAX CAPTURE DELAY TIME*

HI-t
0.1

0.1 to 3275.0 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE DELAY TIME*

LO-t
0.1

0.1 to 3275.0 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE*

dSP-t
2

1 2 5 10 updates/sec.

This parameter determines the rate of display update. When set to 10 updates/second, the internal re-zero compensation is disabled, allowing for the fastest possible output response.

UNITS LABEL BACKLIGHT*

b-LIt
OFF

On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays which can be installed in to the meter's bezel display assembly. The backlight for these custom units is activated by this parameter.

DISPLAY OFFSET VALUE*

This parameter does not apply for the DP5T.

OFFSt
0.00

-19999 to 19999

Unless a Zero Display was performed or an offset from Module 1 scaling is desired, this parameter can be skipped. The Display Offset Value is the difference from the Absolute (gross) Display value to the Relative (net) Display value for the same input level. The meter will automatically update this Display Offset Value after each Zero Display. The Display Offset Value can be directly keyed-in to intentionally add or remove display offset. See Relative / Absolute Display and Zero Display explanations in Module 2.

DP5T: ICE POINT COMPENSATION*

ICE
On

On OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter.

E

* *Factory Setting can be used without affecting basic start-up.*

5.5 MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-tOt)

PARAMETER MENU

5-tOt → PAR → dECPt — tbASE — SCFAC — Locut — P-UP → Pro

dECPt	tbASE	SCFAC	Locut	P-UP
Totalizer Decimal Point	Totalizer Time Base	Totalizer Scale Factor	Totalizer Low Cut Value	Totalizer Power Up Reset

The totalizer accumulates (integrates) the Input Display value using one of two modes. The first is using a time base. This can be used to compute a time-temperature product. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of temperature integration, useful in curing and sterilization applications. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT*

dECPt
0.00

0 0.0 0.00 0.000 0.0000

For most applications, this matches the Input Display Decimal Point (dECPt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

tbASE
_ 1n

SEC - seconds (÷ 1) hour - hours (÷ 3600)
_ 1n - minutes (÷ 60) dAY - days (÷ 86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR*

SCFAC
1.000

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In these cases, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a different value than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Changing engineering units (example inches to meters)
3. Changing both decimal point location and engineering units.
4. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE*

Locut
-19999

-19999 to 99999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET*

P-UP
NO

NO Do not reset buffer
rSt Reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to reset.

* *Factory Setting can be used without affecting basic start-up.*

TOTALIZER HIGH ORDER DISPLAY

When the total exceeds 5 digits, the front panel annunciator **TOT** flashes. In this case, the meter continues to totalize up to a 9 digit value. The high order 4 digits and the low order 5 digits of the total are displayed alternately. The letter "h" denotes the high order display.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:
- Input Display - the present input reading
- Totalizer Scale Factor - 0.001 to 65.000
- Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at an average of 10.0°C per hour. The Totalizer is used to verify this average reading in a controlled time frame of 4 hours. Because the Input Display and Totalizer are both in tenths of °C, the Totalizer Scale Factor is 1. However, the Totalizer Time Base is hours (3600) divided by the 4 hours in the controlled time frame to yield a Totalizer Scale Factor of 0.250. By placing these values in the equation, the Totalizer will accumulate every second as follows:

$$\frac{10.0 \text{ x } 0.250}{3600} = 0.00069 \text{ accumulates each second}$$

This results in:
0.04167 accumulates each minute
2.5 accumulates each hour
10.0 reached at the end of 4 hours

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPt) location from the Input Display Decimal Point (dECPt), the required Totalizer Scale Factor is multiplied by a power of ten.
   Example: Input (dECPt) = 0.0   Input (dECPt) = 0.00

Totalizer dECPt	Scale Factor
0.00	10
0.0	1
0	.1
x10	.01
x100	.001

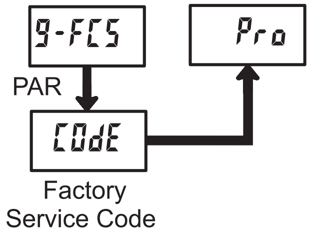
Totalizer dECPt	Scale Factor
0.000	10
0.00	1
0.0	.1
0	.01
x10	.001

(x = Totalizer display is round by tens or hundreds)

2. When changing the Totalizer engineering units, the Totalizer Scale Factor is the known conversion multiplier from Input Display units to Totalizer units.
   Example: If Input Display is feet and the Totalizer needs to be in yards, the conversion multiplier from feet to yards is 0.333. Enter 0.333 as the Totalizer scale factor.
3. When changing both the Totalizer engineering units and Totalizer Decimal Point the two calculations are multiplied together. Example: Input Display = feet in tenths (0.0) with Totalizer = whole yards (0), the scale factor would be 0.033.
4. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.
   Example: Average temperature per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for rtot2. The timer will control the start (reset) and the stopping (hold) of the totalizer.

E

5.9 MODULE 9 - Factory Service Operations (9-FCS)



PARAMETER MENU

RESTORE FACTORY DEFAULTS

CodE
66

Use the arrow keys to display CodE 66 and press **PAR**. The meter will display rESEt and then return to CodE 50. Press **DSP** key to return to Display Mode. This will overwrite all user settings with the factory settings.

CALIBRATION

CodE
48

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored using the Apply (APLY) Scaling Style.

Calibration may be aborted by disconnecting power to the meter before exiting Module 9. In this case, the existing calibration settings remain in effect.

DP5D - Input Calibration

WARNING: Calibration of this meter requires a signal source with an accuracy of 0.01% or better.

Before starting, verify that the Input Ranger Jumper is set for the range to be calibrated. Also verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Use the arrow keys to display CodE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**.
3. When the zero range limit appears on the display, apply the appropriate:
   - Voltage ranges: dead short applied
   - Current ranges: open circuit
4. Press **PAR** and ---- will appear on the display for about 10 seconds.
5. When the top range limit appears on the display, apply the appropriate:
   - Voltage ranges: top range value applied (The 300 V range is the exception. It is calibrated with a 100 V signal.)
   - Current ranges: top range value
6. Press **PAR** and ---- will appear on the display for about 10 seconds.
7. When no appears, press **PAR** twice.
8. If the meter is not field scaled, then the input display should match the value of the input signal.
9. Repeat the above procedure for each input range to be calibrated.

DP5P - Input Calibration

WARNING: Calibration of this meter requires a signal source with an accuracy of 0.01% or better.

Before starting, verify that the precision signal source is connected to the correct terminals and ready. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Use the arrow keys to display CodE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**.
3. When the zero range limit appears on the display, apply the appropriate:
   - Voltage range: dead short applied
   - Current range: open circuit
4. Press **PAR** and ---- will appear on the display for about 10 seconds.
5. When the top range limit appears on the display, apply the appropriate:
   - Voltage range: 10 VDC
   - Current range: 20 mADC
6. Press **PAR** and ---- will appear on the display for about 10 seconds.
7. When no appears, press **PAR** twice.
8. If the meter is not field scaled, then the input display should match the value of the input signal.
9. Repeat the above procedure for each input range to be calibrated.

DP5T - Input Calibration

Warning: Calibration of this meter requires precision instrumentation operated by qualified technicians. It is recommended that a calibration service calibrates the meter.

Before selecting any of the calibration procedures, the input to the meter must be at 0 mV or 0 ohms. Set the digital filer in Module 1 to 1 second. Allow a 30 minute warm-up period before calibrating the meter. The no and **PAR** can be chosen to exit calibration mode without any changes taking place.

10 OHM RTD Range Calibration

1. Set the Input Range Jumper to 10 ohm.
2. Use the arrow keys to display CodE 48 and press **PAR**. Then choose r_10 and press **PAR**.
3. At 0 r, apply a direct short to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press **PAR**.
4. At 15 r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) using a three wire link, to input terminals 3, 4 and 5. Wait 10 seconds, then press **PAR**.
5. Connect the RTD, return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat calibration.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm.
2. Use the arrow keys to display CodE 48 and press **PAR**. Then choose r-100 and press **PAR**.
3. At 0 r, apply a direct short to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press **PAR**.
4. At 300 r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) using a three wire link, to terminals 3, 4 and 5. Wait 10 seconds, press **PAR**.
5. Connect the RTD, return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat calibration.

E

THERMOCOUPLE Range Calibration

1. Use the arrow keys to display CodE 48 and press **PAR**. Then choose tC and press **PAR**.
2. At 0.0 u, apply a dead short or set calibrator to zero to input terminals 4 and 5. Wait 10 seconds, then press **PAR**.
3. At 50.0 u, apply 50.000 mV input signal (with an accuracy of 0.01% or better) to input terminals 4 and 5. Wait 10 seconds, then press **PAR**.
4. Return to the Display Mode.
5. Continue with Ice Point Calibration.

ICE POINT Calibration

1. The ambient temperature must be within 20°C to 30°C.
2. Connect a thermocouple (types T, E, J, K, or N only) with an accuracy of 1°C or better to the meter.
3. Verify the readout Display Offset is 0, Temperature Scale is °C, Display Resolution is 0.0, and the Input Range is set for the connected thermocouple.
4. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
5. In the Normal Display mode, compare the readouts.
6. If a difference exists then continue with the calibration.
7. Enter Module 9, use the arrow keys to display CodE 48 and press **PAR**. Then choose ICE and press **PAR**.
8. Calculate a new Ice Point value using: existing Ice Point value + (reference temperature - Display Mode reading). All values are based on °C.
9. Enter the new Ice Point value.
10. Return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat steps 8 through 10.

TROUBLESHOOTING

PROBLEM	REMEDIES
NO DISPLAY	CHECK: Power level, power connections
PROGRAM LOCKED-OUT	CHECK: Active (lock-out) user input ENTER: Security code requested
MAX, MIN, TOT LOCKED-OUT	CHECK: Module 3 programming
INCORRECT INPUT DISPLAY VALUE	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level, Module 4 Display Offset is zero, press DSP for Input Display PERFORM: Module 9 Calibration (If the above does not correct the problem.)
“OLOL” in DISPLAY (SIGNAL HIGH)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
“ULUL” in DISPLAY (SIGNAL LOW)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
JITTERY DISPLAY	INCREASE: Module 1 filtering, rounding, input range CHECK: Wiring is per EMC installation guidelines
ERROR CODE (Err 1-4)	PRESS: Reset KEY (If cannot clear contact factory.)

For further assistance, contact technical support at the appropriate company numbers listed.

MODEL PAX – 1/8 DIN ANALOG INPUT PANEL METERS

C UL US LISTED
IND. CONT. EQ.
51EB

- PROCESS, VOLTAGE, CURRENT, TEMPERATURE, AND STRAIN GAGE INPUTS
- 5-DIGIT 0.56" RED SUNLIGHT READABLE DISPLAY
- VARIABLE INTENSITY DISPLAY
- 16 POINT SCALING FOR NON-LINEAR PROCESSES
- PROGRAMMABLE FUNCTION KEYS/USER INPUTS
- 9 DIGIT TOTALIZER (INTEGRATOR) WITH BATCHING
- OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT
- FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)
- COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)
- RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)
- CRIMSON® PROGRAMMING SOFTWARE
- NEMA 4X/IP65 SEALED FRONT BEZEL

GENERAL DESCRIPTION

The PAX® Analog Panel Meters offer many features and performance capabilities to suit a wide range of industrial applications. Available in five different models to handle various analog inputs, including DC Voltage/Current, AC Voltage/Current, Process, Temperature, and Strain Gage Inputs. Refer to pages 4 through 6 for the details on the specific models. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs.

The meters employ a bright 0.56" LED display. The unit is available with a red sunlight readable or a standard green LED. The intensity of display can be adjusted from dark room applications up to sunlight readable, making it ideal for viewing in bright light applications.

The meters provide a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow, calculate service intervals of motors or pumps, etc. The totalizer can also accumulate batch weighing operations.

The meters have four setpoint outputs, implemented on Plug-in option cards. The Plug-in cards provide dual FORM-C relays (5A), quad FORM-A (3A), or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

Communication and Bus Capabilities are also available as option cards. These include RS232, RS485, Modbus, DeviceNet, and Profibus-DP. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meters have a feature that allows a remote computer to directly control the outputs of the meter. With an RS232 or RS485 card installed, it is possible to configure the meter using a Windows® based program. The configuration data can be saved to a file for later recall.

A linear DC output signal is available as an optional Plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track either the input, totalizer, max or min readings.

Once the meters have been initially configured, the parameter list may be locked out from further modification in its entirety or only the setpoint values can be made accessible.

The meters have been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

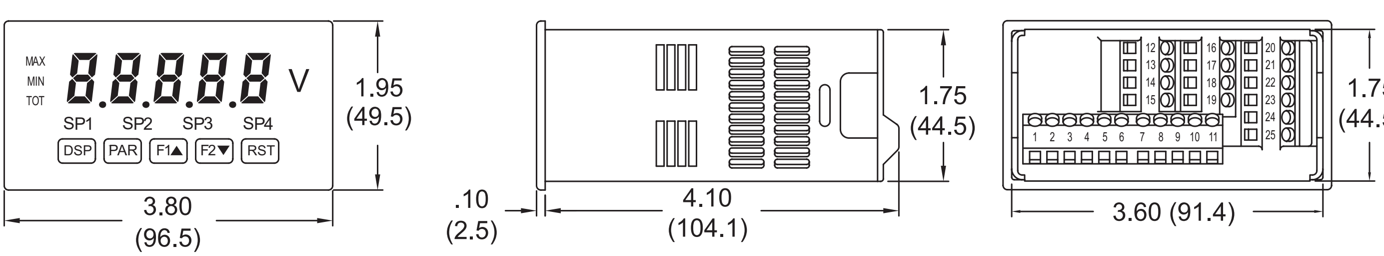


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

PAX		0			0

D - DC Volt/ Current Input
P - Process Input
H - AC True RMS Volt/Current Input *
S - Strain Gage/Bridge Input
T - Thermocouple and RTD Input

0 - Red, Sunlight Readable Display
1 - Green Display

0 - 85 to 250 VAC
1 - 11 to 36 VDC, 24 VAC

*** PAXH is only available with 85-250 VAC power supply.**

E

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	**PAXCDS**	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
	PAXUSB	PAX USB Programming Card (Not included in PAX product UL E179259 file)	PAXUSB00
Accessories	**CBLUSB**	USB Programming Cable Type A-Mini B	CBLUSB01
	ICM8	Ethernet Gateway	ICM80000
	PAXLBK	Units Label Kit Accessory (Not required for PAXT)	PAXLBK10
	SFCRD *	Crimson PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200

* Crimson® software is available for free download from http://www.redlion.net/

General Meter Specifications

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) red sunlight readable or standard green LEDs, (-19999 to 99999)
2. **POWER**:
   AC Versions:
   AC Power: 85 to 250 VAC, 50/60 Hz, 15 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
   DC Versions (Not available on PAXH):
   DC Power: 11 to 36 VDC, 11 W
   (derate operating temperature to 40° C if operating <15 VDC and three plug-in option cards are installed)
   AC Power: 24 VAC, ± 10%, 50/60 Hz, 15 VA
   Isolation: 500 Vrms for 1 min. to all inputs and outputs (50 V working).
3. **ANNUNCIATORS**:
   MAX - maximum readout selected
   MIN - minimum readout selected
   TOT - totalizer readout selected, flashes when total overflows
   SP1 - setpoint alarm 1 is active
   SP2 - setpoint alarm 2 is active
   SP3 - setpoint alarm 3 is active
   SP4 - setpoint alarm 4 is active
   Units Label - optional units label backlight
4. **KEYPAD**: 3 programmable function keys, 5 keys total
5. **A/D CONVERTER**: 16 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: 20 readings/sec.
   Step response: 200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled)
   700 msec. max. (digital filter disabled, internal zero correction enabled)
   PAXH Only: 1 sec max. to within 99% of final readout value (digital filter disabled)
   Display update rate: 1 to 20 updates/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.
   Analog output update rate: 0 to 10 sec
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   PAXT: "SHrt" - Appears when shorted sensor is detected. (RTD only)
   PAXT: "OPEN" - Appears when open sensor is detected.
   ". . . ." - Appears when display values exceed + display range.
   "- . . ." - Appears when display values exceed - display range.
   "E . . ." - Appears when Totalizer exceeds 9 digits.
   "h . . ." - Denotes the high order display of the Totalizer.
8. **INPUT CAPABILITIES**: See specific product specifications, pages 4-6
9. **EXCITATION POWER**: See specific product specifications, pages 4-6
10. **LOW FREQUENCY NOISE REJECTION**: (Does not apply to PAXH)
    Normal Mode: > 60 dB @ 50 or 60 Hz ±1%, digital filter off
    Common Mode: >100 dB, DC to 120 Hz
11. **USER INPUTS**: Three programmable user inputs
    Max. Continuous Input: 30 VDC
    Isolation To Sensor Input Common: Not isolated. (Not PAXH)
    PAXH: Isolation to Sensor Input Common: 1400 Vrms for 1 min.
    Working Voltage: 125 V
    Response Time: 50 msec. max.
    Logic State: Jumper selectable for sink/source logic

INPUT STATE	SINKING INPUTS 22 KΩ pull-up to +5 V	SOURCING INPUTS 22 KΩ pull-down
Active	V_{IN} < 0.9 VDC	V_{IN} > 3.6 VDC
Inactive	V_{IN} > 3.6 VDC	V_{IN} < 0.9 VDC

12. **TOTALIZER**:
    Function:
    Time Base: second, minute, hour, or day
    Batch: Can accumulate (gate) input display from a user input
    Time Accuracy: 0.01% typical
    Decimal Point: 0 to 0.0000
    Scale Factor: 0.001 to 65.000
    Low Signal Cut-out: -19,999 to 99,999
    Total: 9 digits, display alternates between high order and low order readouts
13. **CUSTOM LINEARIZATION**:
    Data Point Pairs: Selectable from 2 to 16
    Display Range: -19,999 to 99,999
    Decimal Point: 0 to 0.0000
    PAXT: Ice Point Compensation: user value (0.00 to 650.00 µV/°C)
14. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters and display values.
15. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50°C (0 to 45°C with all three plug-in cards installed)
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
    Shock According to IEC 68-2-27: Operational 25 g (10 g relay), 11 msec in 3 directions.
    Storage Temperature Range: -40 to 60°C
    Operating and Storage Humidity: 0 to 85% max. RH non-condensing
    Altitude: Up to 2000 meters
16. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 61010-1
    PAXT Only: File # E156876, UL873, CSA C22.2 No. 24
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report #04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part I
    IP65 Enclosure rating (Face only), IEC 529
    IP20 Enclosure rating (Rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326:2006: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:

Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A[4] 10 V/m (80 MHz to 1 GHz) 3 V/m (1.4 GHz to 2 GHz) 1 V/m (2 GHz to 2.7 GHz)
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 1 kV I/O signal 2 kV I/O signal connected to power
Surge	EN 61000-4-5 power signal	Criterion A 1 kV L to L, 2 kV L to G 1 kV
RF conducted interference	EN 61000-4-6	Criterion A 3 Vrms
Power freq magnetic fields	EN 61000-4-8	Criterion A 30 A/m
AC power	EN 61000-4-11	
Voltage dip		Criterion A 0% during 1 cycle 40% during 10/12 cycle 70% during 25/30 cycle
Short interruptions		Criterion C 0% during 250/300 cycles

Emissions:

Emissions	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.
3. Criterion C: Temporary loss of function where system reset occurs.
4. Self-recoverable loss of performance during EMI disturbance at 10 V/m: Measurement input and/or analog output signal may deviate during EMI disturbance.
   For operation without loss of performance:
   Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent)
   I/O and power cables are routed in metal conduit connected to earth ground.

Refer to EMC Installation Guidelines section of the bulletin for additional information.

17. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
18. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
19. **WEIGHT**: 10.4 oz. (295 g)

MODEL PAXD - UNIVERSAL DC INPUT

- FOUR VOLTAGE RANGES (300 VDC Max)
- FIVE CURRENT RANGES (2A DC Max)
- THREE RESISTANCE RANGES (10K Ohm Max)
- SELECTABLE 24 V, 2 V, 1.75 mA EXCITATION

PAXD SPECIFICATIONS

INPUT RANGES:

INPUT RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
±200 μADC	0.03% of reading +0.03 μA	0.12% of reading +0.04μA	1.11 Kohm	15 mA	10 nA
±2 mADC	0.03% of reading +0.3 μA	0.12% of reading +0.4 μA	111 ohm	50 mA	0.1 μA
±20 mADC	0.03% of reading +3μA	0.12% of reading +4 μA	11.1 ohm	150 mA	1 μA
±200 mADC	0.05% of reading +30 μA	0.15% of reading +40 μA	1.1 ohm	500 mA	10 μA
±2 ADC	0.5% of reading +0.3 mA	0.7% of reading +0.4 mA	0.1 ohm	3 A	0.1 mA
±200 mVDC	0.03% of reading +30 μV	0.12% of reading +40 μV	1.066 Mohm	100 V	10 μV
±2 VDC	0.03% of reading +0.3 mV	0.12% of reading +0.4 mV	1.066 Mohm	300 V	0.1 mV
±20 VDC	0.03% of reading +3 mV	0.12% of reading +4 mV	1.066 Mohm	300 V	1 mV
±300 VDC	0.05% of reading +30 mV	0.15% of reading +40 mV	1.066 Mohm	300 V	10 mV
100 ohm	0.05% of reading +0.03 ohm	0.2% of reading +0.04 ohm	0.175 V	30 V	0.01 ohm
1000 ohm	0.05% of reading +0.3 ohm	0.2% of reading +0.4 ohm	1.75 V	30 V	0.1 ohm
10 Kohm	0.05% of reading +1 ohm	0.2% of reading +1.5 ohm	17.5 V	30 V	1 ohm

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.
Reference Voltage: 2 VDC, ± 2%
Compliance: 1 kohm load min. (2 mA max.)
Temperature coefficient: 40 ppm/°C max.
Reference Current: 1.75 mADC, ± 2%
Compliance: 10 kohm load max.
Temperature coefficient: 40 ppm/°C max.

E

MODEL PAXP - PROCESS INPUT

- DUAL RANGE INPUT (20 mA or 10 VDC)
- 24 VDC TRANSMITTER POWER

PAXP SPECIFICATIONS

SENSOR INPUTS:

INPUT (RANGE)	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	DISPLAY RESOLUTION
20 mA (-2 to 26 mA)	0.03% of reading +2 μA	0.12% of reading +3 μA	20 ohm	150 mA	1 μA
10 VDC (-1 to 13 VDC)	0.03% of reading +2 mV	0.12% of reading +3 mV	500 Kohm	300 V	1 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85%RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.

MODEL PAXH - AC TRUE RMS VOLT AND CURRENT

- *FOUR VOLTAGE RANGES (300 VAC Max)*
- *FIVE CURRENT RANGES (5 A Max)*
- *ACCEPTS AC OR DC COUPLED INPUTS*
- *THREE WAY ISOLATION: POWER, INPUT AND OUTPUTS*

PAXH SPECIFICATIONS

INPUT RANGES:

Isolation To Option Card Commons and User Input Commons: 125 Vrms
Isolation To AC Power Terminals: 250 Vrms

INPUT RANGE	ACCURACY*	IMPEDANCE (60 Hz)	MAX CONTINUOUS OVERLOAD	MAX DC BLOCKING	RESOLUTION
200 mV	0.1% of reading +0.4 mV	686 Kohm	30 V	±10 V	0.01 mV
2 V	0.1% of reading +2 mV	686 Kohm	30 V	±50 V	0.1 mV
20 V	0.1% of reading +20 mV	686 Kohm	300 V	±300 V	1 mV
300 V	0.2% of reading +0.3 V	686 Kohm	300 V	±300 V***	0.1 V
200 μA	0.1% of reading +0.4 μA	1.11 Kohm	15 mA	±15 mA	0.01 μA
2 mA	0.1% of reading +2 μA	111 ohm	50 mA	±50 mA	0.1 μA
20 mA	0.1% of reading +20 μA	11.1 ohm	150 mA	±150 mA	1 μA
200 mA	0.1% of reading +0.2 mA	1.1 ohm	500 mA	±500 mA	10 μA
5 A	0.5% of reading +5 mA	0.02 ohm	7 A**	±7 A***	1 mA

*Conditions for accuracy specification:
- 20 minutes warmup
- 18-28°C temperature range, 10-75% RH non-condensing
- 50 Hz - 400 Hz sine wave input with 1.414 crest factor
- 1% to 100% of range

For conditions outside the above listed:
Temperature from 0-18 and 28-50°C: Add 0.1% reading + 20 counts error
Crest factors:
1-3: Add 0.2% reading + 10 counts error
3-5: Add 1% reading
DC component: Add 0.5% reading + 10 counts
20-50 Hz and 400-10 KHz: Add 1% reading + 20 counts error

** Non-repetitive surge rating: 15 A for 5 seconds

*** Inputs are direct coupled to the input divider and shunts. Input signals with high DC component levels may reduce the usable range.

MAX CREST FACTOR (Vp/VRMS): 5 @ Full Scale Input
INPUT COUPLING: AC or AC and DC
INPUT CAPACITANCE: 10 pF
COMMON MODE VOLTAGE: 125 VAC working
COMMON MODE REJECTION: (DC to 60 Hz) 100 dB

MODEL PAXS - STRAIN GAGE INPUT

- *LOAD CELL, PRESSURE AND TORQUE BRIDGE INPUTS*
- *DUAL RANGE INPUT: ±24 mV OR ±240 mV*
- *SELECTABLE 5 VDC OR 10 VDC BRIDGE EXCITATION*
- *PROGRAMMABLE AUTO-ZERO TRACKING*

PAXS SPECIFICATIONS

SENSOR INPUTS:

INPUT RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
±24 mVDC	0.02% of reading +3 μV	0.07% of reading +4 μV	100 Mohm	30 V	1 μV
±240 mVDC	0.02% of reading +30 μV	0.07% of reading +40 μV	100 Mohm	30 V	10 μV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28 °C and 10 to 75% RH environment; and accuracy over a 0 to 50 °C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50 °C range includes the temperature coefficient effect of the meter.

CONNECTION TYPE: 4-wire bridge (differential)
2-wire (single-ended)
COMMON MODE RANGE (w.r.t. input common): 0 to +5 VDC
Rejection: 80 dB (DC to 120 Hz)
BRIDGE EXCITATION :
Jumper Selectable: 5 VDC @ 65 mA max., ±2%
10 VDC @ 125 mA max., ±2%
Temperature coefficient (ratio metric): 20 ppm/°C max.

MODEL PAXT - THERMOCOUPLE AND RTD INPUT

- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *CUSTOM SCALING FOR NON-STANDARD PROBES*
- *TIME-TEMPERATURE INTEGRATOR*

PAXT SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degrees
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28 °C and 15 to 75% RH environment; and Accuracy over a 0 to 50 °C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50 °C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200 °C is a function of temperature, ranging from 1 °C at -200 °C and degrading to 7 °C at -270 °C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

CUSTOM RANGE: Up to 16 data point pairs
Input range: -10 to 65 mV
0 to 400 ohms, high range
0 to 25 ohms, low range
Display range: -19999 to 99999

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)
Custom mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Custom 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Custom 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

E

ACCESSORIES

UNITS LABEL KIT (PAXLBK) - Not required for PAXT

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each PAXT meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

EXTERNAL CURRENT SHUNTS (APSCM)

To measure DC current signals greater than 2 ADC, a shunt must be used. The APSCM010 current shunt converts a maximum 10 ADC signal into 100.0 mV. The APSCM100 current shunt converts a maximum 100 ADC signal into 100.0 mV. The continuous current through the shunt is limited to 115% of the rating.

PROGRAMMING SOFTWARE

The Crimson software is a Windows based program that allows configuration of the PAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. A PAX serial plug-in card or PAX USB programming card is required to program the meter using the software. Crimson can be downloaded at www.redlion.net.

Optional Plug-in Output Cards

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

PAXH Isolation Specifications For All Option Cards

Isolation To Sensor Commons: 1400 Vrms for 1 min.
Working Voltage: 125 V
Isolation to User Input Commons: 500 Vrms for 1 min.
Working Voltage 50 V

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, a Windows® based program, the RS232, RS485, or USB Cards must be used.

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC40 - Modbus (Terminal)
PAXCDC20 - RS232 Serial (Terminal)	PAXCDC4C - Modbus (Connector)
PAXCDC2C - RS232 Serial (Connector)	PAXCDC50 - Profibus-DP
PAXUSB00 - USB (Mini B)	

SERIAL COMMUNICATIONS CARD
Type: RS485 or RS232
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 300 to 19,200
Parity: No, Odd or Even
Bus Address: Selectable 0 to 99, Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 2 to 50 msec or 50 to 100 msec (RS485)

DEVICENET™ CARD
Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

MODBUS CARD
Type: RS485; RTU and ASCII MODBUS modes
Isolation To Sensor & User Input Commons: 500 Vrms for 1 minute.
Working Voltage: 50 V. Not isolated from all other commons.
Baud Rates: 300 to 38400.
Data: 7/8 bits
Parity: No, Odd, or Even
Addresses: 1 to 247.
Transmit Delay: Programmable; See Transmit Delay explanation.

PROFIBUS-DP CARD
Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PAXUSB PROGRAMMING CARD
Type: USB Virtual Comms Port
Connection: Type mini B
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Baud Rate: 300 to 19.2k
Unit Address: 0 to 99; only 1 meter can be configured at a time

WARNING: Disconnect all power to the unit before installing Plug-in cards.

SETPOINT CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD
Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @120 VAC, inductive load.
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD
Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load), 1/10 HP @120 VAC, inductive load.
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD
Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD
Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 24 VDC ± 10% , 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS
Response Time: 200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled)
700 msec. max. (digital filter disabled, internal zero correction enabled)

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

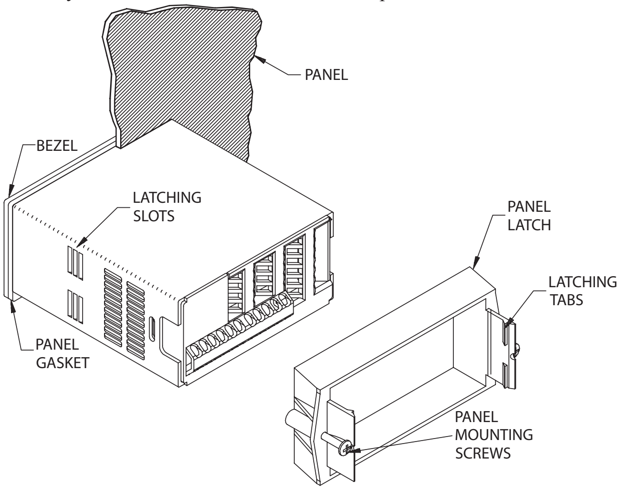
ANALOG OUTPUT CARD
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered (Active)
Update time: 200 msec. max. to within 99% of final output value (digital filter and internal zero correction disabled)
700 msec. max. (digital filter disabled, internal zero correction enabled)

E

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

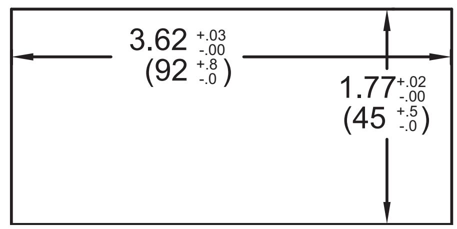
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Jumpers

The meter can have up to four jumpers that must be checked and / or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Input Range Jumper

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum input to avoid overloads. The selection is different for each meter. See the Jumper Selection Figure for appropriate meter.

Excitation Output Jumper

If your meter has excitation, this jumper is used to select the excitation range for the application. If excitation is not being used, it is not necessary to check or move this jumper.

User Input Logic Jumper

This jumper selects the logic state of all the user inputs. If the user inputs are not used, it is not necessary to check or move this jumper.

PAXH:

Signal Jumper

This jumper is used to select the signal type. For current signals, the jumper is installed. For voltage signals, remove the jumper from the board. (For 2 V inputs, this removed jumper can be used in the “2 V only” location.)

Couple Jumper

This jumper is used for AC / DC couple. If AC couple, then the jumper is removed from the board. If DC couple is used, then the jumper is installed.

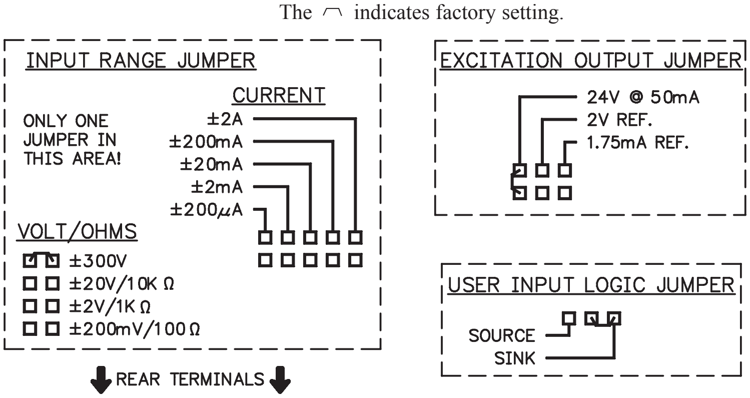
PAXD Jumper Selection

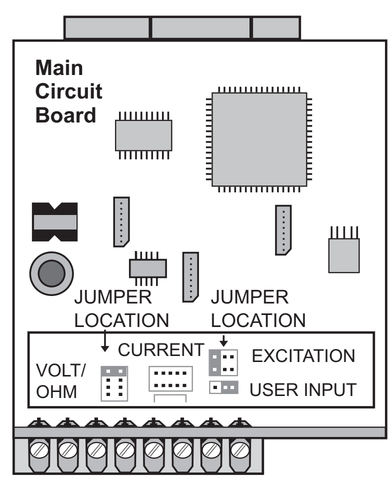
Input Range Jumper

One jumper is used for voltage/ohms or current input ranges. Select the proper input range high enough to avoid input signal overload. Only one jumper is allowed in this area. Do not have a jumper in both the voltage and current ranges at the same time. Avoid placing the jumper across two ranges.

JUMPER SELECTIONS

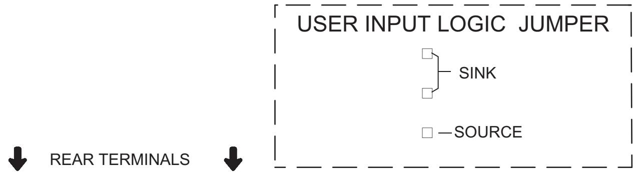
The ⌒ indicates factory setting.

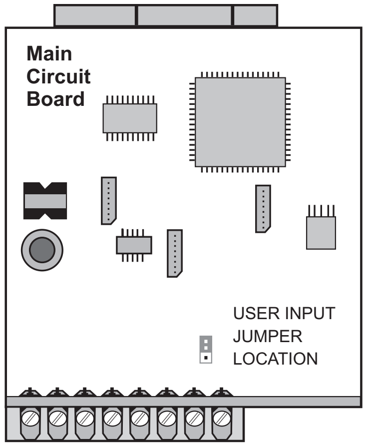




PAXP Jumper Selection

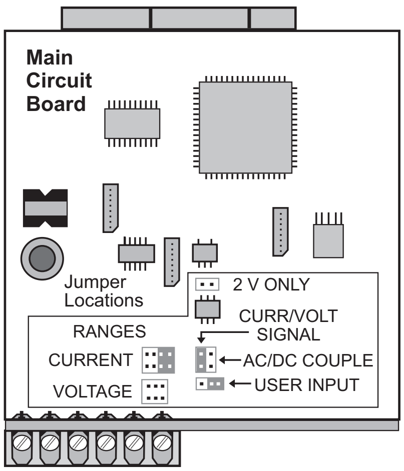
JUMPER SELECTIONS
The ⌒ indicates factory setting.



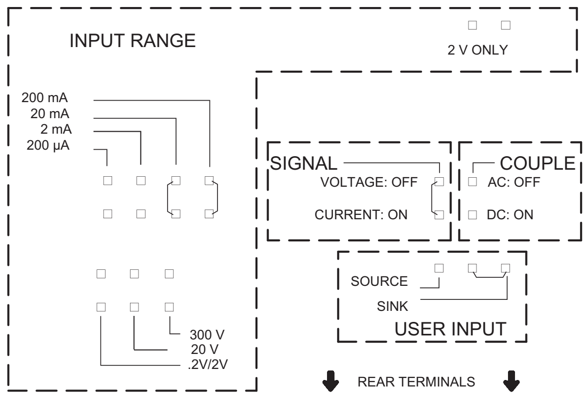


PAXH Jumper Selection

CAUTION: To maintain the electrical safety of the meter, remove unneeded jumpers completely from the meter. Do not move the jumpers to positions other than those specified.



JUMPER SELECTIONS
The ⌒ indicates factory setting.



Signal Jumper

One jumper is used for the input signal type. For current signals, the jumper is installed. For voltage signals, remove the jumper from the board. (For 2 V inputs, this removed jumper can be used in the “2 V only” location.)

Couple Jumper

One jumper is used for AC / DC couple. If AC couple is used, then the jumper is removed from the board. If DC couple is used, then the jumper is installed.

Input Range Jumper

For most inputs, one jumper is used to select the input range. However, for the following ranges, set the jumpers as stated:

5 A: Remove all jumpers from the input range.

2 V: Install one jumper in “.2/2V” position and one jumper in “2 V only”.

All Other Ranges: One jumper in the selected range only.

Do not have a jumper in both the voltage and current ranges at the same time. Avoid placing a jumper across two ranges.

E

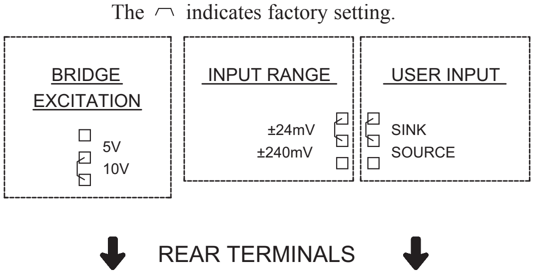
PAXS Jumper Selection

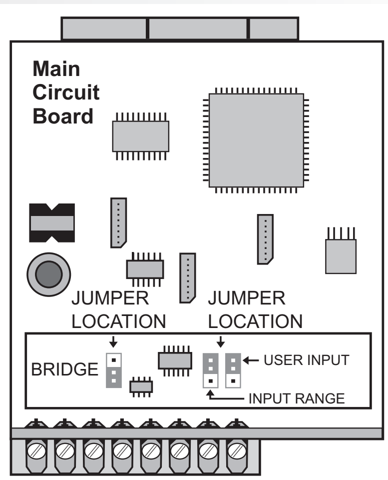
Bridge Excitation

One jumper is used to select bridge excitation to allow use of the higher sensitivity 24 mV input range. Use the 5 V excitation with high output (3 mV/V) bridges. The 5 V excitation also reduces bridge power compared to 10 V excitation.

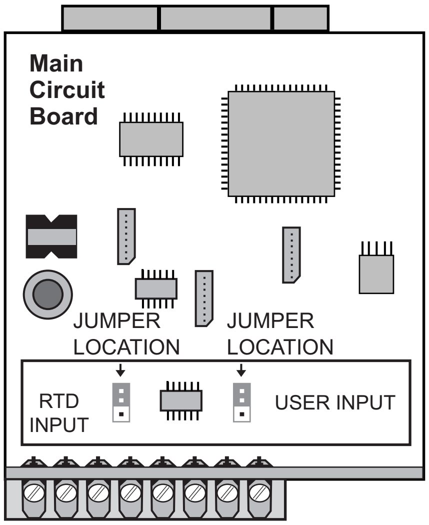
A maximum of four 350 ohm load cells can be driven by the internal bridge excitation voltage.

JUMPER SELECTIONS
The ⌒ indicates factory setting.





PAXT Jumper Selection

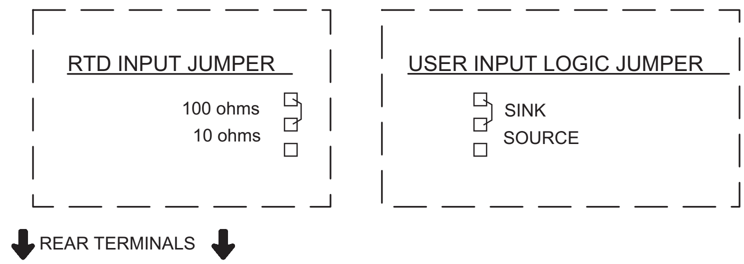


RTD Input Jumper

One jumper is used for RTD input ranges. Select the proper range to match the RTD probe being used. It is not necessary to remove this jumper when not using RTD probes.

JUMPER SELECTIONS

The ⌒ indicates factory setting.

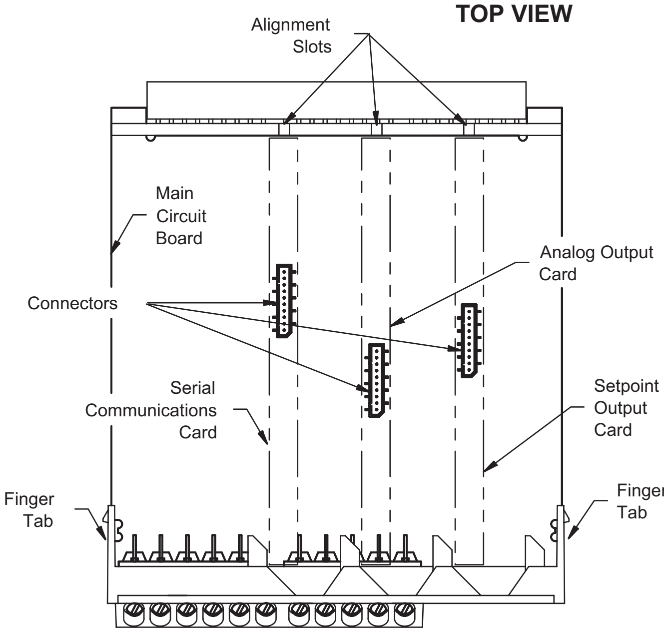


3.0 Installing Plug-In Cards

The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX.

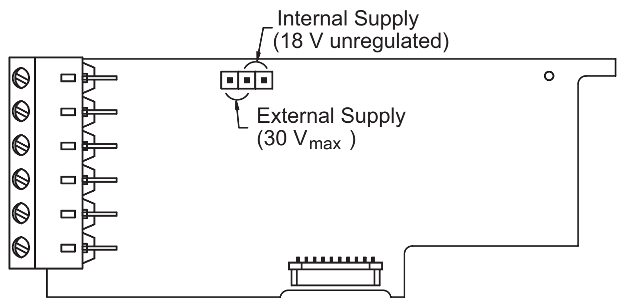
CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

TOP VIEW



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

E

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

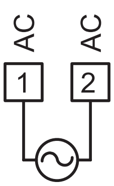
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations.Listed below are some EMC guidelines for successful installation in an industrial environment.

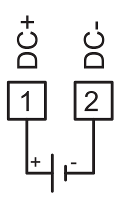
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. With use of the lower input ranges or signal sources with high source impedance, the use of shielded cable may be necessary. This helps to guard against stray AC pick-up. Attach the shield to the input common of the meter. Line voltage monitoring and 5A CT applications do not usually require shielding.
3. To minimize potential noise problems, power the meter from the same power branch, or at least the same phase voltage as that of the signal source.
4. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
5. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
6. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
7. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
8. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

4.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC



DC Power
Terminal 1: +VDC
Terminal 2: -VDC

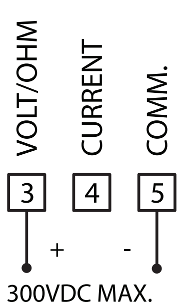


4.2 INPUT SIGNAL WIRING

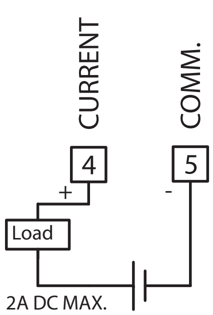
PAXD INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper and Excitation Jumper should be verified for proper position.

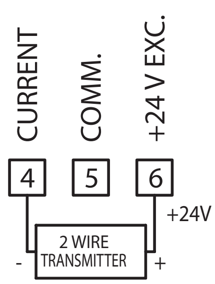
Voltage Signal (self powered)
Terminal 3: +VDC
Terminal 5: -VDC



Current Signal (self powered)
Terminal 4: +ADC
Terminal 5: -ADC

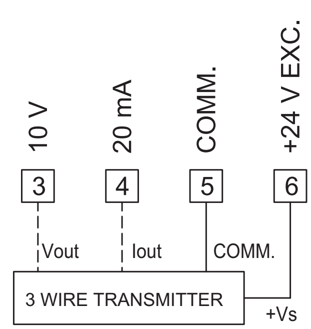


Current Signal (2 wire requiring excitation)
Terminal 4: -ADC
Terminal 6: +ADC
Excitation Jumper: 24 V

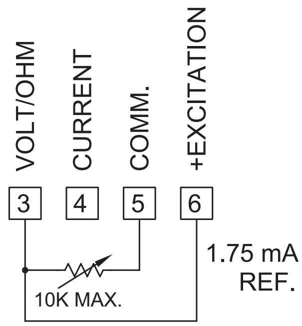


Current Signal (3 wire requiring excitation)
Terminal 4: +ADC (signal)
Terminal 5: -ADC (common)
Terminal 6: +Volt supply
Excitation Jumper: 24 V

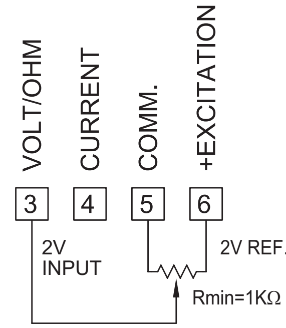
Voltage Signal (3 wire requiring excitation)
Terminal 3: +VDC (signal)
Terminal 5: -VDC (common)
Terminal 6: +Volt supply
Excitation Jumper: 24 V



Resistance Signal (3 wire requiring excitation)
Terminal 3: Resistance
Terminal 5: Resistance
Terminal 6: Jumper to terminal 3
Excitation Jumper: 1.75 mA REF.



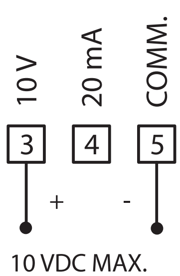
Potentiometer Signal (3 wire requiring excitation)
Terminal 3: Wiper
Terminal 5: Low end of pot.
Terminal 6: High end of pot.
Excitation Jumper: 2 V REF.
Input Range Jumper: 2 Volt
Module 1 Input Range: 2 Volt
Note: The Apply signal scaling style should be used because the signal will be in volts.



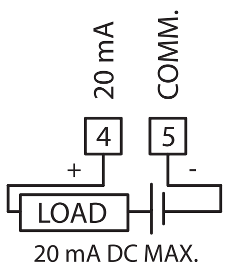
CAUTION: *Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

PAXP INPUT SIGNAL WIRING

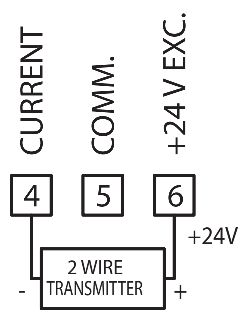
Voltage Signal (self powered)
Terminal 3: +VDC
Terminal 5: -VDC



Current Signal (self powered)
Terminal 4: +ADC
Terminal 5: -ADC

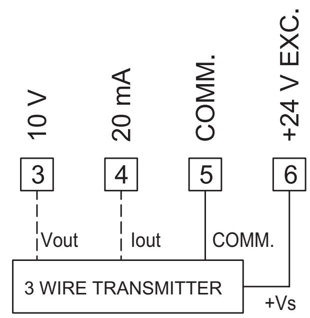


Current Signal (2 wire requiring excitation)
Terminal 4: -ADC
Terminal 6: +ADC



Current Signal (3 wire requiring excitation)
Terminal 4: +ADC (signal)
Terminal 5: -ADC (common)
Terminal 6: +Volt supply

Voltage Signal (3 wire requiring excitation)
Terminal 3: +VDC (signal)
Terminal 5: -VDC (common)
Terminal 6: +Volt supply



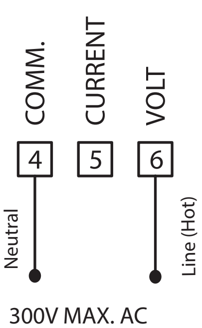
CAUTION: *Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

E

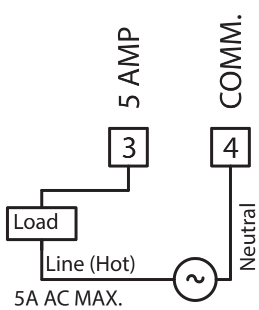
PAXH INPUT SIGNAL WIRING

Before connecting signal wires, the Signal, Input Range and Couple Jumpers should be verified for proper position.

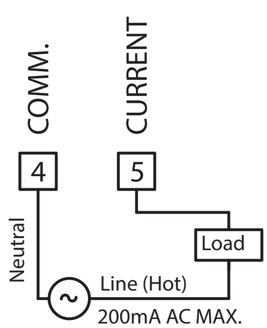
Voltage Signal



Current Signal (Amps)



Current Signal (Milliamps)



CAUTION*: Connect only one input signal range to the meter. Hazardous signal levels may be present on unused inputs.*

CAUTION*: The isolation rating of the input common of the meter with respect to the option card commons and the user input common Terminal 8 (If used) is 125 Vrms; and 250 Vrms with respect to AC Power (meter Terminals 1 & 2). To be certain that the ratings are not exceeded, these voltages should be verified by a high-voltage meter before wiring the meter.*

CAUTION*:*

1. Where possible, connect the neutral side of the signal (including current shunts) to the input common of the meter. If the input signal is sourced from an active circuit, connect the lower impedance (usually circuit common) to the input signal common of the meter.

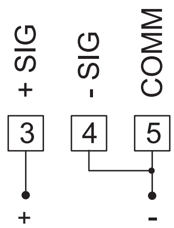
2. For phase-to-phase line monitoring where a neutral does not exist, or for any other signal input in which the isolation voltage rating is exceeded, an isolating potential transformer must be used to isolate the input voltage from earth. With the transformer, the input common of the meter can then be earth referenced for safety.

3. When measuring line currents, the use of a current transformer is recommended. If using external current shunts, insert the shunt in the neutral return line. If the isolation voltage rating is exceeded, the use of an isolating current transformer is necessary.

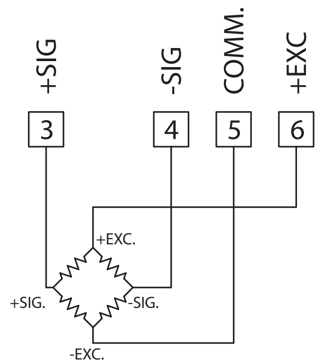
PAXS INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

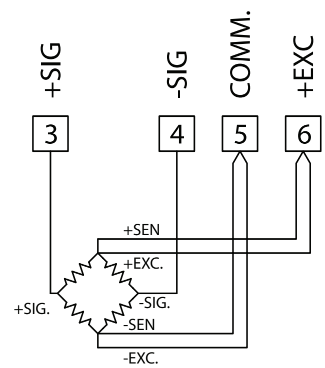
2-Wire Single Ended Input



4-Wire Bridge Input



6-Wire Bridge Input



DEADLOAD COMPENSATION

In some cases, the combined deadload and liveload output may exceed the range of the 24 mV input. To use this range, the output of the bridge can be offset a small amount by applying a fixed resistor across one arm of the bridge. This shifts the electrical output of the bridge downward to within the operating range of the meter. A 100 K ohm fixed resistor shifts the bridge output approximately -10 mV (350 ohm bridge, 10 V excitation).

Connect the resistor between +SIG and -SIG. Use a metal film resistor with a low temperature coefficient of resistance.

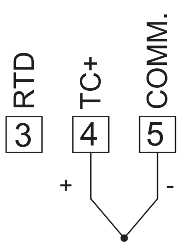
BRIDGE COMPLETION RESISTORS

For single strain gage applications, bridge completion resistors must be employed externally to the meter. Only use metal film resistors with a low temperature coefficient of resistance.

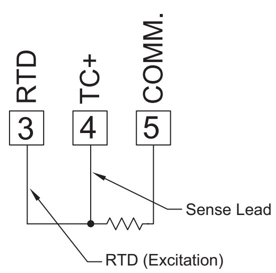
Load cells and pressure transducers are normally implemented as full resistance bridges and do not require bridge completion resistors.

PAXT INPUT SIGNAL WIRING

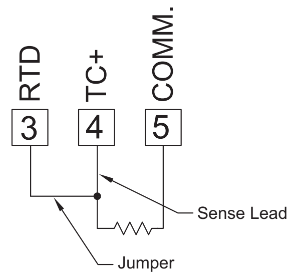
Thermocouple



3-Wire RTD



2-Wire RTD



CAUTION*: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

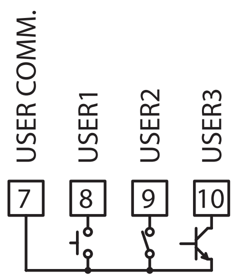
4.3 USER INPUT WIRING

Before connecting the wires, the User Input Logic Jumper should be verified for proper position. If not using User Inputs, then skip this section. Only the appropriate User Input terminal has to be wired.

Sinking Logic

Terminal 8-10: } Connect external switching device between
Terminal 7: } appropriate User Input terminal and User Comm.

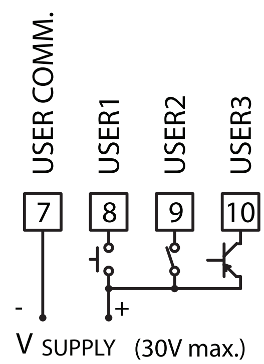
In this logic, the user inputs of the meter are internally pulled up to +5 V with 22 K resistance. The input is active when it is pulled low (<0 .9 V).



Sourcing Logic

Terminal 8-10: + VDC thru external switching device
Terminal 7: -VDC thru external switching device

In this logic, the user inputs of the meter are internally pulled down to 0 V with 22 K resistance. The input is active when a voltage greater than 3.6 VDC is applied.

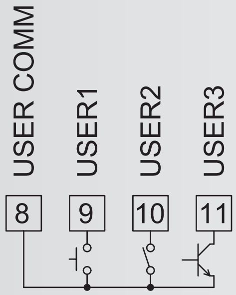


PAXH ONLY

Sinking Logic

Terminals 9-11 } Connect external
Terminal 8 } switching device between appropriate User Input terminal and User Comm.

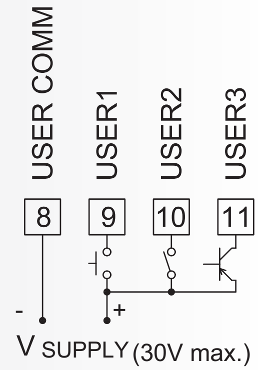
In this logic, the user inputs of the meter are internally pulled up to +5 V with 22 K resistance. The input is active when it is pulled low (<0 .9 V).



Sourcing Logic

Terminals 9-11:
+ VDC through external switching device
Terminal 8:
-VDC through external switching device

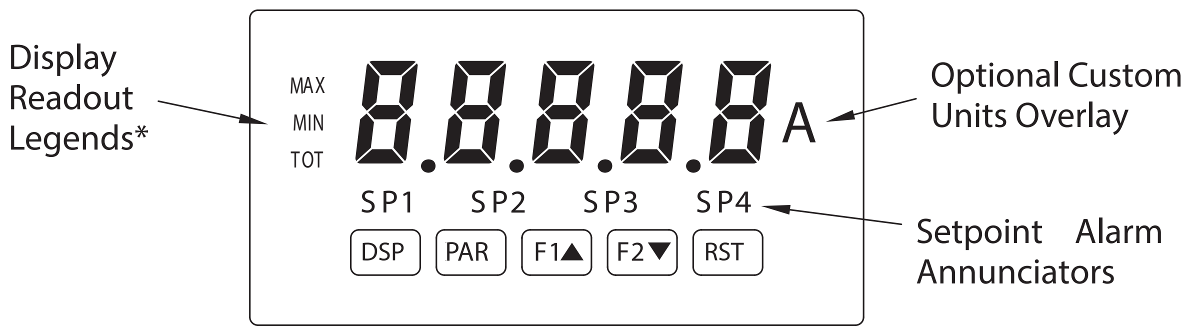
In this logic, the user inputs of the meter are internally pulled down with 22 K resistance. The input is active when a voltage greater than 3.6 VDC is applied.



4.4 SETPOINT (ALARMS) WIRING
4.5 SERIAL COMMUNICATION WIRING
4.6 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for details.

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through max/min/total/input readouts	Quit programming and return to display mode
PAR	Access parameter list	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1**	Increment selected parameter value
F2▼	Function key 2; hold for 3 seconds for Second Function 2**	Decrement selected parameter value
RST	Reset (Function key)**	Hold with F1▲, F2▼ to scroll value by x1000

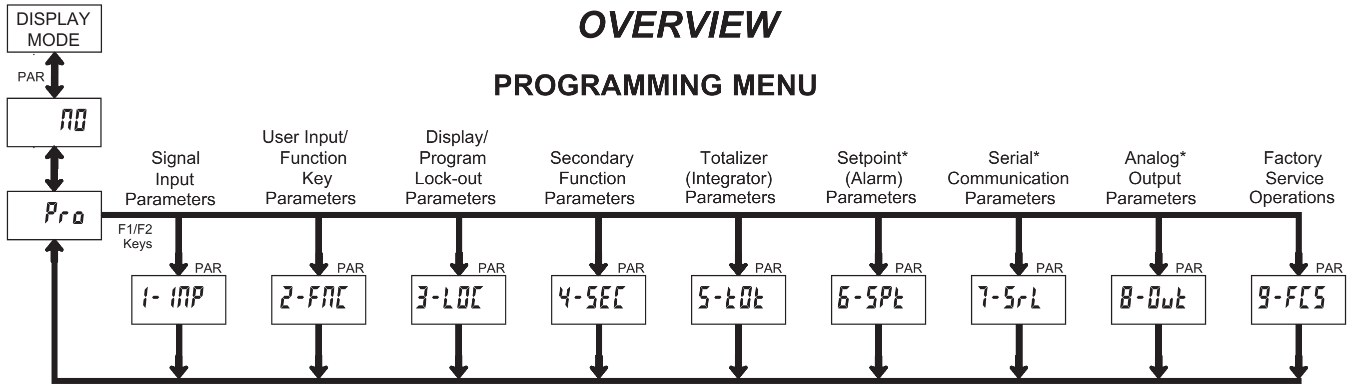
* Display Readout Legends may be locked out in Factory Settings.

** Factory setting for the F1, F2, and RST keys is NO mode.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



* Only accessible with appropriate plug-in card.

DISPLAY MODE

The meter normally operates in the Display Mode. In this mode, the meter displays can be viewed consecutively by pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown; Max Value (MAX), Min Value (MIN), or Totalizer Value (TOT). Each of these displays can be locked from view through programming. (See Module 3) The Input Display Value is shown with no annunciator.

PROGRAMMING MODE

Two programming modes are available.

Full Programming Mode permits all parameters to be viewed and modified. Upon entering this mode, the front panel keys change to Programming Mode operations. This mode should not be entered while a process is running, since the meter functions and User Input response may not operate properly while in Full Programming Mode.

Quick Programming Mode permits only certain parameters to be viewed and/ or modified. When entering this mode, the front panel keys change to Programming Mode operations, and all meter functions continue to operate properly. Quick Programming Mode is configured in Module 3. The Display Intensity Level "d-LEv" parameter is available in the Quick Programming Mode only when the security code is non-zero. For a description, see Module 9—Factory Service Operations. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming Mode.

PROGRAMMING TIPS

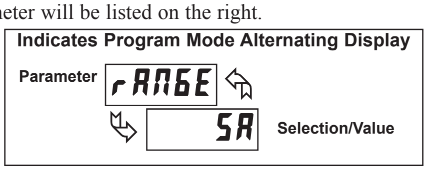
The Programming Menu is organized into nine modules (See above). These modules group together parameters that are related in function. It is recommended to begin programming with Module 1 and proceed through each module in sequence. Note that Modules 6 through 8 are only accessible when the appropriate plug-in option card is installed. If lost or confused while programming, press the **DSP** key to exit programming mode and start over. When programming is complete, it is recommended to record the meter settings on the Parameter Value Chart and lock-out parameter programming with a User Input or lock-out code. (See Modules 2 and 3 for lock-out details.)

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point if encountering programming problems. Throughout the module description sections which follow, the factory setting for each parameter is shown below the parameter display. In addition, all factory settings are listed on the Parameter Value Chart following the programming section.

ALTERNATING SELECTION DISPLAY

In the module description sections which follow, the dual display with arrows appears for each programming parameter. This is used to illustrate the display alternating between the parameter (top display) and the parameter's Factory Setting (bottom display). In most cases, selections or value ranges for the parameter will be listed on the right.



STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (PAR KEY)

The Programming Mode is entered by pressing the **PAR** key. If this mode is not accessible, then meter programming is locked by either a security code or a hardware lock. (See Modules 2 and 3 for programming lock-out details.)

MODULE ENTRY (ARROW & PAR KEYS)

Upon entering the Programming Mode, the display alternates between Pro and the present module (initially NO). The arrow keys (**F1▲** and **F2▼**) are used to select the desired module, which is then entered by pressing the **PAR** key.

PARAMETER (MODULE) MENU (PAR KEY)

Each module has a separate parameter menu. These menus are shown at the start of each module description section which follows. The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. From this point, programming may continue by selecting and entering additional modules. (See **MODULE ENTRY** above.)

PARAMETER SELECTION ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the parameter and the present selection or value for that parameter. For parameters which have a list of selections, the arrow keys (**F1▲** and **F2▼**) are used to sequence through the list until the desired selection is displayed. Pressing the **PAR** key stores and activates the displayed selection, and also advances the meter to the next parameter.

NUMERICAL VALUE ENTRY (ARROW, RST & PAR KEYS)

For parameters which require a numerical value entry, the arrow keys can be used to increment or decrement the display to the desired value. When an arrow key is pressed and held, the display automatically scrolls up or scrolls down. The longer the key is held, the faster the display scrolls.

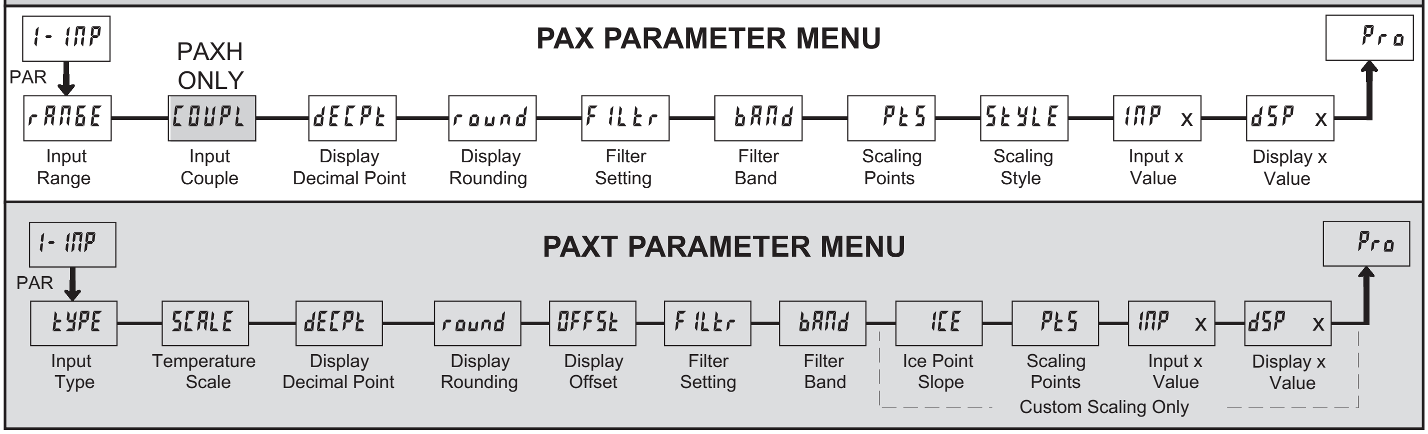
The **RST** key can be used in combination with the arrow keys to enter large numerical values. When the **RST** key is pressed along with an arrow key, the display scrolls by 1000's. Pressing the **PAR** key stores and activates the displayed value, and also advances the meter to the next parameter.

PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pro NO)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro NO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

E

6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1- INP)



Refer to the appropriate Input Range for the selected meter. Use only one Input Range, then proceed to Display Decimal Point.

PAXD INPUT RANGE

rANGE → 300u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
200uA	±200.00 µA	2u	±2.0000 V
0.002A	±2.0000 mA	20u	±20.000 V
0.02A	±20.000 mA	300u	±300.00 V
0.2A	±200.00 mA	100o	100.00 ohm
2A	±2.0000 A	1000o	1000.0 ohm
0.2u	±200.00 mV	10Ko	10000 ohm

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

PAXP INPUT RANGE

rANGE → 0.02A

SELECTION	RANGE RESOLUTION
0.02A	20.000 mA
10u	10.000 V

Select the input range that corresponds to the external signal.

PAXH INPUT RANGE

rANGE → 5A

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
0.2u	200.00 mV	0.002A	2.0000 mA
2u	2.0000 V	0.02A	20.000 mA
20u	20.000 V	0.2A	200.00 mA
300u	300.0 V	5A	5.000 A
200uA	200.00 µA		

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

PAXH INPUT COUPLE

COUPL → AC

AC or dC

The input signal can be either AC coupled (rejecting the DC components of the signal) or DC coupled (measures both the AC and DC components of the signal). The coupling jumper and the setting of this parameter must match.

PAXS INPUT RANGE

rANGE → 0.02u

SELECTION	RANGE RESOLUTION
0.02u	±24 mV
0.2u	±240 mV

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

PAXT INPUT TYPE

tYPE → tc-J

SELECTION	TYPE	SELECTION	TYPE
tc-t	T TC	tc-c	C TC
tc-E	E TC	Pt385	RTD platinum 385
tc-J	J TC	Pt392	RTD platinum 392
tc-K	K TC	Ni672	RTD nickel 672
tc-r	R TC	Cu427	RTD copper 10 Ω
tc-S	S TC	CS-tc	Custom TC
tc-b	B TC	CS-rH	Custom RTD High
tc-n	N TC	CS-rL	Custom RTD Low

Select the input type that corresponds to the input sensor. For RTD types, check the RTD Input Jumper for matching selection. For custom types, the Temperature Scale parameter is not available, the Display Decimal Point is expanded, and Custom Sensor Scaling must be completed.

PAXT TEMPERATURE SCALE

SCALE → oF

oF oC

Select the temperature scale. This selection applies for Input, MAX, MIN, and TOT displays. This does not change the user installed Custom Units Overlay display. If changed, those parameters that relate to the temperature scale should be checked. This selection is not available for custom sensor types.

DISPLAY DECIMAL POINT

dECPt → 0

0 0.0 0.00 0.000 0.0000

For the PAXT, these are only available with Custom Scaling.

Select the decimal point location for the Input, **MAX** and **MIN** displays. (The **TOT** display decimal point is a separate parameter.) This selection also affects round, dSP1 and dSP2 parameters and setpoint values.

E

DISPLAY ROUNDING*

`round` / `1`

1 2 5
10 20 50 100

These bottom selections are not available for the PAXT.

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

PAXT: TEMPERATURE DISPLAY OFFSET*

`OFFSt` / `0`

- 19999 to 99999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the affects of offset.

FILTER SETTING*

`FiLtr` / `1.0`

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND*

`bANd` / `10`

0.0 to 25.0 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units. A band setting of '0' keeps the digital filter permanently engaged.

For the PAXT, the following parameters only apply to Custom Sensor Scaling.

PAXT: ICE POINT SLOPE

`ICE` / `0.00`

0 to 650.00 µV/°C

This parameter sets the slope value for ice point compensation for the Custom TC range (CS-tc) only. The fixed thermocouple ranges are automatically compensated by the meter and do not require this setting. To calculate this slope, use µV data obtained from thermocouple manufacturers' tables for two points between 0°C and 50°C. Place this corresponding µV and °C information into the equation:

$$\text{slope} = (\mu V_2 - \mu V_1)/(°C_2 - °C_1).$$

Due to the nonlinear output of thermocouples, the compensation may show a small offset error at room temperatures. This can be compensated by the offset parameter. A value of 0 disables internal compensation when the thermocouple is externally compensated.

* *Factory Setting can be used without affecting basic start-up.*

SCALING POINTS*

`PtS` / `2`

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (INP) and an associated desired Display Value (dSP).

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (INP) and an associated desired Display Value (dSP). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs. In the SFPAX software, several linearization equations are available.

SCALING STYLE

This parameter does not apply for the PAXT. Scaling values for the PAXT must be keyed-in.

`StYLE` / `KEY`

KEY key-in data
APLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used. After using the Apply (APLY) scaling style, this parameter will default back to KEY but the scaling values will be shown from the previous applied method.

INPUT VALUE FOR SCALING POINT 1

`INP 1` / `0.00`

- 19999 to 99999

For Key-in (KEY), enter the known first Input Value by using the arrow keys. The Input Range selection sets up the decimal location for the Input Value. With 0.02A Input Range, 4mA would be entered as 4.000. For Apply (APLY), apply the input signal to the meter, adjust the signal source externally until the desired Input Value appears. In either method, press the **PAR** key to enter the value being displayed.

Note: APLY style - Pressing the **RST** *key will advance the display to the next scaling display point without storing the input value.*

DISPLAY VALUE FOR SCALING POINT 1

`dSP 1` / `0.00`

- 19999 to 99999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

`INP 2` / `100.00`

- 19999 to 99999

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (APLY), adjust the signal source externally until the next desired Input Value appears. (Follow the same procedure if using more than 2 scaling points.)

E

DISPLAY VALUE FOR SCALING POINT 2

dSP 2 / 100.00 — -19999 to 99999

Enter the second coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

General Notes on Scaling

1. Input Values for scaling points should be confined to the limits of the Input Range Jumper position.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 10.)
   This is referred to as read out jumps (vertical scaled segments).
3. The same Display Value can correspond to more than one Input Value. (Example: 0 mA and 20 mA can equal 10.)
   This is referred to as readout dead zones (horizontal scaled segments).
4. The maximum scaled Display Value spread between range maximum and minimum is limited to 65,535. For example using +20 mA range the maximum +20 mA can be scaled to is 32,767 with 0 mA being 0 and Display Rounding of 1. (Decimal points are ignored.) The other half of 65,535 is for the lower half of the range 0 to -20 mA even if it is not used. With Display Rounding of 2, +20 mA can be scaled for 65,535 (32,767 x 2) but with even Input Display values shown.
5. For input levels beyond the first programmed Input Value, the meter extends the Display Value by calculating the slope from the first two coordinate pairs (INP1 / dSP1 & INP2 / dSP2). If INP1 = 4 mA and dSP1 = 0, then 0 mA would be some negative Display Value. This could be prevented by making INP1 = 0 mA / dSP1 = 0, INP2 = 4 mA / dSP2 = 0, with INP3 = 20 mA / dSP3 = the desired high Display Value. The calculations stop at the limits of the Input Range Jumper position.
6. For input levels beyond the last programmed Input Value, the meter extends the Display Value by calculating the slope from the last two sequential coordinate pairs. If three coordinate pair scaling points were entered, then the Display Value calculation would be between INP2 / dSP2 & INP3 / dSP3. The calculations stop at the limits of the Input Range Jumper position.

6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)

PARAMETER MENU

2-FNC → PAR → USr-1 — USr-2 — USr-3 — F1 — F2 — rSt — Sc-F1 — Sc-F2 → Pro

USER INPUTS | FUNCTION KEYS

The three user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state.

The front panel function keys are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

***Note**: In the following explanations, not all selections are available for both user inputs and front panel function keys. Alternating displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USr-1 will represent all three user inputs. F1 will represent all five function keys.*

NO FUNCTION

USr-1 / NO   F1 / NO

No function is performed if activated. This is the factory setting for all user inputs and function keys. No function can be selected without affecting basic start-up.

PROGRAMMING MODE LOCK-OUT

USr-1 / PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USr-1 / rEL   F1 / rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Offset Value and is automatically stored as the new Display Offset Value (OFFSt). If another Zero (tare) Display is performed, the display will again change to zero and the Display reading will shift accordingly.

RELATIVE/ABSOLUTE DISPLAY

USr-1 / d-rEL   F1 / d-rEL

This function will switch the Input Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input Display will normally show the Relative unless switched by this function. Regardless of the display selected, all meter functions continue to operate based on relative values. The Absolute is a gross value (based on Module 1 **DSP** and **INP** entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative display. AbS (absolute) or rEL (relative) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USr-1
d-HLd

The shown display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USr-1
A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USr-1
SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USr-1 F1
bAt bAt

The Input Display value is one time added (batched) to the Totalizer at transition to activate (momentary action). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden.

SELECT TOTALIZER DISPLAY

USr-1
d-tot

The Totalizer display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Totalizer continues to function including associated outputs independent of being displayed.

RESET TOTALIZER

USr-1 F1
rtot1 r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USr-1
rtot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USr-1
E-tot

The Totalizer continues to operate as long as activated (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USr-1
d-HI

The Maximum display is selected as long as activated (maintained action). When the user input is released, the Input Display returns. The **DSP** key overrides the active user input. The Maximum continues to function independent of being displayed.

RESET MAXIMUM

F1
r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MAXIMUM DISPLAY

USr-1
r-HI

When activated (momentary action), the Maximum value is set to the present Input Display value. Maximum continues from that value while active (maintained action). When the user input is released, Maximum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Maximum function.

SELECT MINIMUM DISPLAY

USr-1
d-Lo

The Minimum display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Minimum continues to function independent of being displayed.

RESET MINIMUM

F1
r-Lo

When activated (momentary action), rESEt flashes and the Minimum reading is set to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MINIMUM DISPLAY

USr-1
r-Lo

When activated (momentary action), the Minimum value is set to the present Input Display value. Minimum continues from that value while active (maintained action). When the user input is released, Minimum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Minimum function.

RESET MAXIMUM AND MINIMUM

USr-1 F1
r-HL r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

CHANGE DISPLAY INTENSITY LEVEL

USr-1 F1
d-LEV d-LEV

When activated (momentary action), the display intensity changes to the next intensity level (of 4). The four levels correspond to Display Intensity Level (d-LEu) settings of 0, 3, 8, and 15. The intensity level, when changed via the User Input/ Function Key, is not retained at power-down, unless Quick Programming or Full Programming mode is entered and exited. The meter will power-up at the last saved intensity level.

E

SETPOINT SELECTIONS

The following selections are accessible only with the Setpoint plug-in card installed. Refer to Module 6 for an explanation of their operation.

Setpoint Card Only

- LISt - **Select main or alternate setpoints**
- r-1 - **Reset Setpoint 1 (Alarm 1)**
- r-2 - **Reset Setpoint 2 (Alarm 2)**
- r-3 - **Reset Setpoint 3 (Alarm 3)**
- r-4 - **Reset Setpoint 4 (Alarm 4)**
- r-34 - **Reset Setpoint 3 & 4 (Alarm 3 & 4)**
- r-234 - **Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)**
- r-ALL - **Reset Setpoint All (Alarm All)**

PRINT REQUEST

USr-1 → Print F1 → Print

The meter issues a block print through the serial port when activated. The data transmitted during a print request is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

6.3 MODULE 3 - DISPLAY AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)

PARAMETER MENU

3-LOC → PAR → HI (Max Display Lock-out) — LO (Min Display Lock-out) — tOt (Total Display Lock-out) — SP-1 (Setpoint 1 Access) — SP-2 (Setpoint 2 Access) — SP-3 (Setpoint 3 Access) — SP-4 (Setpoint 4 Access) — CodE (Security Code) → Pro

Module 3 is the programming for Display lock-out and "Full" and "Quick" Program lock-out.

When in the Display Mode, the available displays can be read consecutively by repeatedly pressing the **DSP** key. An annunciator indicates the display being shown. These displays can be locked from being visible. It is recommended that the display be set to LOC when the corresponding function is not used.

SELECTION	DESCRIPTION
rEd	Visible in Display Mode
LOC	Not visible in Display Mode

"Full" Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input. When locked and the **PAR** key is pressed, the meter enters a Quick Programming Mode. In this mode, the setpoint values can still be read and/or changed per the selections below. The Display Intensity Level (d-LEV) parameter also appears whenever Quick Programming Mode is enabled and the security code is greater than zero.

SELECTION	DESCRIPTION
rEd	Visible but not changeable in Quick Programming Mode
Ent	Visible and changeable in Quick Programming Mode
LOC	Not visible in Quick Programming Mode

* *Factory Setting can be used without affecting basic start-up.*

MAXIMUM DISPLAY LOCK-OUT*
MINIMUM DISPLAY LOCK-OUT*
TOTALIZER DISPLAY LOCK-OUT*

HI → LOC LO → LOC tOt → LOC

These displays can be programmed for LOC or rEd. When programmed for LOC, the display will not be shown when the **DSP** key is pressed regardless of Program Lock-out status. It is suggested to lock-out the display if it is not needed. The associated function will continue to operate even if its display is locked-out.

SP-1 SP-2 SP-3 SP-4 SETPOINT ACCESS*

SP-1 → LOC SP-2 → LOC SP-3 → LOC SP-4 → LOC

The setpoint displays can be programmed for LOC, rEd or Ent (See the following table). Accessible only with the Setpoint plug-in card installed.

PROGRAM MODE SECURITY CODE*

CodE → 0 0 to 250

By entering any non-zero value, the prompt CodE 0 will appear when trying to access the Program Mode. Access will only be allowed after entering a matching security code or universal code of 222. With this lock-out, a user input would not have to be configured for Program Lock-out. However, this lock-out is overridden by an inactive user input configured for Program Lock-out.

PROGRAMMING MODE ACCESS

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN PAR KEY IS PRESSED	"FULL" PROGRAMMING MODE ACCESS
0	not PLOC	————	"Full" Programming	Immediate access.
>0	not PLOC	————	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Active	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Not Active	"Full" Programming	Immediate access.
0	PLOC	Active	Quick Programming	No access
0	PLOC	Not Active	"Full" Programming	Immediate access.

Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming (all meter parameters are accessible).

6.4 MODULE 4 - SECONDARY FUNCTION PARAMETERS (4-SEC)

PARAMETER MENU

4-SEC → PAR → Hi-t — LO-t — dSP-t — At-t (PAXS ONLY) — At-b (PAXS ONLY) — b-LIt — OFFSt (NOT PAXT) — ICE (PAXT ONLY) → Pro

Hi-t	LO-t	dSP-t	At-t	At-b	b-LIt	OFFSt	ICE
Max. Capture Delay Time	Min. Capture Delay Time	Display Update Time	Auto-Zero Tracking Delay Time	Auto-Zero Tracking Band	Units Label BackLight	Display Offset Value	Ice Point Compensation

MAX CAPTURE DELAY TIME*

Hi-t
0.0

0.0 to 3275.0 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE DELAY TIME*

LO-t
0.0

0.0 to 3275.0 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE*

dSP-t
2

1 2 5 10 20 updates/sec.

This parameter determines the rate of display update. When set to 20 updates/second, the internal re-zero compensation is disabled, allowing for the fastest possible output response.

PAXS: AUTO-ZERO TRACKING

At-t
0

0 to 250 sec.

PAXS: AUTO-ZERO BAND

At-b
0.02

1 to 4095

The meter can be programmed to automatically compensate for zero drift. Drift may be caused by changes in the transducers or electronics, or accumulation of material on weight systems.

Auto-zero tracking operates when the readout remains within the tracking band for a period of time equal to the tracking delay time. When these conditions are met, the meter re-zeroes the readout. After the re-zero operation, the meter resets and continues to auto-zero track.

The auto-zero tracking band should be set large enough to track normal zero drift, but small enough to not interfere with small process inputs.

For filling operations, the fill rate must exceed the auto-zero tracking rate. This avoids false tracking at the start of the filling operation.

$$\text{Fill Rate} \geq \frac{\text{tracking band}}{\text{tracking time}}$$

Auto-zero tracking is disabled by setting the auto-zero tracking parameter = 0.

UNITS LABEL BACKLIGHT*

b-LIt
OFF

On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays which can be installed in to the meter's bezel display assembly. The backlight for these custom units is activated by this parameter.

DISPLAY OFFSET VALUE*

This parameter does not apply for the PAXT.

OFFSt
0.00

-19999 to 19999

Unless a Zero Display was performed or an offset from Module 1 scaling is desired, this parameter can be skipped. The Display Offset Value is the difference from the Absolute (gross) Display value to the Relative (net) Display value for the same input level. The meter will automatically update this Display Offset Value after each Zero Display. The Display Offset Value can be directly keyed-in to intentionally add or remove display offset. See Relative / Absolute Display and Zero Display explanations in Module 2.

PAXT: ICE POINT COMPENSATION*

ICE
On

On OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter. If using Custom TC range, the ice point compensation can be adjusted by a value in Module 1 when this is yes.

* *Factory Setting can be used without affecting basic start-up.*

E

6.5 MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-tOt)

PARAMETER MENU

5-tOt → PAR → dECPt — tbASE — SCFAC — Locut — P-UP → Pro

dECPt	tbASE	SCFAC	Locut	P-UP
Totalizer Decimal Point	Totalizer Time Base	Totalizer Scale Factor	Totalizer Low Cut Value	Totalizer Power Up Reset

The totalizer accumulates (integrates) the Input Display value using one of two modes. The first is using a time base. This can be used to compute a time-temperature product. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of temperature integration, useful in curing and sterilization applications. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT*

dECPt
0.00

0 0.0 0.00 0.000 0.0000

For most applications, this matches the Input Display Decimal Point (dECPt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

tbASE
-IN

SEC - seconds (÷ 1) hour - hours (÷ 3600)
-IN - minutes (÷ 60) dAY - days (÷ 86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR*

SCFAC
1.000

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In these cases, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a different value than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE*

Locut
-19999

-19999 to 99999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET*

P-UP
NO

NO Do not reset buffer
rSt Reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to reset.

* *Factory Setting can be used without affecting basic start-up.*

TOTALIZER HIGH ORDER DISPLAY

When the total exceeds 5 digits, the front panel annunciator **TOT** flashes. In this case, the meter continues to totalize up to a 9 digit value. The high order 4 digits and the low order 5 digits of the total are displayed alternately. The letter "h" denotes the high order display. When the total exceeds a 9 digit value, the Totalizer will show "E . . ." and will stop.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:
Input Display - the present input reading
Totalizer Scale Factor - 0.001 to 65.000
Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at a constant rate of 10.0 gallons per minute. The Totalizer is used to determine how many gallons in tenths has flowed. Because the Input Display and Totalizer are both in tenths of gallons, the Totalizer Scale Factor is 1. With gallons per minute, the Totalizer Time Base is minutes (60). By placing these values in the equation, the Totalizer will accumulate every second as follows:

$\frac{10.0 \times 1.000}{60}$ = 0.1667 gallon accumulates each second

This results in:
10.0 gallons accumulates each minute
600.0 gallons accumulates each hour

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPt) location from the Input Display Decimal Point (dECPt), the required Totalizer Scale Factor is multiplied by a power of ten.

Example:

Input (dECPt) = 0

Totalizer dECPt	Scale Factor
0.0	10
0	1
x10	0.1
x100	0.01
x1000	0.001

Input (dECPt) = 0.0

Totalizer dECPt	Scale Factor
0.00	10
0.0	1
0	0.1
x10	0.01
x100	0.001

Input (dECPt) = 0.00

Totalizer dECPt	Scale Factor
0.000	10
0.00	1
0.0	0.1
0	0.01
x10	0.001

(x = Totalizer display is round by tens or hundreds)

2. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.

Example: Average temperature per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for rtot2. The timer will control the start (reset) and the stopping (hold) of the totalizer.

6.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPt) ∇

PARAMETER MENU

6-SPt → PAR → SPSEL — ACt-n — SP-n — HYS-n — tON-n — tOF-n — out-n — rSt-n — Stb-n — LIt-n — brn-n (PAXT ONLY) → Pro

SPSEL	ACt-n	SP-n	HYS-n	tON-n	tOF-n	out-n	rSt-n	Stb-n	LIt-n	brn-n
Setpoint Select	Setpoint Action	Setpoint Value	Setpoint Hysteresis	On Time Delay	Off Time Delay	Output Logic	Reset Action	Standby Operation	Setpoint Annunciators	Burn-out Action

∇ - A setpoint card must be installed in order to access this module.

Depending on the card installed, there will be two or four setpoint outputs available. For maximum input frequency, unused Setpoints should be configured for OFF action.

The setpoint assignment and the setpoint action determine certain setpoint feature availability.

SETPOINT SELECT

SPSEL → NO

NO SP-1 SP-2 SP-3 SP-4

Enter the setpoint (alarm output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL NO. Repeat step for each setpoint to be programmed. The NO chosen at SPSEL will return to PRO NO. The number of setpoints available is setpoint output card dependent.

SETPOINT ACTION

ACt-n → OFF

OFF Ab-HI Ab-LO AU-HI AU-LO dE-HI dE-LO bAnd totLo totHI

Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action.

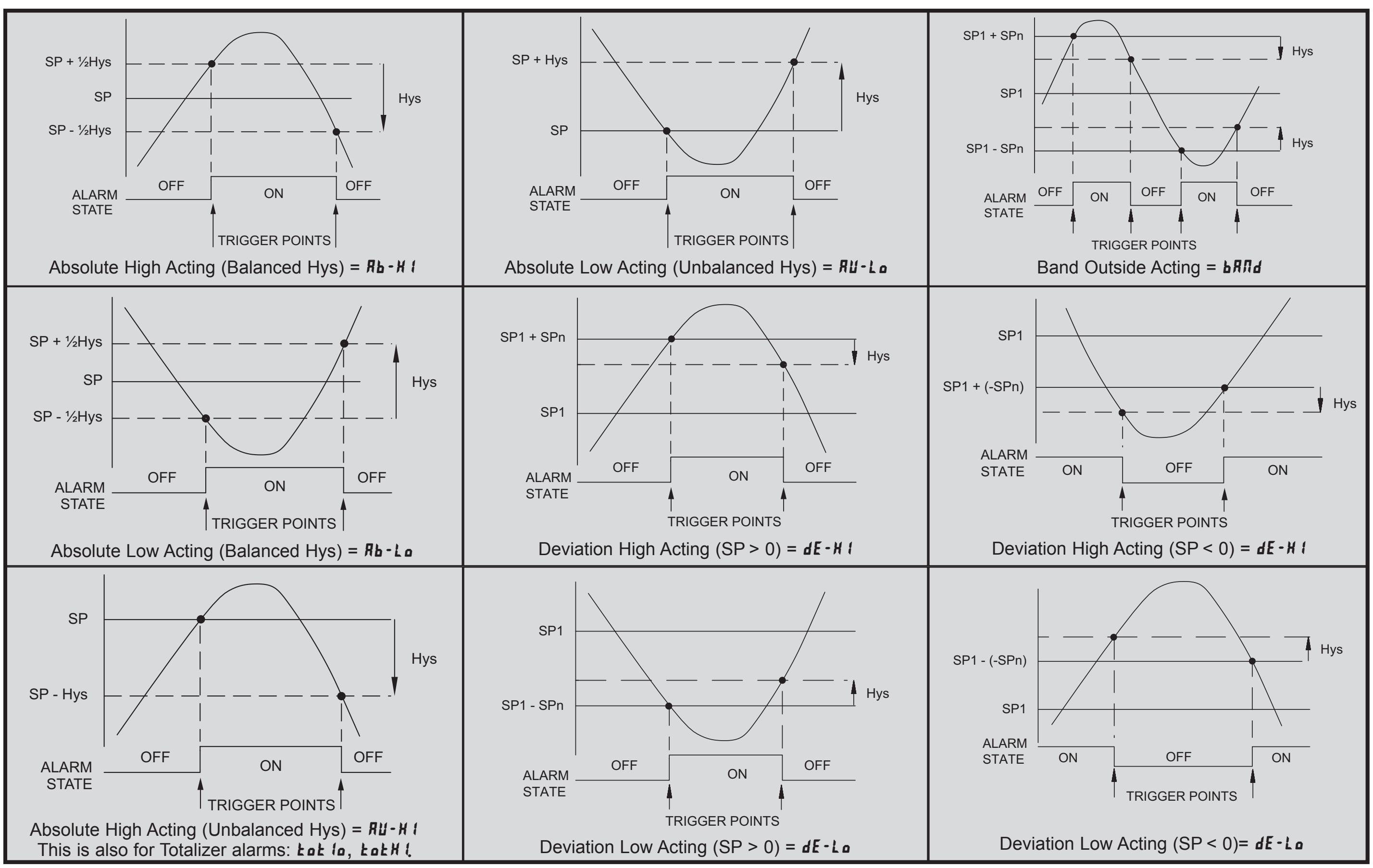
OFF	=	Setpoint always off, (returns to SPSEL NO)
Ab-HI	=	Absolute high, with balanced hysteresis
Ab-LO	=	Absolute low, with balanced hysteresis
AU-HI	=	Absolute high, with unbalanced hysteresis
AU-LO	=	Absolute low, with unbalanced hysteresis
dE-HI	=	Deviation high, with unbalanced hysteresis *
dE-LO	=	Deviation low, with unbalanced hysteresis *
bAnd	=	Outside band, with unbalanced hysteresis *
totLo	=	Lower Totalizer absolute high, unbalance hysteresis**
totHI	=	Upper Totalizer absolute high, unbalance hysteresis**

* Deviation and band action setpoints are relative to the value of setpoint 1. It is not possible to configure setpoint 1 as deviation or band actions. It is possible to use setpoint 1 for an absolute action, while its value is being used for deviation or band.

** The lower Totalizer action totLo allows setpoints to function off of the lower 5 digits of the Totalizer. The upper Totalizer action totHI allows setpoints to function off of the upper 4 digits of the Totalizer. To obtain absolute low alarms for the Totalizer, program the totLo or totHI output logic as reverse.

Setpoint Alarm Figures

With reverse output logic rEu, the below alarm states are opposite.



Absolute High Acting (Balanced Hys) = Ab-HI

Absolute Low Acting (Unbalanced Hys) = AU-Lo

Band Outside Acting = bAnd

Absolute Low Acting (Balanced Hys) = Ab-Lo

Deviation High Acting (SP > 0) = dE-HI

Deviation High Acting (SP < 0) = dE-HI

Absolute High Acting (Unbalanced Hys) = AU-HI
This is also for Totalizer alarms: totLo, totHI

Deviation Low Acting (SP > 0) = dE-Lo

Deviation Low Acting (SP < 0)= dE-Lo

E

SETPOINT VALUE

SP-n
10.00

-19999 to 99999

Enter desired setpoint alarm value. These setpoint values can also be entered in the Display Mode during Program Lock-out when the setpoint is programmed as Ent in Parameter Module 3. When a setpoint is programmed as deviation or band acting, the associated output tracks SP1 as it is changed. The value entered is the offset, or difference from SP1.

HYSTERESIS VALUE

HYS-n
0.02

1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balance and unbalance) are affected by the hysteresis. When the setpoint is a control output, usually balance hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

tOF-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

out-n
nor

nor rEu

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEu logic reverses the output logic. In rEu, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

rSt-n
Auto

Auto LAtC1 LAtC2

Enter the reset action of the alarm output.

Auto = Automatic action; This action allows the alarm output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input.The alarm remains reset off until the trigger point is crossed again.

LAtC1 = Latch with immediate reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtC2 = Latch with delay reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the event until the corresponding "on" alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)

STANDBY OPERATION

Stb-n
no

no YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. Once the alarm is on, the alarm operates normally per the Setpoint Action and Reset Mode.

SETPOINT ANNUNCIATORS

Lit-n
nor

OFF nor rEu FLASH

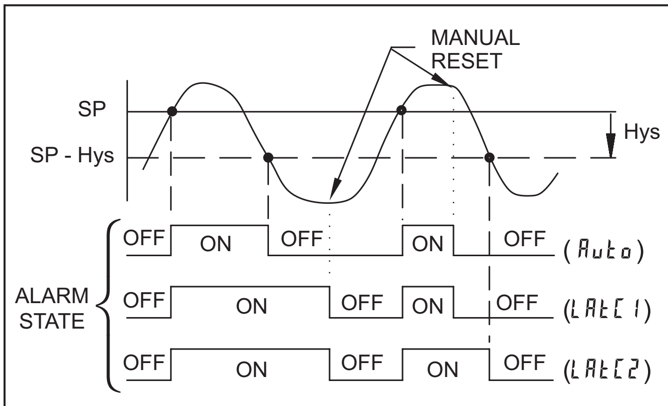
The OFF mode disables display setpoint annunciators. The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEu mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASH mode flashes the corresponding setpoint annunciators of "on" alarm outputs.

PROBE BURN-OUT ACTION (PAXT ONLY)

brn-n
oFF

ON OFF

Enter the probe burn-out action. In the event of a temperature probe failure, the alarm output can be programmed to go on or off.



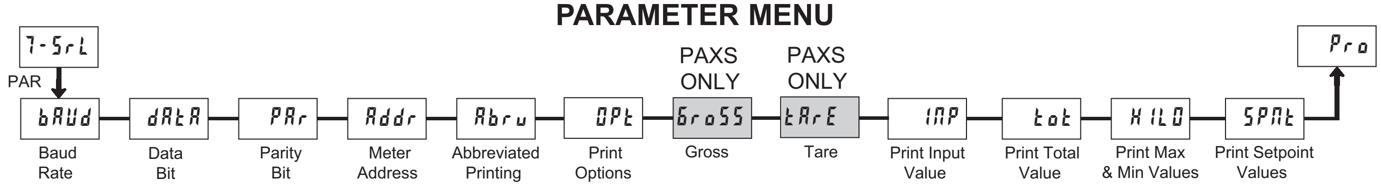
Setpoint Alarm Reset Actions

Alternate Setpoints

An Alternate list of setpoint values can be stored and recalled as needed. The Alternate list allows an additional set of setpoint values. (The setpoint numbers nor rear terminal numbers will change in the Alternate list.) The Alternate list can only be activated through a function key or user input programmed for L1St in Module 2. When the Alternate list is selected, the Main list is stored and becomes inactive. When changing between Main and Alternate, the alarm state of Auto Reset Action alarms will always follow their new value. Latched "on" alarms will always stay latched during the transition and can only be reset with a user input or function key. Only during the function key or user input transition does the display indicate which list is being used.

6.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL) ∇

PARAMETER MENU



∇ - A communication card must be installed in order to access this module.

BAUD RATE

bAUd — 9600

300 1200 4800 19200
600 2400 9600

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting.

DATA BIT

dAtA — 7

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match that of other serial communication equipment. Since the meter receives and transmits 7-bit ASCII encoded data, 7 bit word length is sufficient to request and receive data from the meter.

PARITY BIT

PAr — Odd

Odd EVEN NO

Set the parity bit to match that of the other serial communications equipment used. The meter ignores the parity when receiving data, and sets the parity bit for outgoing data. If no parity is selected with 7-bit word length the meter transmits and receives data with 2 stop bits. (For example: 10 bit frame with mark parity)

METER ADDRESS

Addr — 0

0 to 99

Enter the serial node address. With a single unit on a bus, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abrv — YES

YES NO

Select abbreviated transmissions (numeric only) or full field transmission. When the data from the meter is sent directly to a terminal for display, the extra characters that are sent identify the nature of the meter parameter displayed. In this case, select NO. When the data from the meter goes to a computer, it may be desirable to suppress the node address and mnemonic when transmitting. In this case, set this parameter to YES.

PRINT OPTIONS

OPt — NO

YES NO

YES - Enters the sub-menu to select those meter parameters to appear in the block print. For each parameter in the sub-menu select YES for the parameter to appear with the block print, and NO to disable the parameter.

*Setpoints 1-4 are setpoint plug-in card dependent.

Gross Value (PAXS Only)	GroSS	YES	NO
Tare Value (PAXS Only)	tArE	YES	NO
Input Value	INP	YES	NO
Max and Min Values	hILO	YES	NO
Total Value	tot	YES	NO
Setpoint values*	SPNt	YES	NO

E

Sending Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a the command terminator character * or $.

Command Chart

Command	Description	Notes
N	Node Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character.
V	Value change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character
P	Block Print Request (read)	Initiates a block print output. Registers are defined in programming.

Register Identification Chart

ID	Value Description	Register ID	Applicable Commands/Comments	
A	Input	INP	T, P, R	(Reset command [Ver2.5+] zeros the input ["REL" or Tare])
B	Total	TOT	T, P, R	(Reset command resets total to zero)
C	Max Input	MAX	T, P, R	(Reset command resets MAX to current reading)
D	Min Input	MIN	T, P, R	(Reset command resets MIN to current reading)
E	Setpoint 1	SP1	T, P, V, R	(Reset command resets the setpoint output)
F	Setpoint 2	SP2	T, P, V, R	(Reset command resets the setpoint output)
G	Setpoint 3	SP3	T, P, V, R	(Reset command resets the setpoint output)
H	Setpoint 4	SP4	T, P, V, R	(Reset command resets the setpoint output)
I	Analog Output Register	AOR	T, V	(Applies to manual mode)
J	Control Status Register	CSR	T, V	
L	Absolute (gross) input display value	ABS GRS †	T, P	
Q	Offset/Tare (PAXS)	OFS TAR †	T, P, V	(Ver 2.5+)

† -Register ID for the PAXS.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences of * and $ terminating characters.

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1, response delay of 2 msec min
   String: N17VE350$
2. Node address = 5, Read Input value, response delay of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output, response delay of 50 msec min
   String: RH*

Sending Numeric Data

Numeric data sent to the meter must be limited to 5 digits (-19,999 to 99,999). If more than 5 digits are sent, the meter accepts the last 5. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5 In this case, write a value = 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

E

Receiving Data

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. In this case, the response contains only the numeric field. The meter response mode is established in programming.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 10 bytes for number, one byte for sign, one byte for decimal point (The T command may be a different byte length)
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned =0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register ID (Serial Mnemonic).

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative value have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

(CSR) Control Status Register

The Control Status Register is used to both directly control the meter's outputs (setpoints and analog output), and interrogate the state of the setpoint outputs. The register is bit mapped with each bit position within the register assigned to a particular control function. The control function are invoked by writing to each bit position. The bit position definitions are:

bit 0: Setpoint 1 Output Status
- 0 = output off
- 1 = output on

bit 1: Setpoint 2 Output Status
- 0 = output off
- 1 = output on

bit 2: Setpoint 3 Output Status
- 0 = output off
- 1 = output on

bit 3: Setpoint 4 Output Status
- 0 = output off
- 1 = output on

bit 4: Manual Mode
- 0 = automatic mode
- 1 = manual mode

bit 5: Always stays 0, even if 1 is sent.

bit 6: Sensor Status (PAXT only)
- 0 = sensor normal
- 1 = sensor fail

bit 7: Always stays 0, even if 1 is sent.

Although the register is bit mapped starting with bit 7, HEX < > characters are sent in the command string. Bits 7 and 5 always stay a zero, even if a "1" is sent. This allows ASCII characters to be used with terminals that may not have extended character capabilities.

Writing a "1" to bit 4 of CSR selects manual mode. In this mode, the setpoint outputs are defined by the values written to the bits b0, b1, b2, b3; and the analog output is defined by the value written to the AOR. Internal control of these outputs is then overridden.

In automatic mode, the setpoint outputs can only be reset off. Writing to the setpoint output bits of the CSR has the same effect as a Reset command (R). The contents of the CSR may be read to interrogate the state of the setpoint outputs and to check the status of the temperature sensor (PAXT only).

Examples:

1. Set manual mode, turn all setpoints off:

		7	6	5	4	3	2	1	0:bit location
VJ<30>* or VJ0*	ASCII 0 =	0	0	1	1	0	0	0	0 or <30>

V is command write, J is CSR and * is terminator.

2. Turn SP1, SP3 outputs on and SP2, SP4 outputs off:

		7	6	5	4	3	2	1	0:bit location
VJ<35>* or VJ5*	ASCII 5 =	0	0	1	1	0	1	0	1 or <35>

3. Select Automatic mode:

		7	6	5	4	3	2	1	0:bit location
VJ<40>* or VJ@*	ASCII @ =	0	1	0	0	0	0	0	0 or <40>

Note: Avoid writing values <0A> (LF), <0D> (CR), <24> ($) and <2E> (*) to the CSR. These values are interpreted by the meter as end of command control codes and will prematurely end the write operation.

(AOR) Analog Output Register

The Analog Output Register controls the analog output of the meter. The manual mode must first be engaged by setting bit 4 of the Control Status Register. The range of values of this register is 0 to 4095, which corresponds to 0 mA, 0 V and 20 mA, 10 V; respectively. The table lists correspondence of the output signal with the register value.

Register Value	Output Signal*	
	I (mA)	V (V)
0	0.000	0.000
1	0.005	0.0025
2047	10.000	5.000
4094	19.995	9.9975
4095	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (20 mA or 10 V).*

Writing to this register while the meter is in the manual mode causes the output signal to update immediately. While in the automatic mode, this register may be written to, but the output will not update until the meter is placed in manual mode.

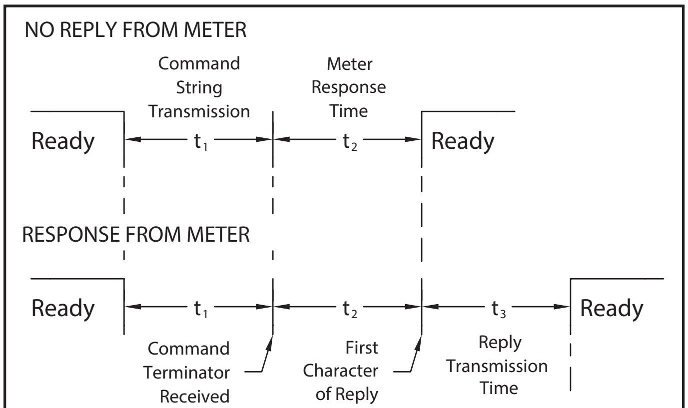
Examples:

1. Set output to full scale:
   VI4095*
2. Set output to zero scale:
   VI0*

E

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). The meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.



Timing Diagram Figure

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \# \text{ of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 50 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The standard command line terminating character is '*'. This terminating character results in a response time window of 50 msec minimum and 100 msec maximum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time window (t_2) of 2 msec minimum and 50 msec maximum. The faster response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. $t_3 = (10 * \# \text{ of characters}) / \text{baud rate}$. At the end of t_3, the meter is ready to receive the next command.

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

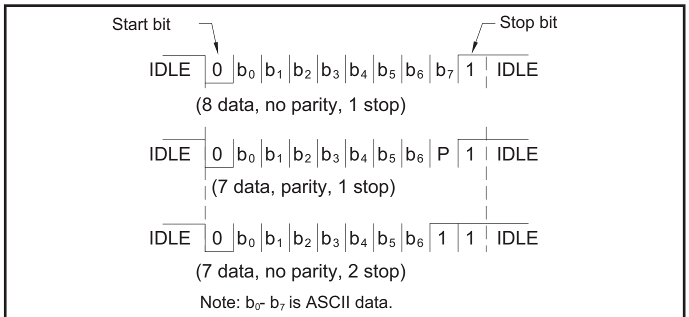
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional error detection parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

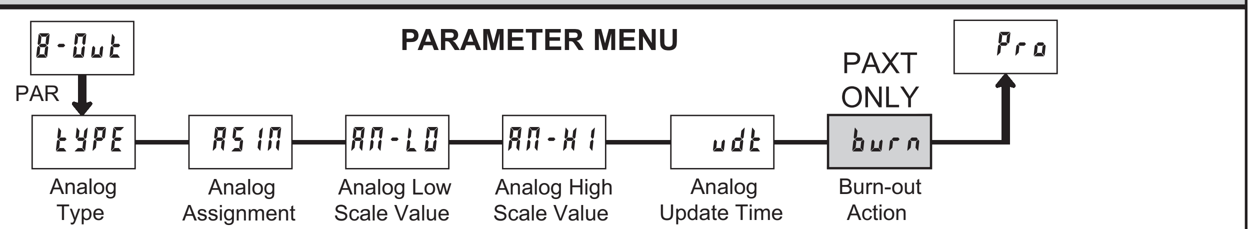
Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit.

6.8 MODULE 8 - Analog Output Parameters (8-Out) ∇



∇ - An analog output card must be installed in order to access this module.

ANALOG TYPE

tYPE
4-20

SELECTION	RANGE
0-20	0 to 20 mA
4-20	4 to 20 mA
0-10	0 to 10 V

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG ASSIGNMENT

AS In
InP

InP HI LO tot

Enter the source for the analog output to retransmit:
InP = Display Input Value
HI = Maximum Display Input Value
LO = Minimum Display Input Value
tot = Totalize Display Value

ANALOG LOW SCALE VALUE

An-LO
0.00

-19999 to 99999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

An-HI
100.00

-19999 to 99999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

udt
0.0

0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at a rate of 20/sec.

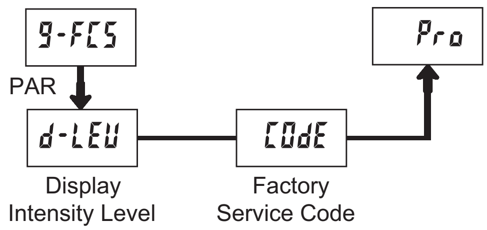
PROBE BURN-OUT ACTION (PAXT ONLY)

burn
LO

LO HI

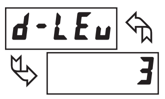
Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

6.9 MODULE 9 - FACTORY SERVICE OPERATIONS (9-FCS)



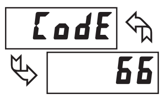
PARAMETER MENU

DISPLAY INTENSITY LEVEL



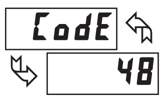
Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in Quick Programming Mode when enabled.

RESTORE FACTORY DEFAULTS



Use the arrow keys to display CodE 66 and press **PAR**. The meter will display rESEt and then return to CodE 50. Press **DSP** key to return to Display Mode. This will overwrite all user settings with the factory settings.

CALIBRATION



The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored using the Apply (APLY) Scaling Style.

Calibration may be aborted by disconnecting power to the meter before exiting Module 9. In this case, the existing calibration settings remain in effect.

PAXP - Input Calibration

***WARNING**: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.*

Before starting, verify that the precision signal source is connected to the correct terminals and ready. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Use the arrow keys to display CodE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**. (no and **PAR** can be chosen to exit the calibration mode without any changes taking place.)
3. When the zero range limit appears on the display, apply the appropriate:
   - Voltage range: dead short applied
   - Current range: open circuit
4. Press **PAR** and ---- will appear on the display for about 10 seconds.
5. When the top range limit appears on the display, apply the appropriate:
   - Voltage range: 10 VDC
   - Current range: 20 mADC
6. Press **PAR** and ---- will appear on the display for about 10 seconds.
7. When no appears, press **PAR** twice.
8. If the meter is not field scaled, then the input display should match the value of the input signal.
9. Repeat the above procedure for each input range to be calibrated.

PAXD - Input Calibration

***WARNING**: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better. Resistance inputs require a resistance substitution device with an accuracy of 0.01% or better.*

Before starting, verify that the Input Ranger Jumper is set for the range to be calibrated. Also verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Use the arrow keys to display CodE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**.
3. When the zero range limit appears on the display, apply the appropriate:
   - Voltage ranges: dead short applied
   - Current ranges: open circuit
   - Resistance ranges: dead short with current source connected
4. Press **PAR** and ---- will appear on the display for about 10 seconds.
5. When the top range limit appears on the display, apply the appropriate:
   - Voltage ranges: top range value applied (The 300 V range is the exception. It is calibrated with a 100 V signal.)
   - Current ranges: top range value
   - Resistance ranges: top range value (The ohms calibration requires connection of the internal current source through a resistance substitution device and the proper voltage range selection.)
6. Press **PAR** and ---- will appear on the display for about 10 seconds.
7. When no appears, press **PAR** twice.
8. If the meter is not field scaled, then the input display should match the value of the input signal.
9. Repeat the above procedure for each input range to be calibrated.

PAXH - Input Calibration

***WARNING**: In the PAXH, DC signals are used to calibrate the AC ranges. Calibration of the PAXH requires a DC voltmeter with an accuracy of 0.025% and a precision DC signal source capable of:*

1. +1% of full scale, DC
2. -1% of full scale, DC
3. +100% of full scale, DC; (300 V range = +100 V calibration)
4. -100% of full scale, DC; (300 V range = -100 V calibration)

Before starting, verify the Input Range and Signal Jumpers are set for the range to be calibrated and the Couple jumper is installed for DC. Also verify the DC signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Press the arrow keys to display CodE 48 and press **PAR**.
2. The meter displays CAL. Use the arrow keys to select the range that matches the Signal Jumper setting. Press **PAR**.
3. Apply the signal matching the meter prompt.
4. Press **PAR** and ----- will appear on the display, wait for next prompt.
5. Repeat steps 3 and 4 for the remaining three prompts.
6. When NO appears, press **PAR** twice.
7. If the meter is scaled to show input signal, the Input Display should match the value of the input signal in the Display Mode.
8. Repeat the above procedure for each range to be calibrated or to recalibrate the same range. It is only necessary to calibrate the input ranges being used.
9. When all desired calibrations are completed, remove the external signal source and restore original configuration and jumper settings. If AC is being measured, continue with AC Couple Offset Calibration.

AC Couple Offset Calibration - PAXH

It is recommended that Input Calibration be performed first.
1. With meter power removed, set the Input Range Jumper for 20 V, the Couple Jumper for DC, and set the Signal Jumper for voltage by removing the jumper.
2. Connect a wire (short) between Volt (terminal 6) and COMM (terminal 4).
3. Apply meter power.
4. In Module 1, program as follows: Range: 20u; Couple: dC; Decimal Point: 0; Round: 1; Filter: 0.5; Band: 20; Points: 2; Style: KEY; INP1: 0.000; DSP1: 0; INP2: 20.000; DSP2: 20000
5. In Module 4, program as follows: Hi-t: 0.0; Lo-t: 3271.1
6. Press **PAR** then **DSP** to exit programming and view the Input Display.
7. The readout displays the DC coupled zero input, record the value.
8. Remove the meter power and set the Couple Jumper to AC by removing the jumper.
9. Maintaining the short between terminals 4 and 6, reapply the meter power.
10. Keeping all programming the same, view the Input Display.
11. The readout now displays the AC coupled zero input, record the value.
12. In Module 9, Use the arrow keys to display CodE 48 and press **PAR**.
13. Press the down arrow key twice to AC-OF and press **PAR**.
14. Calculate the offset OFFSt using the following formula:
    OFFSt = AC coupled reading (step 11) - DC coupled reading (step 7)
15. Use the arrow keys to enter the calculated OFFSt.
16. Press **PAR** three times, to exit programming.
17. Remove the meter power and remove the short from terminals 4 and 6.
18. Restore the original jumper and configuration settings.

PAXS - Input Calibration

WARNING: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.

Before starting, connect -SIG (terminal 4) to COMM (terminal 5). This allows a single ended signal to be used for calibration. Connect the calibration signal to +SIG (terminal 3) and -SIG (terminal 4). Verify the Input Range jumper is in the desired position. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place. Perform the following procedure:
1. Press the arrow keys to display CODE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**.
3. When the zero range limit appears on the display, apply 0 mV between +SIG and -SIG.
4. Press **PAR** and ---- will appear, wait for next prompt.
5. When the top range limit appears on the display, apply the corresponding +SIG and -SIG voltage (20 mV or 200 mV).
6. Press **PAR** and ---- will appear, on the display for about 10 seconds.
7. When NO appears, press **PAR** twice to exit programming.
8. Repeat the above procedure for each range to be calibrated or to recalibrate the same range. It is only necessary to calibrate the input ranges being used.
9. When all desired calibrations are completed, remove -SIG to COMM connection and external signal source.
10. Restore original configuration and jumper settings.

PAXT - Input Calibration

Warning: Calibration of this meter requires precision instrumentation operated by qualified technicians. It is recommended that a calibration service calibrates the meter.

Before selecting any of the calibration procedures, the input to the meter must be at 0 mV or 0 ohms. Set the digital filer in Module 1 to 1 second. Allow a 30 minute warm-up period before calibrating the meter. The no and **PAR** can be chosen to exit calibration mode without any changes taking place.

10 OHM RTD Range Calibration
1. Set the Input Range Jumper to 10 ohm.
2. Use the arrow keys to display CodE 48 and press **PAR**. Then choose r-10 and press **PAR**.
3. At 0 r, apply a direct short to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press **PAR**.
4. At 15 r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) using a three wire link, to input terminals 3, 4 and 5. Wait 10 seconds, then press **PAR**.
5. Connect the RTD, return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat calibration.

100 OHM RTD Range Calibration
1. Set the Input Range Jumper to 100 ohm.
2. Use the arrow keys to display CodE 48 and press **PAR**. Then choose r-100 and press **PAR**.
3. At 0 r, apply a direct short to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press **PAR**.
4. At 300 r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) using a three wire link, to terminals 3, 4 and 5. Wait 10 seconds, press **PAR**.
5. Connect the RTD, return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat calibration.

THERMOCOUPLE Range Calibration
1. Use the arrow keys to display CodE 48 and press **PAR**. Then choose tC and press **PAR**.
2. At 0.0 u, apply a dead short or set calibrator to zero to input terminals 4 and 5. Wait 10 seconds, then press **PAR**.
3. At 50.0 u, apply 50.000 mV input signal (with an accuracy of 0.01% or better) to input terminals 4 and 5. Wait 10 seconds, then press **PAR**.
4. Return to the Display Mode.
5. Continue with Ice Point Calibration.

ICE POINT Calibration
1. **Remove all option cards or invalid results will occur.**
2. The ambient temperature must be within 20°C to 30°C.
3. Connect a thermocouple (types T, E, J, K, or N only) with an accuracy of 1°C or better to the meter.
4. Verify the readout Display Offset is 0, Temperature Scale is °C, Display Resolution is 0.0, and the Input Range is set for the connected thermocouple.
5. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
6. In the Normal Display mode, compare the readouts.
7. If a difference exists then continue with the calibration.
8. Enter Module 9, use the arrow keys to display CodE 48 and press **PAR**. Then choose ICE and press **PAR**.
9. Calculate a new Ice Point value using: existing Ice Point value + (reference temperature - Display Mode reading). All values are based on °C.
10. Enter the new Ice Point value.
11. Return to the Display Mode and verify the input reading (with 0 Display Offset) is correct. If not correct repeat steps 8 through 10.

ANALOG OUTPUT CARD CALIBRATION

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure:
1. Use the arrow keys to display CodE 48 and press **PAR**.
2. Use the arrow keys to choose OUt and press **PAR**.
3. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX arrow keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if this range is not being calibrated, press **PAR**.

SELECTION	EXTERNAL METER	ACTION
0.0-A	0.00	Adjust if necessary, press **PAR**
4.0-A	4.00	Adjust if necessary, press **PAR**
20.0-A	20.00	Adjust if necessary, press **PAR**
0.0u	0.00	Adjust if necessary, press **PAR**
10.0u	10.00	Adjust if necessary, press **PAR**

4. When NO appears remove the external meters and press **PAR** twice.

TROUBLESHOOTING

PROBLEM	REMEDIES
NO DISPLAY	CHECK: Power level, power connections
PROGRAM LOCKED-OUT	CHECK: Active (lock-out) user input ENTER: Security code requested
MAX, MIN, TOT LOCKED-OUT	CHECK: Module 3 programming
INCORRECT INPUT DISPLAY VALUE	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level, Module 4 Display Offset is zero, press DSP for Input Display PERFORM: Module 9 Calibration (If the above does not correct the problem.)
"OLOL" in DISPLAY (SIGNAL HIGH)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
"ULUL" in DISPLAY (SIGNAL LOW)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
JITTERY DISPLAY	INCREASE: Module 1 filtering, rounding, input range CHECK: Wiring is per EMC installation guidelines
MODULES or PARAMETERS NOT ACCESSIBLE	CHECK: Corresponding plug-in card installation
ERROR CODE (Err 1-4)	PRESS: Reset KEY (If cannot clear contact factory.)
DISPLAY ZERO'S AT LEVELS BELOW 1% OF RANGE	PROGRAM: Module 4 as Hi-t: 0.0 LO-t: 3271.1 (to disable zero chop feature)

For further assistance, contact technical support at the appropriate company numbers listed.

E

MODEL PAX2A – 1/8 DIN ANALOG PANEL METER

- *UNIVERSAL PROCESS, VOLTAGE, CURRENT, RESISTANCE AND TEMPERATURE INPUTS*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *PROGRAMMABLE UNITS DISPLAY*
- *VARIABLE CONTRAST AND INTENSITY DISPLAY*
- *UP TO 160 SAMPLES PER SECOND CONVERSION RATE*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

DESCRIPTION

The PAX2A Analog Panel Meter offers many features and performance capabilities to suit a wide range of industrial applications. The PAX2A has a universal input to handle various input signals including DC Voltage/Current, Process, Resistance and Temperature. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs. The PAX2A employs a dual line, tri-color display with a large 0.71", tri-color 6 digit top display line and a 0.35", 9 digit green bottom display line.

The meter provides a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow or calculate service intervals of motors, pumps, etc. The meter has up to four setpoint outputs, implemented on plug-in option cards. The plug-in cards provide dual FORM-C relays, quad FORM-A, or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and Profibus-DP. The PAX2A can be programmed to utilize ModBus protocol. With ModBus, the user has access to most configuration parameters. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meter has a feature that allows a remote computer to directly control the outputs of the meter.

The PAX2A includes a built-in USB programming port. With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2A without the need of any additional option cards.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track either the input, totalizer, max or min readings.

The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects and CE requirements, the meter provides a tough reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.

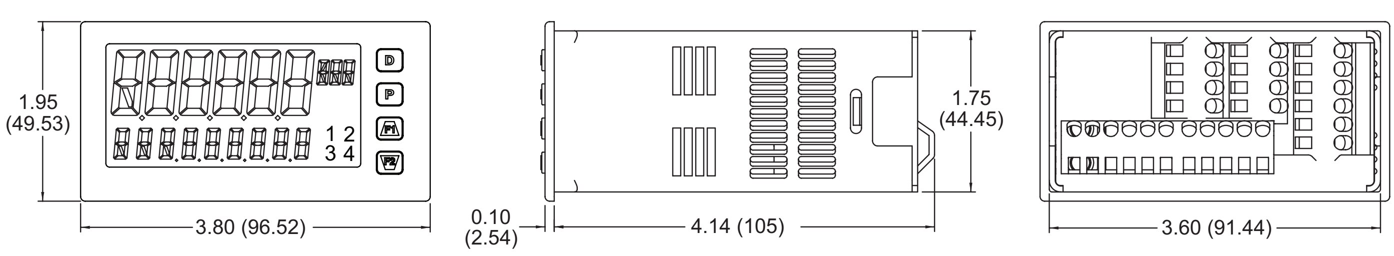


Table Of Contents

Ordering Information

Meter Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2A	Universal DC Analog Input Panel Meter	PAX2A000

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	**PAXCDS**	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	**SFCRD**[2]	Crimson PC Configuration Software for Windows 2000 and XP	SFCRD200
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Notes:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.
2. Crimson software is available for free download from http://www.redlion.net/

E

General Meter Specifications

1. **DISPLAY**: Negative image LCD
   Top Line - 6 digit, 0.71" (18 mm), with tri-color backlight (red, green or orange), display range: -199999 to 999999;
   Bottom Line - 9 digit, 0.35" (8.9 mm), with green backlight, display range: - 199,999,999 to 999,999,999
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **ANNUNCIATORS**: Backlight color: Red
   1 - setpoint alarm 1
   2 - setpoint alarm 2
   3 - setpoint alarm 3
   4 - setpoint alarm 4
   Line 1 Units Display – programmable 3 digit units annunciator with tri-color backlight (red, green or orange)
4. **KEYPAD**: 2 programmable function keys, 4 keys total
5. **A/D CONVERTER**: 24 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: programmable 5 to 160 readings/sec.
   Step response:

Input Type	Input Update Rate						Readings/ Sec
	5	10	20	40	80	160	
V/I/Resistance	400	200	100	50	30	20	msec response time *
Thermocouple	600	250	100	-	-	-	
RTD	1000	500	250	-	-	-	

   * - max. to within 99% of final readout value (digital filter disabled)
   Display update rate: 1 to 20 updates/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.
   Analog output update rate: 0 to 10 sec
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   "Short" - Appears when shorted sensor is detected. (RTD range only)
   "OPEN" - Appears when open sensor is detected. (TC/RTD range only)
   ". . . . ." - Appears when display values exceed + display range.
   "- . . . . ." - Appears when display values exceed - display range.
8. **INPUT CAPABILITIES**:

Current Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 µADC	0.03% of rdg + 0.03µA	0.12% of rdg + 0.04µA	1.11 KΩ	10nA
± 2.5 mADC	0.03% of rdg + 0.3µA	0.12% of rdg + 0.4µA	111 Ω	0.1µA
± 25 mADC	0.03% of rdg + 3µA	0.12% of rdg + 4µA	11.1 Ω	1µA
± 250 mADC	0.05% of rdg + 30µA	0.12% of rdg + 40µA	1.1 Ω	10µA
± 2 ADC	0.5% of rdg + 0.3mA	0.7% of rdg + 0.4mA	0.1 Ω	0.1mA

‡ Higher resolution can be achieved via input scaling.

Voltage Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 mVDC	0.03% of rdg + 30µV	0.12% of rdg + 40µV	451 KΩ	10µV
± 2.0 VDC	0.03% of rdg + 0.3mV	0.12% of rdg + 0.4mV	451 KΩ	0.1mV
± 10 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 25 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 100 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	10mV
± 200 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	10mV

‡ Higher resolution can be achieved via input scaling.

Temperature Inputs:
READOUT:
Scale: F or C
Offset Range: -199,999 to 999,999 display units.

Thermocouple Inputs:
Input Impedance: 20MΩ
Lead Resisitance Effect: 0.03 µV/Ω
Max Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C	1.2°C	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 750°C	1.0°C	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1250°C	1.3°C	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	150 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C	1.3°C	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90**	no standard	no standard

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD **
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 259°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-110 to 260°C	0.4°C	0.9°C	no official standard

Resistance Inputs:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	MAX CONT. OVERLOAD	‡ RESOLUTION
100 ohm	0.05% of rdg +0.03 ohm	0.2% of rdg +0.04 ohm	0.175 V	30 V	0.01 ohm
1000 ohm	0.05% of rdg +0.3 ohm	0.2% of rdg +0.4 ohm	1.75 V	30 V	0.1 ohm
10 Kohm	0.05% of rdg +1 ohm	0.2% of rdg +1.5 ohm	17.5 V	30 V	0.1 ohm

‡ Higher resolution can be achieved via input scaling.

* After 20 min. warm-up, @ 5 sample per second input rate. Accuracy is specified in two ways: Accuracy over an 18 to 28ºC and 15 to 75% RH environment; and Accuracy over a 0 to 50ºC and 0 to 85% RH (non condensing) environment. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** These curves have been corrected to ITS-90.

9. **EXCITATION POWER**: Jumper selectable
   Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
   Reference Voltage: + 2 VDC, ± 2%
      Compliance: 1KΩ load min (2 mA max)
      Temperature Coefficient: 40 ppm/ºC max.
   Reference Current: 1.05 mADC, ± 2%
      Compliance: 10 KΩ load max.
      Temperature Coefficient: 40 ppm/ºC max.
10. **USER INPUTS**: Two programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Common: Not isolated.
   Response Time: 12 msec. max.
   Logic State: User programmable (USrACt) for sink/source (Lo/Hi)

INPUT STATE (USrACt)	LO/SINK	HI/SOURCE
	20KΩ pull-up to +3.3V	20KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

11. **TOTALIZER**:
   Time Base: second, minute, hour, or day
   Batch: Can accumulate (gate) input display from a user input
   Time Accuracy: 0.01% typical
   Decimal Point: 0 to 0.0000
   Scale Factor: 0.001 to 65.000
   Low Signal Cut-out: -199,999 to 999,999
   Total: 6 digits on Line 1; 9 digits on Line 2
12. **CUSTOM LINEARIZATION**:
   Data Point Pairs: Selectable from 2 to 16
   Display Range: -199,999 to 999,999
   Decimal Point: 0 to 0.0000
13. **MEMORY**: Nonvolatile FRAM memory retains all programmable parameters and display values.
14. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50 °C
   Storage Temperature Range: -40 to 60 °C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 25 g (10 g relay)
   Operating and Storage Humidity: 0 to 85% max. RH non-condensing
   Altitude: Up to 2000 meters
15. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
      EN 61326-1 Immunity to Industrial Locations
      Emission CISPR 11 Class A
      IEC/EN 61010-1
      RoHS Compliant
   UL Listed: File #E179259
   Type 4X Indoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
16. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)
17. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
18. **WEIGHT**: 8 oz. (226.8 g)

Optional Plug-in Output Cards

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2A meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2A meter. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC50 - Profibus-DP
PAXCDC20 - RS232 Serial (Terminal)	
PAXCDC2C - RS232 Serial (Connector)	

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. Crimson can be downloaded at www.redlion.net

SETPOINT CARDS (PAXCDS)

The PAX2A meter has 4 available setpoint alarm output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See Update Rates step response specification on page 3; add 6 msec (typical) for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

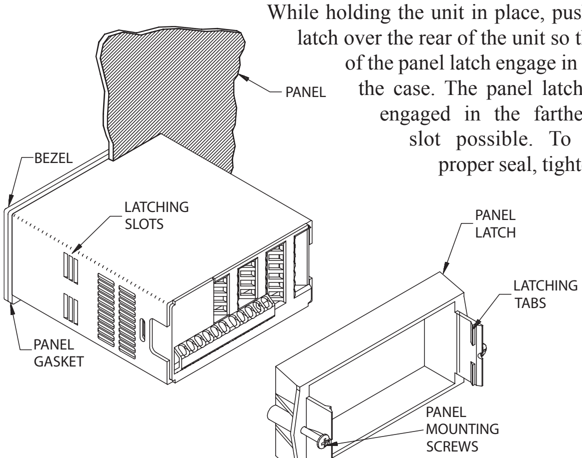
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Step Response: See Update Rates step response specification on page 3.
Update time: See ADC Conversion Rate and Update Time parameter

1.0 Installing the Meter

Installation

The PAX2A meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



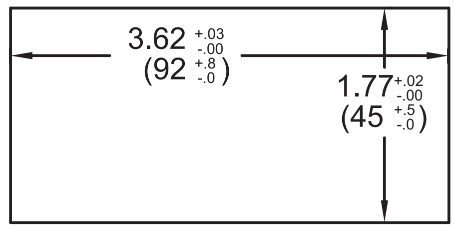
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

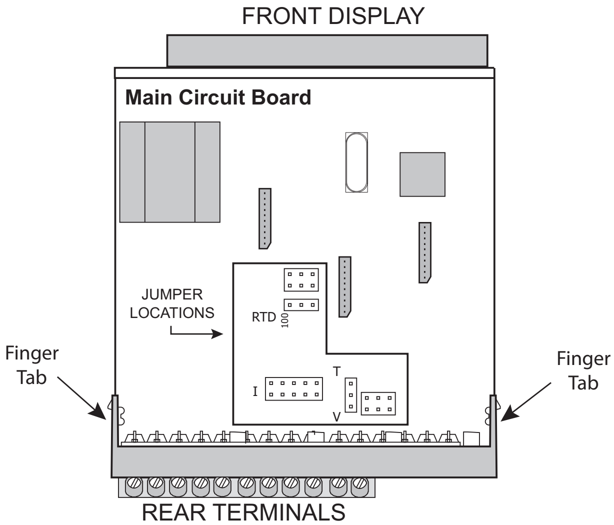


2.0 Setting the Jumpers

The PAX2A meter has four jumpers that must be checked and/or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.



INPUT RANGE JUMPERS

Voltage Input

Two jumpers are used in configuring the meter for voltage/resistance. The first jumper, T/V, must be in the V (voltage) position. The second jumper is used to select the proper voltage input range. (This jumper is also used to select the current input range.) Select a range that is high enough to accommodate the maximum signal input to avoid overloads. For proper operation, the input range selected in programming must match the jumper setting.

Current Input

For current input, only one jumper must be configured to select the current range. This jumper is shared with the voltage input range. To avoid overloads, select the jumper position that is high enough to accommodate the maximum signal input level to be applied.

Note: The position of the T/V jumper does not matter when the meter is in the current input mode.

Temperature Input

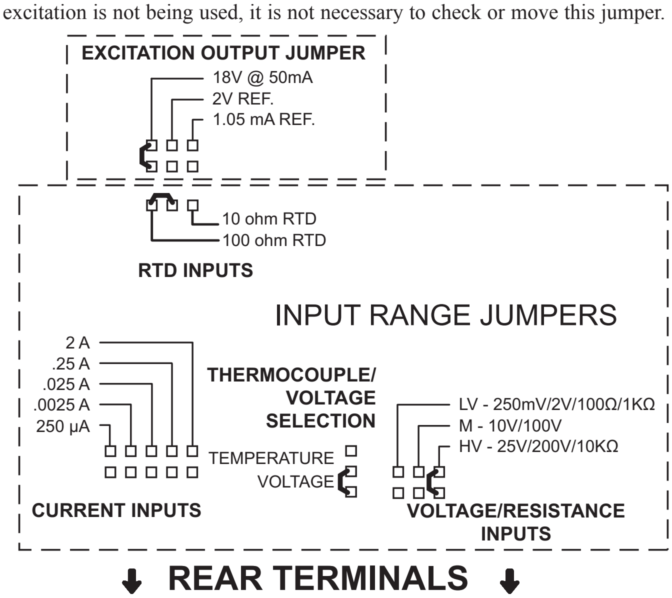
For temperature measurement the T/V jumper must be in the T (temperature) position. For RTD sensors the RTD jumper must also be set.

Resistance Input

Three jumpers are used to configure the resistance input. The T/V jumper must be in the V (voltage) position, and the excitation jumper must be in the 1.05 mA REF position. The voltage/resistance jumper position is determined by the input range.

Excitation Output Jumper

This jumper is used to select the excitation range for the application. If excitation is not being used, it is not necessary to check or move this jumper.

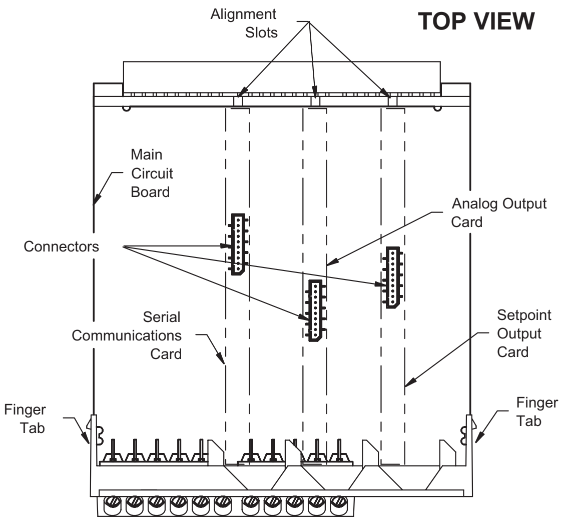


E

3.0 Installing Plug-In Cards

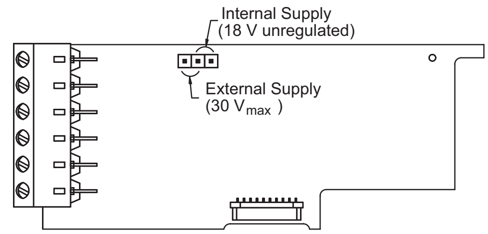
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX2A.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

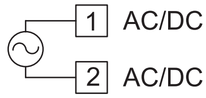
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

AC Power



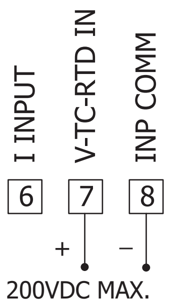
DC Power

The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

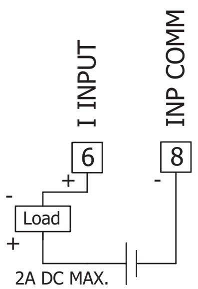
4.2 VOLTAGE/RESISTANCE/CURRENT INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, the Input Range Jumpers and Excitation Jumper should be verified for proper position.

Voltage Signal

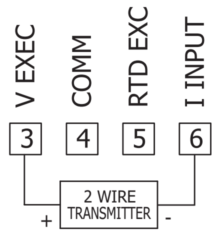


Process/Current Signal (external powered)



Process/Current Signal (2 wire requiring 18V excitation)

Excitation Jumper: 18 V

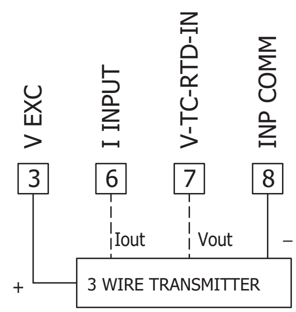


Current Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 6: +ADC (signal)
Terminal 8: -ADC (common)
Excitation Jumper: 18 V

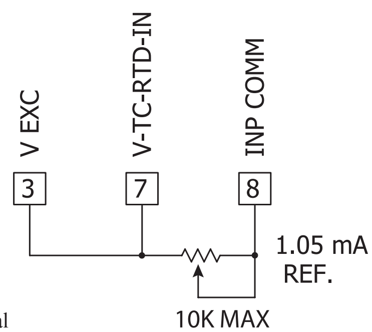
Voltage Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 7: +VDC (signal)
Terminal 8: -VDC (common)
Excitation Jumper: 18 V



Resistance Signal (2 wire requiring excitation)

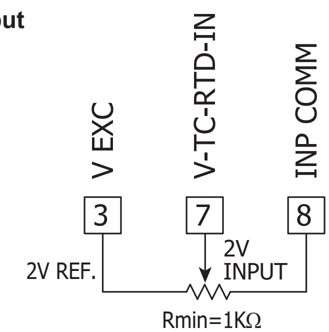
Terminal 3: Jumper to terminal 7
Terminal 7: Resistance
Terminal 8: Resistance
Excitation Jumper: 1.05 mA REF.
T/V Jumper: V position
Voltage/Resistance Input Jumper: Set per input signal



Potentiometer Signal as Voltage Input (3 wire requiring excitation)

Terminal 3: High end of pot.
Terminal 7: Wiper
Terminal 8: Low end of pot.
Excitation Jumper: 2 V REF.
T/V Jumper: V
Voltage/Resistance Input Jumper: 2 Volt
Module 1 Input Range: 2 Volt

Note: The Apply signal scaling style should be used because the signal will be in volts.



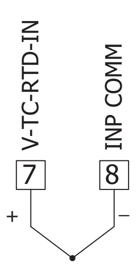
E

CAUTION: *Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

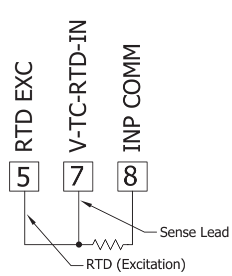
4.3 TEMPERATURE INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, verify the T/V Jumper is in the T position.

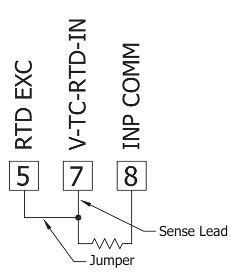
Thermocouple



3-Wire RTD



2-Wire RTD



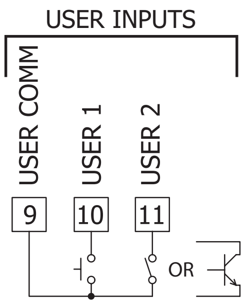
CAUTION*: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 USER INPUT WIRING

If not using User Inputs, then skip this section. Only the appropriate User Input terminal has to be wired.

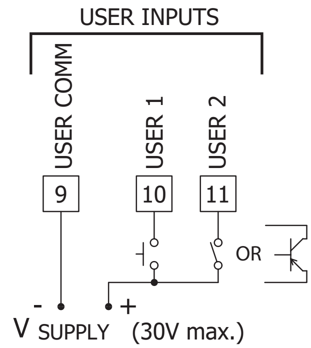
Sinking Logic (USrACt Lo)

When the USrACt parameter is programmed to Lo, the user inputs of the meter are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (USrACt Hi)

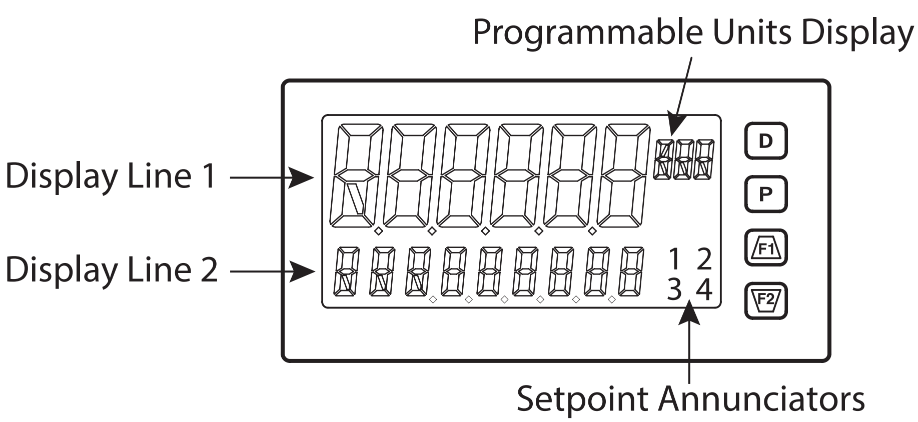
When the USrACt parameter is programmed to Hi, the user inputs of the meter are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



4.5 SETPOINT (ALARMS) WIRING
4.6 SERIAL COMMUNICATION WIRING
4.7 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



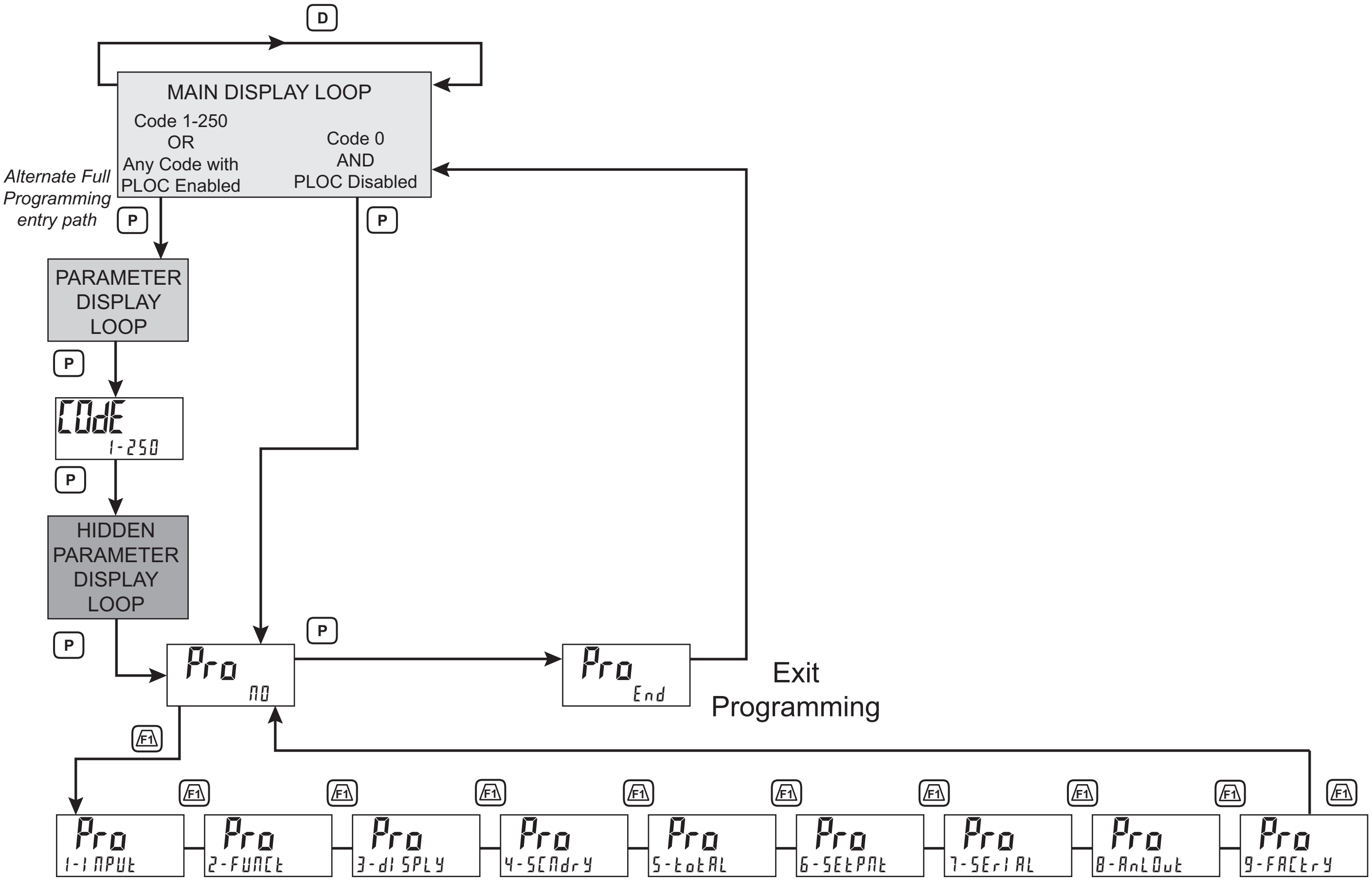
KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
D	Index Line 2 through enabled, max/min/input/total, readouts	Quick exit to display mode
P	Access the parameter and hidden display loops	Access the programming parameter menus, store selected parameter and index to next parameter
F1	Function key 1; hold for 3 seconds for second function 1*	Increment selected parameter value
F2	Function key 2; hold for 3 seconds for second function 2*	Decrement selected parameter value

**Factory setting for F1 and F2 is no mode*

The PAX2A display consists of a large, 6-digit upper display referred to as Line 1 and a smaller 9-digit lower display referred to as Line 2. Line 1 can be configured to show one of several values, including the main input reading, min, max, setpoints or total values. Line 2 can be used to display several selectable values including; input value, min, max, total, list, setpoint values, and other values. For these values the mnemonics is shown in the left most digits of Line 2. To the right of Line 1 is a Programmable Units Display. This display consists of 3 programmable digits that are user defined as mnemonics for Line 1.

E

PAX2A DISPLAY LOOPS



* Pressing “D” at any time exits back to the Main Display Loop.

E

PAX2A DISPLAY LOOPS

The PAX2A offers three display loops to allow users quick access to needed information. These display loops are available when the meter is in the normal display mode. By pressing the **D** key, the user can view parameters such as the Total, Min, Max or the Input in the Main Display Loop. Display selections are fully programmable and are viewed on the 9 digit line of the meter.

Pressing the **P** key with no security code (CODE 0) will put the meter directly into the programming mode. When a security code is programmed (Code 1-250), pressing the **P** key will allow access to the Parameter Display Loop. This loop is where the parameters like setpoint values are normally put for general public access. Parameters in this loop can only be viewed/changed if enabled in the meter programming. After all the parameters in the Parameter Display Loop are viewed, an additional press of the **P** key will bring up the security code (CODE 0). Access the Hidden Parameter Display Loop by entering the selected security code. In this loop displayed parameters can be changed. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on your application needs.

During programming of the meter you will need to select if a value is to be displayed or not. If the value is not required, select the lock mode (LOC). If you decide to display the value, you will need to assign it to a loop; **D** for the Main Display Loop, **P** for the Parameter Display Loop, and HIdE for the Hidden Display Loop. In the case of the parameters, such as the setpoint values you will also need to decide if the value can only be read (rEd) or entered (ENt). The F1 and F2 key will increment or decrement the value when the edit mode is active. After the change, press the **P** key to save and move to the next value. Any values placed in the Hidden Parameter Loop can be changed as they are protected by the security code. While in the parameter display and hidden parameter loops, pressing the **D** key will return the meter to the main display.

There are selections in the programming that allow for the values to be reset. When the **P** key is pushed on a resettable display, the unit will display the value mnemonic and “NO” (if Line 2 value was set for “d-ENt” in “3-dISPLY”). Pressing the F1 and F2 keys will toggle between “NO” and “YES”. Pressing the **P** key with “YES” displayed will cause the reset action to be performed.

The **P**, Parameter key is used to scroll among the programmed Line 2 parameter values when at the main display or to step through the parameter loop and hidden parameter loop. It is used as the enter key when the meter is in the programming mode.

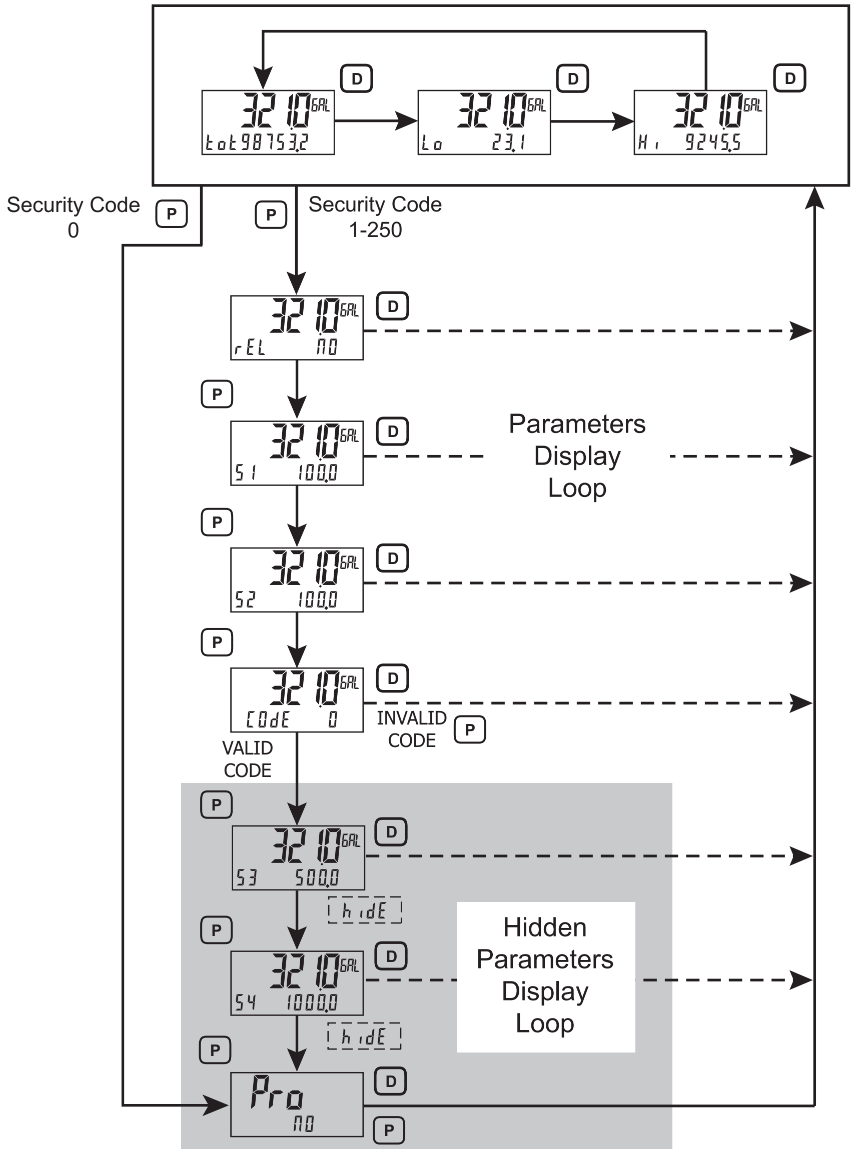
Numerical Value Entry

If the parameter is programmed for enter (ENt), the F1 and F2 keys are used to change the parameter values in any of the display loops.

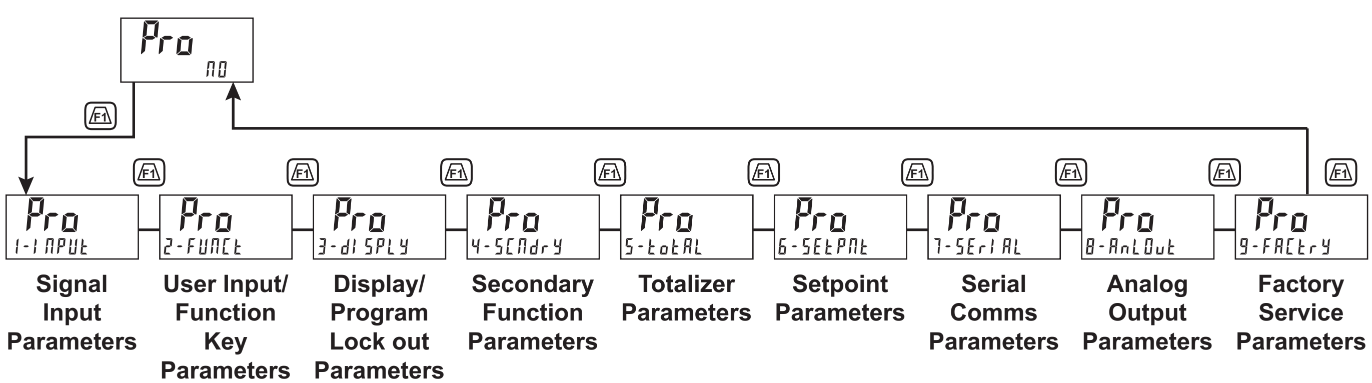
The F1 and F2 keys will increment or decrement the parameter value. When the arrow key is pressed and held, the value automatically scrolls. The longer the arrow key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the **D** key and the value scrolls by 1000’s as the arrow key is held. Releasing the arrow key removes the 1000’s scroll feature. The arrow keys can then be used to make small value changes as described above.

Main Display Loop

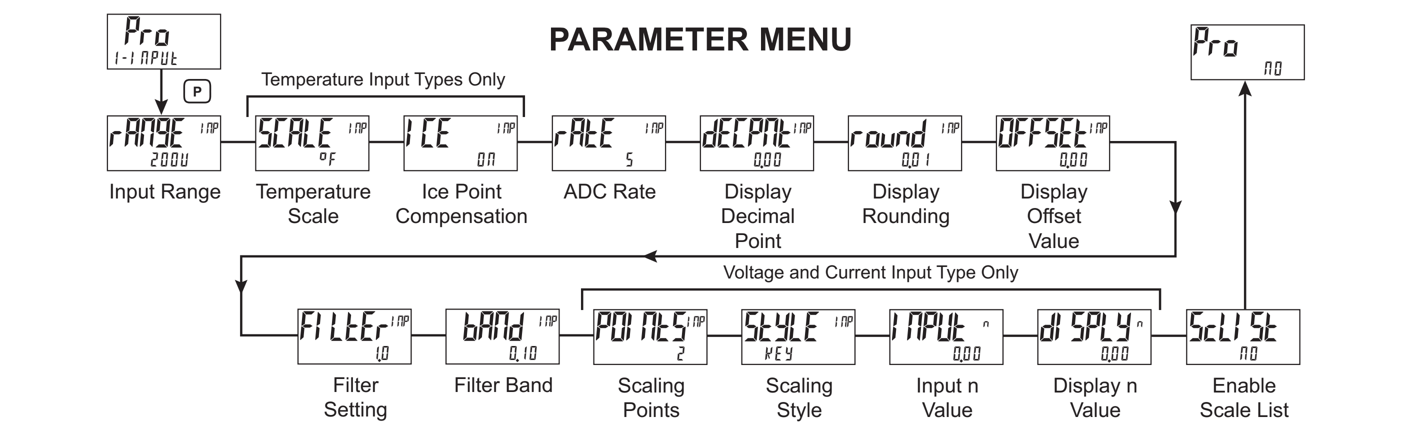


6.0 PROGRAMMING THE PAX2A



E

MODULE 1 - INPUT SETUP PARAMETERS (1-INPUt)



INPUT RANGE

rANGE INP 200U

250uA	2U	1000o	tc-r	r392
0.0025A	10U	10000o	tc-S	r672
0.025A	25U	tc-t	tc-b	r427
0.25A	100U	tc-E	tc-n	
2A	200U	tc-J	tc-C	
0.25U	100o	tc-K	r385	

Select the desired input range.

TEMPERATURE SCALE

For TC and RTD Input Range Selection only.

SCALE INP °F

°F °C

Select the temperature scale. This selection applies for Input, MAX, MIN, and TOT displays. If changed, those parameters that relate to the temperature scale should be checked.

ICE POINT COMPENSATION

For TC Input Range Selection only.

ICE INP ON

ON OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter.

INPUT UPDATE RATE (/SEC)

rAtE INP 5

5 10 20 40 80 160

Select the ADC conversion rate (conversions per second). Temperature inputs can not be set higher than 20 updates per second. The selection does not affect the display update rate, however it does affect setpoint and analog output response time. The default factory setting of 5 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

dECPNt INP 0.00

0 to 0.0000 (curr/volt)
0 to 0.0 (temp)

Select desired display resolution. The available selections are dependent on the Input Range selected (rANGE).

ROUNDING INCREMENT

round INP 0.01

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

OFFSEt INP 0.00

-199999 to 999999

The display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the affects of offset.

E

DIGITAL FILTERING

FILtEr INP 1.0

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND

bANd INP 0.10

0 to 250 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the digital filter permanently engaged.

When the meter is programmed for TC or RTD, the following programming steps are not active.

SCALING POINTS

POINtS INP 2

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n).

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs. In the Crimson software, several linearization equations are available.

SCALING STYLE

This parameter does not apply for thermocouple or RTD input ranges.

StYLE INP / KEY

KEY key-in data
APPLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APPLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INPUt 1 / 0.00

-199999 to 999999

For Key-in (KEY), enter the known first Input Value by using the F1 or F2 arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 1, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter.

DISPLAY VALUE FOR SCALING POINT 1

dISPLY 1 / 0.00

-199999 to 999999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APPLY scaling styles. The decimal point follows the dECPNt selection.

INPUT VALUE FOR SCALING POINT 2

INPUt 2 / 100.00

-199999 to 999999

For Key-in (KEY), enter the known second Input Value by using the F1 or F2 arrow keys. For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 2, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter. (Follow the same procedure if using more than 2 scaling points.)

DISPLAY VALUE FOR SCALING POINT 2

dISPLY 2 / 100.00

-199999 to 999999

Enter the second coordinating Display Value by using the F1 or F2 arrow keys. This is the same for KEY and APPLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

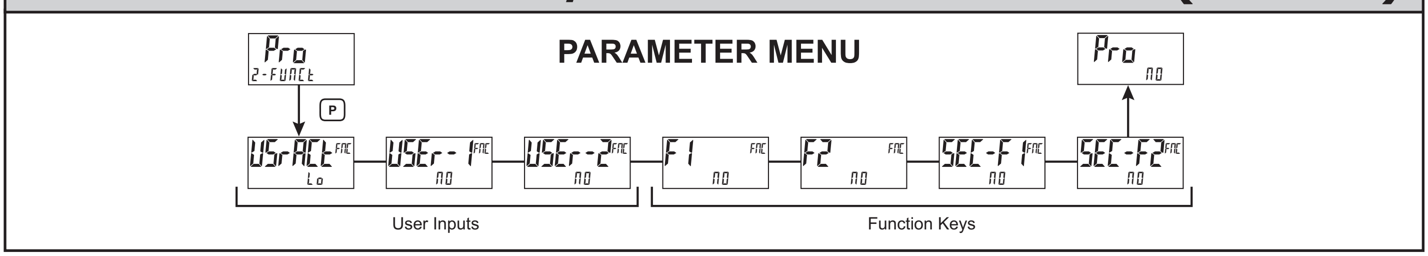
ENABLE SCALE LIST

ScLISt / NO

NO YES

When enabled, a second list of scaling points is active in the selected parameter list for List A and List B.

MODULE 2 - USER INPUT/FUNCTION KEY PARAMETERS (2-FUNCt)



The two user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state. The front panel function keys, F1 and F2, are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USEr-n will represent both user inputs. Fn will represent both function keys and second function keys.

USER INPUT ACTIVE STATE

USrACt FNC / Lo

Lo Hi

Select the desired active state for the User Inputs. Select Lo for sink input, active low. Select Hi for source input, active high.

NO FUNCTION

USEr-n FNC / NO

Fn FNC / NO

No function is performed if activated. This is the factory setting for all user inputs and function keys.

PROGRAMMING MODE LOCK-OUT

USEr-n FNC PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USEr-n FNC rEL   Fn FNC rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Offset Value and is automatically stored as the new Display Offset Value. If another Zero (tare) Display is performed, the display will again change to zero and the Display offset value will shift accordingly.

RELATIVE/ABSOLUTE DISPLAY

USEr-n FNC d-rEL   Fn FNC d-rEL

This function will switch the Input Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input Display will normally show the Relative unless switched by this function. Regardless of the display selected, all meter functions continue to operate based on relative values. The Absolute is a gross value (based on Module 1 DSP and INP entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative display. (Abs) or (rEL) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USEr-n FNC d-HLd

The active display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USEr-n FNC A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USEr-n FNC SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USEr-n FNC bAt   Fn FNC bAt

The Input Display value is added (batched) to the Totalizer at transition to activate (momentary action) and Line 2 flashes bAtCh. The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden and only batched Input Display values accumulate in the Totalizer.

SELECT TOTALIZER DISPLAY

USEr-n FNC d-tot

The Totalizer display appears on Line 2 as long as activated (maintained action). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Totalizer continues to function including associated outputs independent of being displayed.

RESET TOTALIZER

USEr-n FNC r-tot1   Fn FNC r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USEr-n FNC r-tot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USEr-n FNC E-tot

The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USEr-n FNC d-HI

The Maximum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Maximum continues to function independent of being displayed.

RESET MAXIMUM DISPLAY

USEr-n FNC r-HI   Fn FNC r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

SELECT MINIMUM DISPLAY

USEr-n FNC d-Lo

The Minimum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Minimum continues to function independent of being displayed.

E

RESET MINIMUM DISPLAY

USEr-n FNC
r-Lo

Fn FNC
r-Lo

When activated (momentary action), rESEt flashes and the Minimum resets to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM DISPLAY

USEr-n FNC
r-HL

Fn FNC
r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

DISPLAY SELECT

USEr-n FNC
dISP

When activated (momentary action), Line 2 advances to the next display that is not locked out from the Display Mode.

ADJUST DISPLAY INTENSITY

USEr-n FNC
d-LEU

Fn FNC
d-LEU

When activated (momentary action), the display intensity changes to the next intensity level.

CHANGE DISPLAY COLOR

USEr-n FNC
CoLor

When activated (momentary action), Line 1 will change color.

SELECT PARAMETER LIST

USEr-n FNC
LISt

Fn FNC
LISt

Two lists of input scaling points and setpoint values (including band and deviation) are available. The two lists are named LISt-A and LISt-b. If a user input is used to select the list then LISt-A is selected when the user input is not active and LISt-b is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed. To program the values for LISt-A and LISt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the desired values for the input scaling points, setpoints, band, and deviation if used.

SETPOINT SELECTIONS

The following selections are functional only with a Setpoint plug-in card installed.

r-1 - Reset Setpoint 1 (Alarm 1)
r-2 - Reset Setpoint 2 (Alarm 2)
r-3 - Reset Setpoint 3 (Alarm 3)
r-4 - Reset Setpoint 4 (Alarm 4)
r-34 - Reset Setpoint 3 & 4 (Alarm 3 & 4)
r-234 - Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)
r-ALL - Reset All Setpoints (Alarms 1-4)

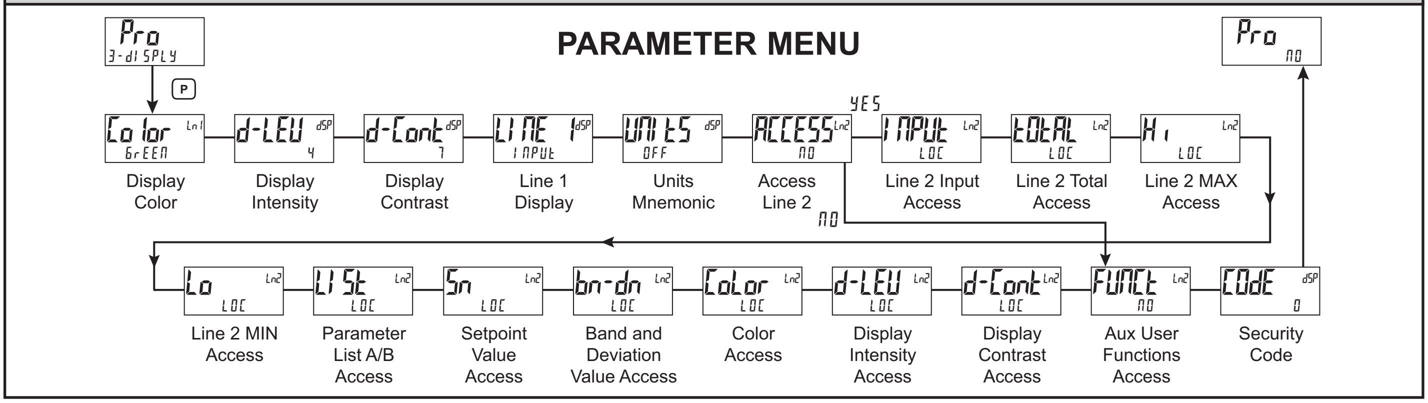
PRINT REQUEST

USEr-n FNC
Print

Fn FNC
Print

The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

MODULE 3 - DISPLAY PARAMETERS (3-dISPLY)



Module 3 is the programming of the Main Display Loop, Parameter Display Loop, Hidden Parameter Loop, and Full Programming lock-out. The large upper display line value is configured by the "LINE 1" parameter. The Units mnemonic can be used to assign a custom display mnemonic to the upper display value. When in the Main Display Loop, the available Line 2 displays (items configured for d-rEd or d-ENt) can be consecutively read on lower display by repeatedly pressing the **D** key. A left justified 3 character mnemonic indicates which parameter value is being shown on the lower display. When in the Main Display Loop the User keys F1 and F2 function as programmed in Module 2.

The Parameter display loop items can be accessed by pressing the **P** key. To edit a main display line item, that is configured as d-ENt , the **P** key is pushed and the unit enters a parameter edit mode in which the F1 and F2 key increments or decrements the value.

Full Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input.

LINE 1 DISPLAY COLOR

Color Ln1 GrEEN — GrEEN rEd OrANGE

Enter the desired Display Line 1 and programmable Units Display color.

DISPLAY INTENSITY LEVEL

d-LEU dSP 4 — 0 to 4

Enter the desired Display Intensity Level (0-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in the Parameter Display Loop when enabled.

DISPLAY CONTRAST LEVEL

d-Cont dSP 7 — 0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively move up or down as the levels are changed. This parameter also appears in the Parameter Display Loop when enabled.

LINE 1 DISPLAY

LINE 1 dSP INPUt — INPUt totAL Hi Lo S1 S2 S3 S4 NONE

Select the value to be assigned to the primary or top line of the meter display.

UNITS MNEMONIC

UNItS dSP OFF — OFF LISt

This parameter allows programming of the display mnemonics characters. Three individual characters may be selected from a preprogrammed list. The list includes:

_ A b C d E F G H I J K L N O P Q R S t U V Y Z 0 1 2 3 4 5 6 7 8 9 c e g h i n o q r u - ° blank

LINE 2 MAIN, SECONDARY & HIDDEN DISPLAY LOOP ACCESSIBLE ITEMS

ACCESS Ln2 NO — NO YES

Select YES to program the display Line 2 accessible values. The default setting of NO bypasses the programming of these values to shorten the module.

All of the individual Line 2 settings are retained.

The following values can be made accessible on Line 2 of the Main (**D** key), Parameter (**P** key) and Hidden (**P** key following code entry) Display Loops.

Each of the following parameters can be configured for one of the following settings. Not all selections are available for each parameter.

SELECTION	DESCRIPTION
LOC	Not viewed on display line
d-rEd	View in Main Display Loop. Cannot change or reset.
d-ENt	View and change (reset) in Main Display Loop
P-rEd	View in Parameter Display Loop. Cannot change or reset.
P-ENt	View and change (reset) in Parameter Display Loop
HidE	View and change in Hidden Parameter Display Loop

LINE 2 INPUT ACCESS

INPUt Ln2 LOC — LOC d-rEd d-ENt

When configured for d-ENt , the Input value can be reset (tare) using a front keypad sequence. To reset (tare), push the **P** key while viewing the Input value on Line 2. The display will show rEL NO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 TOTAL ACCESS

totAL Ln2 LOC — LOC d-rEd d-ENt

When configured for d-ENt , the Total value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Total value on Line 2. The display will show r-tot NO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

E

LINE 2 MAX ACCESS

Hi Ln2 LOC | LOC d-rEd d-Ent

When configured for d-Ent, the Max Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Hi value on Line 2. The display will show r-Hi nO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 MIN ACCESS

Lo Ln2 LOC | LOC d-rEd d-Ent

When configured for d-Ent, the Min Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Lo value on Line 2. The display will show r-Lo nO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 PARAMETER LIST A/B ACCESS

LISt Ln2 LOC | LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the Parameter list can be selected using a front keypad sequence. To select, push the **P** key while viewing LISt x". "x" will begin to flash, press the F1 key to select "A" or "B" and then press **P** key. The selected Parameter List will become active and the display will advance to Parameter Display. See User Functions "Select Parameter List" for a description of the list function. The Line 2 Parameter List provides a means of setting or viewing the active parameter list.

LINE 2 SETPOINTS ACCESS

Sn Ln2 LOC | LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the **P** key must be pressed to select the item for change before the F1 and F2 keys will increment or decrement the value.

LINE 2 BAND/DEVIATION ACCESS

bn-dn Ln2 LOC | LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the **P** key must be pressed to select the item for change before the F1 and F2 keys will increment or decrement the value.

LINE 1 DISPLAY COLOR ACCESS

Color Ln2 LOC | LOC P-rEd P-Ent HidE

When configured for P-Ent, Line 1 Color can be selected in the Parameter Display by using the F1 and F2 keys while viewing Color.

DISPLAY INTENSITY ACCESS

d-LEU Ln2 LOC | LOC P-rEd P-Ent HidE

When configured for P-Ent, the display intensity can be selected in the Parameter Display by using the F1 and F2 keys while viewing d-LEU.

DISPLAY CONTRAST ACCESS

d-Cont Ln2 LOC | LOC P-rEd P-Ent HidE

When configured for P-Ent, the display contrast can be selected in the Parameter Display by using the F1 and F2 keys while viewing d-Cont.

LINE 2 USER FUNCTIONS ACCESSIBLE ITEMS

FUnCt Ln2 nO | YES nO

Select YES to display the following list of User functions that can be made available at the end of the Parameter (P-Ent) or Hidden (HidE) display loops. The more critical and frequently used Functions should be first assigned to the User Inputs and User Function keys. If more functions are needed than what can be obtained with User Inputs, this feature will provide a means to provide that access. Refer to module 2, 2-FUnCt for a description of the function.

rEL bAt r-tot r-HI r-Lo
r-HL r-1 r-2 r-3 r-4
r-34 r-234 r-ALL Print

PROGRAMMING SECURITY CODE

COdE dSP 0 | 000 to 250

To activate either the Parameter or Hidden Parameter Display Loops, a security code (1-250) must be entered. If a "0" security code is programmed, pressing the **P** key takes you directly to the Full Programming Mode.

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Module 2).

Two programming modes are available. Full Programming Mode allows all parameters to be viewed and modified. Parameter Display Loop mode provides access to those selected parameters, that can be viewed and/or modified without entering the Full programming mode.

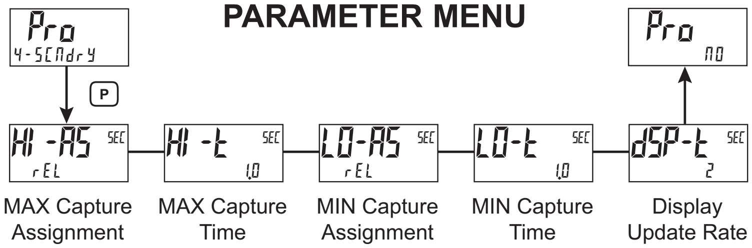
The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN P KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
0	not PLOC	———	Full Programming	Immediate Access
>0	not PLOC	———	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at COdE prompt.
>0	PLOC	Active	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at COdE prompt.
>0	PLOC	Not Active	Full Programming	Immediate Access
0	PLOC	Active	Enter Parameter Display Loop	No Access
0	PLOC	Not Active	Full Programming	Immediate Access

E

MODULE 4 - Secondary Function Parameters (4-SECndrY)

PARAMETER MENU



MAX CAPTURE ASSIGNMENT

HI -AS SEC rEL

rEL AbS

Select the desired parameter that will be assigned to the Max Capture.

MAX CAPTURE DELAY TIME

HI -t SEC 1.0

0.0 to 3275.0 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE ASSIGNMENT

LO-AS SEC rEL

rEL AbS

Select the desired parameter that will be assigned to the Min Capture.

MIN CAPTURE TIME

LO-t SEC 1.0

0.0 to 3275.0 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE

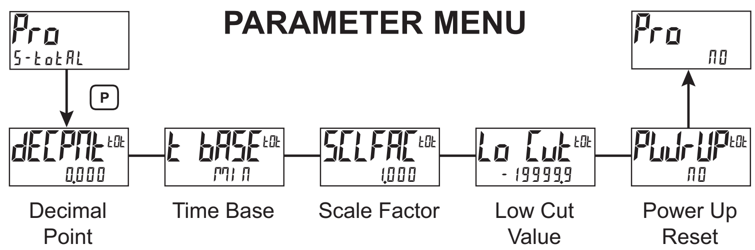
dSP-t SEC 2

1 2 5 10 20 updates/second

This parameter configures the display update rate. It does not affect the response time of the setpoint output or analog output option cards.

E

MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-totAL)



The totalizer accumulates (integrates) the Input Display value using one of two modes. The first is using a time base. This can be used to compute a time temperature product. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of temperature integration, useful in curing and sterilization applications. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT

dECPNt tot
0.000

0   0.0   0.00   0.000   0.0000

For most applications, this matches the Input Display Decimal Point (dECPNt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

t bASE tot
MIn

SEC -seconds (/1)   MIn -minutes (/60)
hour -hours (/3600)   dAY -days (/86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR

SCLFAC tot
1.000

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In this case, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a value that is different than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE

Lo Cut tot
-1999.99

-199999 to 999999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET

PWrUP tot
NO

NO - do not reset buffer
YES - reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to YES.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:
Input Display - the present input reading
Totalizer Scale Factor - 0.001 to 65.000
Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at a constant rate of 10.0 gallons per minute. The Totalizer is used to determine how many gallons in tenths has flowed. Because the Input Display and Totalizer are both in tenths of gallons, the Totalizer Scale Factor is 1. With gallons per minute, the Totalizer Time Base is minutes (60). By placing these values in the equation, the Totalizer will accumulate every second as follows:

$\frac{10.0 \times 1.000}{60}$ = 0.1667 gallon accumulates each second

This results in:
10.0 gallons accumulates each minute
600.0 gallons accumulates each hour

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPNt) location from the Input Display Decimal Point (dECPNt), the required Totalizer Scale Factor is multiplied by a power of ten.

Example:

Input (dECPNt) = 0

Totalizer dECPNt	Scale Factor
0.0	10
0	1
x10	0.1
x100	0.01
x1000	0.001

Input (dECPNt) = 0.0

Totalizer dECPNt	Scale Factor
0.00	10
0.0	1
0	0.1
x10	0.01
x100	0.001

Input (dECPNt) = 0.00

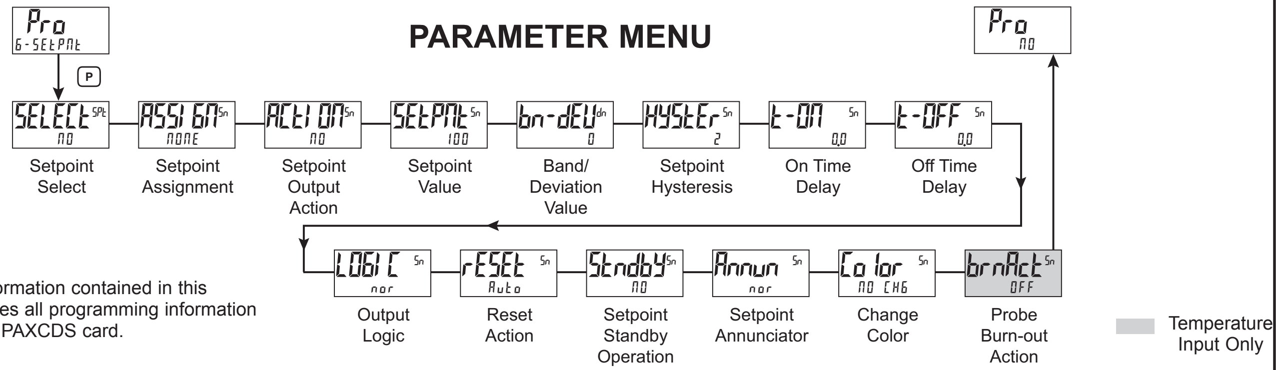
Totalizer dECPNt	Scale Factor
0.000	10
0.00	1
0.0	0.1
0	0.01
x10	0.001

2. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.

Example: Average temperature per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for r-tot. The timer will control the start (reset) and the stopping (hold) of the totalizer.

E

MODULE 6 - Setpoint Output Parameters (6-SEtPNt)



Programming information contained in this manual supercedes all programming information included with the PAXCDS card.

SETPOINT SELECT

SELECt SPt
NO

NO   S1   S2   S3   S4

Enter the setpoint (alarm output) to be programmed. The "n" in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to NO. Repeat step for each setpoint to be programmed. The NO chosen at SELECt SPt, will return to Pro NO. The number of setpoints available is setpoint output card dependent.

SETPOINT ASSIGNMENT

ASSIGN Sn
NONE

NONE   rEL   AbS   totAL

Selects the meter value to be used to trigger the Setpoint Alarm. The rEL setting will cause the setpoint to trigger off of the relative (net) input value. The relative input value is the absolute input value that includes the Display Offset Value. The AbS setting will cause the setpoint to trigger off of the absolute (gross) input value. The absolute input value is based on Module 1 dISPLY and INPUt entries.

SETPOINT ACTION

ACtION Sn
NO

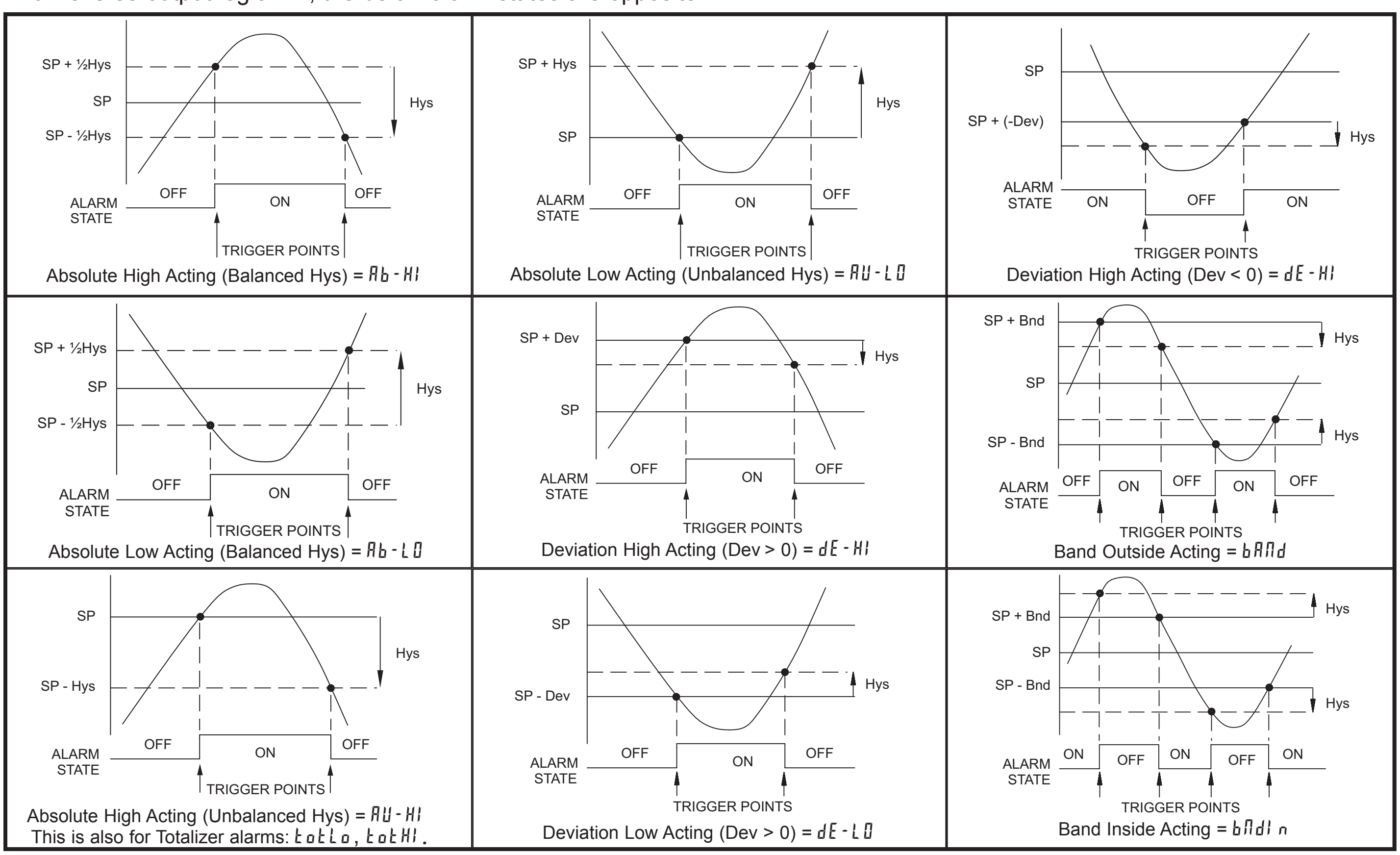
NO   Ab-HI   Ab-LO   AU-HI
AU-LO   dE-HI   dE-LO   bANd
bNdIn   totLo   totHI

Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action. The Setpoint Actions that pertains to the total is only active when the Setpoint Assignment is set to totAL.

NO	= No Setpoint Action
Ab-HI	= Absolute high, with balanced hysteresis
Ab-LO	= Absolute low, with balanced hysteresis
AU-HI	= Absolute high, with unbalanced hysteresis
AU-LO	= Absolute low, with unbalanced hysteresis
dE-HI	= deviation high, with unbalanced hysteresis
dE-LO	= deviation low, with unbalanced hysteresis
bANd	= Outside band, with unbalanced hysteresis
bNdIn	= Inside band, with unbalanced hysteresis
totLo	= Lower 6 digits of 9 digit Totalizer, with unbalanced hysteresis
totHI	= Upper 6 digits of 9 digit Totalizer, with unbalanced hysteresis

Setpoint Alarm Figures

With reverse output logic rEU, the below alarm states are opposite.



Absolute High Acting (Balanced Hys) = Ab-HI

Absolute Low Acting (Unbalanced Hys) = AU-LO

Deviation High Acting (Dev < 0) = dE-HI

Absolute Low Acting (Balanced Hys) = Ab-LO

Deviation High Acting (Dev > 0) = dE-HI

Band Outside Acting = bANd

Absolute High Acting (Unbalanced Hys) = AU-HI
This is also for Totalizer alarms: totLo, totHI.

Deviation Low Acting (Dev > 0) = dE-LO

Band Inside Acting = bNdIn

E

SETPOINT VALUE

SEtPNt Sn 100 — -199999 to 999999

Enter desired setpoint alarm value. Setpoint values can also be entered in the Display Mode during Program Lockout when the setpoint is programmed as ENt in Parameter Module 3. The decimal point position is determined by the Setpoint Assignment value.

BAND/DEVIATION VALUE

bn-dEV dn 0 — -199999 to 999999

This parameter is only available in band and deviation setpoint actions. Enter desired setpoint band or deviation value. When the Setpoint Action is programmed for Band, this value can only be a positive value.

HYSTERESIS VALUE

HYStEr Sn 2 — 1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints. Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

t-ON Sn 0.0 — 0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

t-OFF Sn 0.0 — 0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

LOGIC Sn nor — nor rEv

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEv logic reverses the output logic. In rEv, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

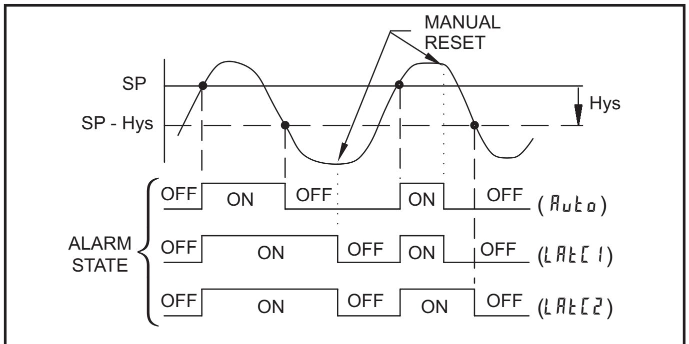
rESEt Sn Auto — Auto LAtCh1 LAtCh2

Enter the reset action of the alarm output.

Auto = Automatic action; This action allows the alarm output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input.The alarm remains reset off until the trigger point is crossed again.

LAtCh1 = Latch with immediate reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtCh2 = Latch with delay reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the event until the corresponding "on" alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)



Setpoint Alarm Reset Actions

SETPOINT STANDBY OPERATION

Stndby Sn NO — NO YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. Once the alarm is on, the alarm operates normally per the Setpoint Action and Reset Mode.

SETPOINT ANNUNCIATOR

Annun Sn nor — nor rEv FLASh OFF

The OFF mode disables display setpoint annunciators. The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEv mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASh mode flashes the corresponding setpoint annunciators of "on" alarm outputs.

LINE 1 CHANGE COLOR

Color Sn NO CHG — NO CHG GrEEN OrANGE rEd GrnOrG rEdOrG rEdGrn LINE 1

This parameter allows the Line 1 Display to change color, or alternate between two colors, when the alarm is activated. When multiple alarms are programmed to change color, the highest numbered active alarm (S4-S1) determines the display color.

The NO CHG selection will maintain the color displayed prior to the alarm activation. The LINE 1 selection sets the display to the Line 1 Display Color (Color), programmed in Module 3.

The following programming step is only available when Input Range in Module 1 is set for a temperature input (TC/RTD).

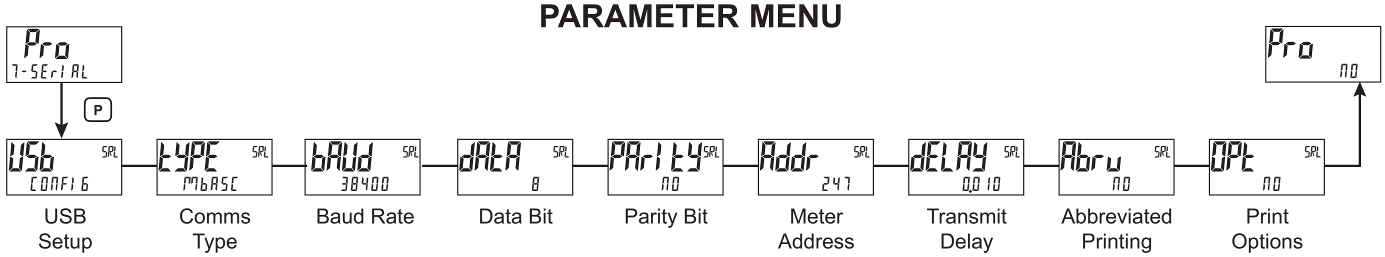
PROBE BURN-OUT ACTION

brnAct Sn OFF — OFF ON

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the output can be programmed to be on or off.

MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SErIAL)

PARAMETER MENU



Programming information contained in this manual supercedes all programming information included with the PAXCDC card.

USB SETUP

USb SPL CONFIG

CONFIG Port

CONFIG – Configures USB with settings required to operate with Crimson configuration software. This will automatically internally configure the PAX2A to use ModBus RTU protocol, 38400 baud, 8 bits, and unit address of 247 when a USB cable is attached to PAX2A and PC. The serial port settings shown in 7- SErIAL (this module) will not change, or show this.

Port – Configures USB to utilize serial settings and protocol as configured in "7- SErIAL" (this module).

COMMUNICATIONS TYPE

tYPE SPL MbASC

MbASC - ModBus ASCII
rLC - RLC Protocol (ASCII)
Mbrtu - ModBus RTU

Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2A, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd SPL 38400

1200	4800	19200
2400	9600	38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

DATA BIT

dAtA SPL 8

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PArItY SPL NO

NO EVEN Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

METER UNIT ADDRESS

Addr SPL 247

0 to 99 - RLC Protocol
1 to 247 - ModBus

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

dELAY SPL 0.010

0.000 to 0.250 seconds

Following a transmit value ("*" terminator) or Modbus command, the PAX2A will wait this minimum amount of time in seconds before issuing a serial response

---

The following programming steps are only available when Communications Type (tYPE) is programmed for rLC.

ABBREVIATED PRINTING

Abru SPL NO

NO YES

Select YES for full print or Command T transmissions (meter address, mnemonics and parameter data) or NO for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, it will not be sent during a full transmission.

PRINT OPTIONS

OPt SPL NO

NO YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INPUt	Signal Input	YES	INP
totAL	Total Value	NO	TOT
HI LO	Max & Min	NO	MAX, MIN
SPNt	Setpoint Values	NO	SP1-SP4

E

SERIAL COMMUNICATIONS

The PAX2A supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 Pax option cards, the PAX2A supports both the RLC protocol and also supports ModBus communications. The Pax ModBus option card should not be used with the PAX2A, as the PAX2A internal ModBus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2A with the Crimson programming software. It can also, be used as a virtual serial communications port following installation of the PAX2A USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2A and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2A CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2A
3. Insure “USB” parameter in module 7-SERIAL, is set to “CONFIG” (factory default setting).
4. Attach USB A – MiniB cable between PC and PAX2A
5. Create a new (File, New) or open an existing PAX2A database within Crimson.
6. Configure Crimson 2 Link, Options to the serial port the communication cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communication Type Parameter (tYPE) be set to “MbrtU” or “MbASC”.

PAX2A CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2A to PC.
3. Supply power to PAX2A
4. Configure serial parameters in 7-SERIAL to MbrtU, 38,400 baud, address 247.
5. Create a new (File, New) or open an existing PAX2A database within Crimson.
6. Configure Crimson 2 Link, Options to the serial port the comunication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 32 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 32 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 32 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), “Total Comms” 2 byte count, “Total Good Comms” 2 byte count, checksum of the string

“Total Comms” is the total number of messages received that were addressed to the PAX2. “Total Good Comms” is the total messages received by the PAX2A with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAX2A ab<0100h><20h><20h><10h>
a = SP Card, “0”-No SP, “2” or “4” SP
b = Linear Card “0” = None, “1” = Yes
<0100> Software Version Number (1.00)
<20h>Max Register Reads (32)
<20h>Max Register Writes (32)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAX2A FREQUENTLY USED MODBUS REGISTER TABLE

Only frequently used registers are shown below. THe entire Modbus Register Table can be found at www.redlion.net.

The below limits are shown as Integers or HEX < > values. Read and write functions can be performed in either Integers or Hex as long as the conversion was done correctly. Negative numbers are represented by two's complement.

Note 1: The PAX2A should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Input Relative Value (Hi word)	N/A	N/A	N/A	Read Only	Process value of present input level. This value is affected by Input Type, Resolution, Scaling, & Offset Value. (Relative Value = Absolute Input Value + Offset Value)
40002	Input Relative Value (Lo word)					
40003	Maximum Value (Hi word)	-199999	999999	N/A	Read/Write	
40004	Maximum Value (Lo word)					
40005	Minimum Value (Hi word)	-199999	999999	N/A	Read/Write	
40006	Minimum Value (Lo word)					
40007	Total Value (Hi word)	-199999999	999999999	N/A	Read/Write	
40008	Total Value (Lo word)					
40009	Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	Active List (A or B)
40010	Setpoint 1 Value (Lo word)					
40011	Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	Active List (A or B)
40012	Setpoint 2 Value (Lo word)					
40013	Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	Active List (A or B)
40014	Setpoint 3 Value (Lo word)					
40015	Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	Active List (A or B)
40016	Setpoint 4 Value (Lo word)					
40017	Setpoint 1 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40018	Setpoint 1 Band/Dev. Value (Lo word)					
40019	Setpoint 2 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40020	Setpoint 2 Band/Dev. Value (Lo word)					
40021	Setpoint 3 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40022	Setpoint 3 Band/Dev. Value (Lo word)					
40023	Setpoint 4 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40024	Setpoint 4 Band/Dev. Value (Lo word)					
40025	Setpoint Output Register (SOR)	0	15	N/A	Read/Write	Status of Setpoint Outputs. Bit State: 0 = Off, 1 = On. Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4. Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40026	Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = S1, Bit 3 = S2, Bit 2 = S3, Bit 1 = S4, Bit 0 = Linear Output
40027	Reset Output Register	0	15	0	Read/Write	Bit State: 1 = Reset Output, bit is returned to zero following reset processing; Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4
40028	Analog Output Register (AOR)	0	4095	0	Read/Write	Linear Output Card written to only if Linear Output is in Manual Mode.(MMR bit 0 = 1)
40029	Input Absolute Value (Hi word)	N/A	N/A	N/A	Read Only	Gross value of present Input level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value
40030	Input Absolute Value (Lo word)					
40031	Input Offset Value (Hi word)	-199999	999999	0	Read/Write	Input Offset Value plus the Input Absolute Value equals the Relative Input Value (standard meter value).
40032	Input Offset Value (Lo word)					

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to "rLC".

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node Address Specifier	Address a specific meter. Must be followed by a one or two digit node address. Not required when address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register or output. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	APPLICABLE COMMANDS/COMMENTS
A	Input (relative value)	INP	T, P, R (Reset command resets input to zero; tares)
B	Total	TOT	T, P, R (Reset command resets total to zero)
C	Max Input	MAX	T, P, R (Reset command resets Max to current reading)
D	Min Input	MIN	T, P, R (Reset command resets Min to current reading)
E	Setpoint 1	SP1	T, P, V, R (Reset command resets the setpoint output)
F	Setpoint 2	SP2	
G	Setpoint 3	SP3	
H	Setpoint 4	SP4	
I	Band/Deviation 1	BD1	T, V
J	Band/Deviation 2	BD2	T, V
K	Band/Deviation 3	BD3	T, V
L	Band/Deviation 4	BD4	T, V
M	Absolute Input value	ABS	T
O	Offset	OFS	T, V
U	Auto/Manual Register	MMR	T, V
W	Analog Output Register	AOR	T, V
X	Setpoint Register	SOR	T, V

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1.
   String: N17VE350$
2. Node address = 5, Read Input value.
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output.
   String: RH*

Sending Numeric Data

Numeric data sent to the meter must be limited to 6 digits (-199999 to 999999). Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

RECEIVING DATA FROM THE METER

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response mode is selected in program Module 7 (Abru).

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	2 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

U abcde
e = Analog Output
d = SP4
c = SP3
b = SP2
a = SP1

Example: VU00011 places SP4 and Analog in manual.

Analog Output Register (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Setpoint Output Register (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A "0" in the setpoint location means the output is off and a "1" means the output is on.

X abcd
d = SP4
c = SP3
b = SP2
a = SP1

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10 will result in output 1 on and output 2 off.

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \# \text{ of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the (Serial Transmit Delay parameter (dELAY)). The standard command line terminating character is "*". This terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15 msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with "$" results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

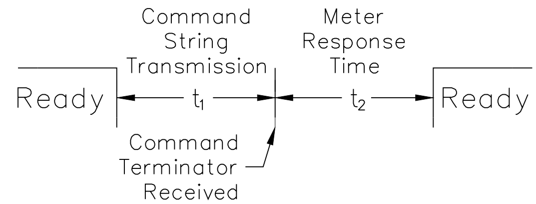
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \# \text{ of characters}) / \text{baud rate.}$$

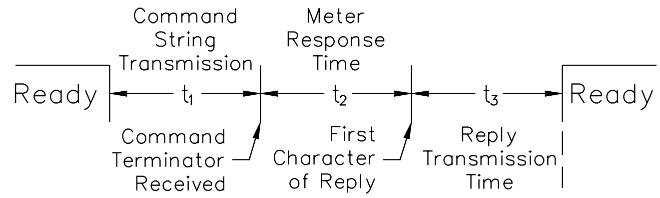
At the end of t_3, the meter is ready to receive the next command. The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

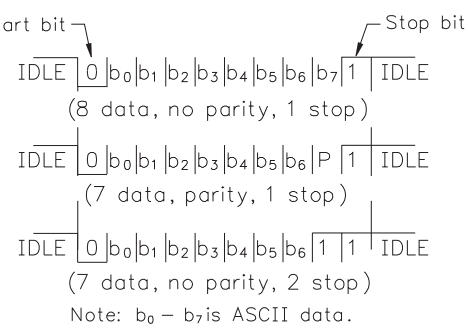
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

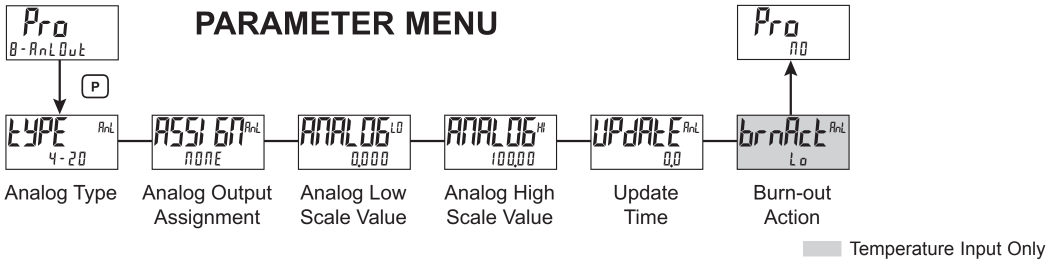
The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX meter.

MODULE 8 - ANALOG OUTPUT PARAMETERS (8-AnLOut)

PARAMETER MENU

This module is only accessible with the optional PAXCDL Analog card installed.

Programming information contained in this manual supercedes all programming information included with the PAXCDL card.



ANALOG OUTPUT TYPE

tYPE AnL 4-20 — 4-20 0-10 0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

ASSIGN AnL NONE — NONE rEL AbS totAL Hi Lo S1 S2 S3 S4

Enter the source for the analog output to retransmit:

NONE = Manual Mode operation. (See Module 7, Serial RLC Protocol).
rEL = Relative (net) Input Value. The Relative Input Value is the Absolute Input Value including the Display Offset Value.
AbS = Absolute (gross) Input Value. The Absolute Input Value is the scaled input value. It does not include the Display Offset Value.
totAL = Totalizer Value
Hi = Maximum Display Value
Lo = Minimum Display Value
S1-S4 = Setpoint Values

ANALOG LOW SCALE VALUE

ANALOG LO 0 — -199999 to 999999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

ANALOG HI 10000 — -199999 to 999999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

UPdAtE AnL 0.0 — 0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

The following programming step is only available when Input Range in Module 1 is set for a temperature input (TC/RTD).

PROBE BURN-OUT ACTION

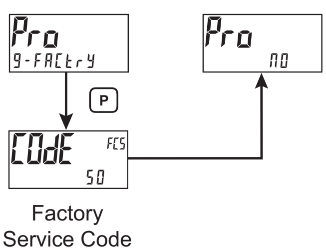
brnAct AnL Lo — Hi Lo

Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

E

MODULE 9 - FACTORY SERVICE OPERATIONS (9-FACtrY)

PARAMETER MENU



RESTORE FACTORY DEFAULTS

COdE FCS 66 — P — rESEt — COdE FCS 50

Use the F1 and F2 keys to display COdE 66 and press **P**. The meter will flash rESEt and then return to COdE 50. Press the **P** key to return to Display Mode. This will overwrite all user settings with the factory settings.

MODEL AND CODE VERSION

COdE FCS 51 — P — P2A FCS VEr x.xx — COdE FCS 50

The meter will briefly display the model (P2A) on Line 1, and the current firmware version (VEr x.xx) on Line 2, and then return to COdE 50.

CALIBRATION

COdE FCS 48 — P — CAL FCS NO — NO Curr VoLt OhMS tc ICE rtd AnLOut

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it will affect the accuracy of the input signal and the values previously stored using the Apply (APPLY) Scaling Style.

Preparation for Current, Volt, and Ohm Input Calibration

Warning: Input Calibration of this meter requires a signal source capable of producing a signal greater than or equal to the range being calibrated with an accuracy of 0.01% or better.

Before starting, verify that the Input Range, T/V, and Excitation Jumper is set for the range to be calibrated. Verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing the **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

Current, Volt and Ohm Calibration Procedure

1. After entering Code 48, in Module 9, select the input signal type (Curr, Volt, OhMS) to be calibrated.
2. Press the **P** key until the desired range along with ZER is indicated on Line 1 of the meter.
3. Apply the zero input limit of the range indicated on Line 1 of the meter.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with FUL on Line 1 of the meter.
7. Apply the signal level indicated on Line 1 of the meter.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Preparation for TC calibration

TC calibration parameters will affect RTD calibration. If using an RTD, it is recommended that the RTD calibration be performed after completing the TC calibration.

Warning: TC Input Calibration of this meter requires a signal source capable of producing a 60 mV signal with an accuracy of 0.01% or better.

Before starting, verify the T/V jumper is in the T position. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

TC Calibration Procedure

1. After entering Code 48, in Module 9, select the tc.
2. Press the **P** key. Display will indicate 0.060V with ZER in upper right.
3. Apply 0 mV to input.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate 0.060V with FUL in upper right.
7. Apply 60 mV to input.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. TC Calibration complete.

Preparation for RTD Input Calibration

RTD calibration is dependent on TC calibration parameters. Therefore, the TC calibration should be performed prior to attempting the RTD calibration.

Warning: RTD Input Calibration of this meter requires a signal source capable of producing a 300 ohm resistance with an accuracy of 0.01% or better.

Before starting, verify that the T/V Jumper is in the T position. Verify the RTD jumper is in the proper range. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

RTD Calibration Procedure

1. After entering Code 48, in Module 9, select rtd.
2. Press the **P** key until the desired range along with 0 in upper right corner is indicated on Line 1 of the meter.
3. Apply zero ohms to the input of the meter.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with a value in the upper right corner, in ohms, to be applied in the next step on Line 1 of the meter.
7. Apply the signal level, in ohms, indicated in the upper right corner of Line 1 on the meter.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Ice Point Calibration Procedure

1. Remove all option cards.
2. Verify ambient temperature of meter environment is between 20°C and 30°C.
3. Set T/V jumper in the T position.
4. Connect a thermocouple with an accuracy of 1°C or better to the meter.
5. In Module 1 of unit programming, verify Input Range (rANGE) is set to the type thermocouple connected in step 4, Temperature Scale (SCALE) is °C, Ice Point Compensation (ICE) is turned ON, Decimal Resolution (dECPNt) is 0.0, Rounding Increment (round) is 0.1 and Display Offset (OFFSEt) is set to 0.
6. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25% °C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
7. If a difference exits between PAX2A display and reference thermometer, continue calibration.
8. Note the PAX2A display reading as the "Display Mode" reading to be used in Step 12.
9. Enter Module 9, select Code 48 and press **P**.
10. Select ICE and press **P**.
11. Display will indicate the Existing ICE Point Value.
12. Calculate a new ICE Point Value using: Existing ICE Point Value + (reference temperature – Display Mode reading). All values are in °C.
13. Using F1 and F2 change Existing ICE Point Value to indicate the new ICE Point Value calculated in Step 12.
14. Press **P** and return to Display Mode. Verify the Display Mode reading (with 0 Display Offset) matches the reference temperature. If not, repeat steps 8 thru 14.

Preparation for Analog Output Card Calibration

Warning: Calibration of this meter requires an external meter with an accuracy of 0.005% or better.

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure.

1. After entering Code 48, in Module 9, select AnLOut.
2. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2A F1 and F2 keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if the particular range is not in need of calibration, press the **P** key to advance to the next range.

PAX2A DISPLAY	EXTERNAL METER	ACTION
0.000A	0.00 mA	F1 and F2 to adjust External Meter
0.004A	4.00 mA	F1 and F2 to adjust External Meter
0.020A	20.00 mA	F1 and F2 to adjust External Meter
0.0u	0.00 V	F1 and F2 to adjust External Meter
10.0u	10.00 V	F1 and F2 to adjust External Meter

3. Calibration Complete.

E

TROUBLESHOOTING

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections
No Display After Power-Up	Check Module 3: d-LEU, d-Cont, and LInE 1 program settings.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CODE 0 prompt.
No Line 1 Display	Check Module 3: LInE 1 program setting.
No Line 2 Display	Check Module 3: ACCESS program settings.
No Programmable Units Display	Check Module 3: UnItS Mnemonic program settings.
Incorrect Input Display Value	Check Input Jumper Setting, Input Level, and Input Connections.
	Verify Module 1 program settings.
	Contact factory
Display of OLOL, ULUL, Short, OPEN, or ". . . ."	See General Meter Specifications, Display Messages.
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: ErrKEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EE PAr Error Code: EE Pdn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ErrPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EE CAL	Calibration Data Validation Error. Contact factory.
Error Code: EE Lin	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

MODEL PAXH - AC TRUE RMS VOLT AND CURRENT

This is a brief overview of the PAXH. For complete specifications and programming information, see the **PAX Analog Input Panel Meters Bulletin** starting on **page 301**.

- *5-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *FOUR VOLTAGE RANGES (300 VAC Max)*
- *FIVE CURRENT RANGES (5 A Max)*
- *ACCEPTS AC OR DC COUPLED INPUTS*
- *THREE WAY ISOLATION: POWER, INPUT AND OUTPUTS*
- *FOUR SETPOINT ALARM OUTPUTS (w/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (w/OPTION CARD*

c UL US LISTED
IND. CONT. EQ.
51EB

CE

PAXH SPECIFICATIONS

INPUT RANGES:

Isolation To Option Card Commons and User Input Commons: 125 Vrms
Isolation To AC Power Terminals: 250 Vrms

INPUT RANGE	ACCURACY*	IMPEDANCE (60 Hz)	MAX CONTINUOUS OVERLOAD	MAX DC BLOCKING	RESOLUTION
200 mV	0.1% of reading +0.4 mV	686 Kohm	30 V	±10 V	0.01 mV
2 V	0.1% of reading +2 mV	686 Kohm	30 V	±50 V	0.1 mV
20 V	0.1% of reading +20 mV	686 Kohm	300 V	±300 V	1 mV
300 V	0.2% of reading +0.3 V	686 Kohm	300 V	±300 V***	0.1 V
200 µA	0.1% of reading +0.4 µA	1.11 Kohm	15 mA	±15 mA	0.01 µA
2 mA	0.1% of reading +2 µA	111 ohm	50 mA	±50 mA	0.1 µA
20 mA	0.1% of reading +20 µA	11.1 ohm	150 mA	±150 mA	1 µA
200 mA	0.1% of reading +0.2 mA	1.1 ohm	500 mA	±500 mA	10 µA
5 A	0.5% of reading +5 mA	0.02 ohm	7 A**	±7 A***	1 mA

*Conditions for accuracy specification:
- 20 minutes warmup
- 18-28°C temperature range, 10-75% RH non-condensing
- 50 Hz - 400 Hz sine wave input
- 1% to 100% of range
- Add 0.1% reading + 20 counts error over 0-50°C range
- Add 0.2% reading + 10 counts error for crest factors up to 3, add 1% reading up to 5
- Add 0.5% reading + 10 counts of DC component
- Add 1% reading + 20 counts error over 20 Hz to 10 KHz range

** Non-repetitive surge rating: 15 A for 5 seconds

*** Inputs are direct coupled to the input divider and shunts. Input signals with high DC component levels may reduce the usable range.

MAX CREST FACTOR (V_P/V_{RMS}): 5 @ Full Scale Input
INPUT COUPLING: AC or AC and DC
INPUT CAPACITANCE: 10 pF
COMMON MODE VOLTAGE: 125 VAC working
COMMON MODE REJECTION: (DC to 60 Hz) 100 dB

MODEL CUB4LP - LOOP POWERED PROCESS INDICATOR
MODEL CUB4CL - CURRENT LOOP INDICATOR

- *DUAL RANGE, 4 to 20 mA OR 10 to 50 mA*
- *3½-DIGIT, 0.6" (15.2 mm) HIGH DIGITS*
- *POSITIVE IMAGE TRANSFLECTIVE LCD WITH RED BACKLIGHT OR POSITIVE IMAGE REFLECTIVE LCD (CUB4LP)*
- *POSITIVE IMAGE TRANSFLECTIVE LCD WITH RED BACKLIGHT OR NEGATIVE IMAGE TRANSMISSIVE WITH RED OR YELLOW/ GREEN BACKLIGHT (CUB4CL)*
- *SPAN AND OFFSET CAPABILITY*
- *NEGATIVE AND OVERRANGE INDICATION*
- *SELECTABLE DECIMAL POINT POSITION*
- *NEMA 4X/IP65 SEALED FRONT PANEL BEZEL*
- *FITS DIN STANDARD CUT-OUT 2.68" (68 mm) X 1.30" (33 mm)*

LISTED 3S60 TELEMETERING EQUIPMENT

FOR USE IN HAZARDOUS LOCATIONS:
Class I, Division 2, Groups A, B, C, and D
Class II, Division 2, Groups F and G
Class III, Division 2

DESCRIPTION

The CUB4LP and CUB4CL are additions to the CUB4 product line. The CUB4LP uses a 4 to 20 mA or a 10 to 50 mA input signal as operating power. The input signal is also used to power the backlighting on the CUB4LP40 unit. The CUB4CL uses a 4 to 20 mA or a 10 to 50 mA input signal to power the unit. An external power supply is used to power the CUB4CL backlighting to provide a brighter, more consistent display and a lower compliance voltage.

The units have a 3½-digit LCD display with 0.6" (15.2 mm) high digits and a DIP switch selectable decimal point. The CUB4LP display is available in positive image reflective (dark digits, reflective background) or positive image transflective (dark digits, illuminated background) with red backlighting. The CUB4CL display is available in positive image transflective (dark digits, illuminated background) with red or yellow/green backlighting or negative image transmissive (illuminated digits, dark background) with red or yellow/ green backlighting.

The ability to scale the display allows indication in any desired unit of measurement such as temperature, pressure, humidity, fluid flow, etc. The unit is calibrated at the factory with 0.0 displayed @ 4 mA input and 100.0 displayed @ 20 mA input.

The units are contained in a lightweight, high impact plastic case with a clear viewing window. When properly installed, the sealed front panel meets NEMA 4X/IP65 specifications for wash-down and dusty environments.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

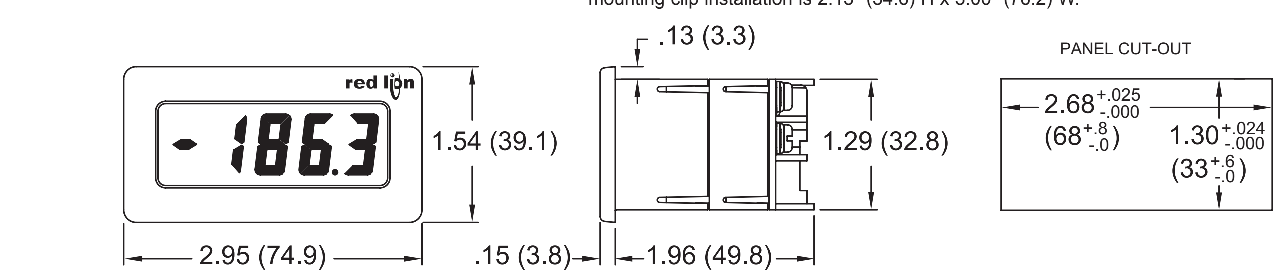
WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2 / CLASS II, DIVISION 2 / CLASS III, DIVISION 2

SPECIFICATIONS

1. **DISPLAY**: 3½-digit (-1999 to 1999), 0.6" (15.2 mm) high digits.
   The CUB4LP is available with a positive image reflective LCD or a red backlit positive image transflective LCD. The intensity of the backlighting will vary with the input signal.
   The CUB4CL is available with a positive image transflective LCD with red or yellow/green backlighting or a negative image transmissive with red or yellow/green backlight.
   A minus sign is displayed when the indicator is adjusted for a negative offset.
   Overrange: Overrange is indicated by a “1” in the most significant digit and the blanking of the three least significant digits.
2. **EXTERNAL BACKLIGHT POWER**: (CUB4CL only)
   9 - 28 VDC, @ 35 mA typ., 50 mA max. Power Supplies must be Class 2 (NEC) or SELV rated. Above 26 VDC, derate the operating temperature to 50°C.
3. **DECIMAL POINTS**: Three DIP switch selectable, decimal point positions allow the display to be read in tenths, hundredths or thousandths.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



SPECIFICATIONS (Cont'd)

4. **MAXIMUM VOLTAGE DROP**:
   3.2 VDC for CUB4LP00
   4.0 VDC for CUB4LP40
   3.2 VDC for CUB4CL all models
5. **EQUIVALENT RESISTANCE**:
   CUB4LP00: 800 Ω max. @ 4 mA; 160 Ω max. @ 20 mA
   320 Ω max. @ 10 mA; 65 Ω max. @ 50 mA
   CUB4LP40: 1000 Ω max. @ 4 mA; 200 Ω max. @ 20 mA
   400 Ω max. @ 10 mA; 80 Ω max. @ 50 mA
   CUB4CL (all models): 800 Ω max. @ 4 mA; 160 Ω max. @ 20 mA
   320 Ω max. @ 10 mA; 65 Ω max. @ 50 mA
6. **MAXIMUM ALLOWABLE INPUT CURRENT**: 100 mA
7. **SCALING RANGE**:
   Span: Two potentiometers provide a coarse and fine span adjustment. Span range = 0 to 2000.
   Offset: Two potentiometers provide a coarse and fine zero offset adjustment. Offset range = -1999 to 1999.
8. **LINEARITY**: (@ 23°C, Less than 85% RH) ±(0.1% + 1 digit).
9. **READING RATE**: 2.5 per second, nominal.
10. **RESPONSE TIME**: 1.5 seconds to settle for a step change.
11. **NORMAL MODE REJECTION**: 60 dB 50/60 Hz
12. **TEMPERATURE EFFECTS**:
    Span Temperature Coefficient: 100 PPM/°C
    Offset Temperature Coefficient: 0.2 digits/°C
13. **CONSTRUCTION**: High impact plastic case with clear viewing window. (Panel gasket and mounting clips included.) This unit is rated for NEMA 4X/IP65 indoor use. Installation Category I, Pollution Degree 2
14. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Listed, File #E184589, UL1604, CSA 22.2 No. 213-M1987
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Indoor Enclosure rating (Face only), UL50
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529

ELECTROMAGNETIC COMPATIBILITY

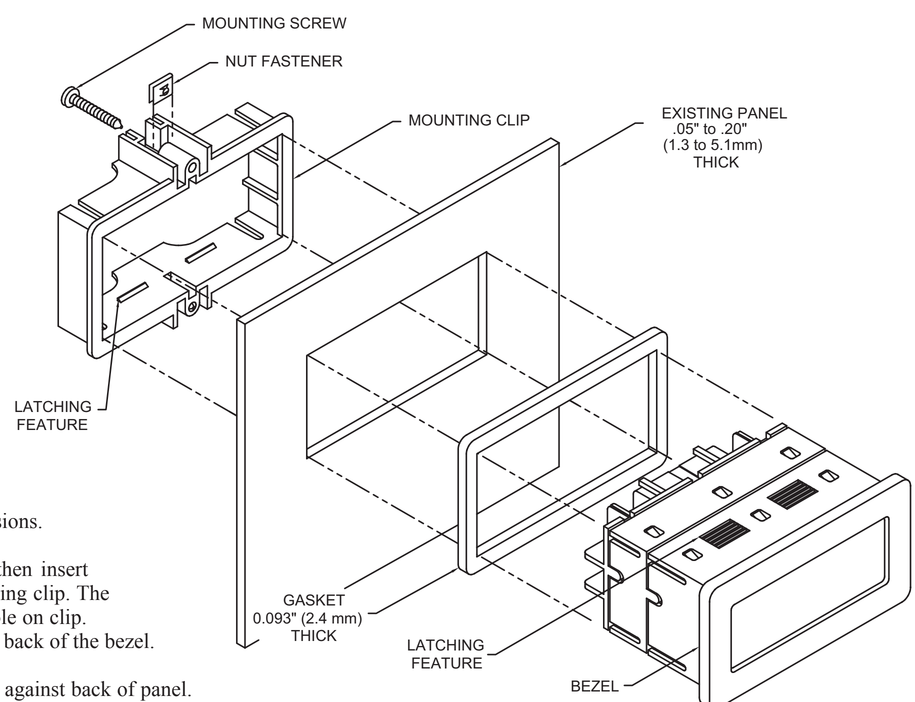
Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m[1] 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms[2] 150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Emissions to EN 50081-1		
RF interference	EN 55011	Enclosure class B Power mains class B

***Notes**:*
1. Self-recoverable loss of performance during EMI disturbance at 10 V/m: Process Signal may deviate during EMI disturbance.
For operation without loss of performance:
Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent) connected to earth ground.
2. Self-recoverable loss of performance during EMI disturbance at 10 Vrms. Process signal may deviate during EMI disturbance.
For operation without loss of performance:
Install 1 ferrite core, RLC #FCOR0000 or equivalent, to signal cable at the unit.
Refer to the EMC Installation Guidelines of this bulletin for additional information.

15. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature: 0° to 60°C
    (Derate backlight voltage to 26 VDC above 50°C.)
    Storage Temperature: -40° to 80°C
    Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 60°C.
    Vibration According to IEC 68-2-6: Operational 5 to 500 Hz, in X, Y, Z direction for 1.5 hours, 5g's.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Altitude: Up to 2000 meters
16. **WEIGHT**: 3.3 oz. (93.5 g)

INSTALLATION

When properly installed, the CUB4LP/CL meets NEMA 4X/IP65 requirements for indoor use. The units are intended to be mounted into an enclosed panel. A sponge rubber gasket, mounting clip, two screws, and nut fasteners are provided to install and seal the unit in the panel cutout.



Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

The following procedure assures proper installation:

1. Cut the panel opening to the specified dimensions. Remove burrs and clean the panel opening.
2. Slide nut fastener into slot on mounting clip and then insert mounting screw through nut on both sides of mounting clip. The tip of mounting screw should not project through hole on clip.
3. Slide the panel gasket over the rear of the unit to the back of the bezel. Install CUB4LP/CL unit through panel cutout.
4. Slide mounting clip over rear of unit until the clip is against back of panel. The mounting clip and CUB4LP/CL housing have a latching feature to hold the unit in place until tightened.

   Note: Hold the CUB4LP/CL front bezel in place when sliding the mounting clip into position.

5. Alternately tighten each mounting screw to ensure uniform gasket pressure. Visually inspect the gasket for proper seal. The gasket should be compressed to approximately 75 to 80% of its original thickness. (Recommended torque is 28 to 36 in-oz.)
6. If the gasket is not adequately compressed and the mounting screws cannot be tightened any further, loosen the mounting screws and insure that the clip is latched as closely as possible to the panel.
7. Repeat Step #6 for tightening the mounting screws.

EMC INSTALLATION GUIDELINES

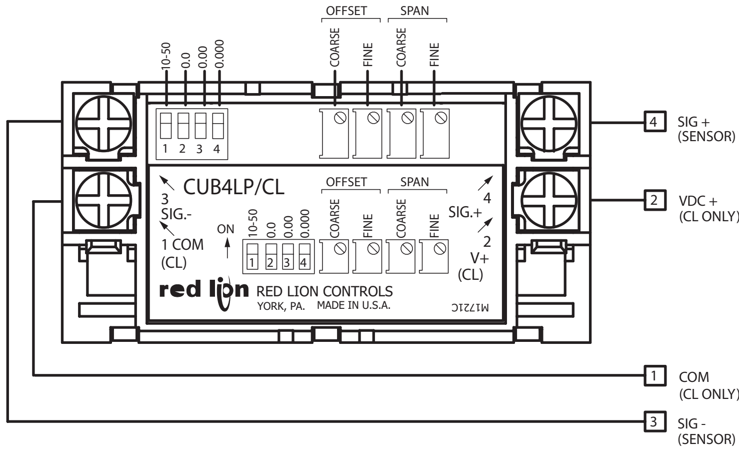
Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. Cable length, routing and shield termination are very important and can mean the difference between a successful installation or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: *Reference manufacturer's instructions when installing a line filter.*
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker.

The electrical connections are made via screw-clamp terminals located on the back of the unit. When wiring the unit, use the label to identify the wire position with the proper function. Strip the wire, leaving approximately ¼" of bare wire (stranded wires should be tinned with solder). Insert the wire into the screw-clamp terminal and tighten the screw until the wire is clamped tightly. Each terminal can accept up to two #14 AWG wires.



CUB4LP/CL SIGNAL INPUT

The current range is selected by setting DIP switch S1 to the OFF position for a 4 to 20 mA input or ON for a 10 to 50 mA input. Attach the signal wires to terminals 3 (SIG-) and 4 (SIG+) observing the correct polarity. The (SIG-) signal input circuit is not reverse polarity protected.

Backlight Power (CUB4CL only)

Attach a 9 to 28 VDC supply to terminals 1 (COM) and 2 (V+) to power the backlight. Terminals 3 (SIG-) and 1 (COM) are AC coupled with a capacitor. This limits the isolation between these terminals to 50 VDC maximum.

OFFSET ADJUSTMENTS

The minimum currents are not zero based with 4 to 20 mA and 10 to 50 mA signals. To obtain a zero minimum display reading, the display must be offset. The display on the CUB4LP/CL can be offset by adjusting the Coarse and Fine Offset pots.

SPAN ADJUSTMENTS

Span is defined as the numerical range that the display traverses, disregarding the decimal point, when the input signal is varied from minimum to maximum (4 to 20 mA or 10 to 50 mA). For example; if a unit is to display 250 @ 4 mA and 1000 @ 20 mA, the span is 750 (the difference between 250 and 1000). Had the minimum display been -250, the span would be 1250 (1000 - (-250) = 1250). The CUB4LP/CL can be set to operate over a wide span range by adjusting the Coarse and Fine Span adjustment pots. The Coarse Span pot is used to get the display to within a couple of counts of the desired reading, and the Fine Span pot is used to adjust for the exact reading.

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

THIS EQUIPMENT IS SUITABLE FOR USE IN:
Class I, Division 2, Groups A, B, C, and D
Class II, Division 2, Groups F and G
Class III, Division 2 or Non Hazardous locations.

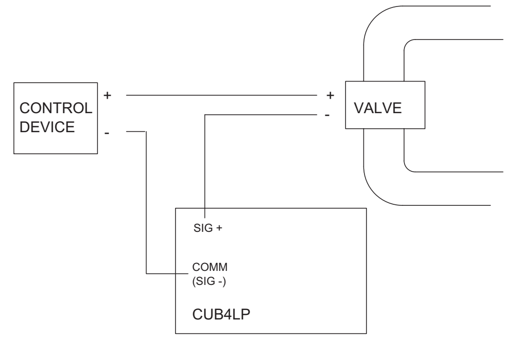
DECIMAL POINT POSITION SELECTION

The decimal point position is DIP switch selectable for one of three locations. The CUB4LP/CL can be set up to read in 10ths, 100ths, or 1000ths. If all the DIP switches are set to the "OFF" position, no decimal point will appear on the display. The DIP switches are located at the rear of the unit.

APPLICATION EXAMPLE

Operation of a refinery process required a local display of the position of a remote pipeline valve. The display would indicate 0 (zero) when the valve was fully closed with an input signal of 4 mA. When the valve was fully open the display would indicate 100 with an input signal of 20 mA.

Both the CUB4LP and the CUB4CL meet the necessary requirements.



E

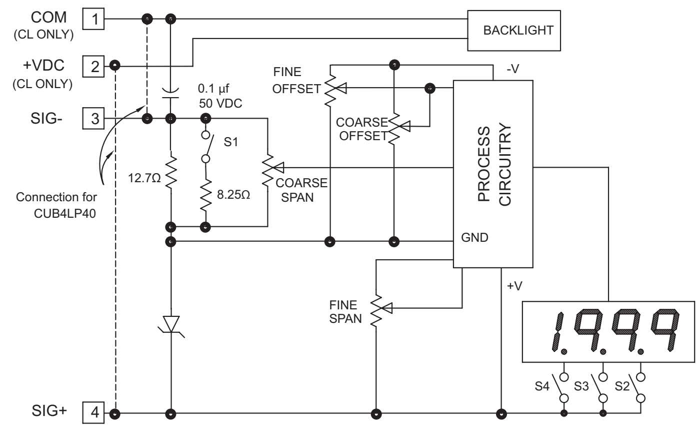
CALIBRATING THE DISPLAY

Calibrating the CUB4LP/CL requires either an accurate adjustable constant current supply or the CUB4LP/CL can be installed and scaled with the process sensor connected to the CUB4LP/CL. To calibrate the unit, proceed as follows.

1. Set DIP switching for the desired current range.
2. Select the desired decimal point position.
3. Apply the minimum input signal to the CUB4LP/CL and adjust the COARSE OFFSET to display the approximate desired minimum value.
4. Apply the maximum input signal to the CUB4LP/CL and adjust the COARSE SPAN to display the approximate desired maximum value.
5. Repeat steps 3 and 4 until the minimum and maximum values are within the desired values.
6. Apply the minimum input signal to the CUB4LP/CL and adjust the FINE OFFSET to display the exact desired minimum value.
7. Apply the maximum input signal to the CUB4LP/CL and adjust the FINE SPAN to display the exact desired maximum value.
8. Apply the minimum input signal and verify that the display indicates correctly.
9. Apply the maximum input signal and verify that the display indicates correctly.
10. Repeat Steps 6 through 9 until display reads exact.

Note: The CUB4LP/CL display is factory calibrated to indicate 0.0 to 100.0 with an input of 4 to 20 mA at approximately 25°C.

BLOCK DIAGRAM



TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CUB4LP	Reflective LCD Loop Powered Process Indicator	CUB4LP00
	Red Backlit LCD Loop Powered Process Indicator Positive Image Transflective LCD	*CUB4LP40
CUB4CL	Yel/Grn Backlit LCD External Powered Process Indicator Negative Image Transmissive LCD	CUB4CL10
	Red Backlit LCD External Powered Process Indicator Negative Image Transmissive LCD	CUB4CL20
	Yel/Grn Backlit LCD External Powered Process Indicator Positive Image Transflective LCD	CUB4CL30
	Red Backlit LCD External Powered Process Indicator Positive Image Transflective LCD	CUB4CL40
MLPS	Micro Line/Sensor Power Supply (Non-hazardous use only)	MLPS1000

*Backlight intensity will vary depending on signal level.

MODEL CUB5P - MINIATURE ELECTRONIC 5-DIGIT PROCESS METER

c UL us LISTED
IND. CONT. EQ.
51EB

- *THREE SELECTABLE D.C. RANGES*
  0 to 10 V, 0(4) to 20 mA, 0 to 50 mA
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR RED/GREEN LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATION CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

GENERAL DESCRIPTION

The CUB5 Series provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5 accepts a DC voltage or current input signal and provides a display in the desired unit of measure. The meter also features minimum and maximum display capture, display offset, units indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective or red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. The setpoint output cards are field installable with programmable setpoints. Serial communications capability for RS232 or RS485 can be added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

INPUT

The CUB5P is a DC Process meter. It features voltage and current input ranges, that are selected by the user via a programming jumper and software input range selection. The ranges consist of the following: 0 to 10 V, 0(4) to 20 mA, or 0 to 50 mA. Users should select the appropriate voltage range that covers their maximum input.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

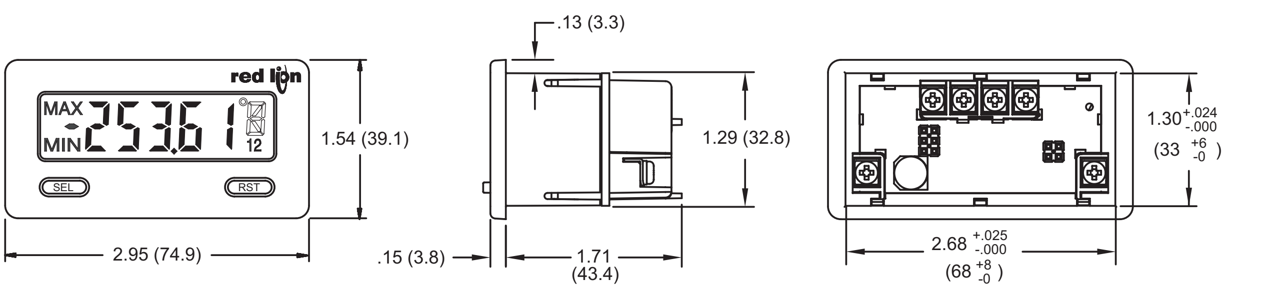
CAUTION: Risk of Danger.
Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

E

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



Ordering Information

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5P	Process Meter with Reflective Display	CUB5PR00
		Process Meter with Backlight Display	CUB5PB00
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output Card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson PC Configuration Software, Free Download Available[1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net. System requirements for the software are listed on the download page.

General Meter Specifications

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5PR00: Reflective LCD with full viewing angle
   CUB5PB00: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5PR00	---	10 mA	40 mA
CUB5PB00	Red (max intensity)	85 mA	115 mA
CUB5PB00	Green (max intensity)	95 mA	125 mA

3. **INPUT RANGES**: Jumper Selectable
   0 to 10 V, 0(4) to 20 mA, 0 to 50 mA
4. **SENSOR INPUTS:**

INPUT RANGE	ACCURACY @23 °C, less than 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
20 / 50 mA	0.1% of span	10 Ω	150 mA	1 µA	70 ppm / °C
10 VDC	0.1% of span	538 KΩ	30 V	1 mV	70 ppm / °C

5. **OVERRANGE RATINGS, PROTECTION & INDICATION:**
   9 to 28 VDC power circuit is not isolated from the signal circuit.
   Input Overrange Indication: "OLOL".
   Input Underrange Indication: "ULUL".
   Display Overrange/Underrange Indication: "….."/"-….."
6. **RESPONSE TIME**:
   Display: 500 msec min.
   Output: 800 msec max (with input filter setting of 0)
7. **NORMAL MODE REJECTION**: 60 dB 50/60 Hz
8. **USER INPUT (USR)**: Programmable input. Connect USR terminal to USR COMM to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
9. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
10. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
11. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5PR00: -35 to 75 °C
    Operating Temperature Range for CUB5PB00 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75 °C
	3	-35 to 70 °C
	4	-35 to 60 °C
	5	-35 to 50 °C
Green Display	1 & 2	-35 to 75 °C
	3	-35 to 65 °C
	4	-35 to 50 °C
	5	-35 to 35 °C

    Storage Temperature: -35 to 85 °C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
12. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission EN 55011 Class A
    IEC/EN 61010-1
    UL Recognized Component: File #E179259
    UL Listed: File #E137808
    Type 4X Enclosure rating (Face only)
    IP65 Enclosure rating (Face only)
    IP20 Enclosure rating (Rear of unit)
    Refer to EMC Installation Guidelines section of the bulletin for additional information.
13. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
14. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

Note: *Measurement errors may occur if signal input common is shared with another circuit common (ie, serial common, Dual Sinking Output option card, or Power Supply common) on multiple units.*

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

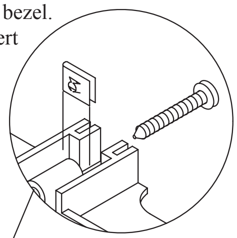
1.0 Installing the Meter

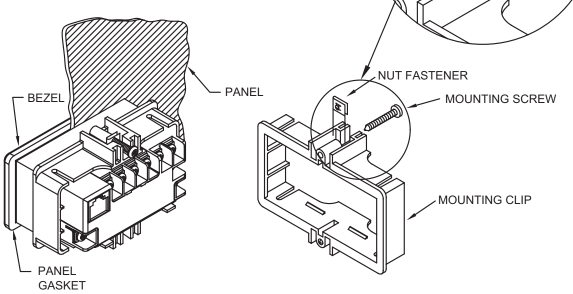
INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel.

The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.





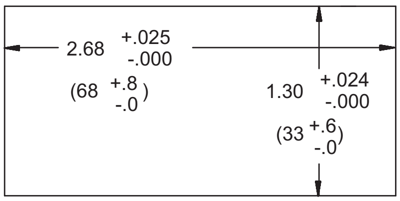
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

E



2.0 Setting the Jumpers

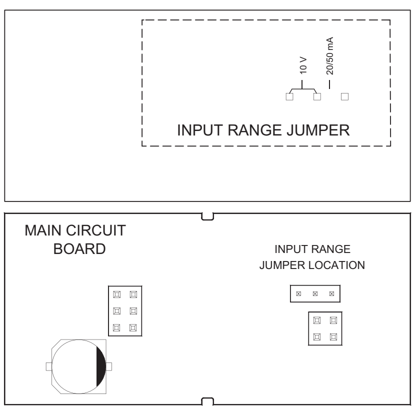
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum input signal to avoid overloads. To access the jumper, remove the rear cover of the meter.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

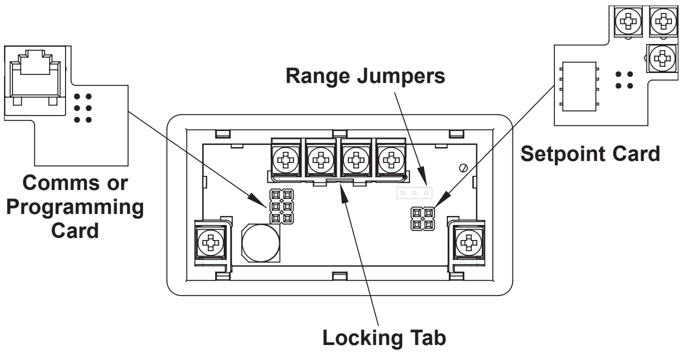
REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.



3.0 INSTALLING PLUG-IN CARDS

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter



CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place**.**

4.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN2010-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

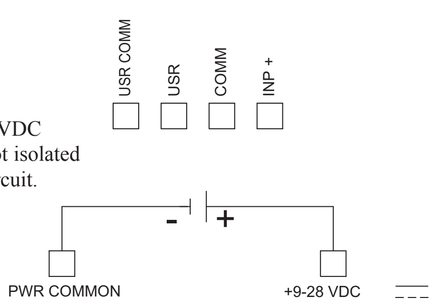
E

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

CAUTION: 9 to 28 VDC power circuit is not isolated from the signal circuit.

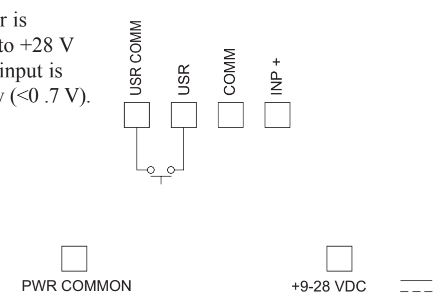


4.2 USER INPUT WIRING

Sinking Logic

USR COMM } Connect external switching device between the
USR } User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).

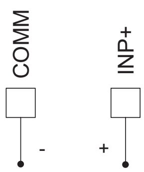


4.3 INPUT WIRING

CAUTION: Power input common is NOT isolated from user and input commons. In order to preserve the safety of the meter application, the power input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the signal or user inputs and input common terminals. Appropriate considerations must then be given to the potential of the user and input commons with respect to earth ground; and the common of the plug-in cards with respect to input common.

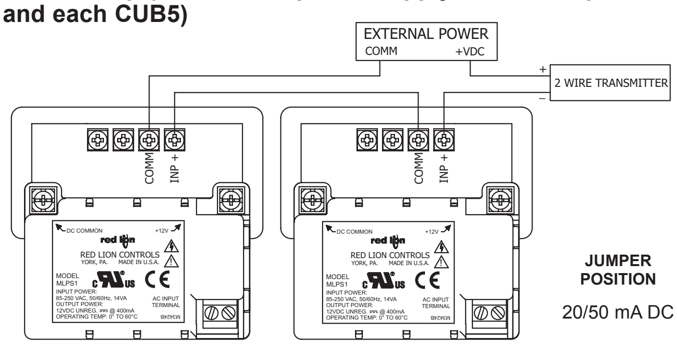
Before connecting signal wires, the Input Range Jumper should be verified for proper position.

Input Signal (self powered)



JUMPER POSITION	MAX SIGNAL INPUT
10 VDC	30 VDC
20/50 mA DC	150 mA

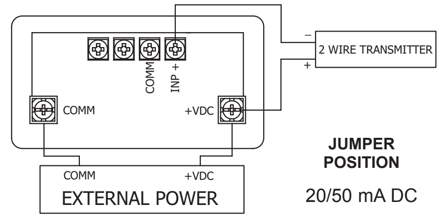
Series Loop (must use separate supply for sensor power and each CUB5)



JUMPER POSITION

20/50 mA DC

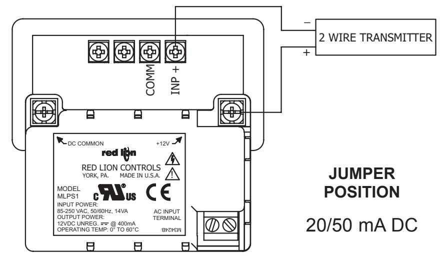
2 Wire With External Power



JUMPER POSITION

20/50 mA DC

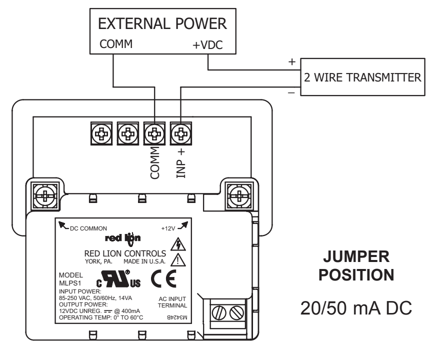
2 Wire With MLPS Power



JUMPER POSITION

20/50 mA DC

2 Wire With Separate Sensor And CUB5 Power

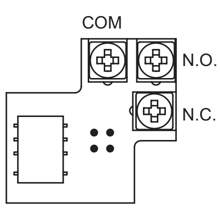


JUMPER POSITION

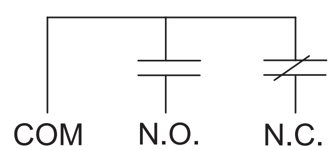
20/50 mA DC

4.4 SETPOINT (OUTPUT) WIRING

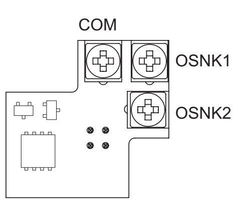
SINGLE SETPOINT RELAY PLUG-IN CARD



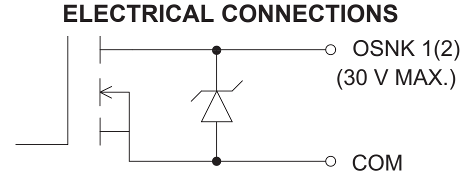
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



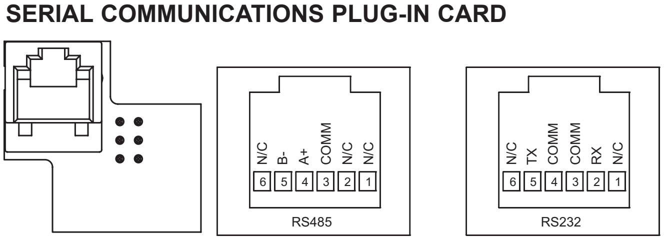
ELECTRICAL CONNECTIONS



Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

4.5 SERIAL COMMUNICATION WIRING

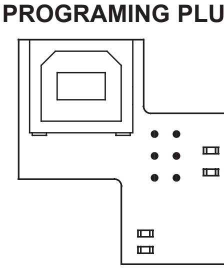
SERIAL COMMUNICATIONS PLUG-IN CARD



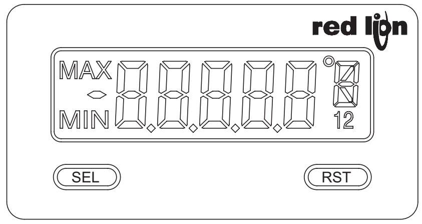
RJ11 CONNECTOR PIN OUTS

4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



5.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN/MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

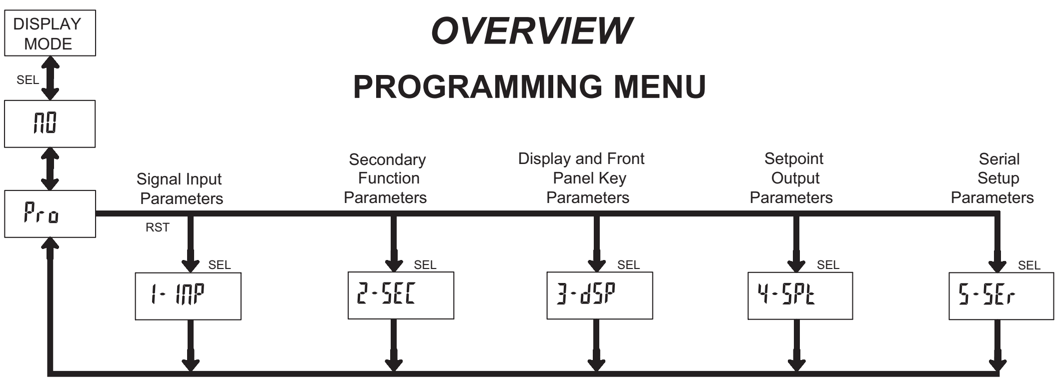
“1” - To the right of the display indicates setpoint 1 output activated.
“2” - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



E

PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

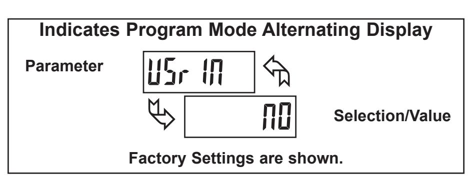
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

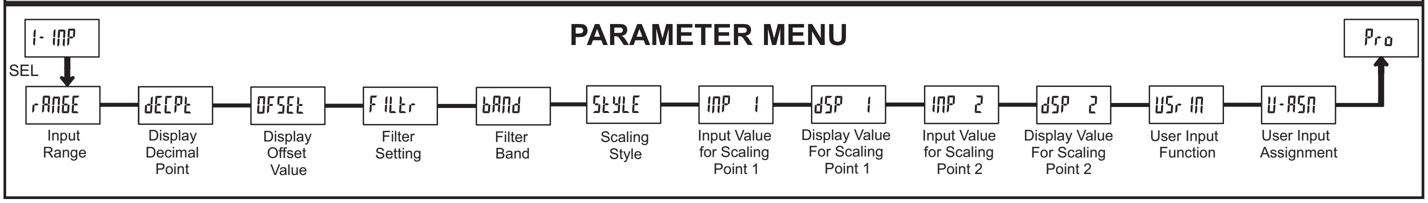
Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter’s Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)



CUB5P INPUT RANGE

rANGE
10u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
		0.02A	20.000 mA
10u	10.000 V	0.05A	50.000 mA

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt
0.000

0   0.0   0.00   0.000   0.0000

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dSP1 and dSP2 parameters and setpoint values.

DISPLAY OFFSET VALUE

OFSEt
0.000

-19999 to 19999

The display can be corrected with an offset value. This can be used to compensate for signal variations or sensor errors. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the effects of offset.

FILTER SETTING

FILtr
1

0 1 2 3

If the displayed value is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bANd
10

0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

SCALING STYLE

StYLE
KEY

KEY   APLY

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INP 1
0.000

0 to 59999

For Key-in (KEY) style, enter the known first Input Value using the front panel buttons. (The Input Range selection sets the decimal location for the Input Value).

For Apply (APLY) style, the meter shows the previously stored Input Value. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 1

dSP 1
0.000

-19999 to 99999

Enter the first Display Value using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

INP 2
10.000

0 to 59999

For Key-in (KEY) style, enter the known second Input Value using the front panel buttons.

For Apply (APLY) style, the meter shows the previously stored Input Value for Scaling Point 2. To retain this value, press the **SEL** button to advance to the next parameter. To change the Input Value, press the **RST** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2
10.000

-19999 to 99999

Enter the second Display Value using the front panel buttons. This is the same for KEY and APLY scaling styles.

General Notes on Scaling

1. When using the Apply (APLY) scaling style, input values for scaling points must be confined to signal limits of the selected range.
2. The same Input Value should not correspond to more than one Display Value. (Example: 10 V can not equal 0 and 10.)
3. For input levels beyond the programmed Input Values, the meter extends the Display Value by calculating the slope from the two coordinate pairs (INP1 / dSP1 & INP2 / dSP2).

E

USER INPUT FUNCTION

USr IN
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
ZErO	Zero Input (Edge triggered)	Zero the Input Display value causing Display Reading to be Offset.
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Pr int	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN
dSP

HI　　HI-LO
LO　　dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → SEL → HI-En — HI-t — LO-En — LO-t — FCS — CodE → Pro

HI-En	HI-t	LO-En	LO-t	FCS	CodE
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations

MAX DISPLAY ENABLE

HI-En
NO

NO　　YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
NO

NO　　YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS
NO

NO　　YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **SEL** button to exit the module.

VIEW VERSION DISPLAY

CodE
50

Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **SEL** button to exit the module.

CALIBRATION

CodE
48

The CUB5P uses stored calibration values to provide accurate voltage and current measurements. Over time, the electrical characteristics of the components inside the meter could slowly change, therefore the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5P involves a voltage or current calibration, which should only be performed by individuals experienced in calibrating electronic equipment. Allow a 30 minute warm up for eqiupment and unit before performing any calibration related procedures. The following procedures should be performed at an ambient temperature of 15 to 35°C (59 to 95°F).

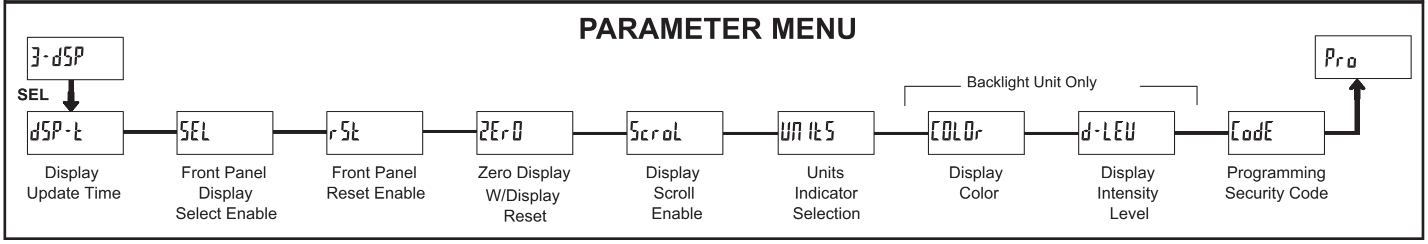
CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5P.

Calibration

1. Connect the negative lead of a precision DC source with an accuracy of 0.01% or better to the COMM. Leave the positive lead of the DC source unconnected.
2. With the display at CodE 48, press and hold the **SEL** button for 2 seconds. Unit will display CAL NO.
3. Press the **RST** button to select the range to be calibrated.
4. Press the **SEL** button. Display reads 0.0A (0.0 U for voltage).
5. Apply 0 signal:
   Current: leave the positive lead of the DC source unconnected.
   Voltage: apply a short to the input or connect the positive lead of the DC source to INP+ and set the source to 0.
   Press **SEL**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range (10 V, 20 mA, or 50 mA), connect the positive lead of the DC source to INP+ and apply the full scale input signal for the range. Press **SEL**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL NO, press the **SEL** button to exit calibration.

E

6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)



DISPLAY UPDATE TIME

dSP-t
1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

NO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

ZERO DISPLAY WITH DISPLAY RESET

ZErO
NO

YES NO

This parameter enables the **RST** button or user input to zero the input display value, causing the display reading to be offset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.

DISPLAY SCROLL ENABLE

ScroL
NO

YES NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS INDICATOR SELECTION

UNItS
OFF

OFF LISt SEGS

This parameter activates the Units Indicator on the display. There are two methods of selecting the Indicator. List will present a group of Units preprogrammed into the meter. Segments allows the user to choose which of the segments should light.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr
rEd

rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

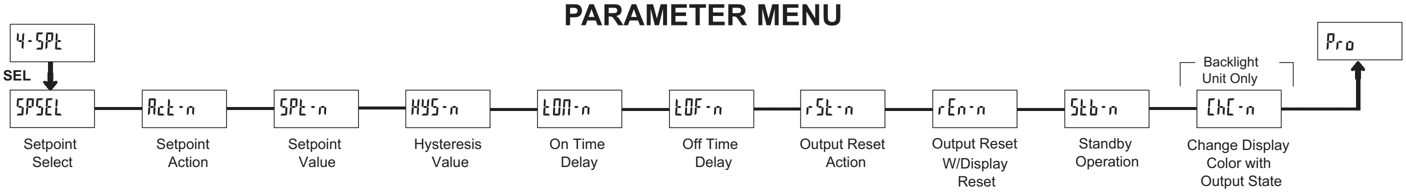
USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

E

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL — nO

nO   SP-1   SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select nO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2 — nO

YES   nO

Select YES to enable Setpoint 2 and access the setup parameters. If nO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

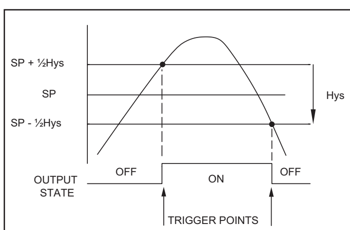
SETPOINT ACTION

Act-n — HI-Ub

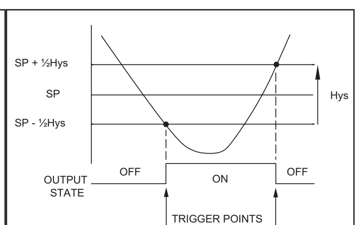
HI-bL   LO-bL   HI-Ub   LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

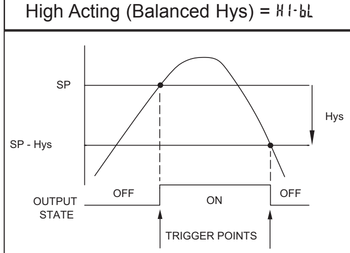
HI-bL = High Acting, with balanced hysteresis
LO-bL = Low Acting, with balanced hysteresis
HI-Ub = High Acting, with unbalanced hysteresis
LO-Ub = Low Acting, with unbalanced hysteresis



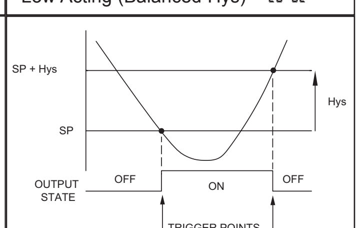
High Acting (Balanced Hys) = HI-bL



Low Acting (Balanced Hys) = LO-bL



High Acting (Unbalanced Hys) = HI-Ub



Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n — 10000

-19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n — 2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n — 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n — 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n — Auto

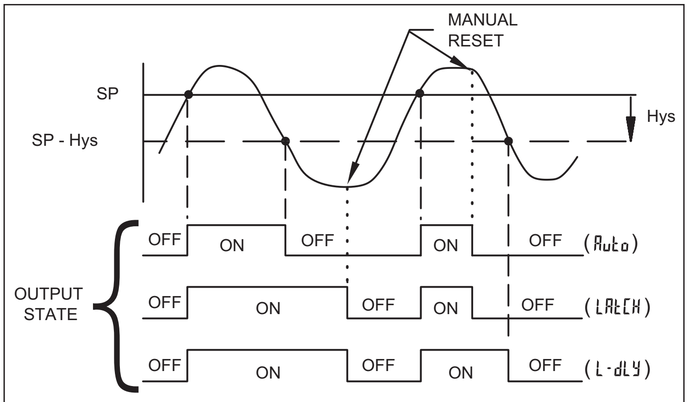
Auto   LAtCH   L-dLY

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding “on” output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding “on” output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n YES

NO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n NO

NO YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset action.

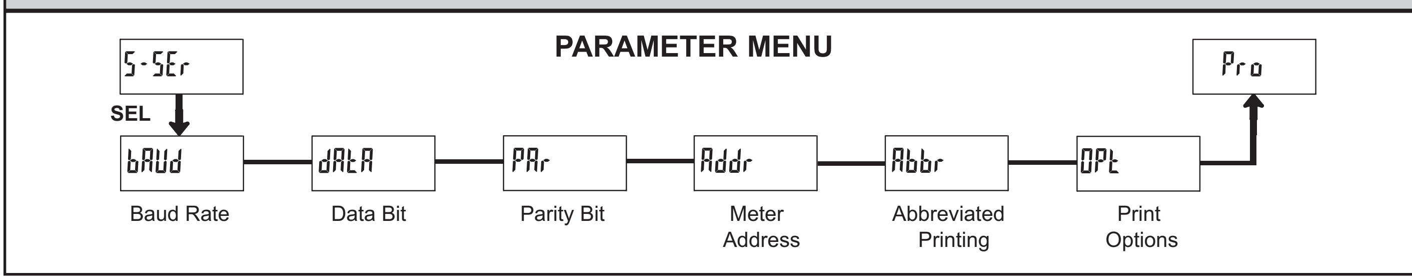
CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n NO

NO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

E

MODEL PAXLCL - PAX LITE CURRENT LOOP METER

- *DUAL RANGE, 4 to 20 mA or 10 to 50 mA **
- *3 1/2-DIGIT, 0.56" (14.2 mm) HIGH RED LED READOUT*
- *24 VDC EXCITATION SUPPLY*
- *WIDE SPAN & OFFSET SCALING RANGE*
- *OVER-RANGE INDICATION*
- *SELECTABLE DECIMAL POINTS*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*

* Also adapts to 0 to 50, 0 to 20, 0 to 10, 1 to 5 mA ranges as well as bi-polar inputs.

C UL US LISTED
IND. CONT. EQ.
51EB

E

GENERAL DESCRIPTION

The premium features of the PAX Lite Series can now be applied to measurement of process variables. With its high sensitivity and programmability, the PAX Lite Current Loop Meter can be set up for a wide variety of applications. In most plants the PAXLCL can be used for 90 to 95% of current loop meter needs for readout of pressure, flow, temperature, level and other variables. The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution. This allows the PAXLCL to be used in dirty, hostile environments and in wash-down areas. The 3 1/2-digit bi-polar display (minus sign displayed when current or voltage is negative) features 0.56" (14.2 mm) high, 7-segment LEDs for easy reading.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

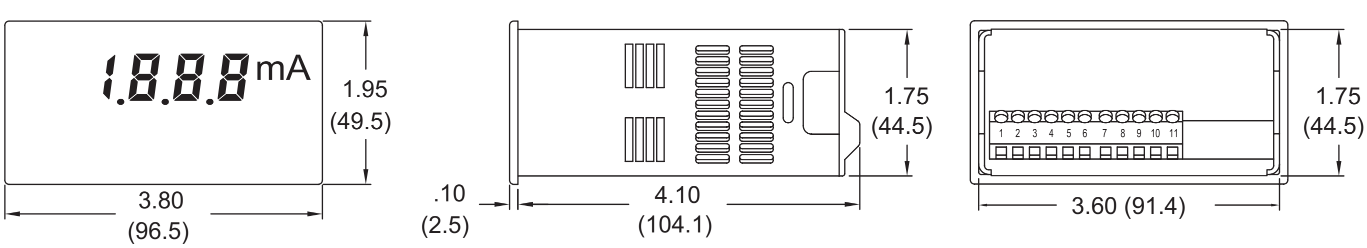


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	CL	0	0

CL - Current Loop Meter

E

Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

General Meter Specifications

1. **DISPLAY**: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED, (-) minus sign displayed when current or voltage is negative. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **OVER-RANGE INDICATION**: Indicated by blanking 3 least significant digits.
3. **POWER**:
   AC Power: 85 to 250 VAC, 50/60 HZ, 6 VA
   Isolation: 2300 Vrms for 1 min. between input and supply (300 V working voltage).
4. **INPUT SENSITIVITY**: (Numerical Readout Change/mA)
   260 units/mA @ 4 to 20 mA input
   105 units/mA @ 10 to 50 mA input
   (max. allowable input current, 170 mA)
5. **COMPLIANCE**: Voltage drop across input at max. signal current, less than 600 mV for both 4 to 20 and 10 to 50 mA ranges.
6. **INPUT RESISTANCE**:
   4 to 20 mA - 29.2 Ω
   10 to 50 mA - 11.8 Ω
7. **SCALING RANGE**:
   SPAN: 32 coarse steps *(binary progression with 5 DIP switches)* Each step providing approx. 8.125 numerical units/mA/step sensitivity for 4 to 20 mA input and 3.25 units/mA/step for 10 to 50 mA input.
   OFFSET: 16 coarse steps *(binary progression with 4 DIP switches)* with ± switch to add or subtract offset. Each step adds or subtracts approximately 175 from the numerical display for a total offset range of ±2700.
8. **LINEARITY**: ±(0.05% ±1 digit)
9. **READING RATE**: 2.5 updated readings/second, nominal.
10. **RESPONSE TIME**: 1 second to settle for step change.
11. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 63 dB @ 50/60 Hz
    Common Mode Rejection: 100 dB, DC to 50/60 Hz
12. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature: 0° to 60°C
    Storage Temperature: -40° to 80°C
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
    Span Temperature Coeff.: 100 PPM/°C
    Offset Temperature Coeff.: 100 PPM/°C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
    Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
    Altitude: Up to 2000 meters
13. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    IP20 Enclosure rating (Rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

14. **EXCITATION SUPPLY**: 24 VDC @ 50 mA max. Regulated and isolated.
15. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
16. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
17. **WEIGHT**: 0.65 lbs (0.24 kg)

Accessories

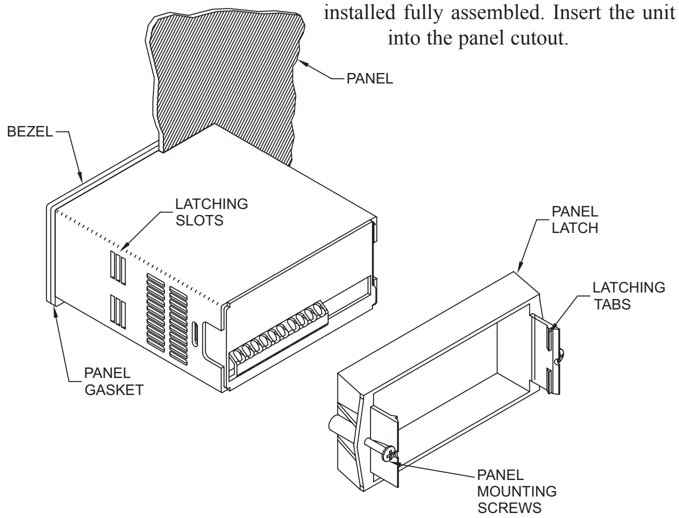
UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit (PAXLBK30). The backlight is controlled by a DIP switch.

1.0 INSTALLING THE METER

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

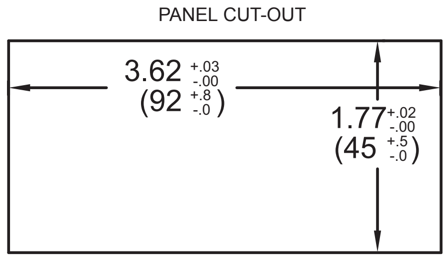


While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.



2.0 SETTING THE SWITCHES

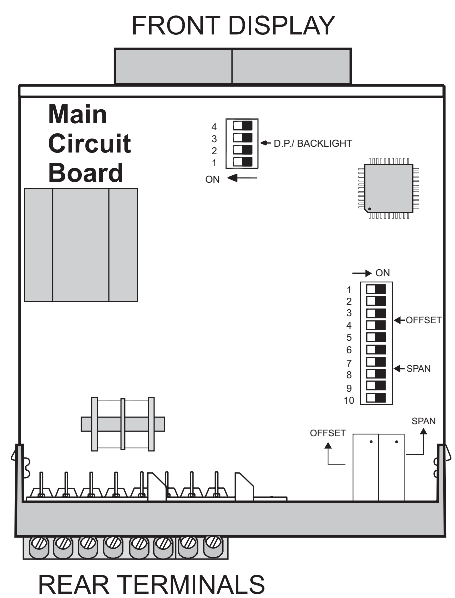
The meter has switches, which must be checked and/or changed prior to applying power. To access the switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Set-Up DIP Switches

Two banks of DIP switches are located inside the meter. The 10 position bank of switches are used for calibrating the meter. The values of these switches are discussed in section 5.0 Calibrating the Meter.

The bank of 4 switches located near the front display are used for the selection of decimal points and backlight annunciator. Selecting “ON” position enables the function.

SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label



E

3.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter’s voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

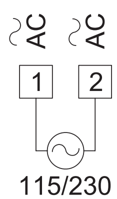
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

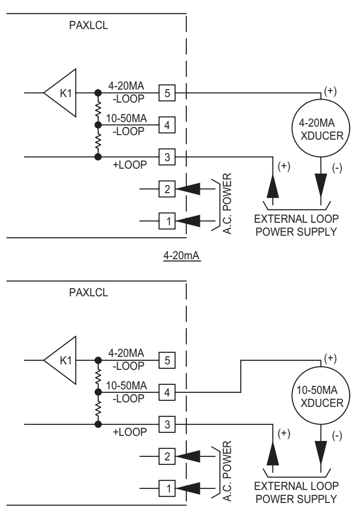
3.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC

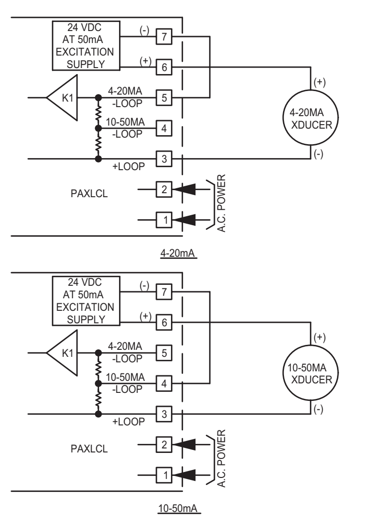


3.2 INPUT SIGNAL WIRING

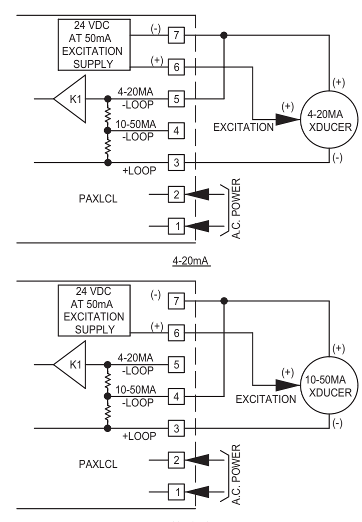
2-WIRE, EXTERNAL EXCITATION



2-WIRE, WITH EXCITATION (Series Conn.)



2-WIRE, WITH EXCITATION (Parallel Conn.)

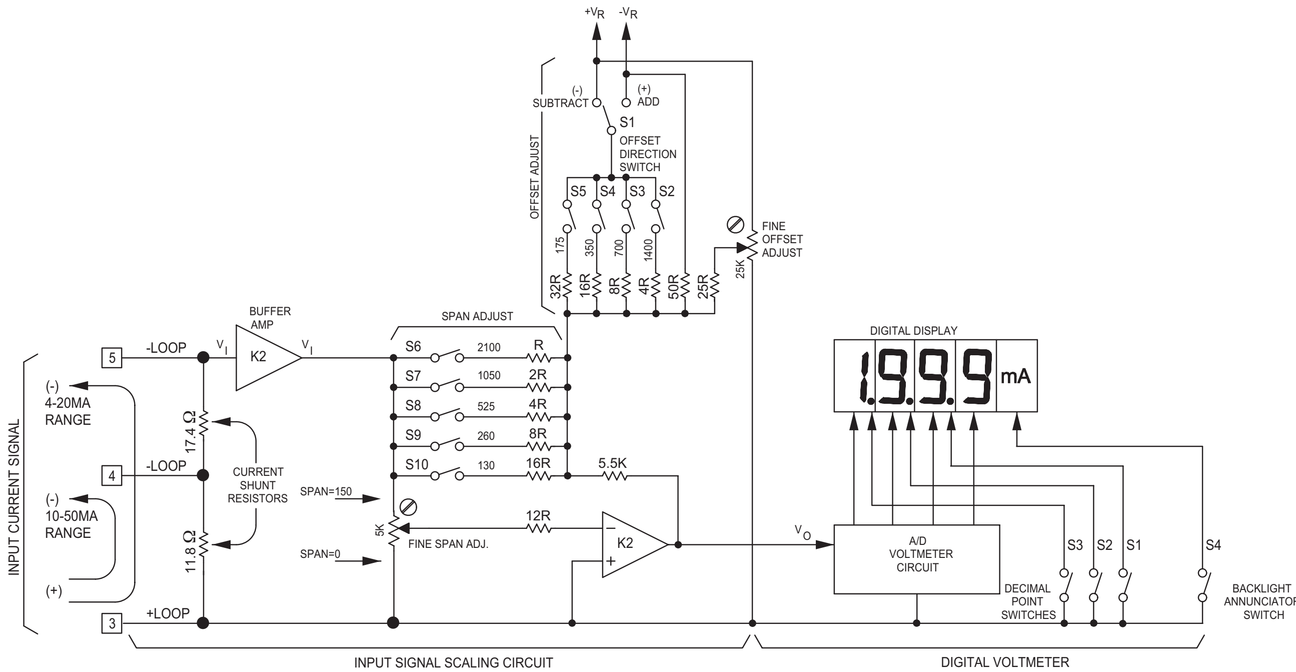


NOTES

1. When shielded wire leads are used, connect the shield to earth ground at the meter and insulate the other end to avoid contact with machine ground.
2. Never run signal leads in conduit, bundles, or race ways with power conductors. Avoid runs close to contactors, relays, solenoids, transformers, and other potential sources of electrical noise.

4.0 SCALING THE METER

PAXLCL SCHEMATIC

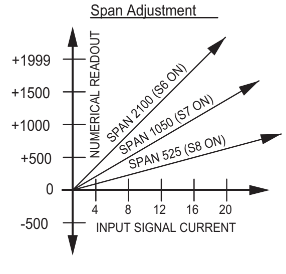


DESCRIPTION OF OPERATION

The PAX Lite Current Loop Meter consists of a digital volt meter combined with an analog scaling circuit (shown above). The unit was designed primarily for use with 4-20 mA and 10-50 mA current loop signal circuits. However, it can also be adapted to other current ranges, such as 0-50 mA, 0-20 mA, 0-10 mA, and in a great many applications it can be used even with 0-5 mA and 1-5 mA current loops. In addition, input current can be reversed in polarity resulting in negative numerical readout with a minus (-) sign displayed. Input terminals 3 and 4 are connected in series with 10-50 mA current loops, and Terminal 3 and 5 are series connected with 4-20 mA loops. In either case, the voltage drop generated across the shunt resistor(s) ranges from approximately 0.12 V min. (@ 4 or 10 mA) to 0.59 V max. (@ 20 or 50 mA). The buffer amplifier (K1) conditions and filters the input signal voltage and applies it to the input of the scaling circuit. The procedure for scaling PAX Lite Current Loop Meters is simplified by dividing the scaling process into two separate components, span adjustments and offset adjustments which are defined in the following discussion.

SPAN ADJUSTMENTS

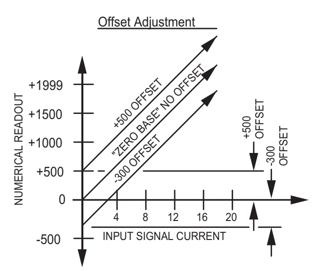
Span is defined as the numerical range that the display traverses, disregarding decimal points, when the input signal current is varied from minimum (4 or 10 mA) to maximum (20 or 50 mA). For example, if a unit is to display 25.0 @ 4 mA and 100.0 @ 20 mA, the span is 750 (the difference between 250 and 1000). Had the minimum display been -25.0 @ 4 mA and +100.0 @ 20 mA, the span would be 1250 (1000 - (-250) = 1250). (Note: the terms "GAIN", "SCALE", and "SENSITIVITY" are also frequently used interchangeably with the term "SPAN.") The PAX Lite Current Loop Meter can be set up over a very wide span range by means of the coarse DIP switches S6-S10, and the fine screwdriver adjustment pot, located at the back cover. The coarse span switches add parallel input resistors to the summing amplifier (K2), thereby increasing its gain, or sensitivity, as more summing resistors are added. Effectively, adding more parallel input resistors, increases the slope of the transfer curve (at right) and increases the numerical readout for a given input signal current change. The input summing resistor values are weighted in a binary progression, so they can be switched in combinations to give 32 discrete steps of span. The fine adjust control brackets these coarse steps and can be adjusted to the exact span needed.



The approximate span contributed by each switch is shown on the rear label. These values are based on the standard current-loop spans of 4 to 20 mA (16 mA current variation) and 10-50 mA (40 mA current variation). In other words, if S7 only is turned "ON", the numerical readout will display a change approximately 1050 for a current swing of 16 mA (4-20 mA input) or 40 mA (10-50 mA input). If S8 were also turned "ON", the numerical readout would swing approximately 1575 (1050 for S7 + 525 for S8) for the same signal current variation. The fine control has a continuous span range of approximately 0-150.

OFFSET ADJUSTMENTS

In the foregoing discussion of span, the transfer curves were shown as "ZERO-BASED", i.e., the numerical readout displays "0" when the signal current goes to zero. With current loop ranges such as 0-5 or 0-10, or 0-20 mA, and with Bi-Polar (+/-) signals, this is often the desired condition. However, with 4-20 and 10-50 mA current loops, the minimum current level of 4 or 10 mA usually represents the zero level of the parameter being displayed. There are also many applications where the minimum (or zero level) represents some value that does not fall on a zero based transfer curve. To accommodate non-zero based applications, the PAX Lite Current Loop Meter has provisions for offsetting the transfer curve over a wide range. Essentially, offset moves the transfer curve up or down to change its intercept with the numerical readout axis, but it does not change the slope (SPAN) of the transfer curve. In the PAX Lite Current Loop Meter, offset is accomplished by adding (or subtracting) a constant at the input of the summing amplifier (K2). This offset constant is summed in with a switched binary resistor network and a fine adjust offset control in a similar manner to that used for span adjustment. Switches S2-S5 can be turned on in combinations to give 16 different coarse offset levels. Each switch is labeled to show the approximate amount of offset contributed when it is turned "ON". Switch 1 selects the polarity of the switched-in offset value and allows offsetting the transfer curve "UP" (adding the offset constant) or "DOWN" (subtracting). The fine offset control has a numerical readout range of ±100 and brackets all the coarse switched ranges.



5.0 Calibrating the Meter

Direct calibration in the signal loop is usually not practical due to the difficulty in varying the measured parameter and the confusing interaction that occurs between span and offset adjustments. However, the PAXLCL can be quickly and easily bench calibrated using a commercially available current calibrator or the calibration set-up shown below.

CALIBRATION PROCEDURE

The procedure outlined below minimizes span/offset interaction and simplifies calibration. In Steps 1 to 4 the unit is "nulled" to zero readout with zero input signal current. In Steps 5 and 6, the span adjustments are made to establish the required slope of the transfer curve. Then in Step 7, the transfer curve is shifted up or down as required by setting the offset adjustments. In Step 8, the final "tweaking" adjustments are made at minimum and maximum signal current. Setting the decimal points in Step 9 completes the calibration.

Before calibrating, the READOUT SPAN (Rs) and SWING CURRENT (Is) must be determined.

WHERE:

Rs = (Max. Numerical Display) - (Min. Numerical Display)   (Disregard Decimal Points)
Is = (Current @ Max. Display) - (Current @ Min. Display)

Example:

Readout is to be 0.00 @ 4 mA and 10.00 @ 20 mA.
READOUT SPAN (Rs) = 1000 - 0 = 1000
SWING CURRENT (Is) = 20 mA - 4 mA = 16

CALIBRATION STEPS

1. Power down the meter and remove it from its case. Turn off all offset and span adjustment switches (S2-S10 down). S1 has no effect when zeroing and can be in either position.
2. Turn the span control pot fully counter-clockwise (20 turns max.).
3. Turn on a combination of span adjust switches (6-10) to obtain a total value closest to (but not greater than) the READOUT SPAN (Rs) desired (1000 in this example). The following chart gives an approximate span adjustment value for each switch:

SWITCH NUMBER	SPAN VALUE
6	2100
7	1050
8	525
9	260
10	130

4. Place unit in its case and apply power. Apply zero current. Adjust the indicator to read zero using the offset adjustment pot.
5. Apply the SWING CURRENT (Is) (16 mA in the example) to the input. Set the exact READOUT SPAN value (1000) with span adj.pot.
6. Apply zero current to see if the zero value has shifted. If it has, re-zero with the offset pot, then repeat Step 5.
7. After the span has been adjusted, set the signal current to the minimum level (4 mA in the example). Record the meter reading (in this example the reading will be 250). Subtract the desired reading at minimum current value (0 in the example) from the recorded reading (0-250 = - 250). Power down the meter and remove it from its case. Set the offset add/subtract switch S1 (subtract = on), and the offset switches (S2-S5) to obtain a total value closest to (but no more than) the difference between the desired reading at minimum current value and the observed reading The following chart gives an approximate offset adjustment value for each switch:

SWITCH NUMBER	OFFSET VALUE
2	1400
3	700
4	350
5	175

   Place the meter in its case and apply power. Using the offset adjust pot, adjust the readout to equal the desired reading at the minimum current value (0 in the example).
8. Adjust the input signal current to its maximum value to see if the proper readout is obtained (1000 @ 20 mA in the example). If the readout is slightly off, adjust the span pot to obtain the true reading. Then, recheck the reading at the minimum input current (4 mA) and readjust the offset pot if necessary. Repeat the maximum and minimum readout adjustments until the unit displays the proper readout at both extremes.
9. Set decimal points as desired using the three decimal point switches. The unit can now be installed.

TROUBLESHOOTING

For further assistance, contact technical support at the appropriate company numbers listed.

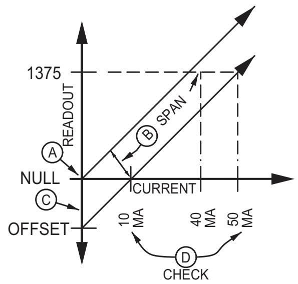
6.0 Applications

Example 1:

A PAXLCL is to be calibrated to match a flow transducer whose output is 10 mA @ 0 GPM and 50 mA @ 1375 GPM.

READOUT SPAN (Rs) = 1375 – 0 = 1375
SWING CURRENT (Is) = 50 mA – 10 mA = 40 mA

ADJUSTMENTS (Refer to the transfer curve below)



Ⓐ Null the unit to zero readout @ 0 current per Steps 1 to 4 of the calibration steps.

Ⓑ Set the coarse and fine span adjustments to get a readout of 1375 @ 40 mA per Steps 5 and 6. *Note: With the full standard swing of 40 mA, the coarse span switch reference markings can be used to determine settings as follows:*

S7 ON (1050) + S9 ON (260) = 1310 Span set with switches.
375 (needed) - 1310 (with SW's) = 65 w. fine span adj.

Ⓒ Set offset to readout 0 @ 10 mA per Step 7. *Note: The read out observed when the 10 mA min. current is first applied can be used to determine the offset switch settings.)* In this example the readout will be *(+)* 344 when the 10 mA min. current is first applied. Applying -344 offset then reduces the readout to zero @ 10 mA.

Ⓓ Check readout at max. *(50 mA)* and min. *(10 mA)* and fine tune *(tweak)* as required per Step 8.

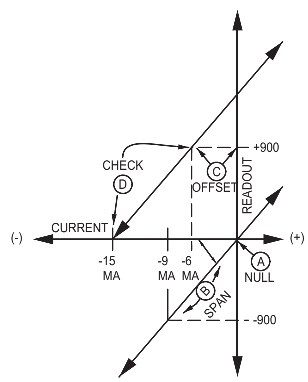
Example 2 (Negative Slope):

A level measuring device puts out 6 mA when a storage tank is full and 15 mA when the tank is empty. The PAXLCL is to readout 90.0 tons at full tank and zero when empty.

READOUT SPAN (Rs) = 900 – 0 = 900 (Disregard Decimal Points)
SWING CURRENT (Is) = 6 mA (@ max rdg) - 15 mA (@ min rdg) = -9 mA

In this case, the signal current is reverse [Term 3 *(-)* with respect to Term 5 *(+)*] causing the readout to go *"down" (increasingly negative)* as the negative current increases.

ADJUSTMENTS



Ⓐ Null the unit per Steps 1 to 4.

Ⓑ Set slope of transfer curve with span adjustments to get readout of -900 @ -9 mA per Steps 5 and 6.

Ⓒ Move transfer curve up by applying *(+)* offset per Step 7 until readout is +900 @ -6 mA.

Ⓓ Check extreme readings per Step 8, 0 readout @ -15 mA and +900 readout @ -6 mA. Set D.P. Switch S1 and replace unit in case.

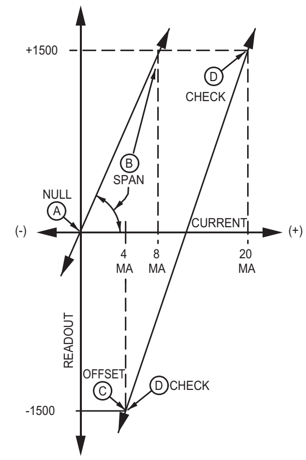
Example 3 (± Display):

A differential pressure transducer has a range of ±1500 PSI with a 4 to 20 mA output *(-1500 @ 4 mA, +1500 @ 20 mA)*.

READOUT SPAN (Rs) = +1500 –(–1500) = 3000
SWING CURRENT (Is) = 20 mA(max) - 4 mA(min) = 16 mA

Note: Since the display readout is limited to 1999 numerical indication, the full READOUT SPAN of 3000 cannot be obtained during zero based span adjustment. However, dividing both the READOUT SPAN and SWING CURRENT by two, i.e. 1500 readout @ 8 mA, allows the span adjustment to be made for the proper transfer curve slope.

ADJUSTMENTS



Ⓐ Null the unit per Steps 1 to 4.

Ⓑ Set transfer curve slope with span adjustments per Steps 5 and 6, to get a readout of +1500 @ 8 mA.

Ⓒ Apply (-) offset per Step 7 to get a reading of -1500 @ 4 mA.

Ⓓ Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 8.

MODEL PAXLPV - PAX LITE PROCESS VOLT METER

- *WIDE SPAN & OFFSET SCALING RANGE*
- *3 1/2-DIGIT, 0.56" (14.2 mm) HIGH RED LED READOUT*
- *24 VDC EXCITATION SUPPLY*
- *OVER-RANGE INDICATION*
- *SELECTABLE DECIMAL POINTS*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*
- *±25 VOLT DC MAXIMUM INPUT*

C UL US LISTED
IND. CONT. EQ.
51EB

E

GENERAL DESCRIPTION

The premium features of the PAX Lite Series can now be applied to measurement of process variables. With its high sensitivity and programmability, the PAX Lite Process Volt Meter can be set up for a wide variety of applications. In most plants the PAXLPV can be used for 90 to 95% of Process Volt meter needs for readout of pressure, flow, temperature, level and other variables. The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution. This allows the PAXLPV to be used in dirty, hostile environments and in wash-down areas. The 3½-digit bi-polar display (minus sign displayed when voltage is negative) features 0.56" (14.2 mm) high, 7-segment LEDs for easy reading.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

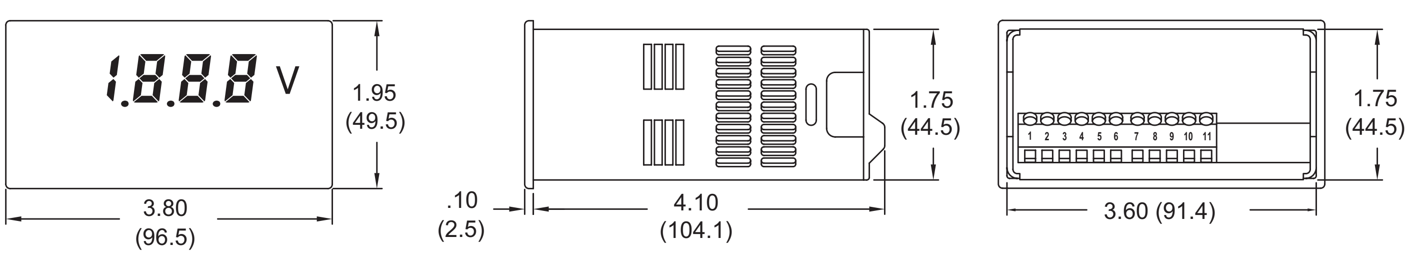


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

PAXL	**PV**	**0**	**0**

PV - Process Volt Meter

Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED, (-) minus sign displayed when current or voltage is negative. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **OVER-RANGE INDICATION**: Indicated by blanking 3 least significant digits.
3. **POWER**:
   AC Power: 85 to 250 VAC, 50/60 HZ, 6 VA
   Isolation: 2300 Vrms for 1 min. to all inputs.
4. **INPUT SENSITIVITY**: (Numerical Readout Change/Volt) Adjustable from 40 units/volt to 1000 units/volt. Max. allowable input voltage, ±25 volts DC.
5. **INPUT RESISTANCE**: 1 M Ω
6. **SCALING RANGE**:
   SPAN: 32 coarse steps *(binary progression with 5 DIP switches)* Each step providing approx. 40 numerical units/volt/step sensitivity. Fine adjust brackets the coarse step increments.
   OFFSET: 16 coarse steps *(binary progression with 4 DIP switches)* with ± switch to add or subtract offset. Each step adds or subtracts approximately 175 from the numerical display for a total offset range of ±2700. Fine control brackets the steps.
7. **LINEARITY**: ±(0.05% ±1 digit)
8. **READING RATE**: 2.5 updated readings / second, nominal.
9. **RESPONSE TIME**: 1 second to settle for step change.
10. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 63 dB @ 50/60 Hz
    Common Mode Rejection: 100 dB, DC to 50/60 Hz
11. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature: 0° to 60°C
    Storage Temperature: -40° to 80°C
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
    Span Temperature Coeff.: 100 PPM/°C
    Offset Temperature Coeff.: 100 PPM/°C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Altitude: Up to 2000 meters
12. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 1010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    IP20 Enclosure rating (Rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

13. **EXCITATION SUPPLY**: 24 VDC @ 50 mA max. Regulated and isolated.
14. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
15. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel Gasket and mounting clip included.
16. **WEIGHT**: 0.65 lbs (0.24 kg)

E

ACCESSORIES

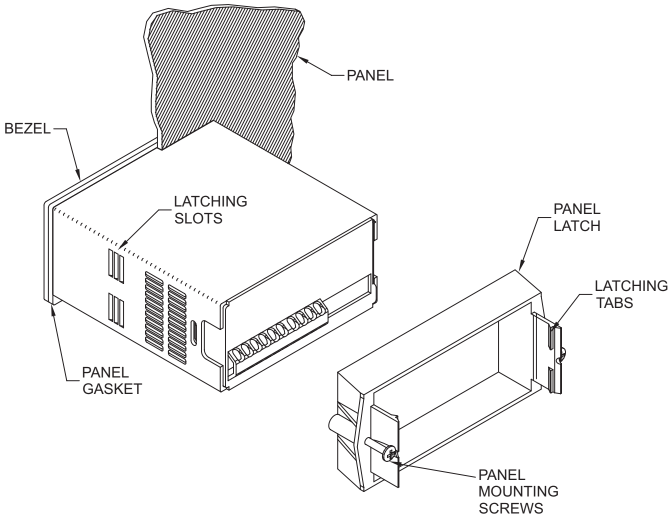
UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit (PAXLBK30). The backlight is controlled by a DIP switch.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



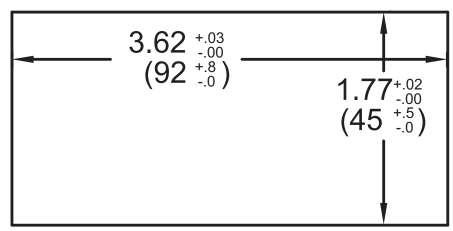
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

PANEL CUT-OUT



2.0 Setting the Switches

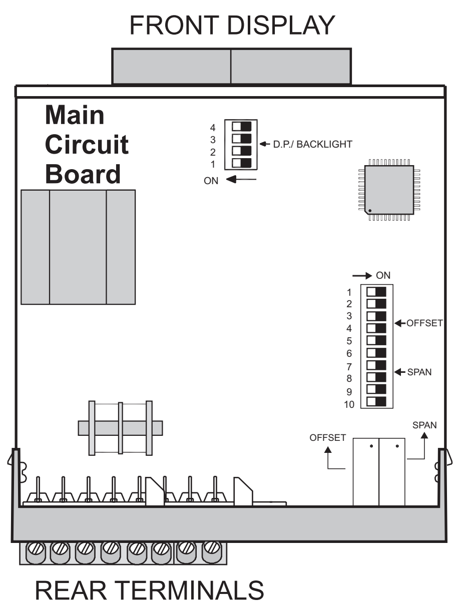
The meter has switches that must be checked and/or changed prior to applying power. To access the switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Set-Up DIP Switches

Two banks of DIP switches are located inside the meter. The 10 position bank of switches are used for calibrating the meter. The values of these switches are discussed in section 5.0 Calibrating the Meter.

The bank of 4 switches located near the front display are used for the selection of decimal points and backlight annunciator. Selecting "ON" position enables the function.

SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

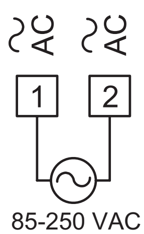
Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   - Ferrite Suppression Cores for signal and control cables:
     - Fair-Rite # 0443167251 (RLC #FCOR0000)
     - TDK # ZCAT3035-1330A
     - Steward #28B2029-0A0
   - Line Filters for input power cables:
     - Schaffner # FN610-1/07 (RLC #LFIL0000)
     - Schaffner # FN670-1.8/07
     - Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

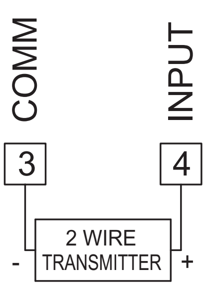
3.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC

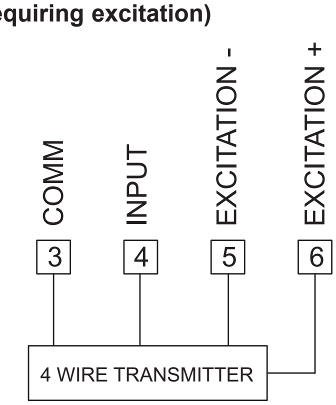


3.1 INPUT WIRING

Voltage Signal (2 wire)
Terminal 3: COMM
Terminal 4: INPUT

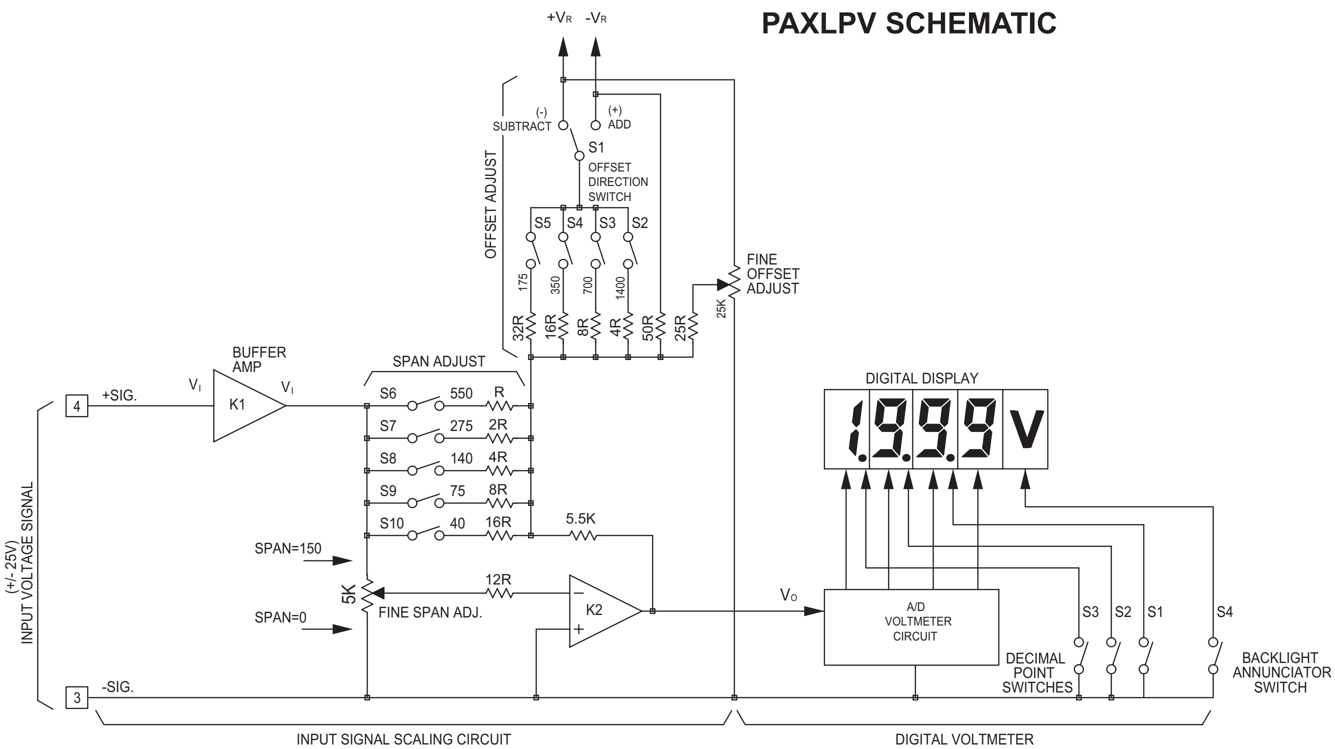


Voltage Signal (4 wire requiring excitation)
Terminal 3: COMM
Terminal 4: INPUT
Terminal 5: EXCITATION -
Terminal 6: EXCITATION +



4.0 Scaling the Meter

PAXLPV SCHEMATIC



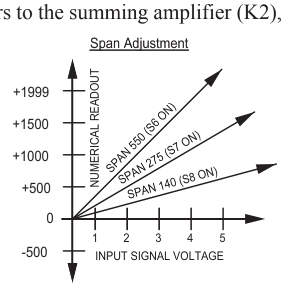
DESCRIPTION OF OPERATION

The PAX Lite Process Volt Meter consists of a digital volt meter combined with an analog scaling circuit (shown above). Input voltage can be reversed in polarity resulting in negative numerical readout with a minus (-) sign displayed. Input terminals 3 and 4 are connected to the signal voltage. The buffer amplifier (K1) conditions and filters the input signal voltage and applies it to the input of the scaling circuit. The procedure for scaling PAX Lite Process Volt Meters is simplified by dividing the scaling process into two separate components, span adjustments and offset adjustments which are defined in the following discussion.

E

SPAN ADJUSTMENTS

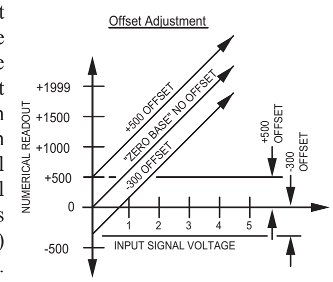
Span is defined as the numerical range that the display traverses, disregarding decimal points, when the input signal is varied from minimum to maximum. For example, if a unit is to display 25.0 @ 1 V and 100.0 @ 5 V, the span is 750 *(the difference between 250 and 1000)*. Had the minimum display been -25.0 @ 1 V and +100.0 @ 5 V, the span would be 1250 (1000 - (-250) = 1250). *(Note: the terms "GAIN," "SCALE," and "SENSITIVITY" are also frequently used interchangeably with the term "SPAN.")* The PAX Lite Process Volt Meter can be set up over a very wide span range by means of the coarse DIP switches S6-S10, and the fine screwdriver adjustment pot, located at the back cover. The coarse span switches add parallel input resistors to the summing amplifier (K2), thereby increasing its gain, or sensitivity, as more summing resistors are added. Effectively, adding more parallel input resistors increases the slope of the transfer curve (at right) and increases the numerical readout for a given input signal change. The input summing resistor values are weighted in a binary progression, so they can be switched in combinations to give 32 discrete steps of span. The fine adjust control brackets these coarse steps and can be adjusted to the exact span needed.



The approximate span contributed by each switch is shown on the rear label. The values shown are "units per volt." For example, if S6 only is turned "ON," the numerical readout will change approximately 550 units for a signal voltage change of 1 volt. If S7 were also turned "ON," the numerical readout would change approximately 825 units for a signal voltage change of 1 volt. The span adjust pot has a continuous span range of approximately 0- 45.

OFFSET ADJUSTMENTS

Effectively, adding more parallel input resistors increases the slope of the transfer curve (at right) and increases the numerical readout for a given input signal change. In the foregoing discussion of span, the transfer curves were shown as "ZERO-BASED," i.e., the numerical readout displays "0" when the signal goes to zero. With voltage ranges such as 0-5 V or 0-10 V, and with Bi-Polar (+/-) signals this is often the desired condition. However, with voltage ranges such as 1-5 V or 1-10 V, the minimum voltage level usually represents the zero level of the parameter being displayed. There are also many applications where the minimum (or zero level) represents some value that does not fall on a zero based transfer curve. To accommodate non-zero based applications, the PAX Lite Process Volt Meter has provisions for offsetting the transfer curve over a wide range. Essentially, offset moves the transfer curve up or down to change its intercept with the numerical readout axis, but it does not change the slope (SPAN) of the transfer curve. In the PAX Lite Process Volt Meter, offset is accomplished by adding (or subtracting) a constant at the input of the summing amplifier (K2). This offset constant is summed in with a switched binary resistor network and a fine adjust offset control in a similar manner to that used for span adjust. Switches S2-S5 can be turned on in combinations to give 16 different coarse offset levels. Each switch is labeled to show the approximate amount of offset contributed when it is turned "ON." Switch 1 selects the polarity of the switched-in offset value and allows offsetting the transfer curve "UP" (adding the offset constant) or "DOWN" (subtracting). The offset adjust pot has a numerical readout range of +/-100 and brackets all the coarse switched ranges.



5.0 CALIBRATING THE METER

Direct calibration in the signal loop is usually not practical due to the difficulty in varying the measured parameter and the confusing interaction that occurs between span and offset adjustments. However, the PAXLPV can be quickly and easily bench calibrated using a commercially available calibrator.

CALIBRATION PROCEDURE

The procedure outlined in the calibration steps below, minimizes span/offset interaction and simplifies calibration. In Steps 1 to 4 the unit is "nulled" to zero readout with zero input signal voltage. In Steps 5 and 6, the span adjustments are made to establish the required slope of the transfer curve. Then in Step 7, the transfer curve is shifted up or down as required by setting the offset adjustments. In Step 8, the final "tweaking" adjustments are made at minimum and maximum signal voltage. Setting the decimal points in Step 9 completes the calibration. Before calibrating, the READOUT SPAN (Rs), SWING VOLTAGE (Vs), and SPAN PER VOLT (Rs/Vs) must be determined.

WHERE:

Rs = (Max. Numerical Display) - (Min. Numerical Display) (Disregard Decimal Points)
Vs = (Voltage @ Max. Display) - (Voltage @ Min. Display)
Rs/Vs = $\frac{\text{READOUT SPAN (Rs)}}{\text{SWING VOLTAGE (Vs)}}$

Example:

Readout is to be 0.00 @ 1 V and 10.00 @ 5 V.
READOUT SPAN (Rs) = 1000 - 0 = 1000
SWING VOLTAGE (Vs) = 5 V - 1 V = 4 V
SPAN PER VOLT (Rs/Vs) = 1000 / 4 V = 250

CALIBRATION STEPS

1. Power down the meter and remove it from its case. Turn off all offset and span adjustment switches (S2-S10 down). S1 has no effect when zeroing and can be in either position.
2. Turn the span control pot. fully counter-clockwise (20 turns max.).
3. Turn on a combination of span adjust switches (6-10) to obtain a total value closest to (but not greater than) the SPAN PER VOLT desired (250 in this example). The following chart gives an approximate span adjustment value for each switch:

SWITCH NUMBER	SPAN VALUE
6	550
7	275
8	140
9	75
10	40

4. Place unit in its case and apply power. Apply zero volts. Adjust the indicator to read zero using the offset adjustment pot.
5. Apply the SWING VOLTAGE (Vs) (4 V in this example) to the input. Set the exact READOUT SPAN value (1000) with span adj. pot.
6. Apply zero volts to see if the zero value has shifted. If it has, re-zero with the offset pot, then repeat Step 5.
7. After the span has been adjusted, set the signal voltage to the minimum level (1 V in the example). Record the meter reading (in this example the reading will be 250). Subtract the desired reading at minimum voltage value (0 in the example) from the recorded reading (0-250 = - 250). Power down the meter and remove it from its case. Set the offset add/subtract switch S1 (subtract = on), and the offset switches (S2-S5) to obtain a total value closest to (but no more than) the difference between the desired reading at minimum voltage value and the observed reading. The following chart gives an approximate offset adjustment value for each switch:

SWITCH NUMBER	OFFSET VALUE
2	1400
3	700
4	350
5	175

   Place the meter in its case and apply power. Using the offset adjust pot, adjust the readout to equal the minimum voltage value (0 in the example).
8. Adjust the input signal voltage to its maximum value to see if the proper readout is obtained (1000 @ 5 V in the example). If the readout is slightly off, adjust the span pot to obtain the true reading. Then, recheck the reading at the minimum input voltage (1 V) and readjust the offset pot if necessary. Repeat the maximum and minimum readout adjustments until the unit displays the proper readout at both extremes.
9. Set decimal points as desired using the three decimal point switches. The unit can now be installed.

TROUBLESHOOTING

For further assistance, contact technical support at the appropriate company numbers listed.

E

6.0 Applications

Example 1 (± Display):

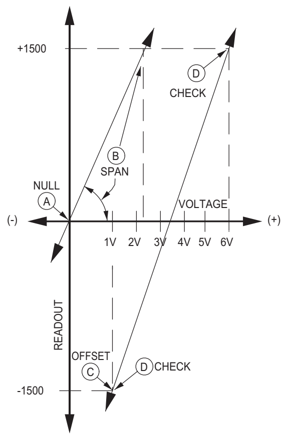
A differential pressure transducer has a range of ±15 PSI with a 1-6 V output (-15 @ 1 V, +15 @ 6 V)

READOUT SPAN (Rs) = +1500 - (-1500) = 3000
SWING VOLTAGE (Vs) = 6 V (max) - 1 V (min) = 5 V
SPAN PER VOLT (Rs/Vs) = 3000 / 5 V = 600

Note: Since the display readout is limited to 1999 numerical indication, the full READOUT SPAN of 3000 cannot be obtained during zero based span adjustment. However, dividing both the READOUT SPAN and SWING VOLTAGE by two, i.e. 1500 readout @ 2.5 V, allows the span adjustment to be made for the proper transfer curve slope.

ADJUSTMENTS

A Null the unit to zero readout @ 0 V per Steps 1 to 4 of the calibration steps.
B Set transfer curve slope with span adjustments per Steps 5 and 6 to get a readout of +1500 @ 2.5 V (SPAN PER VOLT = 600).
C Apply (-) offset per Step 7 to get a reading of -1500 @ 1 V.
D Check min. and max. extremes and tweak if required to get desired readout @ 1 V and 6 V per step 8. Set D.P. switch S2 and replace unit in case.



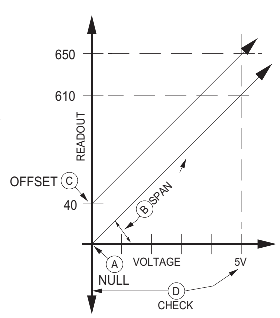
Example 2 (Positive Offset):

PAXLPV is to be calibrated to match a flow transducer whose output is 0 V @ 40 GPM and 5 V @ 650 GPM.

READOUT SPAN (Rs) = 650 - 40 = 610
SWING VOLTAGE (Vs) = 5 V (max) - 0 V (min) = 5 V
SPAN PER VOLT (Rs/Vs) = 610 / 5 V = 122

ADJUSTMENTS

A Null the unit per Steps 1 to 4 of the calibration steps.
B Set the coarse and fine span adjustments to get a readout of 610 @ 5 V (SPAN PER VOLT = 122) per Steps 5 and 6.
C Set offset to readout 40 @ 0 V per Step 7.
D Check the readout @ max. (5 V) and min. (0 V) and fine tune (tweak) as required per Step 8.



Example 3 (Negative Slope):

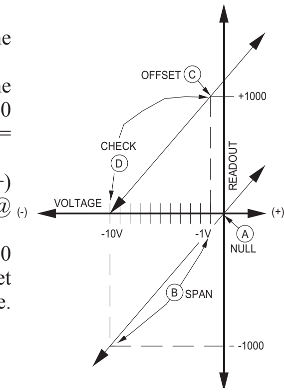
A liquid level sensor puts out 1 V when a storage tank is full and 11 V when the tank is empty. The PAXLPV is to read out 100.0 when the tank is full and zero when the tank is empty.

READOUT SPAN (Rs) = 1000 - 0 = 1000
SWING VOLTAGE (Vs) = 1 V (max) - 11 V (min) = -10 V
SPAN PER VOLT (Rs/Vs) = 1000 / -10 V = -100

In this case, the signal voltage is reversed [Term. 3 (+) with respect to Term. 4 (-)] causing the readout to go "down" (increasingly negative) as the negative voltage increases (hence, the negative (-) SPAN PER VOLT).

ADJUSTMENTS

A Null the unit per Steps 1 to 4 of the calibration steps.
B Set the slope of the transfer curve with the span adjustments to get a readout of -1000 @ -10V (SPAN PER VOLT = -100) per Steps 5 and 6.
C Move the transfer curve up by applying (+) offset per Step 7 until readout is +1000 @ -1 V.
D Check extreme readings per Step 8 0 readout @ -11 V and +1000 @ -1 V. Set D.P. switch S1 ON and replace unit in case.



E

MODEL DP5P - PROCESS INPUT

This is a brief overview of the DP5P. For complete specifications and programming information, see the **DP5 Analog Input Panel Meters Bulletin** starting on **page 283**.

- *DUAL RANGE INPUT (20 mA or 10 VDC)*
- *5-DIGIT 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE FUNCTION KEYS/USER INPUT*
- *24 VDC TRANSMITTER POWER*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

c UL US LISTED
IND. CONT. EQ.
51EB

CE

DP5P SPECIFICATIONS

SENSOR INPUTS:

INPUT (RANGE)	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	DISPLAY RESOLUTION
20 mA (-2 to 26 mA)	0.03% of reading +2 µA	0.12% of reading +3 µA	20 ohm	150 mA	1 µA
10 VDC (-1 to 13 VDC)	0.03% of reading +2 mV	0.12% of reading +3 mV	500 Kohm	300 V	1 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85%RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.

MODEL PAXP - PROCESS INPUT

This is a brief overview of the PAXP. For complete specifications and programming information, see the **PAX Analog Input Panel Meters Bulletin** starting on **page 301**.

- *5-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *DUAL RANGE INPUT (20 mA or 10 VDC)*
- *24 VDC TRANSMITTER POWER*
- *FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)*
- *RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)*
- *CRIMSON PROGRAMMING SOFTWARE*

C UL US LISTED
IND. CONT. EQ.
51EB

CE

PAXP SPECIFICATIONS

SENSOR INPUTS:

INPUT (RANGE)	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	DISPLAY RESOLUTION
20 mA (-2 to 26 mA)	0.03% of reading +2 µA	0.12% of reading +3 µA	20 ohm	150 mA	1 µA
10 VDC (-1 to 13 VDC)	0.03% of reading +2 mV	0.12% of reading +3 mV	500 Kohm	300 V	1 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85%RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

EXCITATION POWER:
Transmitter Power: 24 VDC, ±5%, regulated, 50 mA max.

MODEL PAXDP – 1/8 DIN DUAL PROCESS INPUT METER

c UL US LISTED
IND. CONT. EQ.
51EB

- ACCEPTS TWO 4 - 20 mA OR 0 - 10 VDC INPUT SIGNALS
- PROGRAMMABLE A/D CONVERSION RATE, 5 TO 105 READINGS PER SECOND
- 5-DIGIT 0.56" RED SUNLIGHT READABLE DISPLAY
- VARIABLE INTENSITY DISPLAY
- LINEARIZATION/SQUARE ROOT EXTRACTION INPUT RANGE
- PROGRAMMABLE FUNCTION KEYS/USER INPUTS
- 9 DIGIT TOTALIZER (INTEGRATOR) WITH BATCHING
- OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT
- FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)
- COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)
- RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)
- NEMA 4X/IP65 SEALED FRONT BEZEL
- PC SOFTWARE AVAILABLE FOR METER CONFIGURATION

GENERAL DESCRIPTION

The PAXDP Dual Process Input Meter offers many features and performance capabilities to suit a wide range of industrial applications. Available in two models, AC or DC power, the meter has the capability to accept two, 4 to 20 mA or 0 to 10 VDC input signals. Each input signal can be independently scaled and displayed. In addition, a math function can be performed on the two signals, C + A + B, C - A - B, C + A - B, AB / C, CA / B, or C (A / B - 1). Any of the three meter values can have Alarms, Comms, and/or a Retransmitted Analog Output capability by simply adding optional cards. The optional plug-in output cards allow the opportunity to configure the meter for current applications, while providing easy upgrades for future needs.

The update rate of the meter is user selectable. This will help in those applications where a quick response from the meter is of the utmost importance. The rate can be adjusted from eight selections with a minimum of 5 updates/second to a maximum of 105 updates/second.

The meters employ a bright 0.56" (14.2 mm) red sunlight readable LED display. The intensity of display can be adjusted from dark room applications up to sunlight readable, making it ideal for viewing in bright light applications.

The meters provide a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow, calculate service intervals of motors or pumps, etc. The totalizer can also accumulate batch operations.

The meter has four setpoint outputs, implemented on Plug-in option cards. The Plug-in cards provide dual FORM-C relays (5A), quad FORM-A (3A), or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

Communication and Bus Capabilities are also available as option cards. The standard output is in Modbus Protocol. Any of the following option cards, RS232, RS485, DeviceNet, or Profibus can be used with the meter. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meters have a feature that allows a remote computer to directly control the outputs of the meter.

A linear DC output signal is available as an optional Plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track either the input, totalizer, max/min readings, or math calculation value.

Once the meters have been initially configured, the parameter list may be locked out from further modification in its entirety or only the setpoint values can be made accessible.

The meters have been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

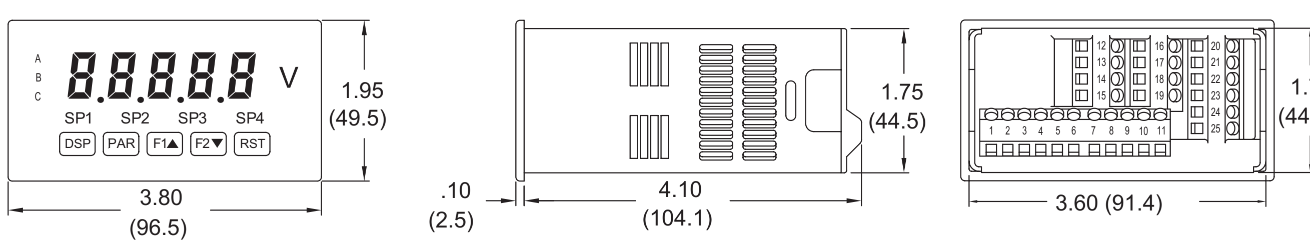
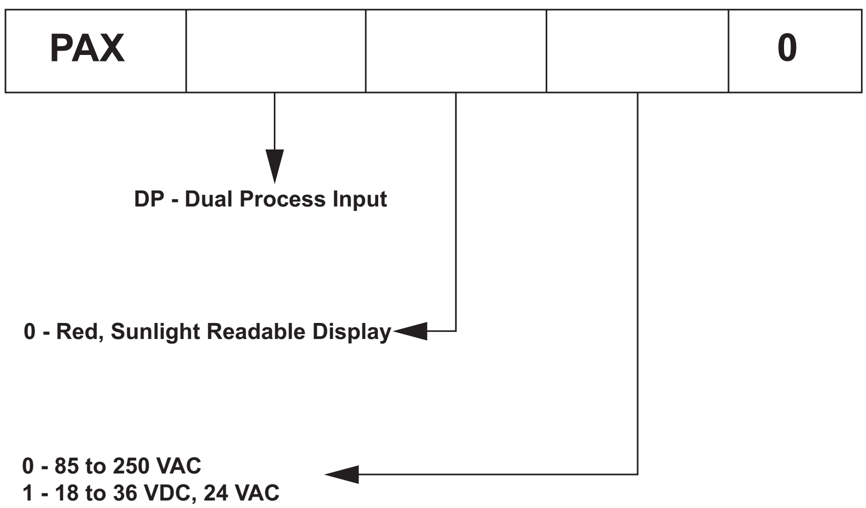


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers



Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
	PAXUSB	PAX USB Programming Card (Not included in PAX product UL E179259 file)	PAXUSB00
Accessories	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01
	ICM8	Ethernet Gateway	ICM80000
	PAXLBK	Units Label Kit Accessory	PAXLBK10
	SFCRD *	Crimson PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200

Notes:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.
2. Crimson® 2 software is available as a free download at http://www.redlion.net/

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) variable intensity red sunlight readable (-19999 to 99999)
2. **POWER**:
   AC Versions:
   AC Power: 85 to 250 VAC, 50/60 Hz, 21 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
   DC Versions: (Derate operating temperature to 40° C if three plug-in option cards or PAXCDC50 are installed.)
   DC Power: 18 to 36 VDC, 13 W
   AC Power: 24 VAC, ± 10%, 50/60 Hz, 16 VA
   Isolation: 500 Vrms for 1 min. to all inputs and outputs (50 V working).
   Must use a Class 2 or SELV rated power supply
3. **ANNUNCIATORS**:
   A - Programmable Display
   B - Programmable Display
   C - Programmable Display
   SP1 - Setpoint alarm 1 is active
   SP2 - Setpoint alarm 2 is active
   SP3 - Setpoint alarm 3 is active
   SP4 - Setpoint alarm 4 is active
   Units Label - Optional units label backlight
4. **KEYPAD**: 3 programmable function keys, 5 keys total
5. **A/D CONVERTER**: 16 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: Adjustable 5.3 to 105 readings/sec.
   Step response: (to within 99% of final readout value with digital filter disabled)

INPUT UPDATE RATE	MAX. TIME (msec)
5.3	770
7.5	560
16.7	260
19.8	220
20	220
30	150
105	60

   Display update rate: adjustable 1 to 20 readings/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.
   Analog output update rate: 0 to 10 sec
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   ". . . ." - Appears when display values exceed + display range.
   "- . . ." - Appears when display values exceed - display range.
8. **SENSOR INPUTS**:

INPUT (RANGE)	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	IMPEDANCE/ COMPLIANCE	MAX CONTINUOUS OVERLOAD	DISPLAY RESOLUTION
±20 mA (-26 to 26 mA)	0.03% of reading +2 µA	0.12% of reading +3 µA	24.6 ohm	90 mA	1 µA
±10 VDC (-13 to 13 VDC)	0.03% of reading +2 mV	0.12% of reading +3 mV	500 Kohm	50 V	1 mV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.

9. **EXCITATION POWER**:
   Transmitter Power: 18 VDC, ±20%, unregulated, 70 mA max. per input channel.
10. **LOW FREQUENCY NOISE REJECTION**:
   Normal Mode: (digital filter off)

INPUT UPDATE RATE	50 Hz ±1 Hz	60 Hz ±1 Hz
5.3	>90 dB	>65 dB
7.5	>60 dB	>55 dB
16.7	>100 dB	>50 dB
19.8*	>60 dB	>95 dB
20	>55 dB	>100 dB
30	>20 dB	>20 dB
105	>20 dB	>13 dB

   *Note: 19.8 Hz Input Rate provides best rate performance and simultaneous 50/60 Hz rejection.
   Common Mode: >100 dB @ 50/60 ±1 Hz (19.8 or 20 Input Rate)
11. **USER INPUTS**: Three programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input A Common: 500 Vrms for 1 min; Working Voltage: 50 V
   Isolation To Sensor Input B Common: Not isolated.

INPUT STATE	SINKING INPUTS 22 KΩ pull-up to +5 V	SOURCING INPUTS 22 KΩ pull-down
Active	V_{IN} < 0.9 VDC	V_{IN} > 3.6 VDC
Inactive	V_{IN} > 3.6 VDC	V_{IN} < 0.9 VDC

   Response Time: 20 msec. max.
   Logic State: Jumper selectable for sink/source logic
12. **TOTALIZER**:
   Function:
   Time Base: second, minute, hour, or day
   Batch: Can accumulate (gate) input display from a user input
   Time Accuracy: 0.01% typical
   Decimal Point: 0 to 0.0000
   Scale Factor: 0.001 to 65.000
   Low Signal Cut-out: -19,999 to 99,999
   Total: 9 digits, display alternates between high order and low order readouts
13. **CUSTOM LINEARIZATION**:
   Data Point Pairs: Selectable from 2 to 16
   Display Range: -19,999 to 99,999
   Decimal Point: 0 to 0.0000
14. **MEMORY**: Nonvolatile memory retains all programmable parameters and display values.
15. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission EN 55011 Class A
   IEC/EN 61010-1
   UL Recognized Component: File #E179259
   UL Listed: File #E137808
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
16. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C (0 to 45°C with all three plug-in option cards installed)
   Storage Temperature Range: -40 to 60°C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 25 g (10 g relay)
   Operating and Storage Humidity: 0 to 85% max. RH non-condensing
   Altitude: Up to 2000 meters
17. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 4.5 inch-lbs (0.51 N-m) max.
18. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
19. **WEIGHT**: 10.4 oz. (295 g)

ACCESSORIES

UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

PROGRAMMING SOFTWARE

The Crimson® 2 (SFCRM2) software is a Windows® based program for configuring and updating the firmware of the PAXDP meter from a PC. Using the software makes programming the PAXDP meter easier and allows the user to save the PAXDP database in a PC file for future use. The software is available as a free download from Red Lion's website.

The first time Crimson 2 software is run from the File menu, select "New" to display a dialog and select the PAXDP. The screen will display icons that represent the various programming sections of the PAXDP. Double-click on an icon to configure the programming parameters pertaining to the selection. Tool Tip help is available for each of the program parameters. A PAX serial plug-in card or PAX USB programming card is required to program the meter using the software.

When communicating with Crimson 2 software, the PAXDP must be set in default configuration type of:

Communications Type: MODBUS RTU
Baud Rate: 38400
Data Bit: 8
ParityBit: no
Meter Unit Address: 247

OPTIONAL PLUG-IN OUTPUT CARDS

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC50 - Profibus-DP
PAXUSB00 - USB (Mini B)

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Baud: 300 to 38,400
Data: 7/8 bits
Parity: No, Odd or Even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PAXUSB PROGRAMMING CARD

Type: USB Virtual Comms Port
Connection: Type mini B
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Baud Rate: 300 to 19.2k
Unit Address: 0 to 99; only 1 meter can be configured at a time

SETPOINT CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @120 VAC, inductive load
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load), 1/10 HP @120 VAC, inductive load
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 24 VDC ± 10%, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See update rates step response specification; add 6 msec (typical)for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

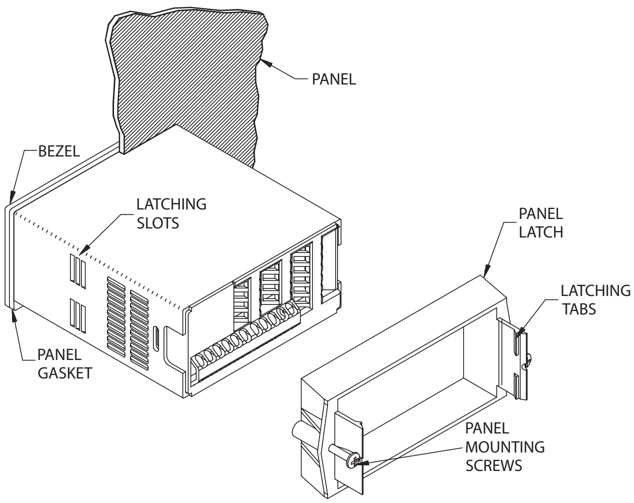
ANALOG OUTPUT CARD

Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28°C); 0.4% of FS (0 to 50°C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered (Active)
Step Response: See update rates step response specification
Update time: See ADC Conversion Rate and Update Time parameter

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

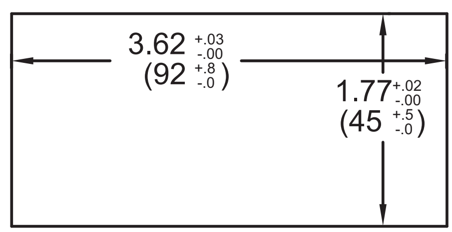
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Setting the Jumpers

The meter has three jumpers that must be checked and/or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

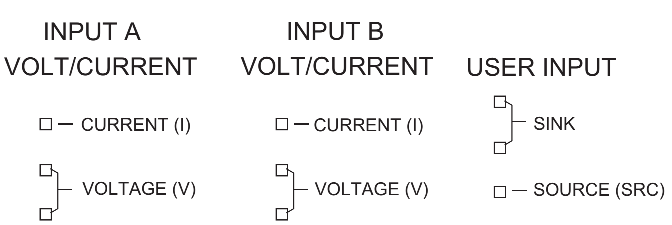
Input Jumpers

These jumpers are used to select the proper input types, Voltage (V) or Current (I). The input type selected in programming must match the jumper setting. See the Jumper Selection Figures for more details.

PAXDP Jumper Selection

JUMPER SELECTIONS

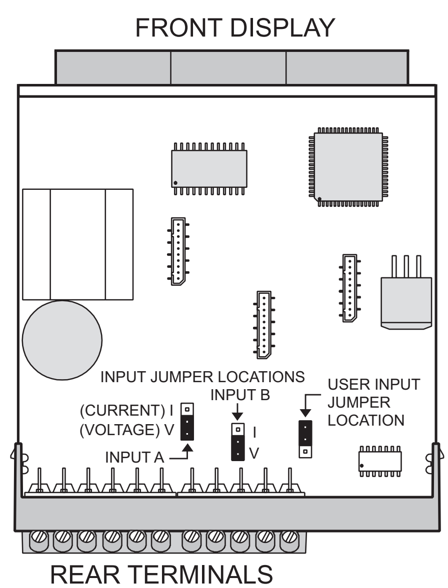
The ⌒ indicates factory setting.



Note: In the figures above, the text shown in parenthesis is printed on the circuit board to help with proper jumper positioning.

User Input Logic Jumper

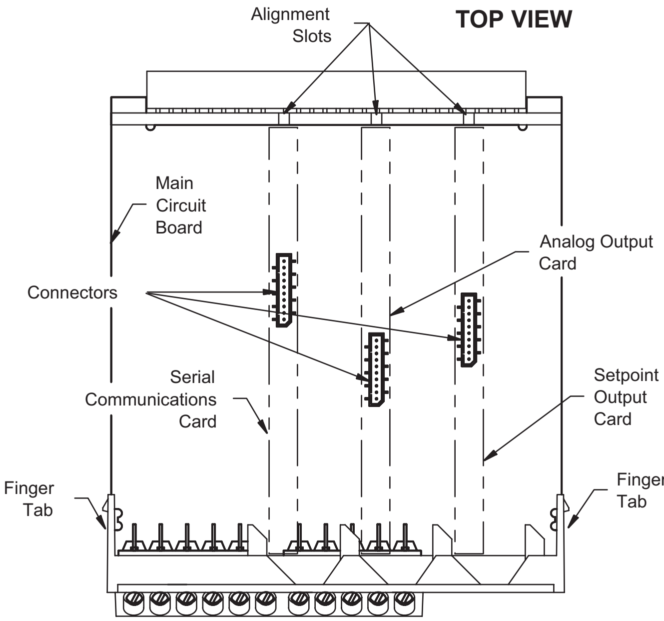
This jumper selects the logic state of all the user inputs. If the user inputs are not used, it is not necessary to check or move this jumper.



3.0 Installing Plug-In Cards

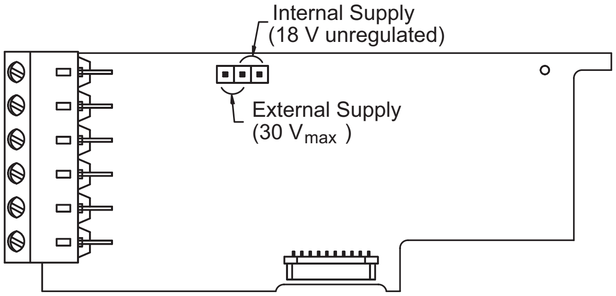
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Meter

E

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

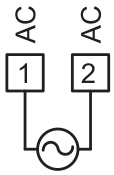
EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

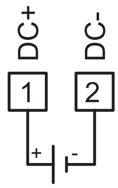
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. With use of the lower input ranges or signal sources with high source impedance, the use of shielded cable may be necessary. This helps to guard against stray AC pick-up. Attach the shield to the input common of the meter.
3. To minimize potential noise problems, power the meter from the same power branch, or at least the same phase voltage as that of the signal source.
4. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
5. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
6. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
7. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
8. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

4.1 POWER WIRING

AC Power
Terminal 1: VAC
Terminal 2: VAC



DC Power
Terminal 1: +VDC
Terminal 2: -VDC

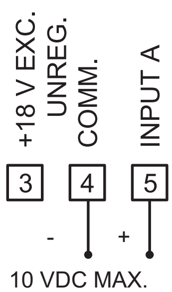


4.2 INPUT SIGNAL WIRING

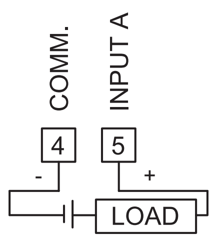
Before connecting signal wires, the Input Range Jumper must be verified for proper position.

INPUT A SIGNAL WIRING

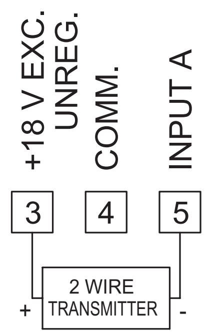
Voltage Signal (self powered)
Terminal 4: -VDC
Terminal 5: +VDC



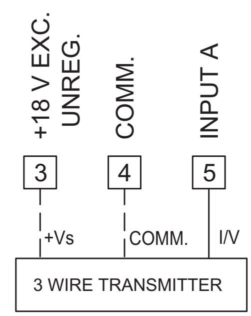
Current Signal (self powered)
Terminal 4: -ADC
Terminal 5: +ADC



Current Signal (2 wire requiring excitation)
Terminal 3: +ADC
Terminal 5: -ADC

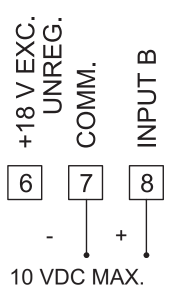


Voltage/Current Signal (3 wire requiring excitation)
Terminal 3: +Volt supply
Terminal 4: -ADC (common)
Terminal 5: +ADC (signal)

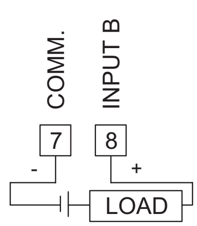


INPUT B SIGNAL WIRING

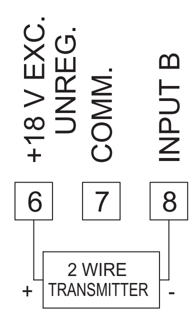
Voltage Signal (self powered)
Terminal 7: -VDC
Terminal 8: +VDC



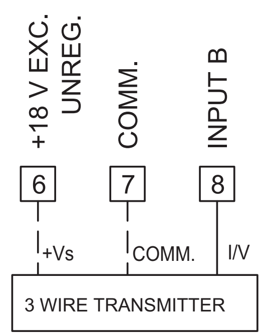
Current Signal (self powered)
Terminal 7: -ADC
Terminal 8: +ADC



Current Signal (2 wire requiring excitation)
Terminal 6: +ADC
Terminal 8: -ADC



Voltage/Current Signal (3 wire requiring excitation)
Terminal 6: +Volt supply
Terminal 7: -ADC (common)
Terminal 8: +ADC (signal)



CAUTION: *Sensor Input B common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

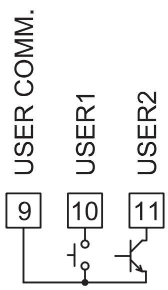
4.3 USER INPUT WIRING

Before connecting the wires, the User Input Logic Jumper should be verified for proper position. If not using User Inputs, then skip this section. Only the appropriate User Input terminal has to be wired.

Sinking Logic

Terminal 9:
Terminal 10-11: } Connect external switching device between appropriate User Input terminal and User Comm.

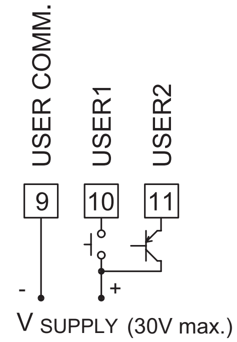
In this logic, the user inputs of the meter are internally pulled up to +5 V with 22 K resistance. The input is active when it is pulled low (<0 .9 V).



Sourcing Logic

Terminal 9: -VDC thru external switching device
Terminal 10-11: + VDC thru external switching device

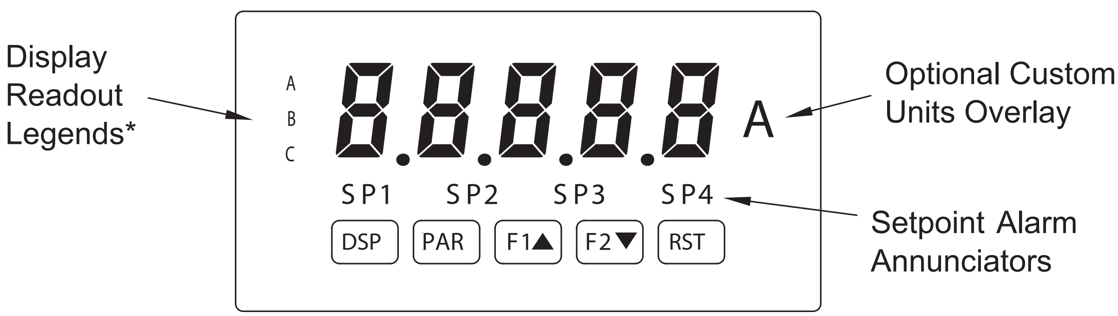
In this logic, the user inputs of the meter are internally pulled down to 0 V with 22 K resistance. The input is active when a voltage greater than 3.6 VDC is applied.



4.4 SETPOINT (ALARMS) WIRING
4.5 SERIAL COMMUNICATION WIRING
4.6 ANALOG OUTPUT WIRING

} ***See appropriate plug-in card bulletin for details.***

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



E

KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through main displays as programmed in 3-LOC	Quit programming and return to display mode
PAR	Access parameter list	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1**	Increment selected parameter value
F2▼	Function key 2; hold for 3 seconds for Second Function 2**	Decrement selected parameter value
RST	Reset (Function key)**	Hold with F1▲, F2▼ to scroll value by x1000

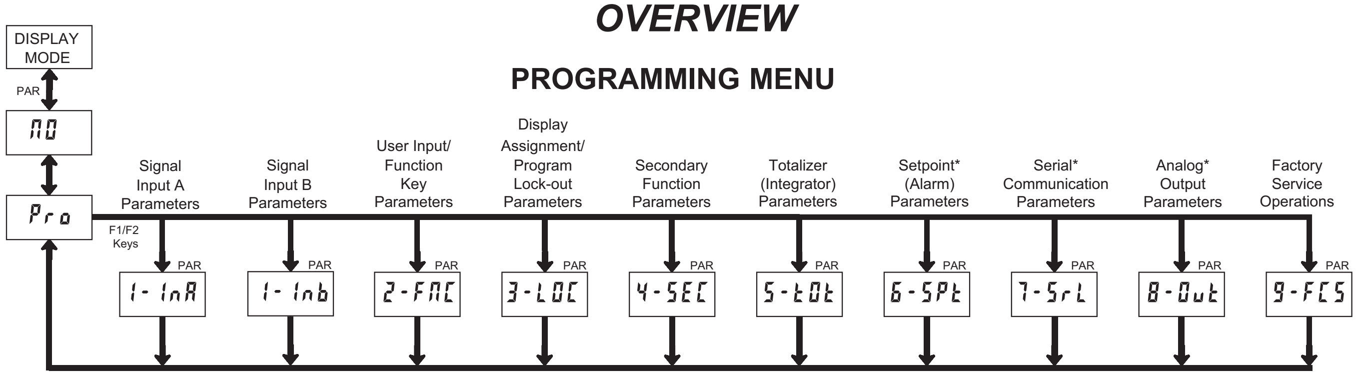
* Display Readout Legends may be locked out in Factory Settings.

** Factory setting for the F1, F2, and RST keys is NO mode.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



* Only accessible with appropriate plug-in card.

DISPLAY MODE

The meter normally operates in the Display Mode. In this mode, the meter displays can be viewed consecutively by pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown; A, B, or C. Each of these displays are programmable and can be locked from view through programming. (See Module 3.)

PROGRAMMING MODE

Two programming modes are available.

Full Programming Mode permits all parameters to be viewed and modified. Upon entering this mode, the front panel keys change to Programming Mode operations. This mode should not be entered while a process is running, since the meter functions and User Input response may not operate properly while in Full Programming Mode.

Quick Programming Mode permits only certain parameters to be viewed and/or modified. When viewing parameters (SP1, etc), the front panel keys change to Programming Mode operations, and all meter functions continue to operate properly. Quick Programming Mode is configured in Module 3. The Display Intensity Level "d-LEv" parameter is available in the Quick Programming Mode only when the security code is non-zero. For a description, see Module 9—Factory Service Operations. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming Mode.

PROGRAMMING TIPS

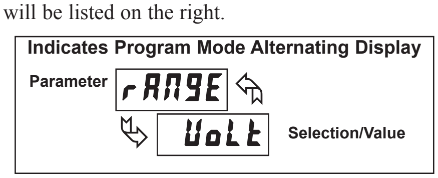
The Programming Menu is organized into ten modules (see above). These modules group together parameters that are related in function. It is recommended to begin programming with Module 1 and proceed through each module in sequence. Note that Modules 6 through 8 are only accessible when the appropriate plug-in option card is installed. If lost or confused while programming, press the **DSP** key to exit programming mode and start over. When programming is complete, it is recommended to record the meter settings on the Parameter Value Chart and lock-out parameter programming with a User Input or lock-out code. (See Modules 2 and 3 for lock-out details.)

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point if encountering programming problems. Throughout the module description sections which follow, the factory setting for each parameter is shown below the parameter display. In addition, all factory settings are listed on the Parameter Value Chart following the programming section.

ALTERNATING SELECTION DISPLAY

In the module description sections which follow, the dual display with arrows appears for each programming parameter. This is used to illustrate the display alternating between the parameter (top display) and the parameter's Factory Setting (bottom display). In most cases, selections or value ranges for the parameter will be listed on the right.



STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (PAR KEY)

The Programming Mode is entered by pressing the **PAR** key. If this mode is not accessible, then meter programming is locked by either a security code or a hardware lock. (See Modules 2 and 3 for programming lock-out details.)

MODULE ENTRY (ARROW & PAR KEYS)

Upon entering the Programming Mode, the display alternates between Pro and the present module (initially NO). The arrow keys (**F1▲** and **F2▼**) are used to select the desired module, which is then entered by pressing the **PAR** key.

PARAMETER (MODULE) MENU (PAR KEY)

Each module has a separate parameter menu. These menus are shown at the start of each module description section which follows. The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. From this point, programming may continue by selecting and entering additional modules. (See **MODULE ENTRY** above.)

PARAMETER SELECTION ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the parameter and the present selection or value for that parameter. For parameters which have a list of selections, the arrow keys (**F1▲** and **F2▼**) are used to sequence through the list until the desired selection is displayed. Pressing the **PAR** key stores and activates the displayed selection, and also advances the meter to the next parameter.

NUMERICAL VALUE ENTRY (ARROW, RST & PAR KEYS)

For parameters which require a numerical value entry, the arrow keys can be used to increment or decrement the display to the desired value. When an arrow key is pressed and held, the display automatically scrolls up or scrolls down. The longer the key is held, the faster the display scrolls.

The **RST** key can be used in combination with the arrow keys to enter large numerical values. When the **RST** key is pressed along with an arrow key, the display scrolls by 1000's. Pressing the **PAR** key stores and activates the displayed value, and also advances the meter to the next parameter.

PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pro NO)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro NO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

E

6.1 MODULE 1 - Signal Input Parameters

INPUT A PARAMETER MENU

1-InA → PAR → rANGE — rAtE — dECPt — round — FILtr — bANd — PtS — StYLE — INP x — dSP x → Pro

rANGE	rAtE	dECPt	round	FILtr	bANd	PtS	StYLE	INP x	dSP x
Input Range	Conversion Rate	Display Decimal Point	Display Rounding	Filter Setting	Filter Band	Scaling Points	Scaling Style	Input x Value	Display x Value

INPUT B PARAMETER MENU

1-Inb → PAR → rANGE — rAtE — dECPt — round — FILtr — bANd — PtS — StYLE — INP x — dSP x → Pro

rANGE	rAtE	dECPt	round	FILtr	bANd	PtS	StYLE	INP x	dSP x
Input Range	Conversion Rate	Display Decimal Point	Display Rounding	Filter Setting	Filter Band	Scaling Points	Scaling Style	Input x Value	Display x Value

INPUT RANGE

rANGE
VoLt

SELECTION	RANGE RESOLUTION
VoLt	10.000 V
Curr	20.000 mA
V-SQr	±10.000 V - Square Root Extraction
C-SQr	±20.000 mA - Square Root Extraction

Select the input range that corresponds to the external signal. Before applying signal configure input jumper to match setting desired.

ADC CONVERSION RATE

rAtE
19.8

5.3 7.5 16.7 19.8
20 30 105

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect setpoint and analog output response time. The default factory setting of 19.8 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DISPLAY DECIMAL POINT

dECPt
0.000

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input display. (The **TOT** display decimal point is a separate parameter.) This selection also affects round, dSP1 and dSP2 parameters and setpoint values.

DISPLAY ROUNDING*

round
0.001

1 2 5 10
20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 121 to round to 120 and 124 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

FILTER SETTING

FILtr
1.0

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND*

bANd
0.010

0 to 250 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the digital filter permanently engaged.

SCALING POINTS

PtS
2

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (INP) and an associated desired Display Value (dSP).

Square Root Extraction Input Range - Scaling Points (2)

The PAXDP can apply the square root function directly to the sensor signal by selecting the Square Root Extraction Input Range (V-SQr or C-SQr). When configured for Square Root Extraction, piecewise multipoint linearization is not required and only the first 2 scaling points are used. For proper operation the Display 1 (dSP 1) value must be zero.

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (INP) and an associated desired Display Value (dSP). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs.

In the Crimson 2 (SFCRM2) software, several linearization equations are available. See the Accessories section for more information.

SCALING STYLE

StYLE
KEY

KEY	key-in data
APLY	apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

* *The decimal point position is dependent on the selection made in the "Display Decimal Point" parameter.*

E

INPUT VALUE FOR SCALING POINT 1

INP 1 / 0.000 — -19.999 to 99.999

For Key-in (KEY), enter the known first Input Value by using the arrow keys. (The Input Range selection sets up the decimal location for the Input Value.) For Apply (APLY), apply the input signal to the meter, adjust the signal source externally until the desired Input Value appears. In either method, press the **PAR** key to enter the value being displayed. In the APLY style, the **RST** key can be pressed to advance the display past the INP1 value or other input value without storing it. This is useful for application scaling of the second scaling point (i.e. when the tank is full), or some other point in multipoint applications.

DISPLAY VALUE FOR SCALING POINT 1*

dSP 1 / 0.000 — -19999 to 99999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection. For Square Root Extraction Input Range, the Display 1 value must be zero.

INPUT VALUE FOR SCALING POINT 2

INP 2 / 10.000 — -19.999 to 99.999

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (APLY), adjust the signal source externally until the next desired Input Value appears. (Follow the same procedure if using more than 2 scaling points.)

* *The decimal point position is dependent on the selection made in the "Display Decimal Point" parameter.*

DISPLAY VALUE FOR SCALING POINT 2*

dSP 2 / 100.00 — -19999 to 99999

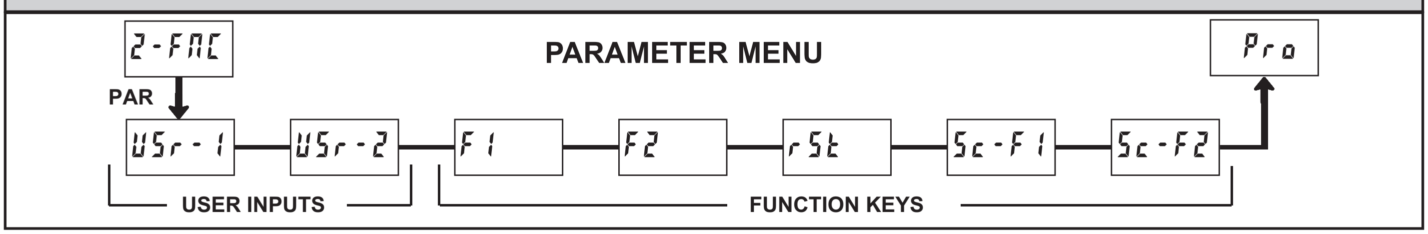
Enter the second coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

General Notes on Scaling

1. Input Values for scaling points should be confined to the limits of the Input Signal, ie. 4-20 mA or 0-10 VDC.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 10.) This is referred to as readout jumps (vertical scaled segments).
3. The same Display Value can correspond to more than one Input Value. (Example: 0 mA and 20 mA can equal 10.) This is referred to as readout dead zones (horizontal scaled segments).
4. The maximum scaled Display Value spread between range maximum and minimum is limited to 65,535. For example using +20 mA range the maximum +20 mA can be scaled to is 32,767 with 0 mA being 0 and Display Rounding of 1. (Decimal points are ignored.) The other half of 65,535 is for the lower half of the range 0 to -20 mA even if it is not used. With Display Rounding of 2, +20 mA can be scaled for 65,535 (32,767 x 2) but with even Input Display values shown.
5. For input levels beyond the first programmed Input Value, the meter extends the Display Value by calculating the slope from the first two coordinate pairs (INP1 / dSP1 & INP2 / dSP2). If INP1 = 4 mA and dSP1 = 0, then 0 mA would be some negative Display Value. This could be prevented by making INP1 = 0 mA / dSP1 = 0, INP2 = 4 mA / dSP2 = 0, with INP3 = 20 mA / dSP3 = the desired high Display Value. The calculations stop at the limits of the Input Range Jumper position.
6. For input levels beyond the last programmed Input Value, the meter extends the Display Value by calculating the slope from the last two sequential coordinate pairs. If three coordinate pair scaling points were entered, then the Display Value calculation would be between INP2 / dSP2 & INP3 / dSP3. The calculations stop at the limits of the Signal Input.

E

6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)



The two user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state.

The front panel function keys are also individually programmable to perform specific meter control functions. While in the Display Mode or when viewing meter values in Quick Programming mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

Note: *In the following explanations, not all selections are available for both user inputs and front panel function keys. Alternating displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USr-1 will represent both user inputs. F1 will represent all five function keys.*

NO FUNCTION

USr-1 / NO   F1 / NO

No function is performed if activated. This is the factory setting for all user inputs and function keys. No function can be selected without affecting basic start-up.

PROGRAMMING MODE LOCK-OUT

USr-1 / PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

INPUT A ZERO (TARE) DISPLAY

USr-1 / A-rEL   F1 / A-rEL

The Zero (Tare) Display provides a way to zero the Input A value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Input A value is set to zero. At the same time, the Input A value (that was on the display before the Zero Display) is subtracted from the Input A Display Offset Value and is automatically stored as the new Display Offset Value (OFS-A). If another Zero (tare) Display is performed, the display will again change to zero and the Input A reading will shift accordingly.

INPUT B ZERO (TARE) DISPLAY

USr-1 / b-rEL   F1 / b-rEL

The Zero (Tare) Display provides a way to zero the Input B value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Input B value is set to zero. At the same time, the Input B value (that was on the display before the Zero Display) is subtracted from the Input B Display Offset Value and is automatically stored as the new Display Offset Value (OFS-b). If another Zero (tare) Display is performed, the display will again change to zero and the Input B reading will shift accordingly.

INPUT A RELATIVE/ABSOLUTE DISPLAY

USr-1 / A-drL   F1 / A-drL

This function will switch the Input A Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input A Display will normally show the Relative unless switched by this function. The Absolute is a gross value (based on Module 1 **DSP** and **INP** entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input A display switches back to Relative display. AbS-A (absolute) or rEL-A (relative) is momentarily displayed at transition to indicate which display is active.

INPUT B RELATIVE/ABSOLUTE DISPLAY

USr-1 / b-drL   F1 / b-drL

This function will switch the Input B Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input B Display will normally show the Relative unless switched by this function. The Absolute is a gross value (based on Module 1 **DSP** and **INP** entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input B display switches back to Relative display. AbS-A (absolute) or rEL-A (relative) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USr-1 / d-HLd

The shown display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USr-1 / A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USr-1 / SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D's with other processes or timing events.

Input assignment for the totalizer is programmed in Module 5, Totalizer (Integrator) Parameters. Only the assigned input or calculation will be active for the following Totalizer User Functions.

STORE BATCH READING IN TOTALIZER

USr-1 / bAt   F1 / bAt

The assigned value is one time added (batched) to the Totalizer at transition to activate (momentary action). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden.

RESET TOTALIZER

USr-1 / rtot1   F1 / r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USr-1 / rtot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USr-1 / E-tot

The Totalizer continues to operate as long as activated (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

RESET MAXIMUM

USr-1 / r-HI   F1 / r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present assigned value. The Maximum function then continues from that value. This selection functions independent of the selected display.

RESET MINIMUM

USr-1 / r-Lo   F1 / r-Lo

When activated (momentary action), rESEt flashes and the Minimum reading is set to the present assigned value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM

USr-1 / r-HL   F1 / r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present assigned values. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

Note: Following display functions are only available on User Input.

ADVANCE DISPLAY

USr-1 / dISP

When activated (momentary action), the display advances to the next display that is not locked out from the Display Mode.

SELECT DISPLAY A

USr-1 / dSP-A

When activated (momentary action), the display advances to Display A, if enabled.

E

SELECT DISPLAY B

USr-1 / dSP-b

When activated (momentary action), the display advances to Display B, if enabled.

SELECT DISPLAY C

USr-1 / dSP-C

When activated (momentary action), the display advances to Display C, if enabled.

SELECT DISPLAY _

USr-1 / dSP-_

When activated (momentary action), the display advances to the Display _ (no annunciator), if enabled.

CHANGE DISPLAY INTENSITY LEVEL

USr-1 / d-LEU   F1 / d-LEU

When activated (momentary action), the display intensity changes to the next intensity level (of 4). The four levels correspond to Display Intensity Level (d-LEU) settings of 0, 3, 8, and 15.

SETPOINT SELECTIONS

The following selections are functional only with the Setpoint plug-in card installed. Refer to Module 6 - Setpoint (Alarm) Parameters for an explanation of their operation.

Setpoint Card Only

- **LISt - Select main or alternate setpoints**
- **r-1 - Reset Setpoint 1 (Alarm 1)**
- **r-2 - Reset Setpoint 2 (Alarm 2)**
- **r-3 - Reset Setpoint 3 (Alarm 3)**
- **r-4 - Reset Setpoint 4 (Alarm 4)**
- **r-34 - Reset Setpoint 3 & 4 (Alarm 3 & 4)**
- **r-234 - Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)**
- **r-ALL - Reset Setpoint All (Alarm All)**

SELECT SETPOINT LIST

USr-1 / LISt   F1 / LISt

Two lists of values are available for SP-1, SP-2, SP-3, SP-4. The two lists are named LSt-A and LSt-b. If a user input is used to select the list then LSt-A is selected when the user input is not active and and LSt-b is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed.

To program the values for LSt-A and LSt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the values for SP-1, SP-2, SP-3, SP-4. If any other parameters are changed then the other list values must be reprogrammed.

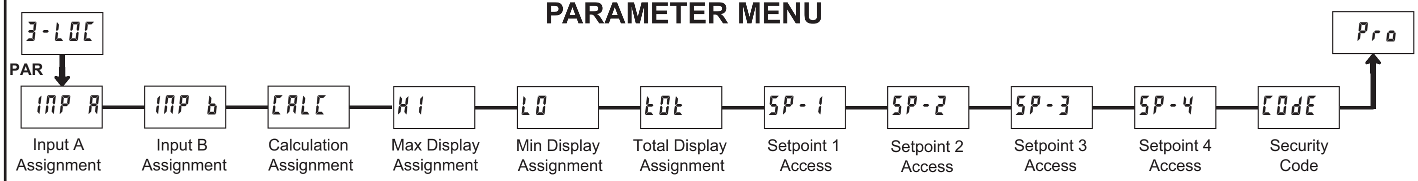
PRINT REQUEST

USr-1 / Print   F1 / Print

The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

6.3 MODULE 3 - DISPLAY ASSIGNMENT AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)

PARAMETER MENU



Module 3 is the programming for the Display, Display assignments, Display lock-out and "Full" and "Quick" Program lock-out.

When in the main Display Mode, the available displays (A,B,C,_) can be read consecutively by repeatedly pressing the **DSP** key. An annunciator indicates the display being shown (_ = No annunciator). A meter display value can be programmed to one of the displays, to the quick programming mode or be locked from being visible. It is recommended that the meter display value be set to LOC when it is not being used in the application.

"Full" Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input. When locked and the PAR key is pressed, the meter enters a Quick Programming Mode. In this mode, the setpoint values can still be read and/or changed per the selections below. The display Intensity Level (d-LEV) parameter also appears whenever Quick Programming Mode is enabled and the security code greater than zero.

DISPLAY ASSIGNMENT

INP A → dSP-A

INP b → dSP-b

CALC → dSP-C

HI → LOC

LO → LOC

tOt → LOC

There are six meter values that can be individually programmed for one of the main displays (A,B,C or _), or programmed to be viewable in Quick Programming mode (rEd), or programmed to be locked out from display (LOC) (see the following table). If two or more values are assigned to the same display the last value assigned will be the one that is displayed.

LOC	Not visible in Display Mode or Quick Programming Mode
rEd	Visible in Quick Programming Mode only
dSP-_	Assign to Display _ (No annunciator)
dSP-A	Assign to Display A
dSP-b	Assign to Display B
dSP-C	Assign to Display C

SP-1 SP-2 SP-3 SP-4 SETPOINT ACCESS*

SP-1 → LOC

SP-2 → LOC

SP-3 → LOC

SP-4 → LOC

The setpoint displays can be programmed for LOC, rEd or ENt (see the following table). Accessible only with the Setpoint plug-in card installed.

SELECTION	DESCRIPTION
LOC	Not visible in Quick Programming Mode Only
rEd	Visible in Quick Programming Mode Only
ENt	Visible and changeable in Quick Programming Mode Only

PROGRAM MODE SECURITY CODE*

CODE → 0

0 to 250

By entering any non-zero value, the prompt CODE 0 will appear when trying to access the Program Mode. Access will only be allowed after entering a matching security code or universal code of 222. With this lock-out, a user input would not have to be configured for Program Lock-out. However, this lock-out is overridden by an inactive user input configured for Program Lock-out.

* *Factory Setting can be used without affecting basic start-up.*

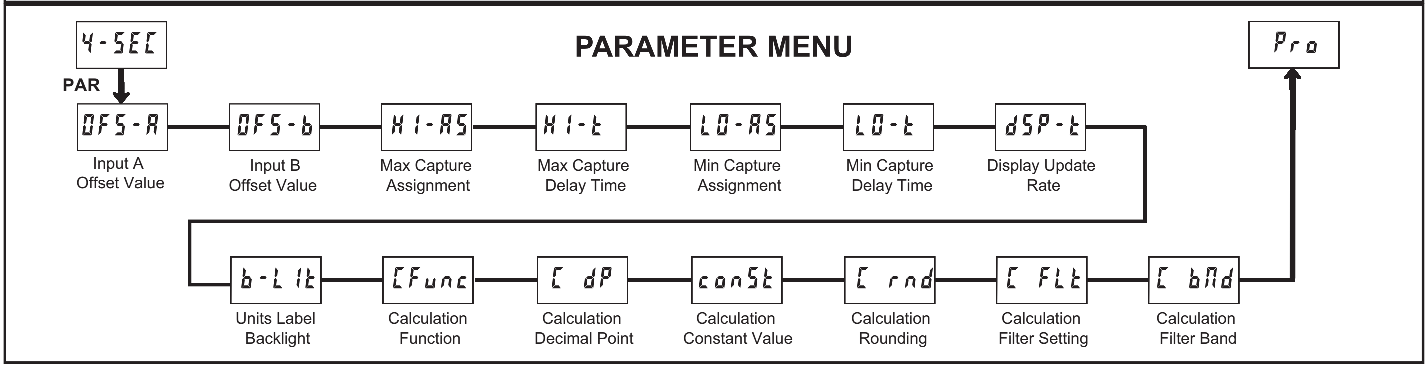
E

PROGRAMMING MODE ACCESS

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN PAR KEY IS PRESSED	"FULL" PROGRAMMING MODE ACCESS
0	not PLOC	————	"Full" Programming	Immediate access.
>0	not PLOC	————	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Active	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Not Active	"Full" Programming	Immediate access.
0	PLOC	Active	Quick Programming	No access
0	PLOC	Not Active	"Full" Programming	Immediate access.

Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming (all meter parameters are accessible).

6.4 MODULE 4 - SECONDARY FUNCTION PARAMETERS (4-SEC)



INPUT A OFFSET VALUE*

OFS-A
0.000

-19999 to 19999

Unless a Zero Display was performed or an offset from Module 1 scaling is desired for Input A, this parameter can be skipped. The Display Offset Value is the difference between the Absolute (gross) Display value and the Relative (net) Display value for the same input level. The meter will automatically update this Display Offset Value after each Zero Display. The Display Offset Value can be directly keyed-in to intentionally add or remove display offset. See Relative / Absolute Display and Zero Display explanations in Module 2.

INPUT B OFFSET VALUE*

OFS-b
0.000

-19999 to 19999

Unless a Zero Display was performed or an offset from Module 1 scaling is desired for Input B, this parameter can be skipped. The Display Offset Value is the difference between the Absolute (gross) Display value and the Relative (net) Display value for the same input level. The meter will automatically update this Display Offset Value after each Zero Display. The Display Offset Value can be directly keyed-in to intentionally add or remove display offset. See Relative / Absolute Display and Zero Display explanations in Module 2.

MAX CAPTURE ASSIGNMENT

HI-AS
A-rEL

A-rEL A-AbS b-rEL b-AbS CALC

Select the desired parameter that will be assigned to the Max Capture.

MAX CAPTURE DELAY TIME

HI-t
1.0

0.0 to 3275.0 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE ASSIGNMENT

LO-AS
A-rEL

A-rEL A-AbS b-rEL b-AbS CALC

Select the desired parameter that will be assigned to the Min Capture.

MIN CAPTURE DELAY TIME

LO-t
1.0

0.0 to 3275.0 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE

dSP-t
1

1 2 5 10 20 updates/sec.

This parameter determines the rate of display update.

UNITS LABEL BACKLIGHT

b-LIt
OFF

On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays which can be installed in to the meter's bezel display assembly. The backlight for these custom units is activated by this parameter.

CALCULATION FUNCTION

CFunc
c+A+b

c+A+b c+A-b cA/b
c-A-b Ab/c c(A/b-1)

This parameter determines the math calculation that will be performed on Input A and Input B and shown on the calculation display. The above formulas represent the available calculations; A = Input A relative value, b = Input B relative value, and c = Calculation Constant Value (conSt). For the average between A and B inputs, scale the display (Input A & Input B dSP x) values in half and then use C + A + b.

Note: + = add, - = subtract, / = division, c(A/b-1) is displayed in the PAX as A/b-1 and the function performs with A divided b then 1 is subtracted and the result is multiply by c.

CALCULATION DECIMAL POINT

C dP
0.000

0 0.0 0.00 0.000 0.0000

This parameter determines the decimal point location for the Calculation Display. For the C+A+b, C-A-b, and C+A-b calculation functions, Input A "Display Decimal Point", Input B "Display Decimal Point" and "Calculation Decimal Point" must all be in the same position.

* *The decimal point position is dependent on the selection made in the "Display Decimal Point" parameter.*

E

CALCULATION CONSTANT VALUE

conSt

1.000

-9999 to 99999

The constant value is used in the Calculation Function formulas to provide offsetting or scaling capabilities. For the C+A+b, C-A-b, and C+A-b calculation functions, the Constant decimal point matches that Calculation Decimal point position. For these functions, the "Constant Value" must be lowered to a value of 0 for no offset.

For the Ab/c, cA/b, and c(A/b-1) calculation functions, there is no "Constant Value" decimal point shown. However, when Input A "Display Decimal Point", Input B "Display Decimal Point" and "Calculation Decimal Point" are in the same position, then the "Constant Value" decimal point will be assumed to be at the same location as the "Calculation Decimal Point". For the Calculation Display to have the same resolution as Inputs A & B, the "Constant Value" must be a value of 1 with trailing 0's for each assumed decimal point location. Example: With Input A, Input B and the Calculation decimal points entered as 0.00, then the "Constant Value" would be entered as 100 for no gain.

CALCULATION ROUNDING*

C rnd

0.001

1 2 5 10

20 50 100

Rounding selections other than one, cause the Calculation Display to 'round' to the nearest rounding increment selected (ie. rounding of '0.005' causes 0.121 to round to 0.120 and 0.124 to round to 125). Rounding starts at the least significant digit of the Calculation Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection. The displayed decimal point reflects that programmed in C dP.

CALCULATION FILTER SETTING

C FLt

1.0

0.0 to 25.0

The calculation filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Calculation Display reading. A value of '0' disables filtering.

CALCULATION FILTER BAND*

C bNd

0.010

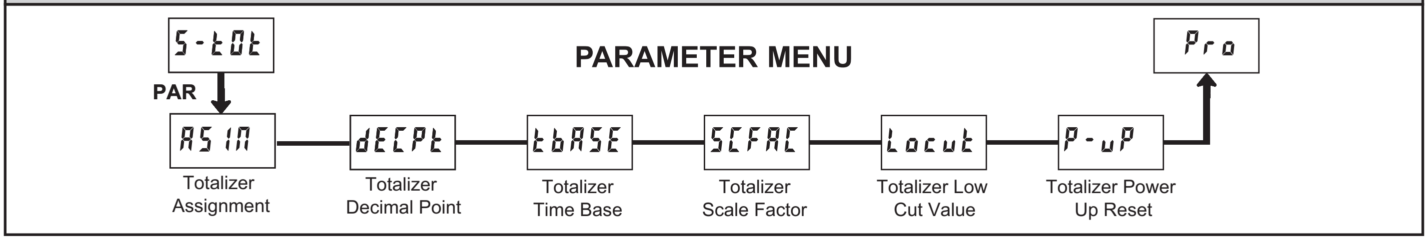
0 to 250 display units

The digital filter will adapt to variations in the calculation filter. When the variation exceeds the calculation filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the digital filter permanently engaged.

* *The decimal point position is dependent on the selection made in the "Display Decimal Point" parameter.*

E

6.5 MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-tOt)



The totalizer accumulates (integrates) the relative Input value using one of two modes. The first is using a time base. This can be used to provide an indication of total flow, usage or consumption over time. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used for weighing applications where accumulation is based on a completed event. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER ASSIGNMENT

A5 IN
A-rEL

A-rEL b-rEL CALC

This parameter determines which value is to be totalized.

TOTALIZER DECIMAL POINT*

dECPt
0.000

0 0.0 0.00 0.000 0.0000

For most applications, this should match the decimal point position of the meter value selected in the totalizer assignment. If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

tbASE
MIN

SEC - seconds (÷ 1) hour - hours (÷ 3600)
MIN - minutes (÷ 60) dAY - days (÷ 86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR*

SCFAC
1.000

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the assigned Input Display. In these cases, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a different value than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE*

Locut
-19.999

-19999 to 99999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

* *The decimal point position is dependent on the selection made in the "Totalizer Decimal Point" parameter.*

TOTALIZER POWER UP RESET

P-uP
NO

NO Do not reset totalizer
YES Reset totalizer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to reset.

TOTALIZER HIGH ORDER DISPLAY

When the total exceeds 5 digits, the front panel annunciator flashes (if assigned to A, B, or C display). In this case, the meter continues to totalize up to a 9 digit value. The high order 4 digits and the low order 5 digits of the total are displayed alternately. The letter "h" denotes the high order display.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:
Input Display - the present input reading
Totalizer Scale Factor - 0.001 to 65.000
Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at a constant rate of 10.0 gallons per minute. The Totalizer is used to determine how many gallons in tenths has flowed. Because the Input Display and Totalizer are both in tenths of gallons, the Totalizer Scale Factor is 1. With gallons per minute, the Totalizer Time Base is minutes (60). By placing these values in the equation, the Totalizer will accumulate every second as follows:

$\frac{10.0 \text{ x } 1.000}{60}$ = 0.1667 gallons accumulate each second

This results in:
10.0 gallons accumulate each minute
600.0 gallons accumulate each hour

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPt) location from the Input Display Decimal Point (dECPt), the required Totalizer Scale Factor is multiplied by a power of ten.

Example: Input (dECPt) = 0.0

Totalizer dECPt	Scale Factor
0.00	10
0.0	1
0	.1
x10	.01
x100	.001

Input (dECPt) = 0.00

Totalizer dECPt	Scale Factor
0.000	10
0.00	1
0.0	.1
0	.01
x10	.001

(x = Totalizer display is round by tens or hundreds)

2. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.

Example: Average flow rate per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for rtot2. The timer will control the start (reset) and the stopping (hold) of the totalizer.

6.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPt) ∇

PARAMETER MENU

6-SPt → PAR

SPSEL Setpoint Select — ASn-n Setpoint Assignment — ACt-n Setpoint Action — SP-n Setpoint Value — HYS-n Setpoint Hysteresis — tON-n On Time Delay — tOF-n Off Time Delay — out-n Output Logic — rSt-n Reset Action — Stb-n Standby Operation — Lit-n Setpoint Annunciators → Pro

∇ - A setpoint card must be installed in order to access this module.

Repeat programming for each setpoint.

SELECT SETPOINT

SPSEL / NO — NO, SP-1, SP-3, SP-2, SP-4

Select a setpoint (alarm output) to open the remaining module menu. (The "n" in the following parameters will reflect the chosen setpoint number.) After the chosen setpoint is programmed, the display will default to SPSEL NO. Select the next setpoint to be programmed and continue the sequence for each setpoint. Pressing **PAR** at SPSEL NO will exit Module 6.

SETPOINT ASSIGNMENT

ASn-n / NONE — NONE, A-rEL, A-AbS, b-rEL, b-AbS, CALC, tot

Selects the meter value that is used to trigger the Setpoint Alarm. The -rEL settings cause the setpoint to trigger off of the relative (net) input value. The relative input value is the absolute input value that includes the Display Offset Value. The -AbS settings cause the setpoint to trigger off of the absolute (gross) input value. The absolute input value is based on Module 1 dSP and INP entries.

SETPOINT ACTION

ACt-n / NO — NO, Ab-HI, Ab-LO, AU-HI, AU-LO, dE-HI*, dE-LO*, bANd*, bNd In, totLo**, totHI**

Enter the action for the selected setpoint (alarm output).

See the Setpoint Alarm Figures in the Setpoint Card Bulletin for a visual detail of each action. The Inside Band action is shown here as it only applies to the PAXDP.

NO	=	No Setpoint Action
Ab-HI	=	Absolute high, with balanced hysteresis
Ab-LO	=	Absolute low, with balanced hysteresis
AU-HI	=	Absolute high, with unbalanced hysteresis
AU-LO	=	Absolute low, with unbalanced hysteresis
dE-HI	=	Deviation high, with unbalanced hysteresis *
dE-LO	=	Deviation low, with unbalanced hysteresis *
bANd	=	Outside band, with unbalanced hysteresis *
bNd In	=	Inside band, with unbalanced hysteresis *
totLo	=	Lower Totalizer absolute high, unbalance hysteresis **
totHI	=	Upper Totalizer absolute high, unbalance hysteresis **

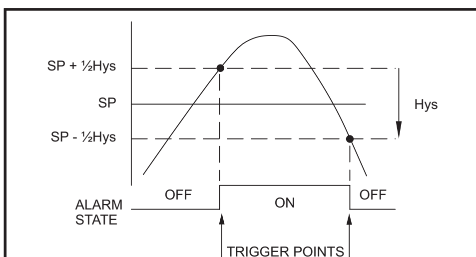
* Setpoint 2 or Setpoint 4 deviation and band action setpoints are relative to the value of setpoint 1 or Setpoint 3 respectively. It is not possible to configure setpoint 1 or 3 as deviation or band actions. It is possible to use setpoint 1 or 3 for an absolute action, while its value is being used for deviation or band.

** These modes only appear, and are the only modes that appear, when the setpoint assignment ASN-n is set to tot. The lower Totalizer action, totLo, allows setpoints to function off of the lower 5 digits of the Totalizer. The upper Totalizer action, totHI, allows setpoints to function off of the upper 4 digits of the Totalizer. To obtain absolute low alarms for the Totalizer, program the totLo or totHI output logic as reverse.

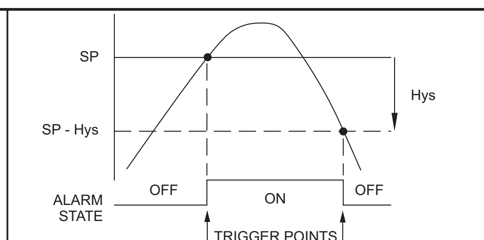
E

Setpoint Alarm Figures

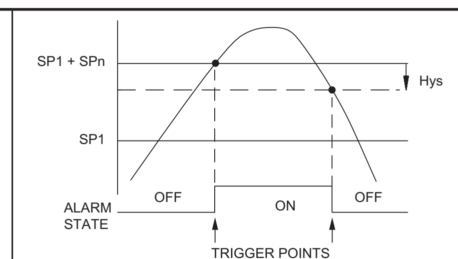
With reverse output logic rEu, the below alarm states are opposite.



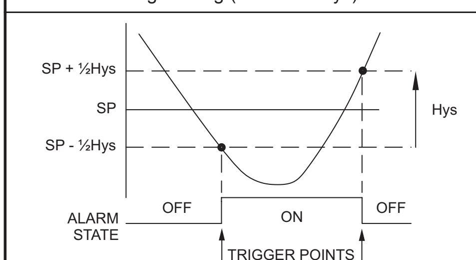
Absolute High Acting (Balanced Hys) = Ab-HI



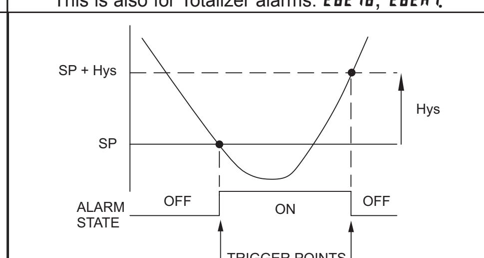
Absolute High Acting (Unbalanced Hys) = AU-HI
This is also for Totalizer alarms: totLo, totHI.



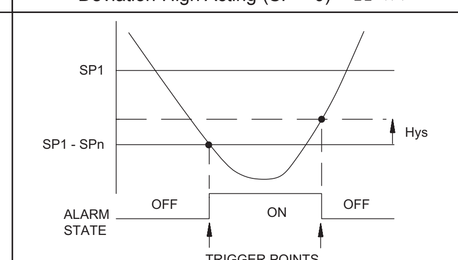
Deviation High Acting (SP > 0) = dE-HI



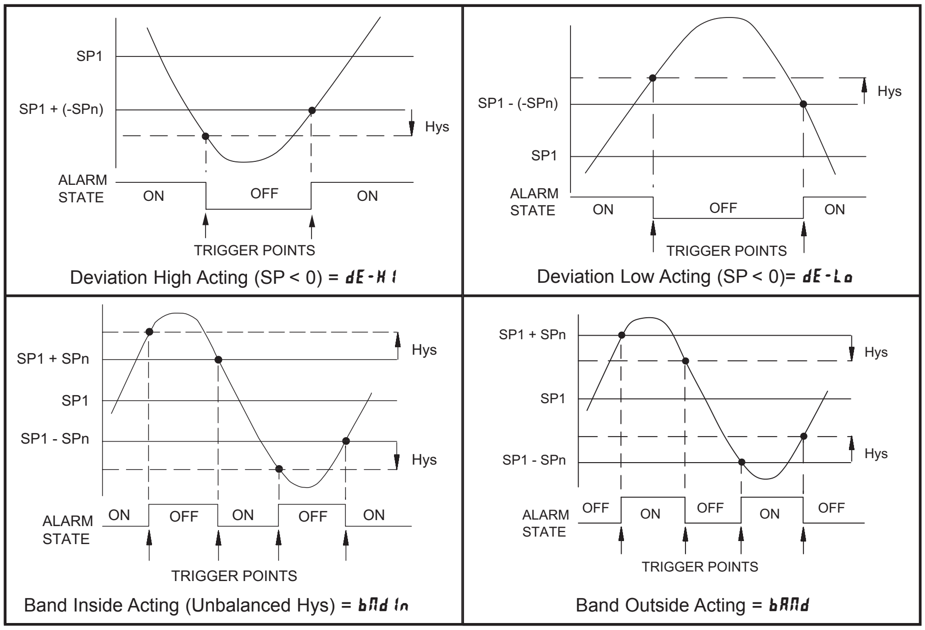
Absolute Low Acting (Balanced Hys) = Ab-Lo



Absolute Low Acting (Unbalanced Hys) = AU-Lo



Deviation Low Acting (SP > 0) = dE-Lo



Deviation High Acting (SP < 0) = dE-HI

Deviation Low Acting (SP < 0)= dE-Lo

Band Inside Acting (Unbalanced Hys) = bANd In

Band Outside Acting = bAND

SETPOINT VALUE

SP-n
10.00

-19999 to 99999

Enter desired setpoint alarm value. These setpoint values can also be entered in the Display Mode during Program Lock-out when the setpoint is programmed as Ent in Parameter Module 3. When a setpoint is programmed as deviation or band acting, the associated output tracks SP1 as it is changed. The value entered is the offset, or difference from SP1.

HYSTERESIS VALUE

HYS-n
0.02

1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balance and unbalance) are affected by the hysteresis. When the setpoint is a control output, usually balance hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

tOF-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

out-n
nor

nor rEv

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEv logic reverses the output logic. In rEv, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

rSt-n
Auto

Auto LAtC1 LAtC2

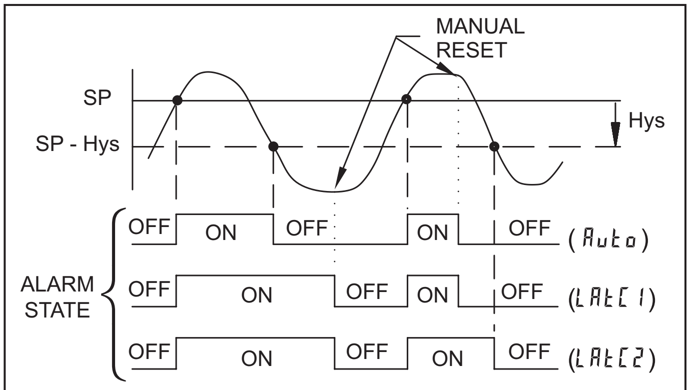
Enter the reset action of the alarm output.

Auto = Automatic action; This action allows the alarm output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The “on” alarm may be manually reset (off) immediately by a front panel function key or user input.The alarm remains reset off until the trigger point is crossed again.

LAtC1 = Latch with immediate reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding “on” alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtC2 = Latch with delay reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the event until the corresponding “on” alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)

E



Setpoint Alarm Reset Actions

STANDBY OPERATION

Stb-n / **no**

no   YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. Once the alarm is on, the alarm operates normally per the Setpoint Action and Reset Mode.

SETPOINT ANNUNCIATORS

Lit-n / **nor**

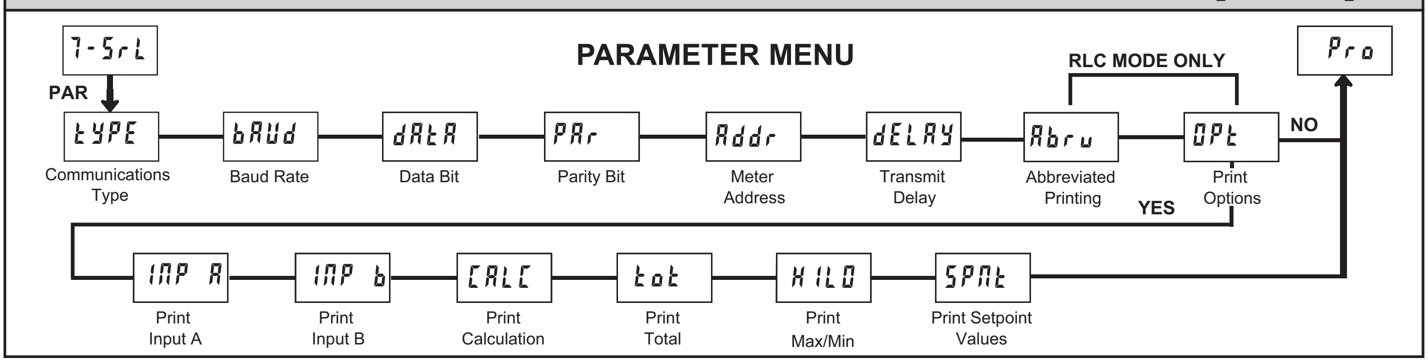
OFF   nor   rEu   FLASH

The OFF mode disables display setpoint annunciators. The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEu mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASH mode flashes the corresponding setpoint annunciators of "on" alarm outputs.

Alternate Setpoints

An Alternate list of setpoint values can be stored and recalled as needed. The Alternate list allows an additional set of setpoint values. (The setpoint numbers nor rear terminal numbers will change in the Alternate list.) The Alternate list can only be activated through a function key or user input programmed for LISt in Module 2. When the Alternate list is selected, the Main list is stored and becomes inactive. When changing between Main and Alternate, the alarm state of Auto Reset Action alarms will always follow their new value. Latched "on" alarms will always stay latched during the transition and can only be reset with a user input or function key. Only during the function key or user input transition does the display indicate which list is being used.

6.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL) ∇



∇ - A communication card must be installed in order to access this module.

COMMUNICATIONS TYPE

tYPE / **MbAS**

rLC - RLC Protocol (ASCII)
Mbrt - Modbus RTU †
MbAS - Modbus ASCII

Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAXDP, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd / **38400**

300	600	1200	2400
4800	9600	19200	38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

† *The Communication Type factory settings must be changed from the Modbus RTU for Crimson 2 communications.*

DATA BIT

dAtA / **8**

7   8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr / **NO**

NO   EUEN   Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

METER UNIT ADDRESS

Addr / **247**

00 to 99 (RLC Protocol)
1 to 247 (Modbus)

Enter the serial meter (node) address. The address range is dependent on the tYPE parameter. With a single unit, configured for RLC protocol (tYPE = rLC), an address is not needed and a value of zero can be used. With multiple units (RS485 applications), a unique 2 digit address number must be assigned to each meter.

E

TRANSMIT DELAY

dELAY
0.010

0.010 to 0.250

Following a transmit value ('*' terminator) or Modbus command, the PAXDP will wait this minimum amount of time in seconds before issuing a serial response.

CRIMSON SOFTWARE

When communicating with Crimson 2 software, the PAXDP must be set in default configuration type of:

Communications Type: MODBUS RTU †
Baud Rate: 38400
Data Bit: 8
ParityBit: no
Meter Unit Address: 247

Parameters below only appear when communications type (tYPE) parameter is set to rLC.

ABBREVIATED PRINTING

Abru
NO

YES NO

Select NO for full print or Command T transmissions (meter address, parameter data and mnemonics) or YES for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. (If the meter address is 00, it will not be sent during a full transmission.)

PRINT OPTIONS

OPt
NO

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, parameter data and mnemonics) can be sent to a printer or computer as a block.

PARAMETER	DESCRIPTION
INP A	Input A Value
INP b	Input B Value
CALC	Calculation
tot	Total Value
HILO	Max. & Min.
SPNt	Setpoint Values

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communication Type Parameter (tYPE) be set to "Mbrt" or "MbAS".

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 32 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 32 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAXDP. "Total Good Comms" is the total messages received by the PAXDP with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 32 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAXDP ab<0100h><20h><20h><10h>

- 16 Guid/Scratch Pad
- Max Register Reads (32)
- Max Register Writes (32)
- Software Version Number
- b = Linear Card "0" = None, "1" = Yes
- a = SP Card, "0"-No SP, "2" or "4" SP

a = "0"(none), "2", "4" SP card installed
b = "0"(none) or "1" Linear Card installed),

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

E

PAXDP FREQUENTLY USED MODBUS REGISTERS

Only frequently used registers are shown below. The entire Modbus Register Table can be found at www.redlion.net. The below limits are shown as Integers or HEX < > values. Read and write functions can be performed in either Integers or Hex as long as the conversion was done correctly. Negative numbers are represented by two's complement.

Note: The PAXDP should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS [1]	REGISTER NAME	LOW LIMIT [2]	HIGH LIMIT [2]	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Input A Relative Value (Hi word)	N/A	N/A	N/A	Read Only	Process value of present input level. This value is affected by Input Type, Resolution, Scaling & Offset Value (Relative Value = Absolute Input Value + Offset Value)
40002	Input A Relative Value (Lo word)					
40003	Input B Relative Value (Hi word)	N/A	N/A	N/A	Read Only	Process value of present input level. This value is affected by Input Type, Resolution, Scaling & Offset Value (Relative Value = Absolute Input Value + Offset Value)
40004	Input B Relative Value (Lo word)					
40005	Calculation Value (Hi word)	N/A	N/A	N/A	Read Only	Calculation Result of Math Function
40006	Calculation Value (Lo word)					
40007	Maximum Value (Hi word)	-19999	99999	N/A	Read/Write	
40008	Maximum Value (Lo word)					
40009	Minimum Value (Hi word)	-19999	99999	N/A	Read/Write	
40010	Minimum Value (Lo word)					
40011	Total Value (Hi word)	-199999000	999999000	N/A	Read/Write	
40012	Total Value (Lo word)					
40013	Setpoint 1 Value (Hi word)	-19999	99999	100	Read/Write	
40014	Setpoint 1 Value (Lo word)					
40015	Setpoint 2 Value (Hi word)	-19999	99999	200	Read/Write	
40016	Setpoint 2 Value (Lo word)					
40017	Setpoint 3 Value (Hi word)	-19999	99999	300	Read/Write	
40018	Setpoint 3 Value (Lo word)					
40019	Setpoint 4 Value (Hi word)	-19999	99999	400	Read/Write	
40020	Setpoint 4 Value (Lo word)					
40021	Setpoint Output Register (SOR)	0	15	N/A	Read/Write See Note	Status of Setpoint Outputs: Bit State: 0=Off, 1=On, Bit 3 = SP1, Bit 2 = SP2, Bit 1 = SP3, Bit 0 = SP4 Outputs can only be activated/reset with this register when respective bits in Manual Mode (MMR) register are set
40022	Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0=Auto Mode, 1=Manual Mode Bit 4 = SP1, Bit 3 = SP2, Bit 2 = SP3, Bit 1 = SP4, Bit 0 = Linear Output
40023	Reset Output Register	0	15	0	Read/Write	Bit State: 1= Reset Output; Bit is returned to zero following reset processing Bit 3 = SP1, Bit 2 = SP2, Bit 1 = SP3, Bit 0 = SP4
40024	Analog Output Register (AOR)	0	4095	0	Read/Write	Functional only if Linear Output is in manual mode (MMR bit 0 = 1). Linear Output Card is written to only if Linear Out (MMR bit 0) is set
40025	Input A Absolute Value (Hi word)	N/A	N/A	N/A	Read Only	Gross value of present Input A level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value
40026	Input A Absolute Value (Lo word)					
40027	Input B Absolute Value (Hi word)	N/A	N/A	N/A	Read Only	Gross value of present Input B level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value
40028	Input B Absolute Value (Lo word)					
40029	Input A Offset Value (Hi word)	-19999	99999	0	Read/Write	Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value
40030	Input A Offset Value (Lo word)					
40031	Input B Offset Value (Hi word)	-19999	99999	0	Read/Write	Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value
40032	Input B Offset Value (Lo word)					
40033	Main Setpoint 1 Value (Hi word)	-19999	99999	100	Read/Write	Setpoint List A
40034	Main Setpoint 1 Value (Lo word)					
40035	Main Setpoint 2 Value (Hi word)	-19999	99999	200	Read/Write	Setpoint List A
40036	Main Setpoint 2 Value (Lo word)					
40037	Main Setpoint 3 Value (Hi word)	-19999	99999	300	Read/Write	Setpoint List A
40038	Main Setpoint 3 Value (Lo word)					
40039	Main Setpoint 4 Value (Hi word)	-19999	99999	400	Read/Write	Setpoint List A
40040	Main Setpoint 4 Value (Lo word)					
40041	Alternate Setpoint 1 Value (Hi word)	-19999	99999	100	Read/Write	Setpoint List B
40042	Alternate Setpoint 1 Value (Lo word)					

[1] For Input Registers, replace the 4xxxx with a 3xxxx in the above register address. The 3xxxx are a mirror of the 4xxxx Holding Registers.
[2] An attempt to exceed a limit will set the register to its high or low limit value.

REGISTER ADDRESS [1]	REGISTER NAME	LOW LIMIT [2]	HIGH LIMIT [2]	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS (Continued)					
40043	Alternate Setpoint 2 Value (Hi word)	-19999	99999	200	Read/Write	Setpoint List B
40044	Alternate Setpoint 2 Value (Lo word)					
40045	Alternate Setpoint 3 Value (Hi word)	-19999	99999	300	Read/Write	Setpoint List B
40046	Alternate Setpoint 3 Value (Lo word)					
40047	Alternate Setpoint 4 Value (Hi word)	-19999	99999	400	Read/Write	Setpoint List B
40048	Alternate Setpoint 4 Value (Lo word)					

[1] For Input Registers, replace the 4xxxx with a 3xxxx in the above register address. The 3xxxx are a mirror of the 4xxxx Holding Registers.
[2] An attempt to exceed a limit will set the register to its high or low limit value.

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to rLC.

SENDING SERIAL COMMANDS AND DATA

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a the command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a one or two digit node address. Not required when address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request (read)	Initiates a block print output. Registers are defined in programming.

E

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	REGISTER NAME [1]	COMMAND SUPPORTED[2]
A	Input A Relative Value	INA	T, R (reset command zeros or tares input)
B	Input B Relative Value	INB	T, R (reset command zeros or tares input)
C	Calculation Value	CLC	T
D	Total	TOT	T, R (reset command zeros Total)
E	Min	MIN	T, R (reset command loads current reading)
F	Max	MAX	T, R (reset command loads current reading)
G	Input A Absolute (Gross) Value	ABA	T
H	Input B Absolute (Gross) Value	ABB	T
I	Input A Offset	OFA	T, V
J	Input B Offset	OFB	T, V
M	Setpoint 1	SP1	T, V, R (reset command resets setpoint output)
O	Setpoint 2	SP2	T, V, R (reset command resets setpoint output)
Q	Setpoint 3	SP3	T, V, R (reset command resets setpoint output)
S	Setpoint 4	SP4	T, V, R (reset command resets setpoint output)
U	Auto/Manual Register	MMR	T, V
W	Analog Output Register	AOR	T, V
X	Setpoint Register	SOR	T, V

1. Register Names are also used as Register Mnemonics during full transmission.
2. The registers associated with the P command are set up in Print Options (Module 7). Unless otherwise specified, the Transmit Details apply to both T and V Commands.

Command String Examples:

1. Address = 17, Write 350 to Setpoint 1
   String: N17VM350*
2. Address = 5, Read Input A value
   String: N5TA*
3. Address = 0, Reset Setpoint 4 output
   String: RS*

Transmitting Data To the Meter

Numeric data sent to the meter must be limited to Transmit Details listed in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (ie. The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Transmitting Data From the Meter

Data is transmitted from the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. See Abbreviated Printing (Abru) parameter.

Full Transmission

Byte	Description
1, 2	2 byte Node (Meter) Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte numeric data field: 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> (Carriage return)
20	<LF> (Line feed)
21	<SP> (Space)☆
22	<CR> (Carriage return)☆
23	<LF> (Line feed)☆

☆ *These characters only appear in the last line of a block print.*

The first two characters transmitted (bytes 1 and 2) are the unit address. If the address assigned is 00, two spaces are substituted. A space (byte 3) follows the unit address field. The next three characters (bytes 4 to 6) are the register mnemonic. The numeric data is transmitted next.

The numeric field (bytes 7 to 18) is 12 characters long. When the requested value exceeds eight digits for count values or five digits for rate values. Byte 8 is always a space. The remaining ten positions of this field (bytes 9 to 18) consist of a minus sign (for negative values), a floating decimal point (if applicable), and eight positions for the requested value. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with <CR> (byte 19), and <LF> (byte 20). When a block print is finished, an extra <SP> (byte 21), <CR> (byte 22), and <LF> (byte 23) are used to provide separation between the transmissions.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> (Carriage return)
14	<LF> (Line feed)
15	<SP> (Space)☆
16	<CR> (Carriage return)☆
17	<LF> (Line feed)☆

☆ *These characters only appear in the last line of a block print.*

The abbreviated response suppresses the address and register mnemonics, leaving only the numeric part of the response.

Meter Response Examples:

1. Address = 17, full field response, Input A = 875
   17 INA 875 <CR><LF>
2. Address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

U abcde
e = Analog Output
d = SP4
c = SP3
b = SP2
a = SP1

Example: VU00011 places SP4 and Analog in manual.

Analog Output Register (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10V
0	0.000	4.000	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Setpoint Output Register (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A "0" in the setpoint location means the output is off and a "1" means the output is on.

X abcd
d = SP4
c = SP3
b = SP2
a = SP1

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10 will result in output 1 on and output 2 off.

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t1 is dependent on the number of characters and baud rate of the channel.

$$t1 = (10 * \# \text{ of characters}) / \text{baud rate}$$

At the start of time interval t2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t2 is controlled by the use of the command terminating character and the Serial Transmit Delay parameter (dELAY). The standard command line terminating character is '*'. This terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time window (t2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

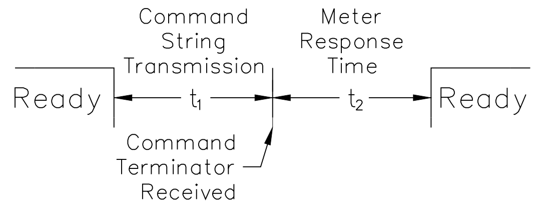
At the beginning of time interval t3, the meter responds with the first character of the reply. As with t1, the time duration of t3 is dependent on the number of characters and baud rate of the channel.

$$t3 = (10 * \# \text{ of characters}) / \text{baud rate.}$$

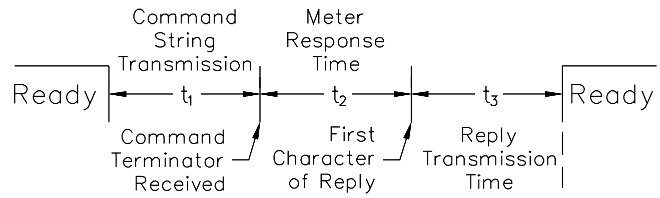
At the end of t3, the meter is ready to receive the next command. The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

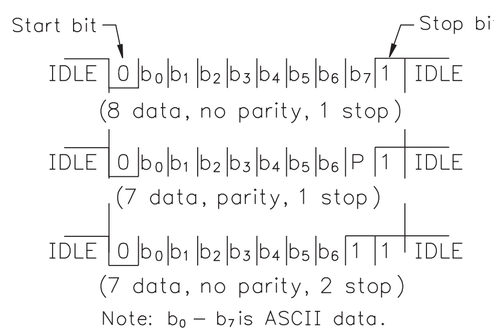
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.



Character Frame Figure

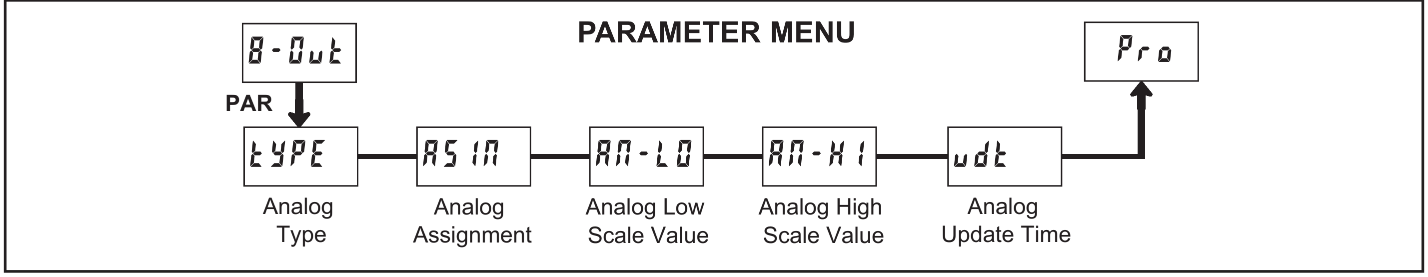
Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAXDP.

6.8 MODULE 8 - ANALOG OUTPUT PARAMETERS (8-Out) ∇



∇ - An analog output card must be installed in order to access this module.

ANALOG TYPE

tYPE
4-20

SELECTION	RANGE
0-20	0 to 20 mA
4-20	4 to 20 mA
0-10	0 to 10 V

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG ASSIGNMENT

ASIN
NONE

NONE A-rEL A-AbS b-rEL
b-AbS CALC tot HI LO

Enter the source for the analog output to retransmit:
rEL = Relative (net) Input Value. The Relative Input Value is the Absolute Input Value that includes the Display Offset Value.
AbS = Absolute (gross) Input Value. The Absolute Input Value is based on Module 1 dSP and INP entries.
CALC = Calculation Value
tot = Totalizer Value
LO = Minimum Display Value
HI = Maximum Display Value

ANALOG LOW SCALE VALUE

AN-LO
0.00

-19999 to 99999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

AN-HI
100.00

-19999 to 99999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

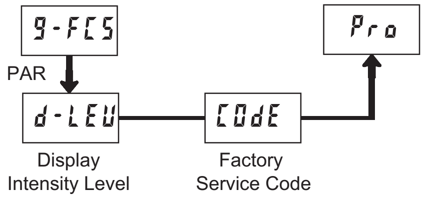
udt
0.0

0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

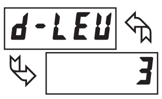
E

6.9 MODULE 9 - Factory Service Operations (9-FCS)



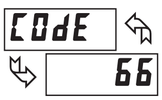
PARAMETER MENU

DISPLAY INTENSITY LEVEL



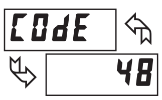
Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in Quick Programming Mode when enabled.

RESTORE FACTORY DEFAULTS



Use the arrow keys to display CODE 66 and press **PAR**. The meter will display rESEt and then return to CODE 50. Press **DSP** key to return to Display Mode. This will overwrite all user settings with the factory settings.

CALIBRATION



The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored using the Apply (APLY) Scaling Style.

Calibration may be aborted by disconnecting power to the meter before exiting Module 9. In this case, the existing calibration settings remain in effect.

E

INPUT CALIBRATION

WARNING: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.

Before starting, verify that the Input Ranger Jumper is set for the range to be calibrated. Also verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. NO and **PAR** can be chosen to exit the calibration mode without any changes taking place.

Then perform the following procedure:

1. Use the arrow keys to display (CODE 48) and press **PAR**.
2. Choose the input channel/range to be calibrated by using the arrow keys and press **PAR**. (NO and **PAR** can be chosen to exit the calibration mode without any changes taking place.)
3. When the zero range limit appears on the display, apply the appropriate:
   - Voltage range: dead short applied
   - Current range: open circuit
4. Press **PAR** and the top range limit will appear on the display after approximately 1 second.
5. With the top range limit on the display, apply the appropriate:
   - Voltage range: 10 VDC
   - Current range: 20 mADC
6. Press **PAR** and CAL. NO will appear on the display after approximately 1 second.
7. When NO appears, press **PAR** twice.
8. If the meter is not field scaled, then the input display should match the value of the input signal.
9. Repeat the above procedure for each input range to be calibrated.

ANALOG OUTPUT CARD CALIBRATION

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure:

1. Use the arrow keys to display CODE 48 and press **PAR**.
2. Use the arrow keys to choose OUt and press **PAR**.
3. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX arrow keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if this range is not being calibrated, press **PAR**.

SELECTION	EXTERNAL METER	ACTION
0.0_A	0.00	Adjust if necessary, press **PAR**
4.0_A	4.00	Adjust if necessary, press **PAR**
20.0_A	20.00	Adjust if necessary, press **PAR**
0.0u	0.00	Adjust if necessary, press **PAR**
10.0u	10.00	Adjust if necessary, press **PAR**

4. When NO appears remove the external meters and press **PAR** twice.

TROUBLESHOOTING

PROBLEM	REMEDIES
NO DISPLAY	CHECK: Power level, power connections, Module 3 programming
PROGRAM LOCKED-OUT	CHECK: Active (lock-out) user input ENTER: Security code requested
DISPLAY LOCKED-OUT	CHECK: Module 3 programming
INCORRECT INPUT DISPLAY VALUE	CHECK: Module 1 programming, Input Jumper position, input connections, input signal level, Module 4 Display Offset is zero, press DSP for Input Display PERFORM: Module 9 Calibration (If the above does not correct the problem.)
“OLOL” in DISPLAY (SIGNAL HIGH)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
“ULUL” in DISPLAY (SIGNAL LOW)	CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level
JITTERY DISPLAY	INCREASE: Module 1 filtering, rounding, input range CHECK: Wiring is per EMC installation guidelines
MODULES or PARAMETERS NOT ACCESSIBLE	CHECK: Corresponding plug-in card installation
ERROR CODE (Err xxx or EE xxx)	PRESS: Reset KEY (If cannot clear contact factory.)

For further assistance, contact technical support at the appropriate company numbers listed.

MODEL PAXLSG - PAX LITE STRAIN GAGE METER / MILLIVOLT METER

- *3 1/2-DIGIT, 0.56" (14.2 mm) HIGH RED LED READOUT*
- *HIGH SENSITIVITY, 10 mV FULL SCALE*
- *WIDE RANGE GAIN AND OFFSET ADJUSTMENTS*
- *BUILT-IN EXCITATION 5 OR 10 VDC*
- *APPLICABLE AS REGULAR MILLIVOLT INDICATOR (Single-ended or Differential Input)*
- *SELECTABLE DECIMAL POINTS*
- *OVER-RANGE INDICATION*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *OPTIONAL CUSTOM UNITS OVERLAY WITH BACKLIGHT*

C UL US LISTED
IND. CONT. EQ.
51EB

CE

E

GENERAL DESCRIPTION

The Model PAXLSG expands the PAX Lite capabilities into the indication of pressure, load, force, and other parameters measured with strain gages. The unit features broad range scaling and can be used with a wide variety of strain gage resistances and bridge configurations. A built-in excitation source is jumper selectable for 5 or 10 VDC @ 120 mA maximum, and can power up to four full 350 Ω bridges in load averaging applications. Although designed primarily for strain-gage indication, the PAXLSG is also ideal for single-ended or differential millivolt input applications, with full-scale input ranges from 0 to 10 mV thru 0 to 2 VDC. Adjustable scaling and offset allow direct readout in nearly any engineering unit.

The meter has a NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, allowing the meter to provide a tough yet reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.

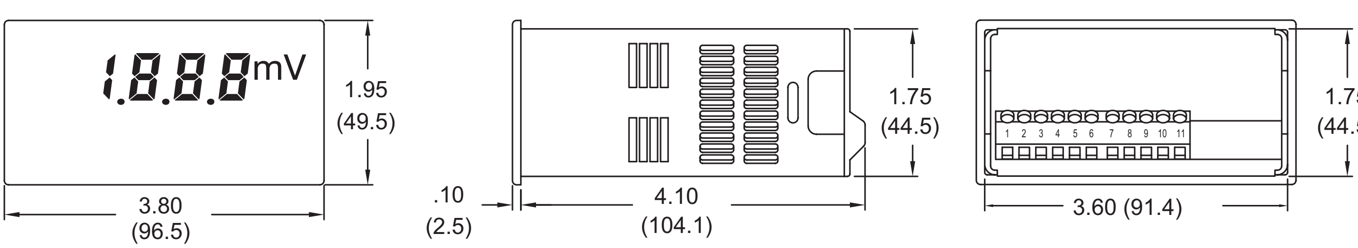


Table Of Contents

Ordering Information

Meter Part Numbers

PAXL	**SG**	**0**	**0**

SG - Strain Gage Meter

E

Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

General Meter Specifications

1. **DISPLAY**: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED, (-) minus sign displayed when voltage is negative. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **OVER-RANGE INDICATION**: Indicated by blanking 3 least significant digits.
3. **POWER**:
   AC Power: 85 to 250 VAC, 50/60 HZ, 6 VA
   Isolation: 2300 Vrms for 1 min. to all inputs.
4. **INPUT SIGNAL**: Single-ended or differential input, ±2.0 V max. Gain (Sensitivity) is adjustable from 200 Units of Numerical Readout/millivolt input (gives full scale readout of 1999 at 10 mV input), to less than 1 Unit of Numerical Readout/mV (gives full scale readout of 1999 at 2.0 V input). Maximum common mode voltage swing with respect to signal ground, 0 to 7 V.
   Note: Absolute maximum voltage that can be applied between the two input terminals or between input and signal common is 50 VDC.
5. **INPUT IMPEDANCE**: 100 MΩ
6. **LINEARITY**: ±(0.05% ±1 digit)
7. **LOW FREQUENCY NOISE REJECTION**:
   Normal Mode Rejection: 84 dB @ 50/60 Hz
   Common Mode Rejection: 50 dB with respect to excitation common; 110 dB with respect to earth ground.
8. **RESPONSE TIME**: 2.0 seconds to settle from step input.
9. **READING RATE**: 2.5 updated readings/second, nominal.
10. **EXCITATION SUPPLY**:
    Jumper Selectable: 5 VDC @ 60 mA max., ±2%
    10 VDC @ 120 mA max., ±2%
    Temperature coefficient (ratio metric): 20 ppm/°C max.
11. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature: 0° to 60°C
    Storage Temperature: -40° to 80°C
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing)
    Span Temperature Coeff.: 100 PPM/°C
    Offset Temperature Coeff.: 100 PPM/°C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Altitude: Up to 2000 meters
12. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Certificate # UL/8843A/UL
    CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    IP20 Enclosure rating (Rear of unit), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Power frequency magnetic fields	EN 61000-4-8	Criterion A 30 A/m
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

13. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
14. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
15. **WEIGHT**: 0.65 lbs (0.24 kg)

Accessories

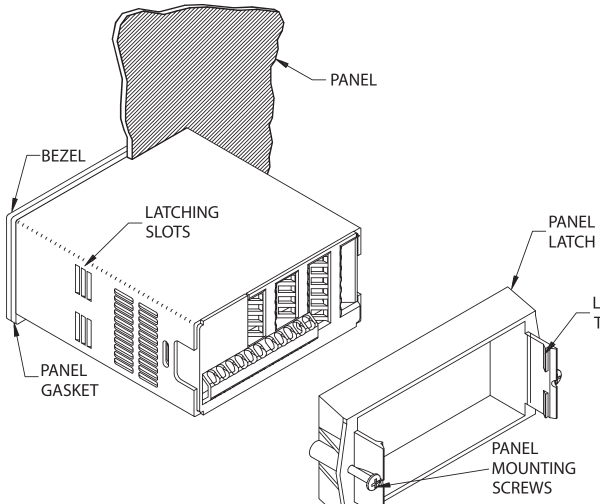
UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled by a DIP switch.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



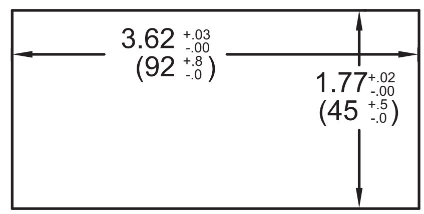
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

PANEL CUT-OUT



2.0 Setting the Switches and Jumpers

The meter has switches that must be checked and/or changed prior to applying power. To access the switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Excitation Range Jumper

A jumper is used for selection of the 5 or 10 volt range. It is important that only one jumper position is used at a time.

Set-Up DIP Switches

Two banks of DIP switches are located inside the meter. The 9 position bank of switches is used for calibrating the meter. The values of these switches is discussed in section 5.0 Calibrating the Meter.

The bank of 4 switches located near the front display are used for the selection of decimal points and backlight annunciator. Selecting "ON" position enables the function.

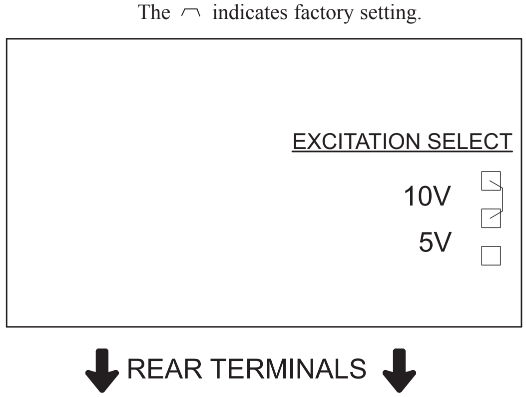
SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label

E

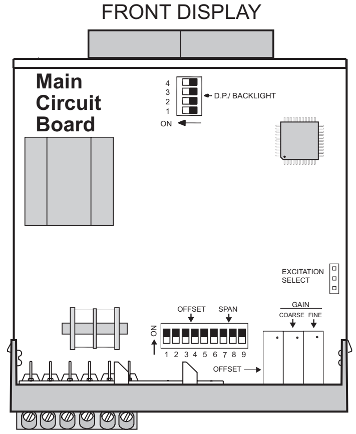
PAXLSG Jumper Selection

JUMPER SELECTIONS

The ⌒ indicates factory setting.



FRONT DISPLAY



REAR TERMINALS

3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, its source or the method of coupling into the unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

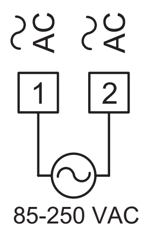
1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   - Ferrite Suppression Cores for signal and control cables:
     - Fair-Rite # 0443167251 (RLC #FCOR0000)
     - TDK # ZCAT3035-1330A
     - Steward #28B2029-0A0
   - Line Filters for input power cables:
     - Schaffner # FN2010-1/07 (RLC #LFIL0000)
     - Schaffner # FN670-1.8/07
     - Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

3.1 POWER WIRING

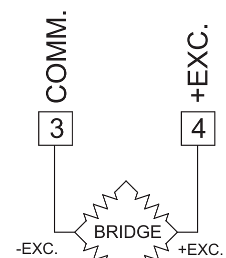
AC Power

Terminal 1: VAC
Terminal 2: VAC



Excitation Power

Terminal 3: Common
Terminal 4: Excitation +

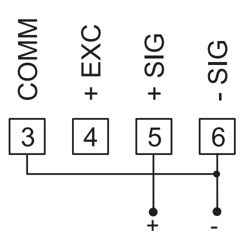


5 VDC @ 60 mA max, ±2%

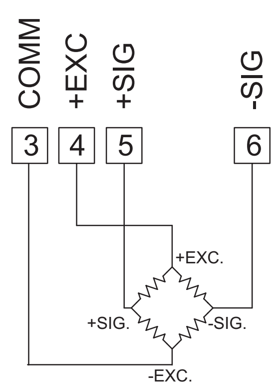
10 VDC @ 120 mA max, ±2%

3.2 INPUT SIGNAL WIRING

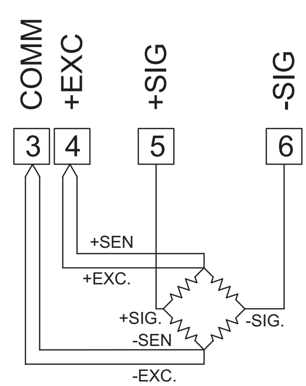
2-Wire Single Ended Input



4-Wire Bridge Input



6-Wire Bridge Input



DEADLOAD COMPENSATION

In some cases, the combined deadload and liveload output may exceed the range of the input. To use this range, the output of the bridge can be offset a small amount by applying a fixed resistor across one arm of the bridge. This shifts the electrical output of the bridge downward to within the operating range of the meter. A 100 K ohm fixed resistor shifts the bridge output approximately -10 mV (350 ohm bridge, 10 V excitation).

Connect the resistor between +SIG and -SIG. Use a metal film resistor with a low temperature coefficient of resistance.

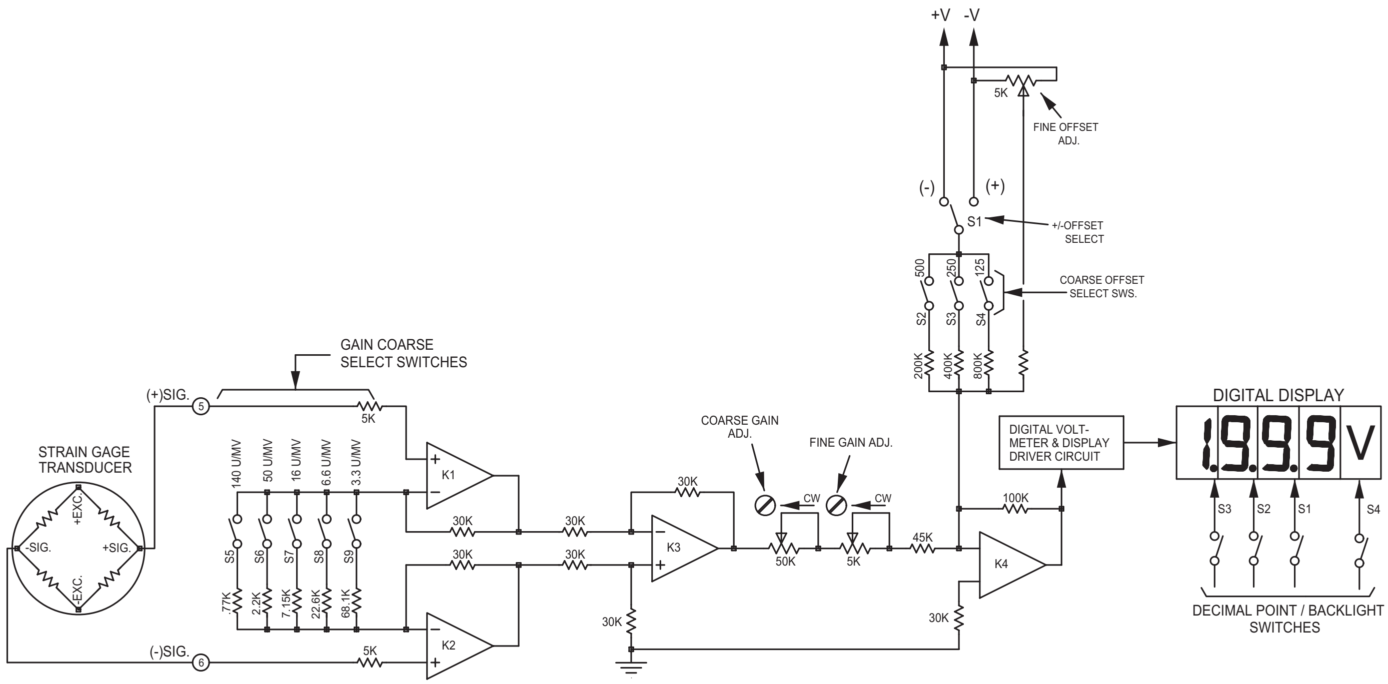
BRIDGE COMPLETION RESISTORS

For single strain gage applications, bridge completion resistors must be employed externally to the meter. Only use metal film resistors with a low temperature coefficient of resistance.

Load cells and pressure transducers are normally implemented as full resistance bridges and do not require bridge completion resistors.

4.0 Scaling the Meter

PAXLSG SCHEMATIC



DESCRIPTION OF OPERATION

The Pax Lite Strain Gage Indicator (PAXLSG) consists of a digital voltmeter combined with a high-gain, differential input amplifier that has provision for wide range scaling adjustment (shown above). The unit also incorporates an excitation power supply (5 or 10 VDC) that delivers up to 120 mA. In the simplified schematic above, K1, K2, and K3 form a high-gain, high-stability, differential input preamplifier with a single ended output. The gain of this preamplifier is set up by coarse gain select switches S5 through S9. These switches can be turned on in combination to provide discrete steps of gain-range adjustment. The output of the preamplifier (K3 output) is applied to the summing amplifier (K4) through coarse and fine adjustable potentiometers. These adjustable potentiometers provide final vernier gain adjustment over a range of slightly more than 2:1. An adjustable offset voltage signal is also added in at the input of K4 for zero-balance or for applications where the transfer curve must be offset from zero.

GAIN ADJUSTMENTS

Gain is defined as the Units of Numerical change seen on the display per mV (millivolt) of input signal change (disregarding display decimal points). In effect, gain determines the slope of the transfer curve and is expressed in Units/mV.

$$\text{GAIN} = \frac{\text{(Max. Num. Readout) - (Min. Num. Readout)}}{\text{(Max. mV Input Sig.) - (Min. mV Input Sig.)}}$$

Note: Disregarded Decimal Points in Readout.

For example, if an PAXLSG is to display 50.0 @ 2 mV (min.) and 169.0 @ 19 mV (max.), the required gain will be:

$$\text{GAIN} = \frac{\text{1690 Units - 500 Units}}{\text{19 mV - 2 mV}} = \text{70 Units/mV}$$

Note: Remember, display decimal points are disregarded.

To establish this gain, the settings of the coarse gain select switches must first be determined. These switches establish the maximum end of the 2:1 adjustment range of the coarse and fine vernier gain adjustments.

COARSE GAIN SELECT SWITCHES

Each of the coarse gain select switches is marked with the amount of maximum gain it will contribute when turned on. They are turned on singly or in combination (adding up each of their gain contributions), to arrive at a maximum gain value that is just above the desired gain value. To achieve the desired gain of 70 Units/mV in the example just given, the following switches would be turned on:

S6 (Gain 50) + S7 (Gain 16) + S8 (Gain 6.6) = 72.6 Units/mV

With these switches ON, the coarse and fine vernier adjustments cover a gain range from about 36 Units/mV (½ of max.) to 72.6 Units/mV. The required gain of 70 Units/mV falls within this adjustable range.

COARSE AND FINE GAIN ADJUSTMENTS

Once the gain select switches have been set, the final gain calibration is made with the Coarse and Fine Gain adjustments. Both of these adjustments are 15-Turn, screwdriver adjustable potentiometers that increase gain with clockwise rotation. The Coarse adjustment has a 2:1 range. The Fine adjustment has a range of 5-10% (depending on the setting of the Coarse adjustment). Both pots are located at the rear of the meter.

OFFSET ADJUSTMENTS

Offset adjustments move the transfer curve up-and-down along the vertical axis without changing the slope (Gain). They are used to "balance" the output of transducers or to intentionally introduce an offset, such as tare-load compensation. The Fine Offset Adjustment is a 15-turn screwdriver adjustable potentiometer, located at the rear of the meter. It has a range of ±125 Numerical Units of offset which is sufficient for balancing the output of most transducers.

The Coarse Offset Switches (S2, 3, and 4) can be used to add additional steps of offset. Like the coarse gain select switches, the offset switches are marked with the approximate value of offset contributed by each switch, and they can be turned on in combinations with each switch, contributing its value to the total. Switch S1 selects the polarity of the offset signal and can be set to either add or subtract the offset contribution of the switches. The maximum offset that can be obtained with all switches ON and the Fine Offset at its maximum is ±1000, which is one half of the full scale readout.

5.0 Calibrating the Meter

There are three different methods that can be used to calibrate the PAXLSG, and the method chosen depends largely on the nature of the application. The three methods are:

VOLTAGE CALIBRATION

In this method, the transducer signal is simply replaced with an accurately measured input voltage that can be varied through the range normally delivered by the transducer (See Voltage Calibration Circuit, below). The PAXLSG is then adjusted to provide the proper readout.

SYSTEM CALIBRATION

In this method, the transducer is connected to the input of the PAXLSG in the final installation, or in a bench set-up simulating the actual installation. Accurately known inputs are then applied to the transducer (i.e. load, pressure, force, etc.), and the PAXLSG adjustments are made to provide the desired indication. This method is usually preferable to the Voltage Calibration method since it calibrates both the transducer and the PAXLSG as a combination, and reduces the inherent risk of inaccuracy or errors accumulated by separate calibration. However, it can only be used in applications where the parameter to be indicated can be easily varied and accurately measured or established. It is also very awkward to use if an offset or transducer unbalance must be dealt with because of Offset/Gain adjustment interaction.

COMBINATION VOLTAGE/SYSTEM CALIBRATION

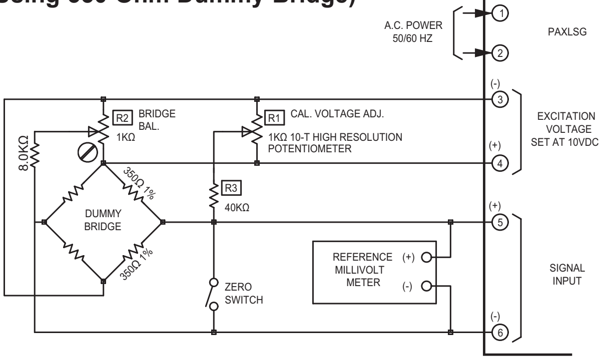
In applications where tare-load, offset, or substantial transducer unbalance exists and where high accuracy is required in the final indication, it may be desirable to voltage calibrate the unit first to get it very close to its final settings. Then, after final installation, the unit can be "tweaked" to its final settings while using accurately known inputs to the system. These various factors make it impossible to set up one calibration procedure to cover all applications. However, using the following information on Voltage Calibration together with the examples given should provide a good basis for handling virtually any calibration requirement.

CALIBRATION EXAMPLE

"Voltage Calibration" can be easily performed for any application, using the calibration circuit shown below.

VOLTAGE CALIBRATION CIRCUIT

(Using 350 Ohm Dummy Bridge)



This 350 Ohms *"Dummy Bridge"* circuit delivers calibration voltages in ranges of 0 to ±22 mV, 0 to +44 mV, or 0 to -44 mV, depending on the setting of R2. The range can be increased or decreased by adjusting the value of R3 *(shown as 40 K)*. An accurate reference millivoltmeter is used to set up the calibration voltage, and a *"Zero Switch"* facilitates balancing without readjusting the calibration voltage. High-stability metalized resistors *(1% tol.)* should be used. The use of a dummy bridge insures a common-mode voltage during calibration that is very similar to that of the actual transducer.

SET-UP:

Before starting the procedure, the Input Swing Voltage (Vs), the Readout Span (Rs) and the required GAIN must be determined.

WHERE:

Rs = (Max. Numerical Display) - (Min. Numerical Display) *Disregard Decimal Points*

Vs = (mV in @ Max. Display) - (mV in @ Min. Display)

$$\text{GAIN} = \frac{\text{Rs}}{\text{Vs}} = \text{Units/mV}$$

EXAMPLE: Readout is to be 5.00 Units @ 2 mV minimum, and 15.00 Units @ 18 mV maximum. The transducer is a 350 Ω strain-gage bridge requiring 10 VDC excitation.

Rs = 1500 - 500 = 1000 Units

Vs = 18 mV - 2 mV = 16 mV

$$\text{GAIN} = \frac{1000}{16} = 62.5 \text{ Units/mV}$$

Note: While most strain gage readout applications are zero-based (i.e. zero readout @ zero input) this example was intentionally chosen because it included an offset reading at zero input. It will be used in the Calibration Procedure below to illustrate the most convenient way to handle offset situations without excessive interaction of gain and offset adjustments. If a zero-based example had been given, the minimum readout and input voltage would have both been zero. Rs and Vs would then simply be the maximum values of readout and input voltage respectively, gain would just be the ratio of (Max. Readout/Max. Input mV), and Steps 7 and 8 of the procedure below could be eliminated.

CALIBRATION PROCEDURE

1. Set the Coarse Gain Select Switches, S5 through S9 to establish a maximum range just exceeding the required gain. Referring to the example given, the required gain was calculated to be 62.5 Units/mV. Setting switches S6 and S7 ON gives 50 + 16 = 66 Units/mV, which is just above the required amount. The following chart gives an approximate gain adjustment value for each switch:

SWITCH NUMBER	SPAN VALUE
5	140
6	50
7	16
8	6.6
9	3.3

All offset switches, S2, 3, and 4, should be off.

2. Connect the unit to the Calibration Circuit as shown. Set the excitation voltage range jumper to the 10 V position.
3. Place unit in the case and turn power on to the unit. Allow 10 minutes of warm-up time for stabilization.
4. Close the "Zero Switch" of the calibration circuit to obtain zero input voltage. Adjust the fine offset control to get a zero readout.
5. Open the "Zero Switch" of the calibrating circuit and set the input voltage to the calculated swing voltage, Vs. (Vs is 16 mV in the example given.) Now, adjust the Gain Coarse and Fine Controls to get a readout equal to the Readout Span.
(Rs = 1000 Units in the example given.)
6. Repeat Step 4 and readjust zero if required. If zero readjustment was needed, repeat Step 5, then back to Step 4, etc., until Zero and Rs readings are acceptable.

*7. Set the calibration voltage to the minimum input level (2 mV in this example). Record the meter reading (125 in this example). Power the meter down and remove it from the case. Set the Coarse Offset Select Switches to get the corresponding minimum readout (add the switch offset value(s) to the recorded meter reading). In the example given, the minimum readout was 500 units @ 2 mV, therefore setting switches 3 and 4 gives us 125 (meter reading) + 125 (SW4) + 250 (SW3) = 500. The following chart gives an approximate offset adjustment value for each switch.

SWITCH NUMBER	OFFSET VALUE
2	500
3	250
4	125

*8. Place unit in the case and turn power on to the unit. Use the fine offset adjustment to fine tune the desired minimum reading (500 in this example). Vary the input from the minimum to maximum levels and check the corresponding readouts. Fine-tune if necessary by readjusting the fine gain adjustment at the maximum end and the fine offset adjustment at the minimum end. (In the example, readout is 500 @ 2 mV min. and 1500 @ 18 mV max.) Alternate between minimum and maximum inputs as required until readout is within desired tolerance at the extremes.9. Set appropriate decimal point switch (S2 for the example given).

The unit is now ready for installation.

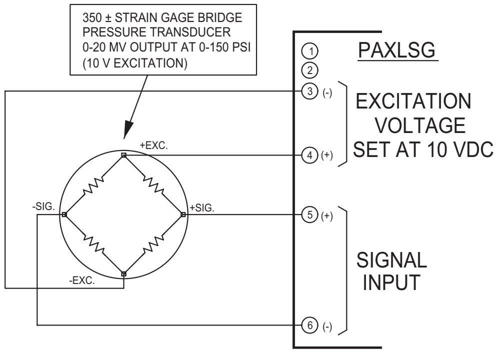
* Steps 7 and 8 are not required in zero-based applications.

E

6.0 APPLICATIONS

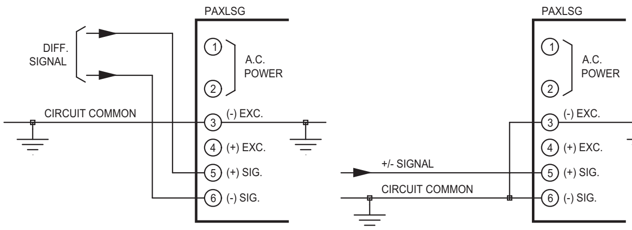
EXAMPLE #1 PRESSURE READOUT & SYSTEM CALIBRATION

This illustration depicts a common application using an PAXLSG with a strain-gage pressure transducer for pressure indication. The gain required to display 150 Units @ 20 mV is 150/20, or 7.5 Units/mV. Setting the Coarse Gain Select Switches S8 and S9 ON, gives a gain range of 6.6 + 3.3, or 9.9 Units/mV maximum, which brackets the required gain. The transducer curve is zero-based *(i.e. zero readout at zero input)*, and can be easily System Calibrated. A variable pressure input is applied to the transducer with a *"Dead-Weight Tester"* and the Fine Offset is adjusted to give a readout of zero with no pressure applied. Then 150 PSI is applied, the Coarse and Fine Gain controls are adjusted for a readout of 150. Pressure is removed, zero is checked and readjusted with the Fine Offset control if needed. Pressure is varied between zero and maximum, with the Fine Gain and Offset adjustments retrimmed as needed until the readout is within tolerance.



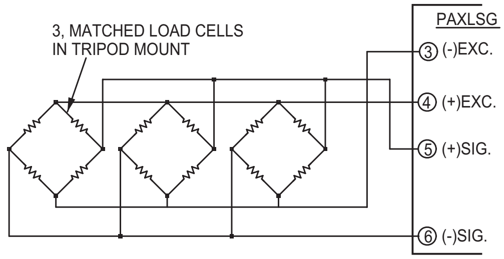
EXAMPLE #2 THE MODEL PAXLSG AS A MILLIVOLT METER

The PAXLSG can be used as a scaleable millivolt meter and will accept either single-ended or differential inputs when connected as shown. Input signals are referenced to the negative (common) side of the excitation supply (Terminal 3). Maximum common-mode voltage (for differential input) is 0 to +7 VDC.



EXAMPLE #3 MULTIPLE LOAD-CELL INPUT, AVERAGE READING

The 120 mA excitation output capability of the PAXLSG allows it to operate multiple strain gage bridges. In this example, it is used to indicate the quantity of granular material held in a hopper that is supported by three load cells in a tripod mounting arrangement. The tare-weight of the empty hopper is about 30% of the full weight, requiring a significant offset for a zero readout when empty. The PAXLSG is first Voltage-Calibrated *(using the known output of the load cells at the empty and full conditions)*. Then the unit is installed and fine trimmed (System Calibration) using known loads.



E

MODEL PAXS - STRAIN GAGE INPUT

This is a brief overview of the PAXS. For complete specifications and programming information, see the **PAX Analog Input Panel Meters Bulletin** starting on **page 301**.

- *LOAD CELL, PRESSURE AND TORQUE BRIDGE INPUTS*
- *DUAL RANGE INPUT: ±24 mV OR ±240 mV*
- *SELECTABLE 5 VDC OR 10 VDC BRIDGE EXCITATION*
- *PROGRAMMABLE AUTO-ZERO TRACKING*

C UL US LISTED
IND. CONT. EQ.
51EB

E

PAXS SPECIFICATIONS

SENSOR INPUTS:

INPUT RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
±24 mVDC	0.02% of reading +3 µV	0.07% of reading +4 µV	100 Mohm	30 V	1 µV
±240 mVDC	0.02% of reading +30 µV	0.07% of reading +40 µV	100 Mohm	30 V	10 µV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28 °C and 10 to 75% RH environment; and accuracy over a 0 to 50 °C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50 °C range includes the temperature coefficient effect of the meter.

CONNECTION TYPE: 4-wire bridge (differential)
2-wire (single-ended)

COMMON MODE RANGE (w.r.t. input common): 0 to +5 VDC
Rejection: 80 dB (DC to 120 Hz)

BRIDGE EXCITATION :
Jumper Selectable: 5 VDC @ 65 mA max., ±2%
10 VDC @ 125 mA max., ±2%
Temperature coefficient (ratio metric): 20 ppm/°C max.

MODEL PAX2S – 1/8 DIN STRAIN GAGE INPUT PANEL METER

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

CE

- *LOAD CELL, PRESSURE AND TORQUE BRIDGE INPUTS*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *SELECTABLE 5 VDC OR 10 VDC BRIDGE EXCITATION*
- *PROGRAMMABLE AUTO-ZERO TRACKING*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *PROGRAMMABLE UNITS DISPLAY*
- *VARIABLE CONTRAST AND INTENSITY DISPLAY*
- *UP TO 160 SAMPLES PER SECOND CONVERSION RATE*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The PAX2S Strain Gage Panel Meter offers many features and performance capabilities to suit a wide range of industrial applications. The PAX2S has a strain gage input to handle various types of bridge configurations including load cell, pressure and torque sensors. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs.

Highlighting the PAX2S is a dual line, display with a large 0.71", tri-color 6 digit top display line and a 0.35", 9 digit green bottom display line. The meter also offers programmable units display, providing capability to tag the display with units of measure. Display color change capability provides machine operators a visual display of changing conditions, even when the operator is not close enough to read the actual display value. In addition, a universal power supply provides the ultimate in flexibility for both AC and DC power.

The meter provides a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events. The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized weight or calculate service intervals of motors, pumps, etc.

The meter has up to four setpoint outputs, implemented on plug-in option cards. The plug-in cards provide dual FORM-C relays, quad FORM-A, or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

The PAX2 can be programmed to utilize Modbus protocol. With Modbus, the user has access to all configuration parameters. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meter has a feature that allows a remote computer to directly control the outputs of the meter. Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and Profibus-DP.

The PAX2 includes a built-in USB programming port. With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2 without the need of any additional option cards.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track either the input, totalizer, max or min readings, or any setpoint value.

After the meter has been initially configured, the parameter programming may be locked out from further modification in its entirety, or allowing selected values accessible for quick entry.

The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects with regard to CE requirements, the meter provides a tough reliable application solution.

E

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.

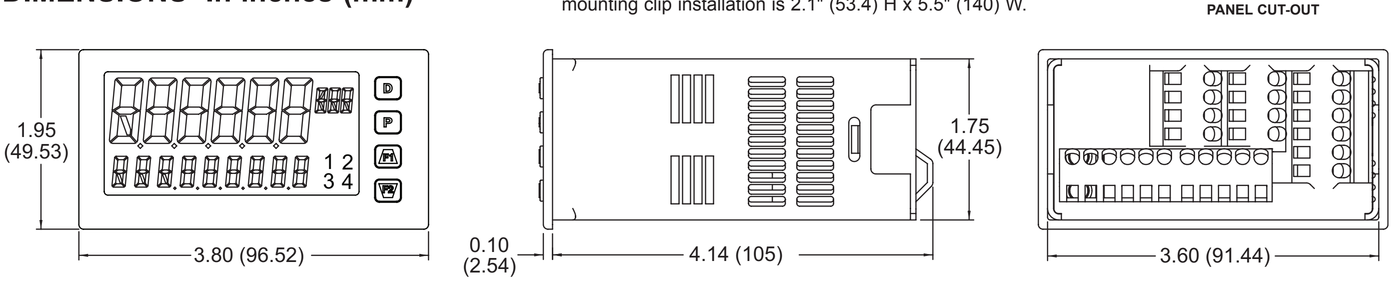


Table Of Contents

Ordering Information

Meter Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2S	Strain Gage Input Panel Meter	PAX2S000

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC [1]	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	SFCRD[2]	Crimson PC Configuration Software for Windows 2000, XP and Windows 7	SFCRD200
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Notes:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.
2. Crimson software is available for free download from http://www.redlion.net/

E

General Meter Specifications

1. **DISPLAY**: Positive image LCD
   Top Line - 6 digit, 0.71" (18 mm), with tri-color backlight (red, green or orange), display range: -199,999 to 999,999;
   Bottom Line - 9 digit, 0.35" (8.9 mm), with green backlight, display range: - 199,999,999 to 999,999,999
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **ANNUNCIATORS**: Backlight color: Red
   1 - setpoint alarm 1   3 - setpoint alarm 3
   2 - setpoint alarm 2   4 - setpoint alarm 4
   Line 1 Units Label – programmable 3 digit units annunciator with tri-color backlight (red, green or orange)
4. **KEYPAD**: 2 programmable function keys, 4 keys total
5. **A/D CONVERTER**: 24 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: programmable 5 to 160 readings/sec.
   Step response:

Input Rate	5	10	20	40	80	160	Readings/ Sec
Response Time *	600	400	200	100	50	30	msec response time *

   * - max. to within 99% of final readout value (digital filter disabled)
   Display update rate: 1 to 20 updates/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.
   Analog output update rate: 0 to 10 sec
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   ". . . . ." - Appears when display values exceed + display range.
   "- . . . . ." - Appears when display values exceed - display range.
8. **INPUT**:
   Connection Type: 4-wire bridge (differential); 2-wire (single-ended)
   Common Mode Range (with respect to input common): 0 to +5 VDC
   Rejection: 80 dB (DC to 120 Hz)

INPUT RANGE	ACCURACY* (18 to 28ºC)	ACCURACY* (0 to 50ºC)	IMPEDANCE/ COMPLIANCE	MAX CONT. OVERLOAD	** RESOLUTION
± 24 mVDC	0.02% of rdg + 3 µV	0.07% of rdg + 4 µV	100 Mohm	30 V	1 µV
± 240 mVDC	0.02% of rdg + 30 µV	0.07% of rdg + 40 µV	100 Mohm	30 V	10 µV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 10 to 75% RH environment; and accuracy over a 0 to 50°C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 50°C range includes the temperature coefficient effect of the meter.
** Higher resolution can be achieved via input scaling

9. **EXCITATION POWER**: Jumper selectable
   +5 VDC @ 65 mADC max., +/-2%
   +10 VDC @ 125 mADC max., +/-2%
   Temperature Coefficient (ratio metric): 20 ppm/ºC max.
10. **USER INPUTS**: Three programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Common: Not isolated.
   Response Time: 12 msec. max.
   Logic State: User programmable (USrACt) for sink/source (LO/HI) logic

INPUT STATE (USrACt)	LO/SINK	HI/SOURCE
	20 KΩ pull-up to +3.3 V	20 KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

11. **TOTALIZER**:
   Time Base: second, minute, hour, or day
   Batch: Can accumulate (gate) input display from a user input
   Time Accuracy: 0.01% typical
   Decimal Point: 0 to 0.0000
   Scale Factor: 0.001 to 65.000
   Low Signal Cut-out: -199,999 to 999,999
   Total: 6 digits on Line 1; 9 digits on Line 2
12. **CUSTOM LINEARIZATION**:
   Data Point Pairs: Selectable from 2 to 16
   Display Range: -199,999 to 999,999
   Decimal Point: 0 to 0.0000
13. **MEMORY**: Nonvolatile memory retains all programmable parameters and display values.
14. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50 °C
   Storage Temperature Range: -40 to 60 °C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 25 g (10 g relay)
   Operating and Storage Humidity: 0 to 85% max. RH non-condensing
   Altitude: Up to 2000 meters
15. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Listed: File #E179259
   Type 4X Indoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
16. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)
17. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
18. **WEIGHT**: 8 oz. (226.8 g)

Optional Plug-in Output Cards

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2S meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2S meter. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)	PAXCDC30 - DeviceNet
PAXCDC1C - RS485 Serial (Connector)	PAXCDC50 - Profibus-DP
PAXCDC20 - RS232 Serial (Terminal)	
PAXCDC2C - RS232 Serial (Connector)	

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. Crimson can be downloaded at www.redlion.net

SETPOINT CARDS (PAXCDS)

The PAX2S meter has 4 available setpoint alarm output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See Update Rates step response specification on page 3; add 6 msec (typical) for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

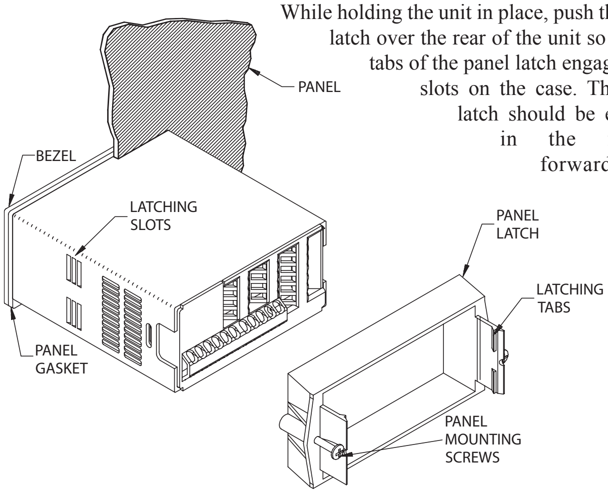
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Step Response: See Update Rates step response specification on page 3.
Update time: See ADC Conversion Rate and Update Time parameter

1.0 Installing the Meter

Installation

The PAX2S meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



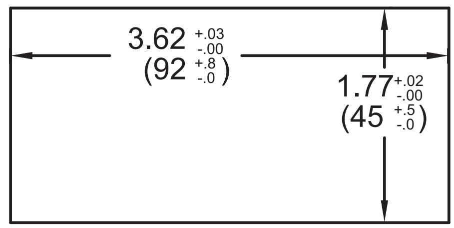
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



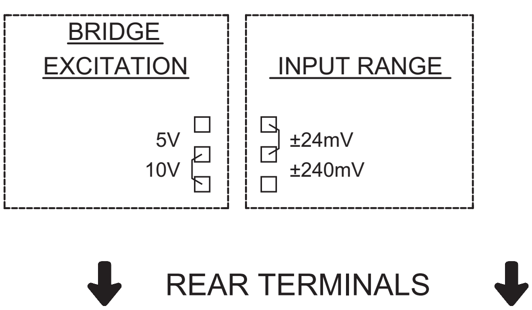
2.0 Setting the Jumpers

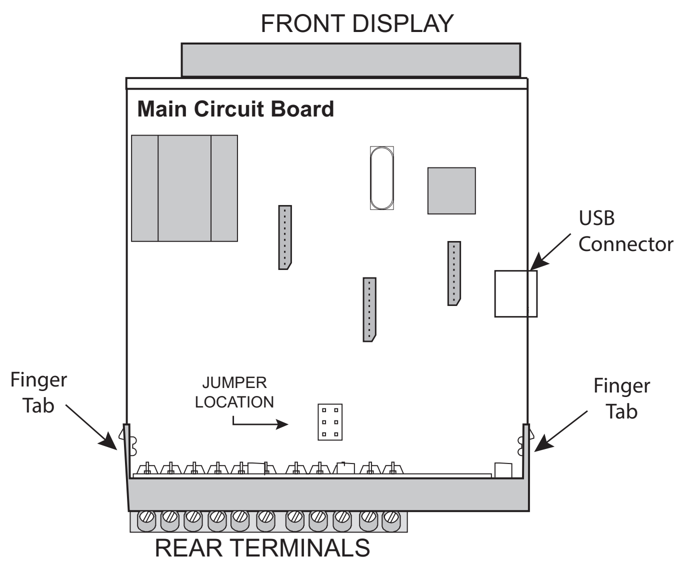
Bridge Excitation

This jumper is used to select bridge excitation voltage level. Use the 5 V excitation with high output (3 mV/V) bridges, so that the higher sensitivity 24 mV range can be used. Using the 5 V excitation also reduces bridge power consumption compared to the 10 V excitation. A maximum of four 350 ohm load cells can be driven by the internal bridge excitation voltage.

JUMPER SELECTIONS

The ⌒ indicates factory setting.



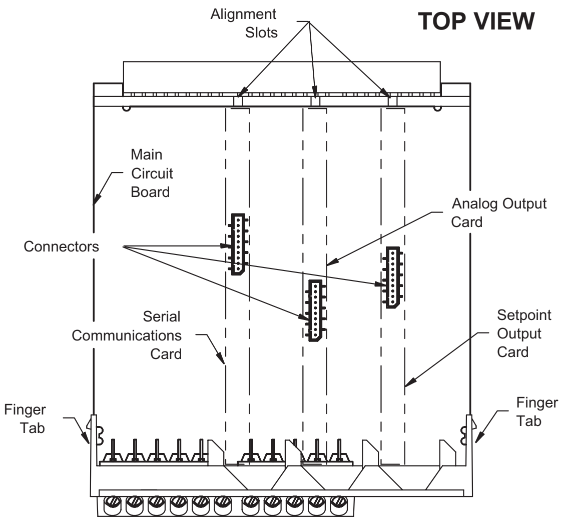


E

3.0 Installing Plug-In Cards

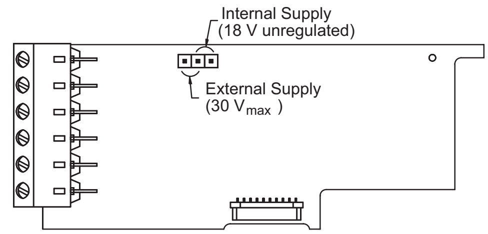
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX2S.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

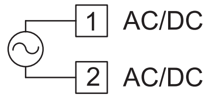
1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

E

4.1 POWER WIRING

AC Power



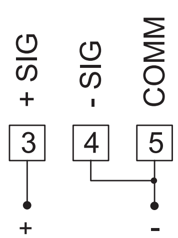
DC Power

The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

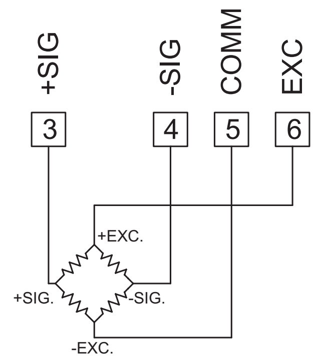
4.2 INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper and Bridge Excitation Jumper should be verified for proper position.

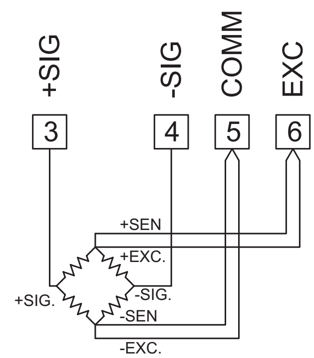
2-Wire Single Ended Input



4-Wire Bridge Input



6-Wire Bridge Input



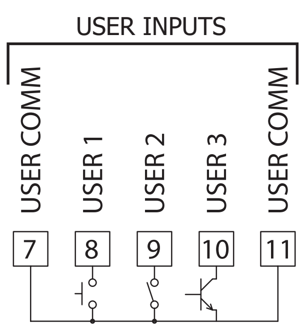
E

4.3 USER INPUT WIRING

If not using User Inputs, then skip this section. User Input terminal does not need to be wired in order to remain in inactive state.

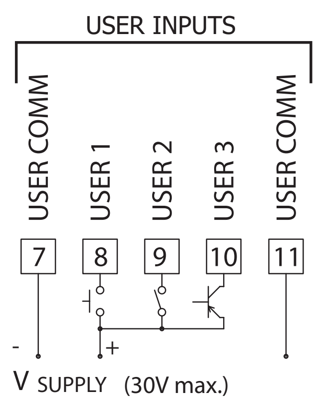
Sinking Logic (USrACt LO)

When the USrACt parameter is programmed to LO, the user inputs of the meter are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (USrACt HI)

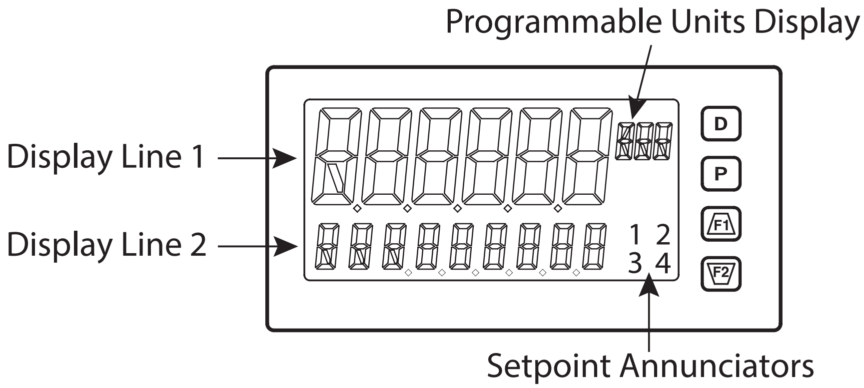
When the USrACt parameter is programmed to HI, the user inputs of the meter are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



4.4 SETPOINT (ALARMS) WIRING
4.5 SERIAL COMMUNICATION WIRING
4.6 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 FRONT PANEL KEYS AND DISPLAY OVERVIEW



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
D	Index Line 2 through enabled Line 2 display values	Return to the previous menu level (momentary press) Quick exit to Display Mode (press and hold)
P	Enter full programming mode or access the parameter and hidden display loops; Press and hold to skip parameters and go directly to Code or Programming Menu	Access the programming parameter menu, store selected parameter and index to next parameter
F1	User programmable Function key 1; hold for 3 seconds for user programmable second function 1*	Increment selected parameter value; Hold F1 and momentarily press F2 key to increment next decade or **D** key to increment by 1000's
F2	User programmable Function key 2; hold for 3 seconds for user programmable second function 2*	Decrement selected parameter value; Hold F2 and momentarily press F1 key to decrement next decade or **D** key to decrement by 1000's

**Factory setting for F1/F2 and second function F1/F2 is no mode*

DISPLAY LINE 1

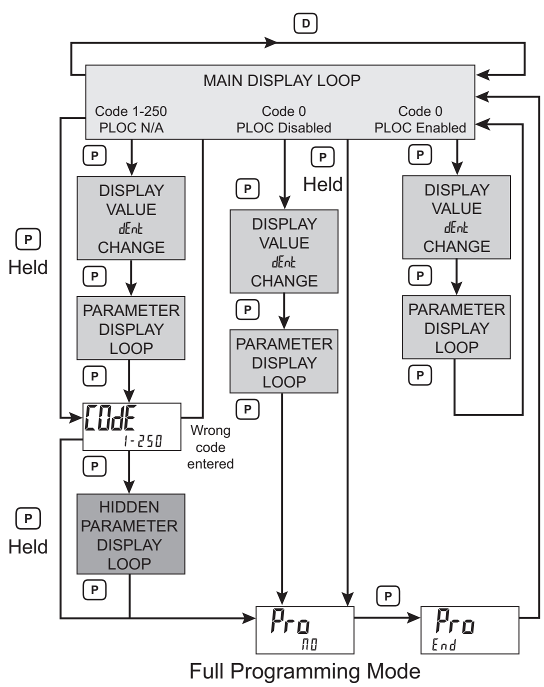
Line 1 is the large, 6-digit top line display. Values such as, Input, Gross, Tare, Max(HI), Min(LO), Total and setpoints, can be shown on Line 1. The 3-digit Units mnemonic characters can be used to indicate which Line 1 display value is shown. Standard or custom mnemonics are available for the Line 1 values. See Line 1 parameters in the Display Parameters programming section for configuration details.

DISPLAY LINE 2

Line 2 is the smaller, 9-digit bottom line display. Values such as Input, Gross, Tare, Max(HI), Min(LO), Total, setpoints, and parameter List A/B status can all be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value. See Line 2 parameters in the Display Parameters programming section for configuration details.

LINE 2 DISPLAY LOOPS

The PAX2S offers three display loops to allow users quick access to needed information.



Main Display Loop

In the Main display loop, the D key is pressed to sequence through the selected Line 2 values. A left justified 2, 3 or 4-character mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the user functions programmed in the User Input parameter section.

Parameter and Hidden Parameter Display Loops

Display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming mode. These values include Parameter List A/B selection, setpoints, and display (color, intensity and contrast) settings. To utilize the Parameter or Hidden Parameter display loops, a security code (1-250) must be programmed. (See Programming Security Code in the Display Parameters programming section for details.)

The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter display loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on the application needs.

While in the Parameter and Hidden Parameter loops, pressing the **D** key will return the meter to the Main display loop. To directly access the Code prompt, press and hold the **P** key. This can be done from the Main display loop or at any point during the Parameter display loop. Also, to directly access Full Programming mode while in the Hidden Parameter loop, press and hold the **P** key to bypass any remaining Hidden Parameter loop values.

6.0 Programming The PAX2S

It is recommended that program settings be recorded as programming is performed. A blank Parameter Value Chart is provided at the end of this bulletin.

PROGRAMMING MODE ENTRY

The Programming Mode is entered by pressing the **P** key. Full Programming Mode will be accessible unless the meter is programmed to use the Parameter loop or Hidden Parameter display loop on the Line 2 display. In this case, programming access will be limited by a security code and/or a hardware program lock. (Refer to the previous section for details on Line 2 display loops and limited programming access.) Full Programming Mode permits all parameters to be viewed and modified. In this mode, the front panel keys change to Programming Mode Operations and certain user input functions are disabled.

MODULE ENTRY

The Programming Menu is organized into five modules. These modules group together parameters that are related in function. The F1 and F2 keys are used to select the desired module. The displayed module is entered by pressing the **P** key.

MODULE MENU

Upon entering a module, a parameter selection sub-menu is provided to choose the specific parameter type for programming. For example, this includes analog and user input under the Input Parameter menu. Use the F1 and F2 keys to select the desired parameter type, and press the **P** key to enter the parameter menu.

PARAMETER MENU

Upon entering the Parameter Menu, the **P** key is pressed to advance to a specific parameter to be changed. After completing the parameter menu, or upon pressing the **D** key, the display returns to the initial entry point for the parameter menu. For each additional press of the **D** key, the display returns to the previous level within the module until exiting the module entirely.

SELECTION/VALUE ENTRY

For each parameter, the top line display shows the parameter while the bottom line shows the selections/value for that parameter. The F1 and F2 keys are used to move through the selections/values for the parameter. Pressing the **P** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

Numerical Value Entry

If the parameter is programmed for enter (Entr), the F1 and F2 keys are used to change the parameter values in any of the display loops.

The F1 and F2 keys will increment or decrement the parameter value. When the F1 or F2 key is pressed and held, the value automatically scrolls. The longer the key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the opposite arrow key (F2 or F1) to shift decades (10's 100's, etc), or momentarily press the **D** key and the value scrolls by 1000's as the arrow key is held. Releasing the arrow key removes the decade or 1000's scroll feature. The arrow keys can then be used to make small value changes as described above.

PROGRAMMING MODE EXIT

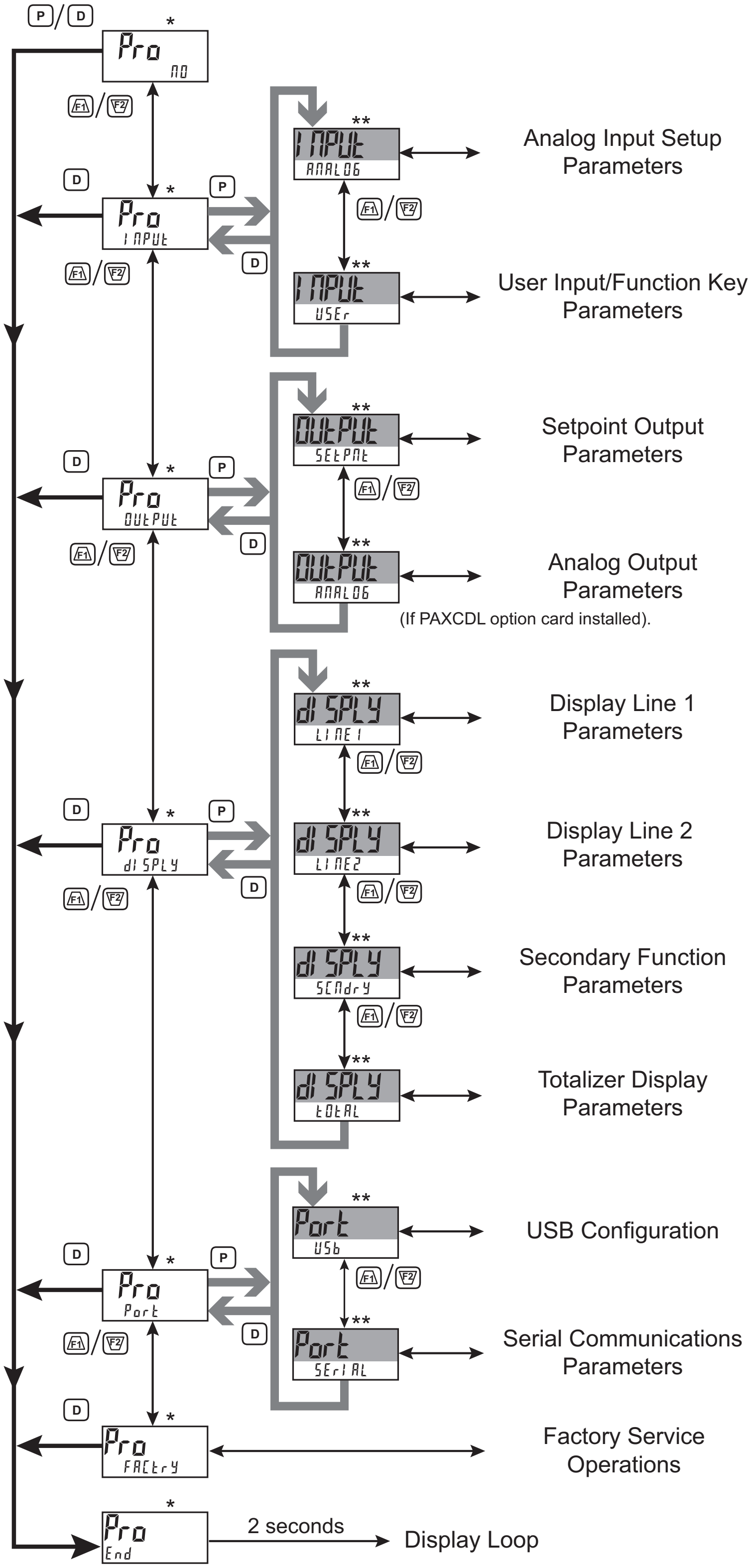
To exit the Programming Mode, press and hold the **D** key (from anywhere in the Programming Mode) or press the **P** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **P** key must be pressed to store the change before pressing the **D** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with the Input Parameters and proceed through each module in sequence. If lost or confused while programming, press and hold the **D** key to exit programming mode and start over. It is recommended that program settings be recorded as programming is performed. When programming is complete lock out programming with a user input or lock-out code.

Factory Settings may be completely restored in the Factory Service Operations module. This is useful when encountering programming problems.

In Programming Menu:
* - Top line is green to indicate top level programming modules
** - Top line is orange to indicate module menu or sub-menu selection
*** - Top line is red to indicate a changeable parameter.



E

INPUT PARAMETERS (INPUT)

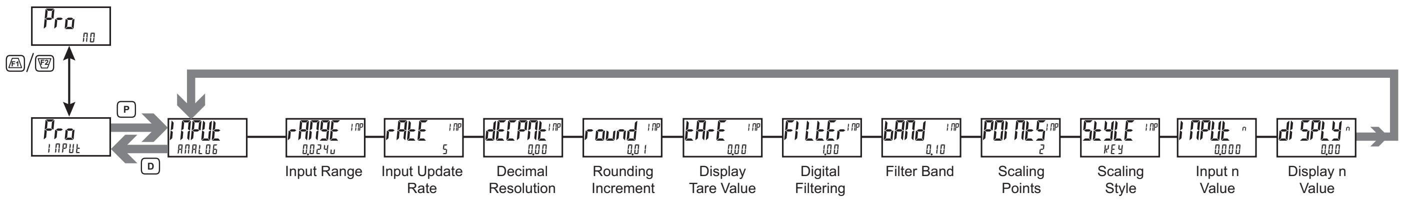
INPUT SELECT

INPUT ANALOG — ANALOG USEr

Select the Input to be programmed.

ANALOG INPUT PARAMETERS (ANALOG)

This section details the programming for the analog input.



INPUT RANGE

rANGE INP 0.024v — 0.024v 0.24v

Select the desired input range.

INPUT UPDATE RATE (/SEC)

rAtE INP 5 — 5 10 20 40 80 160

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect setpoint and analog output response time. The default factory setting of 5 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

dECPNt INP 0.00 — 0 0.00 0.0000 0.0 0.000

Select desired display resolution.

ROUNDING INCREMENT

round INP 0.01 — 1 2 5 10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY TARE (Offset) Value

tArE INP 0.00 — -19999 to 99999

The Display Tare(offset) Value is the difference between the Gross (absolute) Display value and the Relative (net) Display value for the same input level. The meter will automatically update this value after each Zero Display. The Display Tare Value can be directly keyed-in to intentionally add or remove display offset. See Relative/Gross Display and Zero Display explanations in the Input Parameters - User Input Module.

DIGITAL FILTERING

FILtEr INP 1.00 — 0.00 to 25.00 seconds

The input filter setting is a time constant expressed in hundredths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND

bANd INP 0.10 — 0 to 2500 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units. A band setting of '0' keeps the digital filter permanently engaged.

SCALING POINTS

POINtS INP 2 — 2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n).

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n). Data from tables or equations, or empirical data can be used to derive the required number of segments and data values for the coordinate pairs. Several linearization equations are available within Crimson software.

E

SCALING STYLE

KEY key-in data
APPLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APPLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

- 199999 to 999999

For Key-in (KEY), enter the known first Input Value by using the F1 or F2 arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update this value, apply the input signal that corresponds to Scaling Point 1, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter.

DISPLAY VALUE FOR SCALING POINT 1

- 199999 to 999999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APPLY scaling styles. The decimal point corresponds to the dECPNt selection.

INPUT VALUE FOR SCALING POINT 2

- 199999 to 999999

For Key-in (KEY), enter the known second Input Value by using the F1 or F2 arrow keys. For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update this value, apply the input signal that corresponds to Scaling Point 2, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter. (Follow the same procedure if using more than 2 scaling points.)

DISPLAY VALUE FOR SCALING POINT 2

- 199999 to 999999

Enter the second coordinating Display Value by using the F1 or F2 arrow keys. This is the same for KEY and APPLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

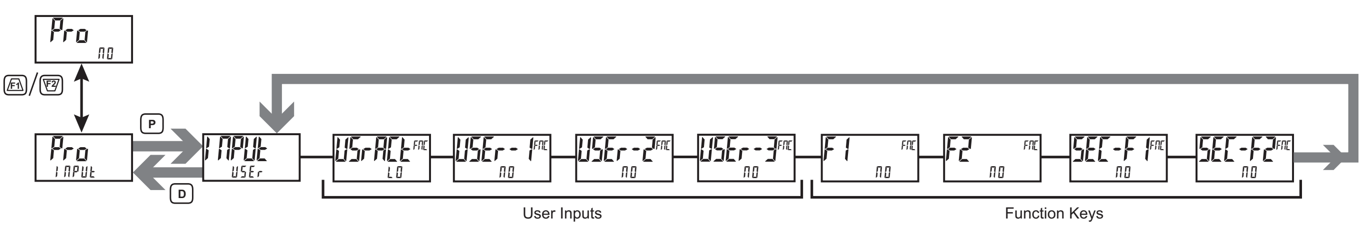
USER INPUT / FUNCTION KEY PARAMETERS (USEr)

This section details the programming for the rear terminal User Inputs and front panel Function Keys. Three user inputs are individually programmable to perform specific meter control functions. While in the Display Mode, the function is executed when the user input transitions to the active state. (Refer to the user input specifications for response times.) Certain User input functions are disabled in Programming Mode. Two front panel function keys, F1 and F2, are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed when the key is pressed. Holding the F1 or F2 function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function. The front panel key functions are disabled while in Programming Mode.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions are performed every time any of those user inputs or function keys transition to the active state.

The List user function has a value assignment sublist, which appears when the **P** key is pressed and LISt is selected. The function will only be performed for the assignment values selected as YES. If a user input or function key is configured for a function with a sublist, then that sublist will need to be scrolled through each time to access the remaining user inputs or function keys following the sublist.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. In the parameter explanations, USEr-n represents all user inputs. Fn represents both function keys and second function keys.

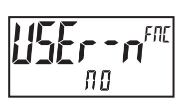


USER INPUT ACTIVE STATE

LO HI

Select the desired active state for the User Inputs. Select LO for sink input, active low. Select HI for source input, active high.

NO FUNCTION



No function is performed if activated. This is the factory setting for all user inputs and function keys.

E

PROGRAMMING MODE LOCK-OUT

USEr-n FNC
PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USEr-n FNC
rEL

Fn FNC
rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future relative input display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Tare Value and is automatically stored as the new Display Tare Value. If another Zero (tare) Display is performed, the display again changes to zero and the Display Tare Value shifts accordingly.

RESET TARE VALUE

USEr-n FNC
r-tArE

Fn FNC
r-tArE

The Reset Tare provides a way to zero the Display Tare (offset) value, eliminating the Tare (offset) from the relative display. When activated (momentary action), rESEt flashes and the Display Tare value is set to zero. Following a Reset Tare, the Input display (relative) value will match the Gross (absolute).

RELATIVE/GROSS (ABSOLUTE) VALUE

USEr-n FNC
d-rEL

Fn FNC
d-rEL

This function will switch the Input Display between Relative and Gross (Absolute) value. The Relative is a net value that includes the Display Tare (Offset)Value. The Input Display will show the Relative unless switched by this function. The Gross is an absolute value (based on Input (Analog) Module dSP and INP entries) without the Display Tare (Offset) Value. The Gross value is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative value. GrOSS (gross) or rEL (relative) is momentarily displayed at transition to indicate which value is being displayed.

HOLD DISPLAY

USEr-n FNC
d-HLd

The active display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USEr-n FNC
A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USEr-n FNC
SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D converter input sampling with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USEr-n FNC
bAt

Fn FNC
bAt

The Input Display value is added (batched) to the Totalizer when activated (momentary action) and the display flashes bAtCh. The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden and only batched Input Display values accumulate in the Totalizer.

SELECT TOTALIZER DISPLAY

USEr-n FNC
d-tot

The Totalizer appears on Line 2 as long as activated (maintained action). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Totalizer continues to function including associated outputs independent of the selected display.

RESET TOTALIZER

USEr-n FNC
r-tot1

Fn FNC
r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USEr-n FNC
r-tot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USEr-n FNC
E-tot

The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USEr-n FNC
d-HI

The Maximum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Maximum continues to function independent of the selected display.

RESET MAXIMUM DISPLAY

USEr-n FNC
r-HI

Fn FNC
r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

SELECT MINIMUM DISPLAY

USEr-n FNC
d-LO

The Minimum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Minimum continues to function independent of the selected display.

RESET MINIMUM DISPLAY

USEr-n FNC / r-LO   Fn FNC / r-LO

When activated (momentary action), rESEt flashes and the Minimum resets to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM DISPLAY

USEr-n FNC / r-HL   Fn FNC / r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

SELECT LINE 1 DISPLAY

USEr-n FNC / SEL L1   Fn FNC / SEL L1

When activated (momentary action), the display advances to the next Line 1 display that has been made available (in the Display Module, Line 1/Select sub-menu).

SELECT LINE 2 DISPLAY

USEr-n FNC / SEL L2   Fn FNC / SEL L2

When activated (momentary action), the display advances to the next Line 2 display that has been made available (in the Display Module, Line 2/Access sub-menu).

ADJUST DISPLAY INTENSITY

USEr-n FNC / d-LEU   Fn FNC / d-LEU

When activated (momentary action), the display intensity changes to the next intensity level.

CHANGE DISPLAY COLOR

USEr-n FNC / Color

When activated (momentary action), Line 1 will change color green to red, red to orange, orange to green.

SELECT PARAMETER LIST

USEr-n FNC / LISt   Fn FNC / LISt

Two lists of values are available to allow the user to either switch between two sets of setpoints, or setpoints and scaling parameters and/or Line 1 & 2 mnemonics (if enabled).

The two lists are named LISt-A and LISt-b. If a user input is used to select the list then LISt-A is selected when the user input is not active and LISt-b is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will indicate which list is active when the list is changed, at power-up, and when entering the Parameter loop (if enabled) or Programming menus.

To program the values for LISt-A and LISt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the desired values for various parameters included in the list.

Two sub-menus are used to select whether scaling parameters and the custom units mnemonics are included in the list function. When the ScLISt sub-menu is selected as YES, the following parameters are also included in the A/B parameter lists:

Scaling Points 1-16
Input Decimal Point
Input Filter Band
Input Rounding Factor
Totalizer Scale Factor
Totalizer Decimal point

When the list is changed, the Offset (tare) value and internal Auto-zero buffer value (if Number of scaling points = 2) are also converted to the new units.

When the UNItS sub-menu is selected as YES, the Custom Units mnemonics are included in A/B parameter list.Using the LISt function and enabling ScLISt & UNItS provides the ability to use the PAX2 meter to read-out and display in 2 different engineering units (i.e., pounds and kilograms).

SUB-MENU	DESCRIPTION	FACTORY
ScLISt	Include Scaling Parameters	NO
UNItS	Include Units mnemonics	NO

SETPOINT SELECTIONS

USEr-n FNC / r-n   Fn FNC / r-n

r-1 - Reset Setpoint 1 (Alarm 1)
r-2 - Reset Setpoint 2 (Alarm 2)
r-3 - Reset Setpoint 3 (Alarm 3)
r-4 - Reset Setpoint 4 (Alarm 4)
r-34 - Reset Setpoint 3 & 4 (Alarm 3 & 4)
r-234 - Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)
r-ALL - Reset All Setpoints (Alarms 1-4)

PRINT REQUEST

USEr-n FNC / Print   Fn FNC / Print

The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Port (Serial) module. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

E

OUTPUT PARAMETERS (OUtPUt)

OUTPUT SELECT

OUtPUt
SEtPNt

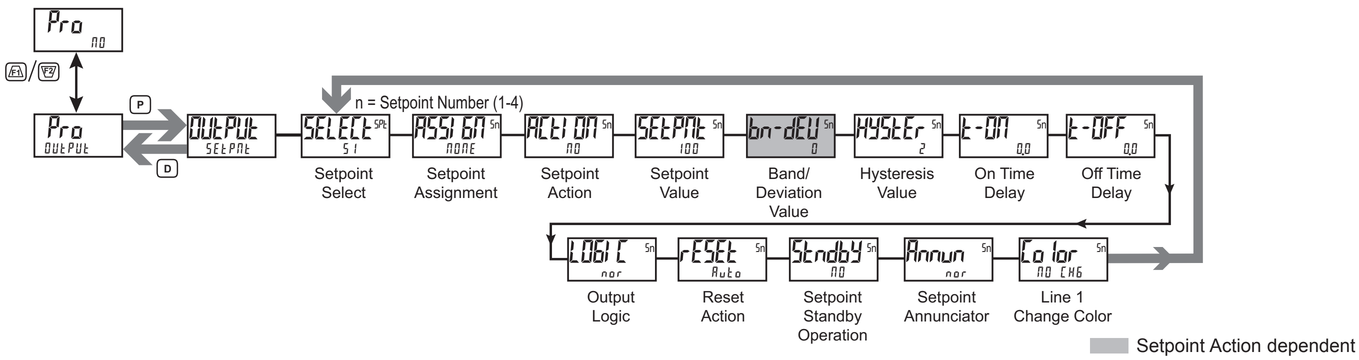
SEtPNt   ANALOG

Select the Setpoint or Analog output to be programmed. The Analog output selection only appears if an analog output plug-in card is installed in the meter.

SETPOINT OUTPUT PARAMETERS (SEtPNt)

This section details the programming for the setpoints. To have output capabilities, a setpoint Plug-in card needs to be installed into the PAX2S (see Ordering Information). Depending on the card installed, there will be two or four setpoint outputs available. If no output card is installed, programming for the setpoints is still available. An Exchange Parameter Lists feature for setpoint values is explained in User Input programming.

The Setpoint Assignment and Setpoint Output Action determine certain setpoint feature availability. The Setpoint Parameter Availability chart illustrates this.



SETPOINT SELECT

SELECt SPt
S1

S1   S2   S3   S4

Select the Setpoint output to be programmed. The "Sn" in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display returns to the Setpoint Select menu. Repeat steps for each setpoint to be programmed.

The number of outputs available is setpoint output card dependent (2 or 4). If no output card is installed, programming is still available for all 4 setpoints. This allows the Line 1 color change feature to provide a visual indication when a setpoint value has been reached, even if no setpoint output is being used.

SETPOINT ASSIGNMENT

ASSIGN Sn
NONE

NONE   rEL   GrOSS   tOtAL

Selects the meter value to be used to trigger the Setpoint Alarm. The rEL setting will cause the setpoint to trigger off of the relative (net) input value. The relative input value is the absolute input value plus the Display Tare (Offset) Value. The GrOSS setting will cause the setpoint to trigger off of the gross (absolute) input value. The gross input value is based on the Input (Analog) module dSP and INP entries.

SETPOINT ACTION

ACtION Sn
NO

NO   Ab-HI   Ab-LO   AU-HI
AU-LO   dE-HI   dE-LO   bANd
bNdIn   totLo   totHi

Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action. The Setpoint Actions that pertains to the total is only active when the Setpoint Assignment is set to tOtAL.

NO	= No Setpoint Action
Ab-HI	= Absolute high, with balanced hysteresis
Ab-LO	= Absolute low, with balanced hysteresis
AU-HI	= Absolute high, with unbalanced hysteresis
AU-LO	= Absolute low, with unbalanced hysteresis
dE-HI	= deviation high, with unbalanced hysteresis
dE-LO	= deviation low, with unbalanced hysteresis
bANd	= Outside band, with unbalanced hysteresis
bNdIn	= Inside band, with unbalanced hysteresis
totLo	= Lower 6 digits of 9 digit Totalizer, with unbalanced hysteresis
totHi	= Upper 6 digits of 9 digit Totalizer, with unbalanced hysteresis

SETPOINT VALUE

SEtPNt Sn
100

-199999 to 999999

Enter desired setpoint alarm value. Setpoint values can also be entered in the Display Mode during Program Lockout when the setpoint is programmed as Entr in the Display (Line 2) Access parameters. The decimal point position is determined by the Setpoint Assignment value.

BAND/DEVIATION VALUE

bN-dEV dn
0

-199999 to 999999

This parameter is only available in band and deviation setpoint actions. Enter desired setpoint band or deviation value. When the Setpoint Action is programmed for Band, this value can only be a positive value.

HYSTERESIS VALUE

HYStEr Sn
2

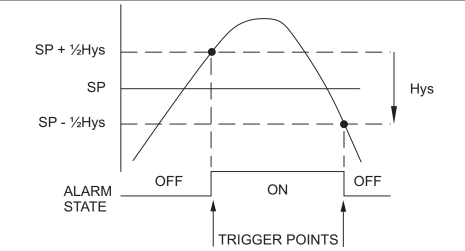
1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints. Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

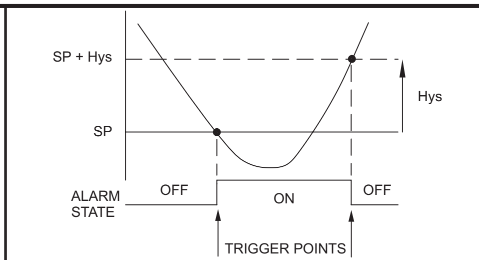
E

Setpoint Alarm Figures

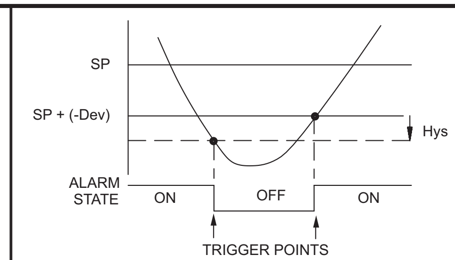
With reverse output logic rEu, the below alarm states are opposite.



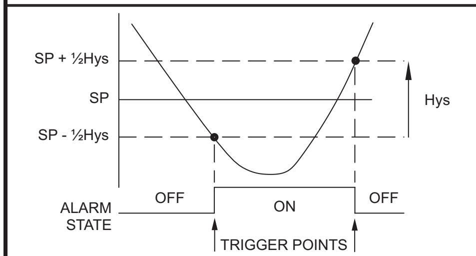
Absolute High Acting (Balanced Hys) = Ab-HI



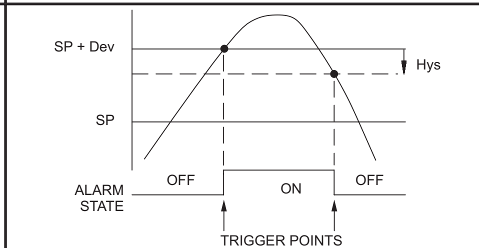
Absolute Low Acting (Unbalanced Hys) = AU-LO



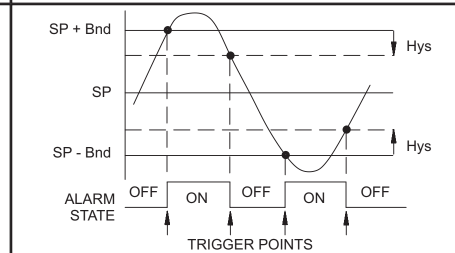
Deviation High Acting (Dev < 0) = dE-HI



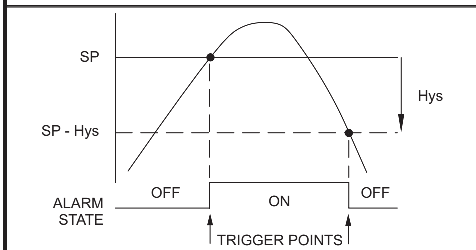
Absolute Low Acting (Balanced Hys) = Ab-LO



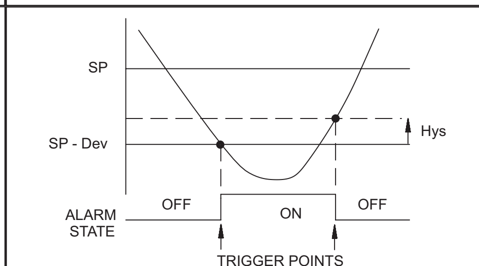
Deviation High Acting (Dev > 0) = dE-HI



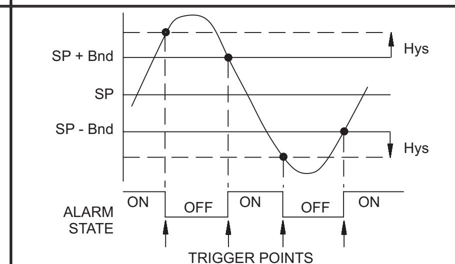
Band Outside Acting = bAnd



Absolute High Acting (Unbalanced Hys) = AU-HI
This is also for Totalizer alarms: totLO, totHI.



Deviation Low Acting (Dev > 0) = dE-LO



Band Inside Acting = bAndIn

ON TIME DELAY

t-On 5n
0.0

0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

t-OFF 5n
0.0

0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

LOGIC 5n
nor

nor rEu

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEu logic reverses the output logic. In rEu, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

rESEt 5n
Auto

Auto LAtCh1 LAtCh2

Enter the reset action of the alarm output.

Auto = Automatic action; This action allows the alarm output to automatically reset at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The “on” alarm may be manually reset immediately by a front panel function key or user input.The alarm remains reset until the trigger point is crossed again.

LAtCh1 = Latch with immediate reset action; This selection latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding “on” alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtCh2 = Latch with delay reset action; This selection latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the reset event until the corresponding “on” alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)

SETPOINT STANDBY OPERATION

Stndby 5n
nO

nO YES

When YES, the alarm is disabled (at power up) until the trigger point is crossed.

E

SETPOINT ANNUNCIATOR

Annun Sn / nor   nor rEu FLASH OFF

The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEu mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASH mode flashes the corresponding setpoint annunciators of "on" alarm outputs. The OFF mode disables display setpoint annunciators.

LINE 1 CHANGE COLOR

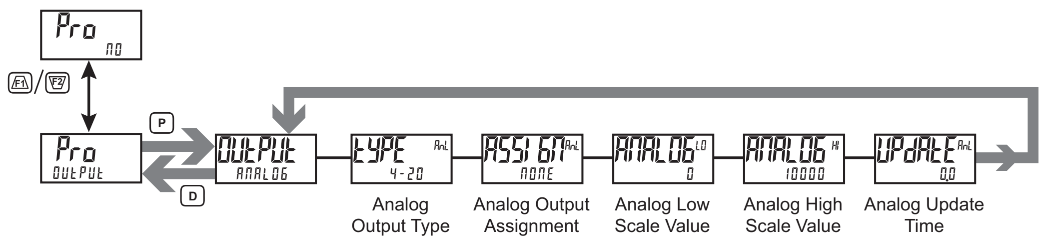
Color Sn / NO CHG   NO CHG GrEEN OrANGE rEd GrnOrG rEdOrG rEdGrn LINE 1

This parameter allows the Line 1 Display to change color, or alternate between two colors, when the alarm is activated. When multiple alarms are programmed to change color, the highest numbered active alarm (S4-S1) determines the display color.

The NO CHG selection will maintain the color displayed prior to the alarm activation. The LINE 1 selection sets the display to the Display (Line 1) Color (Color).

ANALOG OUTPUT PARAMETERS (ANALOG)

This section is only accessible with the optional PAXCDL Analog card installed (see Ordering Information).



ANALOG OUTPUT TYPE

tYPE AnL / 4-20   4-20 0-10 0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

ASSIGN AnL / NONE   NONE rEL GrOSS tOtAL HI LO S1 S2 S3 S4

Enter the source for the analog output to retransmit:

- NONE = Manual Mode operation. (See Serial RLC Protocol in the Communications Port module).
- rEL = Relative (net) Input Value. The Relative Input Value is the Gross (Absolute) Input Value that includes the Display Tare (Offset) Value.
- GrOSS = Gross (Absolute) Input Value. The Gross Input Value is based on the Input (Analog) module dSP and INP entries.
- tOtAL = Totalizer Value
- HI = Maximum Display Value
- LO = Minimum Display Value
- S1-S4 = Setpoint Values

ANALOG LOW SCALE VALUE

ANALOG LO / 0   -199999 to 999999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

ANALOG HI / 10000   -199999 to 999999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

UPdAtE AnL / 0.0   0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

E

DISPLAY PARAMETERS (dISPLY)

DISPLAY SELECT

dISPLY / LINE 1 — LINE 1 LINE 2 SCndrY tOtAL

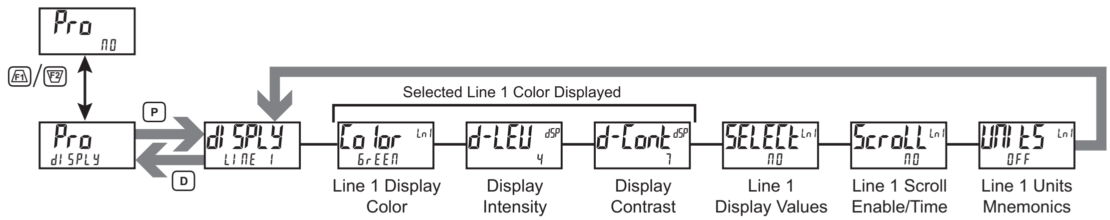
Select the Display to be programmed.

LINE 1 PARAMETERS (LINE 1)

This section details programming for the Line 1 (Top Line) Display. The Input, Gross, Tare, Total, Maximum (HI) and Minimum (LO) capture values and setpoints can be shown on the Line 1 display. The 3-digit Units mnemonic characters can be used to indicate which Line 1 display value is shown. Standard mnemonics are available for Setpoints 1-4. Standard or custom mnemonics are available for all other Line 1 values.

Main Display Loop

In the Main display loop, the selected values can be consecutively read on Line 1 by activating a user input or function key programmed as SEL L1. Each time the user input/function key is activated, Line 1 display will change to the next enabled Line 1 display value. Line 1 can also be programmed for Scroll, which will cause Line 1 to automatically scroll through all of the selected Line 1 display values.



LINE 1 DISPLAY COLOR

CoLor Ln1 / GrEEN — GrEEN rEd OrANGE

Enter the desired Display Line 1 and programmable Units Display color.

DISPLAY INTENSITY LEVEL

d-LEU dSP / 4 — 0 to 4

Enter the desired Display Intensity Level (0-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter can also be accessed in the Parameter display loop when enabled.

DISPLAY CONTRAST LEVEL

d-Cont dSP / 7 — 0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively adjust up or down as the levels are changed. This parameter can also be accessed in the Parameter display loop when enabled.

LINE 1 DISPLAY VALUE SELECT/ENABLE

SELECt Ln1 / NO — NO YES

Enter YES to select which values will be shown on the Line 1 display. A sub-menu provides Yes/No selection for each available Line 1 value. Values set to YES in the sub-menu will be displayable on Line 1.

DISPLAY	DESCRIPTION	FACTORY
INPUt	Input	YES
GrOSS	Gross (absolute)	NO
tArE	Tare	NO
tOtAL	Total	NO
HI	Max value	NO
LO	Min value	NO
S1	Setpoint 1	NO
S2	Setpoint 2	NO
S3	Setpoint 3	NO
S4	Setpoint 4	NO

LINE 1 DISPLAY SCROLL ENABLE/TIME

ScroLL Ln1 / NO — NO 1 to 15 seconds

If Line 1 Display Scrolling is desired, set the scroll time in seconds.

LINE 1 UNITS MNEMONIC(S)

UNItS Ln1 / OFF — OFF LAbEL CUSt FACt

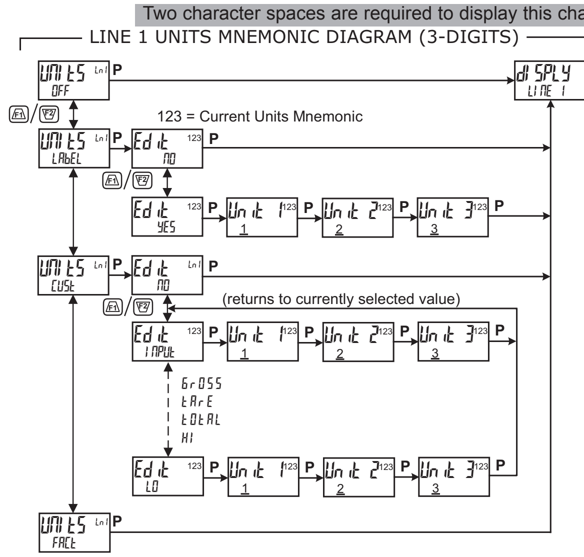
Select the mode for Line 1 Units Mnemonic(s). See LINE 1 UNITS MNEMONIC DIAGRAM for programming details.

SELECTION	MODE	DESCRIPTION
OFF	OFF	No Line 1 mnemonic shown.
LAbEL	LABEL	Single programmable mnemonic shown for all Line 1 values.
CUSt	CUSTOM	Custom programmable mnemonics shown for each Line 1 value.
FACt	FACTORY	Factory default mnemonics shown for each Line 1 value.

The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P Q R S t U V W Y Z 0 1
2 3 4 5 6 7 8 9 a c e g h i m n o q r u w - = [ ] / ° _ blank

Two character spaces are required to display this character.



LINE 2 PARAMETERS (LInE 2)

This section details programming for the Line 2 (Bottom Line) Display. The Input, Gross, Tare, Total, Max, Min, Setpoint, Band/Deviation values and Parameter List A/B status can be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value.

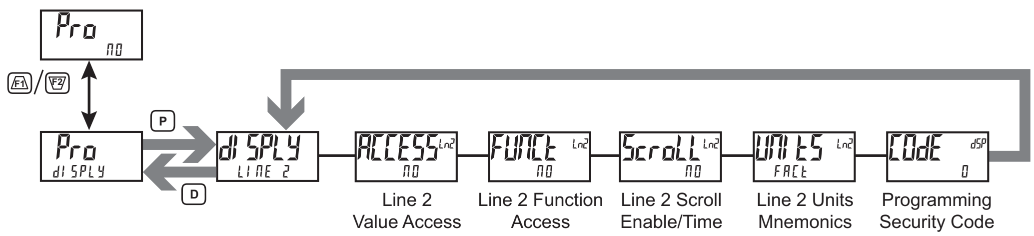
Main Display Loop

In the Main display loop, the selected values can be consecutively read on Line 2 by pressing the **D** key. A left justified 2, 3 or 4-character mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the User functions programmed in the User Input program section.

Parameter Display Loop and Hidden Parameter Loop

These display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming Mode. These values include Parameter List A/B selection, Setpoints and Display Settings (color, intensity and contrast). To utilize the Parameter or Hidden Parameter display loops, a security code (1-250) must be programmed. (See Programming Security Code at the end of this section.)

The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt.



LINE 2 VALUE ACCESS

ACCESS Ln2 NO — NO YES

Select YES to program the Value Access setting for each available Line 2 parameter. Line 2 values can be made accessible in either the Main (**D** key), Parameter (**P** key) or Hidden (**P** key following code entry) display loops. When the List parameter is configured for an Entr setting, a List assignment sub-menu will follow. Refer to Input module, User sub-menu section for a description of the function.

Each parameter must be configured for one of the following settings. Not all settings are available for each parameter, as shown in the Parameter Value Access table.

SELECTION	DESCRIPTION
LOC	Not viewed on Line 2 Display (Factory Default Setting)
d-rEAd	View in Main display loop. Cannot change or reset.
d-rSt	View and reset in Main display loop.
d-Entr	View and change in Main display loop
P-rEAd	View in Parameter display loop. Cannot change or reset.
P-Entr	View and change in Parameter display loop
HidE	View and change in Hidden Parameter display loop

LINE 2 FUNCTIONS ACCESS

FUNCt Ln2 NO — NO YES

Select YES to display the following list of functions that can be made available at the end of the Parameter (P-Entr) or Hidden (HidE) display loops. Each Line 2 Function can be programmed for LOC, P-Entr, or HidE.

The more critical and frequently used functions should be first assigned to the User Inputs and User Function keys, however if more functions are needed than what can be obtained with user inputs and function keys, these will provide a means to provide that access. Refer to Input module, User sub-menu section for a description of the function.

SELECTION	DESCRIPTION
rEL	Zero (tare) display
r-tArE	Reset Display Tare (offset) value
bAt	Store batch reading in Totalizer
r-tot	Reset Totalizer
r-HI	Reset Maximum value
r-LO	Reset Minimum value
r-HL	Reset Max and Min values
r-1	Reset Setpoint output 1

LINE 2 PARAMETER VALUE ACCESS

DISPLAY	DESCRIPTION	NOT VIEWED	MAIN DISPLAY LOOP (D KEY)			PARAMETER DISPLAY LOOP (P KEY)		HIDDEN LOOP
		LOC	d-rEAd	d-rSt	d-Entr	P-rEAd	P-Entr	HidE
INPUt	Input	X	X	X				
GrOSS	Gross (absolute)	X	X					
tArE	Tare Value	X	X		X			
tOtAL	Total	X	X	X				
HI	Max Value	X	X	X				
LO	Min Value	X	X	X				
LISt	Parameter List A/B	X	X		X	X	X	X
Sn	Setpoint Value (S1-S4) *	X	X		X	X	X	X
bn-dn	Band/Deviation	X	X		X	X	X	X
CoLor	Line 1 Display Color	X				X	X	X
d-LEU	Display Intensity Level	X				X	X	X
d-Cont	Display Contrast Level	X				X	X	X

* Indicates multiple value entries.

E

SELECTION	DESCRIPTION
r-2	Reset Setpoint output 2
r-3	Reset Setpoint output 3
r-4	Reset Setpoint output 4
r-34	Reset Setpoint outputs 3 & 4
r-234	Reset Setpoint outputs 2, 3 & 4
r-ALL	Reset all Setpoint outputs
Print	Print Request

LINE 2 DISPLAY SCROLL ENABLE/TIME

ScroLL Ln2
NO

NO   1 to 15 seconds

If Line 2 Display Scrolling is desired, set the scroll time in seconds.

LINE 2 UNITS MNEMONIC(S)

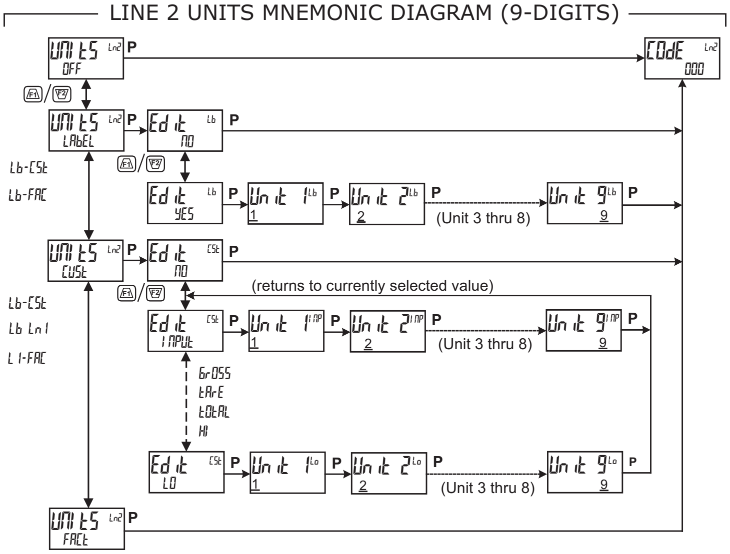
UNITS Ln2
FACt

OFF   LAbEL   CUSt   FACt
Lb-FAC   L1-FAC   Lb-CSt   Lb Ln1

Select the mode for Line 2 Units Mnemonic(s). See LINE 2 UNITS MNEMONIC DIAGRAM for programming details.

SELECTION	MODE	DESCRIPTION
OFF	OFF	No Line 2 mnemonics shown.
LAbEL	LABEL	Single programmable mnemonic shown as a separate item in the Line 2 Display loop. No individual mnemonics are shown with the other Line 2 Display values.
CUSt	CUSTOM	Individual Custom programmable mnemonics shown with each value in the Line 2 Display loop.
FACt	FACTORY	Individual Factory default mnemonics shown with each value in the Line 2 Display loop.
Lb-CSt	LABEL & CUSTOM	A programmable mnemonic shown as a separate item in the Line 2 Display loop. Also, individual Custom programmable mnemonics shown with each value in the Line 2 Display loop.
Lb-FAC	LABEL & FACTORY	A programmable mnemonic shown as a separate item in the Line 2 Display loop. Also, individual Factory default mnemonics shown with each value in the Line 2 Display loop.
Lb Ln1	LINE 1 INDEXED LABELS	Individual programmable mnemonics, indexed to the Line 1 Display value, are shown as a separate item in the Line 2 Display loop. These same mnemonics are also shown with each value in the Line 2 Display loop.
L1-FAC	LINE 1 INDEXED LABELS & FACTORY	Individual programmable mnemonics, indexed to the Line 1 Display value, are shown as a separate item in the Line 2 Display loop. Also, individual Factory default mnemonics are shown with each value in the Line 2 Display loop.

LINE 2 UNITS MNEMONIC DIAGRAM (9-DIGITS)



The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P q r S t U W y Z 0 1
2 3 4 5 6 7 8 9 a c e g h i m n o u w - = [ ] / ° _ blank

Two character spaces are required to display this character.

PROGRAMMING SECURITY CODE

CODE dSP
0

000 to 250

To activate either the Parameter or Hidden Parameter display loops, a security code (1-250) must be entered. If a “0” security code is programmed, pressing the **P** key takes you directly to the Full Programming Mode.

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Input [User] module).

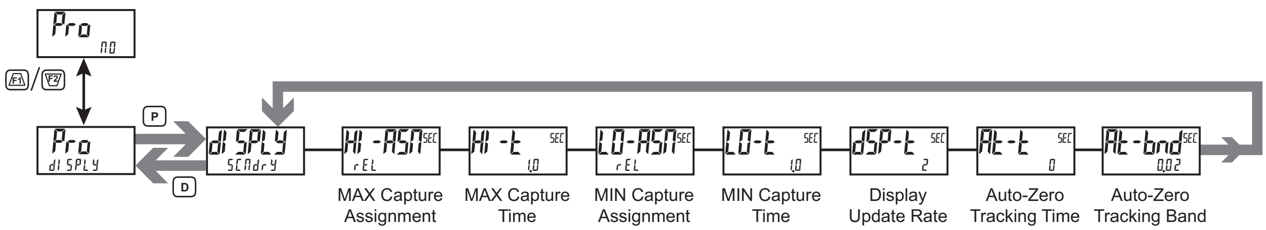
Two programming modes are available. Full Programming Mode allows all parameters to be viewed and modified. Parameter display loop mode provides access to those selected parameters, that can be viewed and/or modified without entering the Full programming mode.

The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN P KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
0	not PLOC	————	Full Programming	Immediate Access
0	PLOC	Not Active	Full Programming	Immediate Access
0	PLOC	Active	Enter Parameter Display Loop	No Access
>0	not PLOC	————	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at CODE prompt.
>0	PLOC	Not Active	Full Programming	Immediate Access
>0	PLOC	Active	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at CODE prompt.

E

SECONDARY FUNCTION PARAMETERS (SCNdrY)



MAX (HI) CAPTURE ASSIGNMENT

HI-ASN SEC rEL — rEL GrOSS

Select the desired input value that will be assigned to the Max Capture.

MAX (HI) CAPTURE DELAY TIME

HI-t SEC 1.0 — 0.0 to 3275.0 seconds

When the Input value is above the present MAX value for the entered delay time, the meter will capture that value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN (LO) CAPTURE ASSIGNMENT

LO-ASN SEC rEL — rEL GrOSS

Select the desired input value that will be assigned to the Min Capture.

MIN (LO) CAPTURE TIME

LO-t SEC 1.0 — 0.0 to 3275.0 seconds

When the Input value is below the present MIN value for the entered delay time, the meter will capture that value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE

dSP-t SEC 2 — 1 2 5 10 20 updates/second

This parameter configures the display update rate. It does not affect the response time of the setpoint output or analog output option cards.

AUTO-ZERO TRACKING TIME

At-t SEC 0 — 0 to 250 seconds

To disable Auto-zero tracking, set this value to 0.

AUTO-ZERO TRACKING BAND

At-bnd SEC 0.02 — 1 to 4095

The meter can be programmed to automatically compensate for zero drift. Drift may be caused by changes in the transducers or electronics, or accumulation of material on weight systems.

Auto-zero tracking operates when the readout remains within the tracking band for a period of time equal to the auto-zero tracking time. When these conditions are met, the meter re-zeroes the readout. After the re-zero operation, the meter resets and continues to auto-zero track.

The auto-zero tracking band should be set large enough to track normal zero drift, but small enough to not interfere with small process inputs.

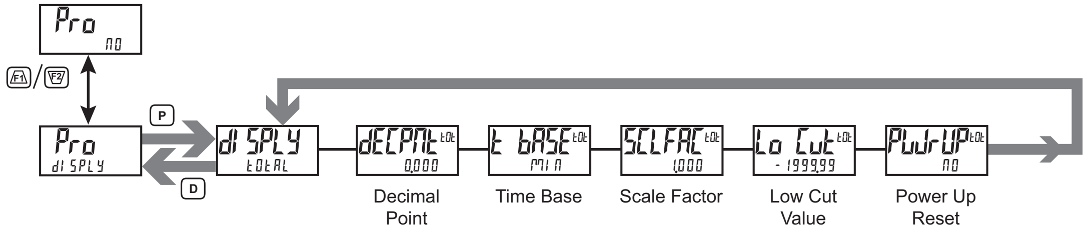
For filling operations, the fill rate must exceed the auto-zero tracking rate. This avoids undesirable tracking at the start of the filling operation.

$$\text{Fill Rate} \geq \frac{\text{tracking band}}{\text{tracking time}}$$

Auto-zero tracking is disabled by setting the auto-zero tracking time parameter = 0.

E

TOTALIZER (INTEGRATOR) PARAMETERS (tOtAL)



The totalizer accumulates (integrates) the Relative Input Display value using one of two modes. The first is using a time base. This can be used to provide an indication of total flow, usage or consumption over time. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of total weight, useful in weight based filling operations. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT

0 0.0 0.00 0.000 0.0000

For most applications, this should match the Input Display Decimal Point (dECPNt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

SEC -seconds (/1) MIn -minutes (/60)
hour -hours (/3600) dAY -days (/86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In this case, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a value that is different than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE

-199999 to 999999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET

nO - do not reset buffer
YES - reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to YES.

TOTALIZER BATCHING

The Totalizer Time Base is overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is multiplied by the totalizer scale factor and then one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\text{Totalizer Scale Factor} = \frac{\text{Totalizer Display*}}{\text{Input Display*}}$$

*Value indicated with decimal and all display units after the decimal; Prior to calculating, "drop" the decimal point leaving all trailing units.

Where:
Input Display = Fixed Input Display value.
Totalizer Display = Totalized value with Input Display constant during a period of time equal to the Totalizer Time Base.

Example: A PAX2S is monitoring the total weight of material on a 20 ft conveyor. The conveyor operates at a constant rate of 1 ft/sec. The Totalizer will calculate the total weight of material output from the conveyor. Although the PAX2S Input Display indicates lbs in whole units, the Totalizer will be programmed to display tons in 1/10 units. Note that this application requires a User Input to enable the Totalizer when the conveyor is running. Accuracy is dependent on the amount of material and position of material still on the conveyor. For accurate totalizer reading, the conveyor should be allowed to "empty" before taking a totalizer reading.

There are several factors to consider in this example. First, the material that clears the end of the conveyor in 1 second is only 1/20 of the weight being displayed at any given time (20 ft conveyor @ 1 ft/sec). Second, the Totalizer display is in tenths of tons, while the input is in pounds.

In order to calculate the Totalizer Scale Factor, choose a constant Input Display (100) value and then determine the Totalizer Display value that would result after the period of the Totalizer Time Base (1 hour) selected.

$\frac{100 \text{ lb}}{20 \text{ sec}} = 5$ lb/sec. → With 100 lb on the conveyor, 5 lbs falls off the end of the conveyor each second.

5 lb/sec x 3600 sec = 18,000 lb → 3600 seconds of material passing the end of the conveyor in an hour.

$\frac{18{,}000 \text{ lb}}{2000 \text{ lb}} = 9.0$ tons → Conversion of lbs to tons.

Conclusion: Input Display of 100 results in a Totalizer Display of 9.0 after 1 hour of constant and continuous operation. Place these values in the Totalizer Scale Factor formula as follows:

Totalizer Scale Factor = Totalizer Display* / Input Display*
Totalizer Scale Factor = 9.0/100
Totalizer Scale Factor = 90/100 **
Totalizer Scale Factor = 0.9

* This value should include the decimal and all display units after the decimal.
** This step requires that the decimal be "dropped", but all other digits remain.

E

COMMUNICATIONS PORT PARAMETERS (Port)

To select SErIAL, an optional communication card must be installed.

PORT SELECT

Port USb — USb SErIAL

Select the Communications Port to be programmed.

USB PORT PARAMETERS (USb)

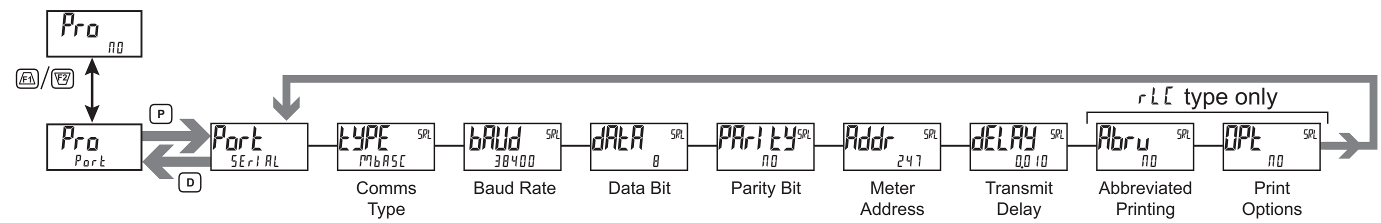
USB CONFIGURATION

CONFIG USb AUtO — AUtO SErIAL

AUtO Meter automatically configures USB port settings to operate with Crimson configuration software. When a USB cable is attached to PAX2S and PC, the port is internally set to Modbus RTU protocol, 38400 baud, 8 bits, and Unit Address 247. The Serial Port settings programmed below will not change, or show this.

SErIAL Configures USB port to utilize the Serial Port settings and protocol programmed below.

SERIAL PORT PARAMETERS (SErIAL)



COMMUNICATIONS TYPE

tYPE SRL MbASC

MbrtU - Modbus RTU
MbASC - Modbus ASCII
rLC - RLC Protocol (ASCII)

Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2S, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd SRL 38400

1200 4800 19200
2400 9600 38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

DATA BIT

dAtA SRL 8

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link. For MbrtU communication type, data bit setting is fixed at 8 bits.

PARITY BIT

PArItY SRL nO

nO EUEn Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits. Parity is not available if dAtA is set for 8 bit.

METER UNIT ADDRESS

Addr SRL 247

1 to 247 - Modbus
0 to 99 - RLC Protocol

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

dELAY SRL 0.010

0.000 to 0.250 seconds

Following a Modbus command or RLC Transmit Value command, the PAX2S will wait this minimum amount of time in seconds before issuing a serial response

E

The following programming steps are only available when Communications Type (tYPE) is programmed for rLC.

ABBREVIATED PRINTING

Abru SRL
no

no   YES

Select YES for full print or Command T transmissions (meter address, mnemonics and parameter data) or NO for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, it will not be sent during a full transmission.

PRINT OPTIONS

OPt SRL
no

no   YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or no for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INPUt	Signal Input	YES	INP
GrOSS	Gross (absolute) Value	no	GRS
tArE	Tare Value	no	TAR
tOtAL	Total Value	no	TOT
HI LO	Max & Min	no	MAX, MIN
SPNt	Setpoint Values	no	SP1-SP4

SERIAL COMMUNICATIONS

The PAX2S supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 Pax option cards, the PAX2S supports both the RLC protocol and also supports Modbus communications. The PAX Modbus option card should not be used with the PAX2S, as the PAX2S internal Modbus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2S with the Crimson programming software. It can also be used as a virtual serial communications port following installation of the PAX2S USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2S and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2S CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2S
3. Insure USB Configuration "CONFIG" in USB Port Parameters is set to "AUtO" (factory default setting).
4. Attach USB cable (USB A to Mini-B) between PC and PAX2S.
5. Create a new file (File, New) or open an existing PAX2S database within Crimson.
6. Configure Crimson Link options (Link, Options) to the serial port which the USB cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communication Type Parameter (tYPE) be set to "MbrtU" or "MbASC".

PAX2S CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2S to PC.
3. Supply power to PAX2S
4. Configure serial parameters (SErIAL) to Modbus RTU "MbrtU", 38,400 baud, address 247.
5. Create a new file (File, New) or open an existing PAX2S database within Crimson.
6. Configure Crimson Link options (Link, Options) to the serial port which the communication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 64 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 64 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 64 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAX2. "Total Good Comms" is the total messages received by the PAX2S with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAX2S ab<0100h><40h><40h><10h>
a = SP Card, "0"-No SP, "2" or "4" SP
b = Linear Card "0" = None, "1" = Yes
<0100> Software Version Number (1.00)
<40h>Max Register Reads (64)
<40h>Max Register Writes (64)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

E

PAX2S MODBUS REGISTER TABLE

Only frequently used registers are shown below. The entire Modbus Register Table can be found at www.redlion.net.
Values less than 65,535 will be in (LO word). Values greater than 65,535 will continue into (Hi word). Negative values are represented by two's complement of the combined (Hi word) and (LO word).
Note 1: The PAX2S should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	TABLE INDEX	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS						
40001	0	Input Relative Value (Hi word)	-199999	999999	N/A	Read Only	Process value of present input level. This value is affected by Input Type, Resolution, Scaling, & Tare (Offset) Value. (Relative Value = Gross (Absolute) Input Value - Tare Value)
40002	1	Input Relative Value (Lo word)					
40003	2	Maximum Value (Hi word)	-199999	999999	N/A	Read/Write	Maximum Relative Input Capture Value obtained since having been reset.
40004	3	Maximum Value (Lo word)					
40005	4	Minimum Value (Hi word)	-199999	999999	N/A	Read/Write	Minimum Relative Input Capture Value obtained since having been reset.
40006	5	Minimum Value (Lo word)					
40007	6	Total Value (Hi word)	-199999	999999	0	Read/Write	Totalizer value
40008	7	Total Value (Lo word)					
40009	8	Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	Active List (A or B)
40010	9	Setpoint 1 Value (Lo word)					
40011	10	Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	Active List (A or B)
40012	11	Setpoint 2 Value (Lo word)					
40013	12	Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	Active List (A or B)
40014	13	Setpoint 3 Value (Lo word)					
40015	14	Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	Active List (A or B)
40016	15	Setpoint 4 Value (Lo word)					
40017	16	Setpoint 1 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40018	17	Setpoint 1 Band/Dev. Value (Lo word)					
40019	18	Setpoint 2 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40020	19	Setpoint 2 Band/Dev. Value (Lo word)					
40021	20	Setpoint 3 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40022	21	Setpoint 3 Band/Dev. Value (Lo word)					
40023	22	Setpoint 4 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40024	23	Setpoint 4 Band/Dev. Value (Lo word)					
40025	24	Setpoint Output Register (SOR)	0	15	0	Read/Write	Status of Setpoint Outputs. Bit State: 0 = Off, 1 = On. Bit 3 = SP1, Bit 2 = SP2, Bit 1 = SP3, Bit 0 = SP4. Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40026	25	Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = SP1, Bit 3 = SP2, Bit 2 = SP3, Bit 1 = SP4, Bit 0 = Linear Output
40027	26	Reset Output Register	0	15	0	Read/Write	Bit State: 1 = Reset Output, bit is returned to zero following reset processing; Bit 3 = SP1, Bit 2 = SP2, Bit 1 = SP3, Bit 0 = SP4
40028	27	Analog Output Register (AOR)	0	4095	0	Read/Write	Functional only if Linear Output is in Manual Mode. (MMR bit 0 = 1) Linear Output Card written to only if Linear Out (MMR bit 0) is set.
40029	28	Input Gross (Absolute) Value (Hi word)	-199999	999999	N/A	Read Only	Gross (absolute) value of present Input level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value
40030	29	Input Gross (Absolute) Value (Lo word)					
40031	30	Tare Value (Hi word)	-199999	999999	0	Read/Write	Relative Input Value (standard meter value) is the difference between the Gross (absolute) input value and the Tare value, i.e. Relative = Gross - Tare
40032	31	Tare Value (Lo word)					

E

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to "rLC".

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $. The <CR> is also available as a terminator when Counter C is in the SLAVE mode.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a two digit node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters *, $ or when Counter C is set for slave mode <CR>. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	APPLICABLE COMMANDS/COMMENTS
A	Input (relative value)	INP	T, P, R (Reset command resets input to zero; tares)
B	Total	TOT	T, P, R (Reset command resets total to zero)
C	Max Input	MAX	T, P, R (Reset command resets Max to current reading)
D	Min Input	MIN	T, P, R (Reset command resets Min to current reading)
E	Setpoint 1	SP1	T, P, V, R (Reset command resets the setpoint output)
F	Setpoint 2	SP2	
G	Setpoint 3	SP3	
H	Setpoint 4	SP4	
I	Band/Deviation 1	BD1	T, V
J	Band/Deviation 2	BD2	T, V
K	Band/Deviation 3	BD3	T, V
L	Band/Deviation 4	BD4	T, V
M	Gross (Absolute) Input value	GRS	T, P
O	Tare (Offset) Value	TAR	T, P, R, V
U	Auto/Manual Register	MMR	T, V
W	Analog Output Register	AOR	T, V
X	Setpoint Register	SOR	T, V

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1.
   String: N17VE350$
2. Node address = 5, Read Input value.
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output.
   String: RH*

Sending Numeric Data

Numeric data sent to the meter must be limited to 6 digits (-199999 to 999999). Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

RECEIVING DATA FROM THE METER

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response mode is selected in Serial Port Parameters (Abru).

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	2 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

U abcde
e = Analog Output
d = SP4
c = SP3
b = SP2
a = SP1

Example: VU00011 places SP4 and Analog in manual.

Analog Output Register (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Setpoint Output Register (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A “0” in the setpoint location means the output is off and a “1” means the output is on.

X abcd
d = SP4
c = SP3
b = SP2
a = SP1

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10 will result in output 1 on and output 2 off.

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \# \text{ of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the Serial Transmit Delay parameter (dELAY). The standard command line terminating character is “*”. This terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15 msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with “$” results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

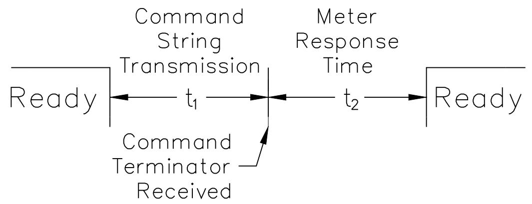
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \# \text{ of characters}) / \text{baud rate.}$$

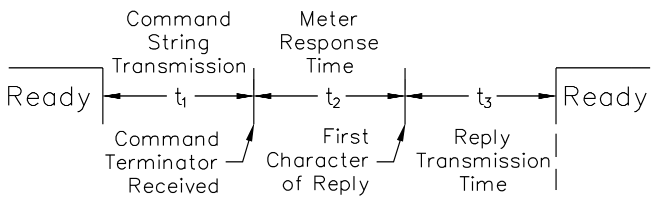
At the end of t_3, the meter is ready to receive the next command. The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

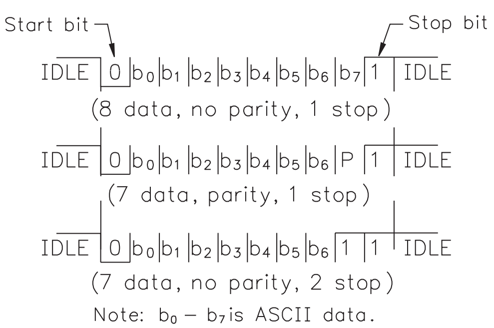
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX meter.

E

FACTORY SERVICE OPERATIONS (FACtrY)

FACTORY SERVICE CODE

COdE 50 FCS   0-250

Enter the Service Code for the desired operation.

RESTORE FACTORY DEFAULTS

CODE 66 FCS — P — rESEt — CODE 50 FCS

Use the F1 and F2 keys to display COdE 66 and press **P**. The meter will flash rESEt and then return to COdE 50. Press the **P** key to return to Display Mode. This will overwrite all user settings with the factory settings. The only exception is the User Mnemonics which retain their programmed values (see Code 69).

RESTORE FACTORY DEFAULTS (w/Units Mnemonics)

CODE 69 FCS — P — rESEt — CODE 50 FCS

Same as Code 66, except the User Mnemonics are also returned to the factory default settings (blank).

MODEL AND CODE VERSION

CODE 51 FCS — P — P2-S VEr x.xx FCS — CODE 50 FCS

The meter will briefly display the model (P2S) on Line 1, and the current firmware version (VEr x.xx) on Line 2, and then return to COdE 50.

METER CALIBRATION

CODE 48 FCS — P — CAL nO FCS   nO InPUt AnLOut

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Input Parameters. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it will affect the accuracy of the input signal and the values previously stored using the Apply (APPLY) Scaling Style.

Preparation for Voltage Input Calibration

Warning: Input Calibration of this meter requires a signal source capable of producing a signal greater than or equal to the range being calibrated with an accuracy of 0.01% or better.

Before starting, verify that the Input Range Jumper is set for the range to be calibrated. Verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting nO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing the **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

Input Calibration Procedure

1. After entering CodE 48, in Factory Service Operations, select the input (0.020v or 0.20v) to be calibrated.
2. Press the **P** key until the desired range along with ZER is indicated on Line 1 of the meter.
3. Apply the zero input limit of the range indicated on Line 1 of the meter.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with FUL on Line 1 of the meter.
7. Apply the signal level indicated on Line 1 of the meter.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for the other Input Range if calibration for the other range is desired.

Analog Output Card Calibration

Before starting, verify that a precision meter with an accuracy of 0.05% or better (voltmeter for voltage output and/or current meter for current output) is connected and ready. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2S F1 and F2 keys to adjust the output so that the external meter display matches the selection being calibrated. When the external reading matches, or if the range is not being calibrated, press the **P** key to advance to the next range. When all the desired ranges have been calibrated, exit programming mode and remove the external meters.

DISPLAY	EXTERNAL METER	ACTION
0.000A	0.00 mA	Adjust if necessary, press **P**
0.004A	4.00 mA	Adjust if necessary, press **P**
0.020A	20.00 mA	Adjust if necessary, press **P**
0.0v	0.00 V	Adjust if necessary, press **P**
10.0v	10.00 V	Adjust if necessary, press **P**

E

TROUBLESHOOTING

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections
No Display After Power-Up	Check Display Module: d-LEU, d-Cont, and LINE 1 program settings.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CODE 0 prompt. (Universal access code = 222)
No Line 1 Display	Check program settings for Line 1 Display Value Select/Enable. Confirm at least one Line 1 Display Value is enabled (YES).
No Line 2 Display	Check program settings for Line 2 Value Access. Confirm at least one Line 2 Parameter Value is enabled in Main Display Loop (d-rEAd, d-rSt, d-Entr).
No Line 1 Units Mnemonic Display	Check program settings for Line 1 Units Mnemonic(s).
Display of OLOL, ULUL, or "...."	See General Meter Specifications, Display Messages.
Incorrect Input Display Value	Check Input Jumper Setting, Input Level, and Input Connections.
	Verify Input - Analog program settings.
	Contact factory
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: ErrKEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EE PAr Error Code: EE Pdn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ErrPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EE CAL	Calibration Data Validation Error. Contact factory.
Error Code: EE Lin	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

E

E

This page intentionally left blank.

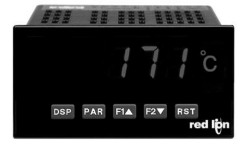
TEMPERATURE CONTROLLERS

F

The Trusted Source for
Innovative Control Solutions

QUICK Specs

Temperature Controllers

	CONTROL	INDICATION	CONTROL	
	CUB5RT/TC	PAXLRT/TC	PAXLT	DP5T
				
Description	RTD/Thermocouple Meter With Output Option Card Capability	1/8 DIN RTD/Thermocouple Indicator	RTD and Thermocouple Meter With Setpoint Capability	1/8 DIN RTD and Thermocouple Temperature Indicator
Dimensions (Height) x (Width)	39 mm (H) x 75 mm (W)	50 mm (H) x 97 mm (W)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)
Display	5 Digit, .48" (12mm) Reflective and Red Backlight LCD	4 Digit, .56" (14mm) Red LED	5 Digit, .56" (14mm) Red LED	4 1/2 Digit, .56" (14mm) Red LED
Input Ranges	RTD (CUB5RT) Pt385, Pt392, Ni672, and Cu427 Thermocouple (CUB5TC) T, E, J, K, R, S, B, N, and mV	RTD (PAXLRT) Pt385 and Pt392 Thermocouple (PAXLTC) T, E, J, K, R, S, B, N, and mV	RTD Pt385, Pt392, Ni672, and Cu427 Thermocouple T, E, J, K, R, S, B, N, and mV	Thermocouple T, E, J, K, R, S, B, N, and C RTD Pt385, Pt392, Ni672, and Cu427 Direct 10 Ohm, 100 Ohm, and mV
Control	Yes	No	Yes	No
Outputs	Single Form C Relay Dual Sinking	No	Dual Form C	No
Communications	RS232 RS485	No	No	No
Other Features/ Options	User Input Min/Max Memory Custom Units Indicato	Programmable Offset, Peak/Valley Memory, Custom Units Overlay	User Input Min/Max Memory, Custom Units Overlay	Min/Max Memory, Integrator/Totalizer, Custom Units Overlay
Power Source	9 to 28 VDC	85 to 250 VAC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 11 to 36 VDC 24 VAC
Page Number	Page 480/469	Page 499/491	Page 506	Page 516

*See website for product information.

† Field Installable Option Card

F

QUICK Specs

Temperature Controllers

	CONTROL		PID CONTROL	
	PAXT	**PAX2A**	**T16**	**T48**
				
Description	1/8 DIN RTD and Thermocouple Temperature Indicator	1/8 DIN Dual Line RTD and Thermocouple Temperature Meter With Output Option Card Capability	1/16 DIN Temperature Controller	1/16 DIN Temperature Controller
Dimensions (Height)x(Width)	50 mm (H) x 97mm (W)	50 mm (H) x 97mm (W)	48 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	4 1/2 Digit, .56" (14mm) Standard Green or Sunlight Readable Red LED, Adjustable Intensity	Top Line: 6 Digit, .71" (18mm) Tri-color Backlight Bottom Line: 9 Digit, .35" (9mm) Green Backlight	2 x 4 Digit, Main Display .3" (7mm) Red Sec. Display .2" (5mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED
Input Ranges	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD 2 or 3 Wire 100 Ohm (ALPHA = .00385, .00391 and .00672)	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD Pt385, Pt392, Ni672, and Cu427 Direct 10 Ohm, 100 Ohm, and mV	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2 or 3 Wire 100 Ohm (ALPHA = .00385 and .00391)	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, 3, or 4 Wire 100 Ohm (ALPHA = .00385 and .00391)
Control	On/Off	On/Off	On/Off, PID	On/Off, PID
Outputs	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive)	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable
Communications	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 RS485 Modbus DeviceNet Profibus	No	RS485
Other Features/ Options	Analog Output*, Min/Max Memory, Integrator/Totalizer, Linearizer, Custom Units Overlay	Analog Output*, Min/Max Memory, Integrator/Totalizer, Linearizer, Custom Units Display	Analog Output	Heater Current Monitor, Analog Output, Remote Setpoint
Power Source	85 to 250 VAC 18 to 36 VDC 24 VAC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 18 to 36 VDC 24 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
Page Number	Page 517	Page 518	Page 519	Page 542

*See website for product information.

† Field Installable Option Card

F

QUICK Specs

Temperature Controllers

PID CONTROL

	PAX2C	TCU	TSC	P16
				
Description	1/8 DIN Dual Line Temperature/Process Controller With Output Option Card Capability	1/8 DIN Temperature Controller	1/8 DIN Temperature Setpoint Controller	1/16 DIN Process Controller
Dimensions (Height) x (Width)	50 mm (H) x 97mm (W)	96 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	Dual Line 4 Digit Tri-color Backlight Vertical: Line 1- .51" (13mm); Line 2- .44" (11.2mm) Horiz.: Line 1- .62" (15.7mm); Line 2- .47" (12.0mm)	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .3" (7mm) Red Sec. Display .2" (5mm) Green LED
Input Ranges	Thermocouple T, E, J, K, R, S, B, N, C, and mV RTD Pt385, Pt392, Ni672, and Cu427 Direct: 10 or 100 Ohm, and mV Process Current: 250µADC - 2ADC Voltage: 250mVDC - 200VDC	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, 3, or 4 Wire 100 Ohm (ALPHA = .00385 and .00391)	Thermocouple T, E, J, K, R, S, B, N, and mV RTD 2, or 3 Wire 100 Ohm (ALPHA = .00385 and .00391)	Process Input 0 to 10 VDC or 0 to 20 mA
Control	On/Off, PID	On/Off, PID	On/Off, PID	On/Off, PID
Outputs	Main Control (Heat/Cool) Cooling Output Alarms	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Heat/Cool), Cooling Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Direct/Reverse), Secondary Output, Dual Alarms
Communications	RS232 or RS485 Modbus DeviceNet Profibus	RS485	RS485	No
Other Features/ Options	Analog Output	Heater Current Monitor, Analog Output, Remote Setpoint	Analog Output	Analog Output
Power Source	50 to 250 VAC 21.6 to 250 VDC	115/230 VAC	115/230 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
Page Number	Page 550	Page 602	Page 611	Page 618

*See website for product information.

† Field Installable Option Card

F

QUICK Specs

Temperature Controllers

	PID CONTROL			CONTROL
	P48	**PCU**	**PSC**	**TLA**
				
Description	1/16 DIN Process Controller	1/8 DIN Process Controller	1/8 DIN Process Setpoint Controller	1/16 DIN Temperature Limit Alarm
Dimensions (Height)x(Width)	48 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	96 mm (H) x 48mm (W)	48 mm (H) x 48mm (W)
Display	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED	2 x 4 Digit, Main Display .4" (10mm) Red Sec. Display .3" (7mm) Green LED
Input Ranges	Process Input 0 to 10 VDC or 0 to 20 mA	Process Input 0 to 10 VDC or 0 to 20 mA	Process Input 0 to 10 VDC or 0 to 20 mA	
Control	On/Off, PID	On/Off, PID	On/Off, PID	On/Off
Outputs	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay Only)	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Main Control (Direct/Reverse), Secondary Output, Dual Alarms (Relay, SSR Drive, Triac) Field Replaceable	Limit Alarm Relay Alarm Output Single or Dual Relay
Communications	RS485	RS485	RS485	No
Other Features/ Options	Dual Setpoint, Remote Setpoint, Analog Output	Motorized Valve Positioner, Analog Output, Remote Setpoint	Analog Output	No
Power Source	85 to 250 VAC 18 to 36 VDC 24 VAC	115/230 VAC	115/230 VAC	85 to 250 VAC 18 to 36 VDC 24 VAC
Page Number	Page 619	Page 624	Page 632	Page 639

*See website for product information.

† Field Installable Option Card

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 APLTC	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: Thermocouple	 PAXLTC	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: Thermocouple
 IMR	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: RTD	 PAXT	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: RTD ■ Requires Appropriate Option Card
 IMT	■ Display: 4 Digit, .56" (14 mm) Red LED ■ Construction: Metal Front Bezel ■ Power Source: 115/230 VAC ■ Measurement: Thermocouple	 PAXT	■ Display: 6 Digit, .56" (14 mm) Red LED ■ Power Source: 85 to 250 VAC ■ Measurement: Thermocouple ■ Requires Appropriate Option Card
 CUB4TC	■ Display: 5 Digit, .48" (12 mm) Reflective and Red Backlight LCD ■ Power Source: 9 to 26 VDC ■ Measurement: Thermocouple	 CUB5TC	■ Display: 5 Digit, .48" (12 mm) Reflective, Green and Red Backlight LCD ■ Power Source: 9 to 28 VDC ■ Measurement: Thermocouple
 CUB4RT	■ Display: 5 Digit, .48" (12 mm) Reflective and Red Backlight LCD ■ Power Source: 9 to 26 VDC ■ Measurement: RTD	 CUB5RT	■ Display: 5 Digit, .48" (12 mm) Reflective, Green and Red Backlight LCD ■ Power Source: 9 to 28 VDC ■ Measurement: RTD

Note: Refer to the current product literature, as some differences may exist.

MODEL CUB5TC - MINIATURE ELECTRONIC 5-DIGIT THERMOCOUPLE METER

- *THERMOCOUPLE INPUTS*
  Thermocouple types T, E, J, K, R, S, B, N, or mV
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *SELECTABLE °F or °C WITH 1 or 0.1 DEGREE RESOLUTION*
- *°F OR °C DISPLAY ANNUNCIATORS*
- *CONFORMS TO ITS-90 TEMPERATURE STANDARD*
- *COLD JUNCTION COMPENSATION (Enable/Disable)*
- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATION CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5TC accepts a thermocouple input and provides a temperature display in Celcius or Farenheit. The meter also features minimum and maximum display capture, display offset, °F or °C indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

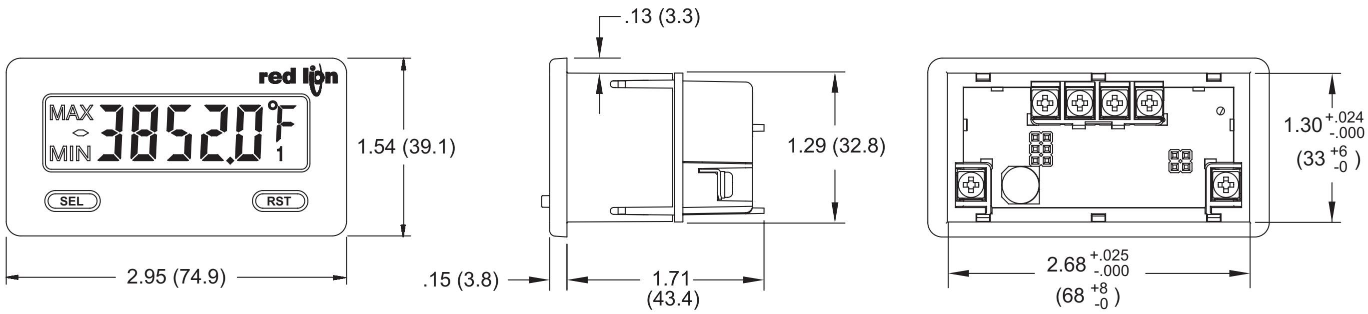
Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

CAUTION: Risk of Danger. Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5TC	Thermocouple Meter with Reflective Display	CUB5TCR0
		Thermocouple Meter with Backlight Display	CUB5TCB0
Optional Plug-in Cards	CUB5RLY	Single Relay Option Card	CUB5RLY0
	CUB5SNK	Dual Sinking Open Collector Output card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	Programming Cable RS232 (RJ11-DB9)	CBLPROG0
	CBPRO	Programming Cable RS485 (RJ11-DB9)	CBPRO007
	SFCRD	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5TCR0: Reflective LCD with full viewing angle
   CUB5TCB0: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or an NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5TCR0	---	10 mA	40 mA
CUB5TCB0	Red (max intensity)	85 mA	115 mA
CUB5TCB0	Green (max intensity)	95 mA	125 mA

3. **READOUT**:
   Resolution: 1 or 0.1 degrees
   Scale: °F or °C
   Offset Range: -999 to 9999 display units
4. **THERMOCOUPLE INPUTS**:
   Isolation: TC+ and TC- terminals are not electrically isolated from the power supply or optional comms cards.
   Open Sensor Display: OPEn
   Overrange/Underrange Input: OLOL/ULUL
   Overrange/Underrange Display : "….."/"-….."
   Maximum Input Voltage: 30 VDC, TC+ to TC-
   Maximum Input Voltage TC-: 3 VDC max. with respect to common

TC TYPE	RANGE	ACCURACY @ 23°C ±°C	ACCURACY @ -35 to 75°C ±°C	WIRE COLOR	
				ANSI	BS 1843
T	-200 to 400°C -328 to 752°F	2.3	5.8	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -328 to 1600°F	2.7	4.9	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C -328 to 1400°F	1.9	4.3	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -328 to 2502°F	2.3	5.8	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
S	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
B	200 to 1820°C 392 to 3308°F	9.1<540°C 4.5>540°C	42.6<540°C 15.0>540°C	no standard	no standard
N	-200 to 1300°C -328 to 2372°F	2.8	8.1	(+) orange (-) red	(+) orange (-) blue
mV	-10.00 to 65.00	0.02 mV	0.08 mV	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a -35 to 75°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the -35 to 75°C operating range includes meter tempco and cold junction tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple cold junction compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RESPONSE TIME:**
   Display: 500 msec min.
   Output: 800 msec max (with input filter setting of 0)
6. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E179259
   UL Listed: File #E137808
   Type 4X Outdoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines for additional information.
8. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
9. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range for CUB5TCR0: -35 to 75°C
    Operating Temperature Range for CUB5TCB0 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

    Storage Temperature: -35 to 85°C
    Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
    Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
12. **WEIGHT**: 3.2 oz (100 g)

Optional Plug-in Cards

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Note: *Non-grounded (isolated) thermocouple probes must be used when multiple units are connected in an RS485 network, or measurement errors will occur.*
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

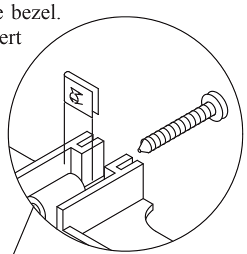
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

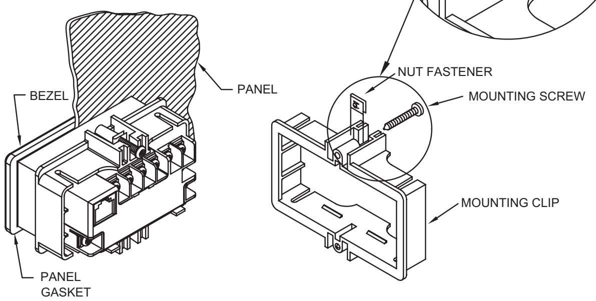
1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel.
The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.



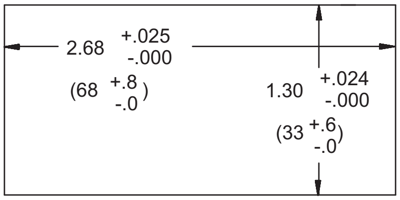


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 Installing Plug-In Cards

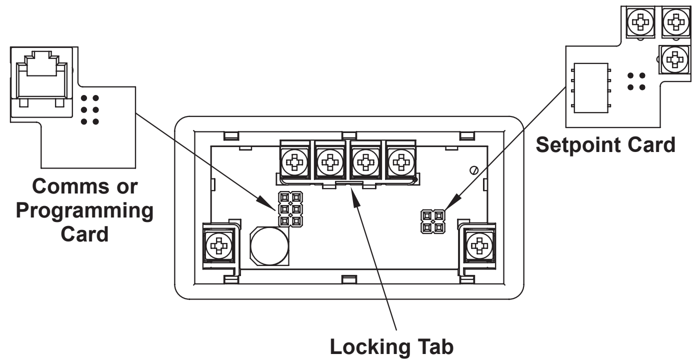
WARNING: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter.



3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

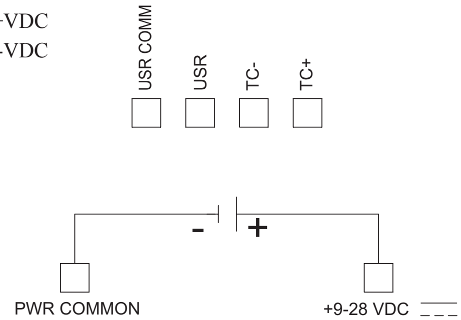
1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (RLC part number LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

3.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC
Power Common: -VDC

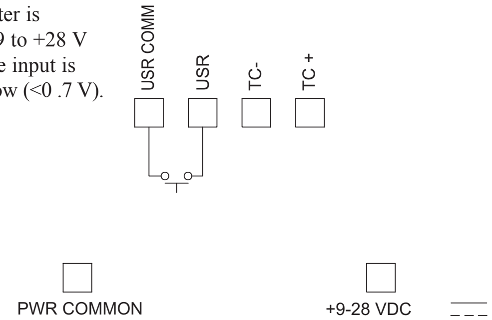


3.2 USER INPUT WIRING

Sinking Logic

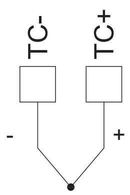
USR COMM } Connect external switching device between the
USR } User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).



3.3 INPUT WIRING

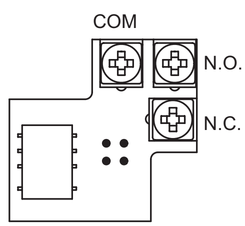
Thermocouple



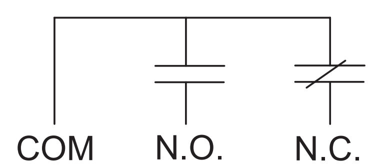
***CAUTION**: Power input common and sensor input common are NOT isolated from user input common. In order to preserve the safety of the meter application, the power input common and the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

3.4 SETPOINT (OUTPUT) WIRING

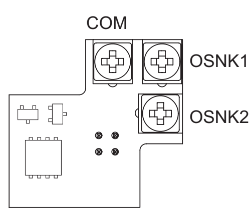
SINGLE SETPOINT RELAY PLUG-IN CARD



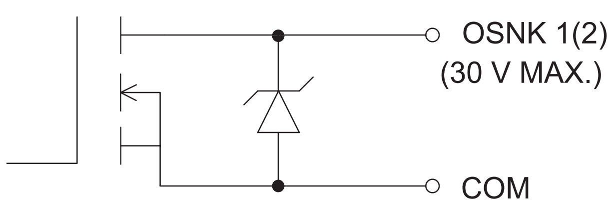
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



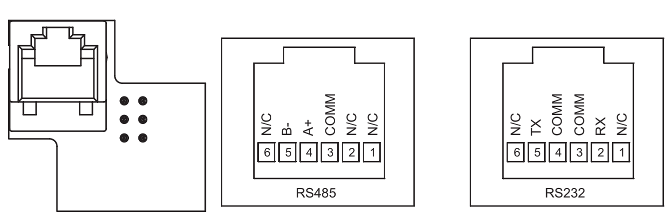
ELECTRICAL CONNECTIONS



Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

3.5 SERIAL COMMUNICATION WIRING

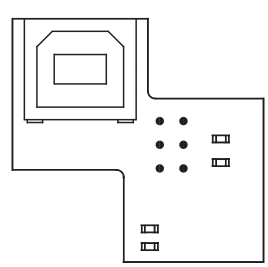
SERIAL COMMUNICATIONS PLUG-IN CARD



RJ11 CONNECTOR PIN OUTS

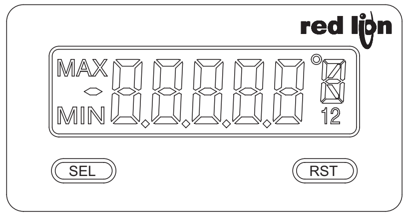
3.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



F

4.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN / MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

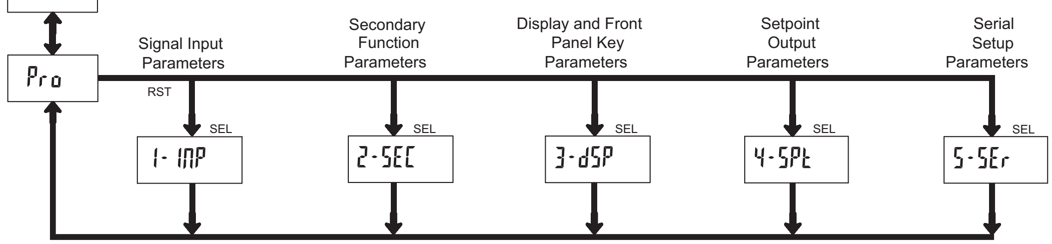
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended that all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro nO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro nO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

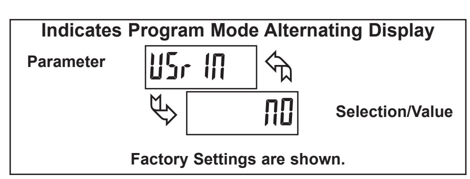
FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



F

5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1- INP)

PARAMETER MENU

1- INP → SEL → Pro

tYPE	CJC	SCALE	dECPt	OFSEt	FILtr	bAnd	USr IN	U-ASN
Thermocouple Type	Cold Junction Compensation	Temperature Scale	Display Decimal Point	Display Offset Value	Filter Setting	Filter Band	User Input Function	User Input Assignment

THERMOCOUPLE TYPE

tYPE
tc-J

SELECTION	TC TYPE	SELECTION	TC TYPE
tc-t	T	tc-S	S
tc-E	E	tc-b	B
tc-J	J	tc-n	N
tc-K	K	UOLt	
tc-r	R		

Select the thermocouple type used for the application. The appropriate curve will be automatically loaded for the selected type.

Selecting UOLt displays the millivolt input signal with 10 µV resolution.

COLD JUNCTION COMPENSATION

CJC
YES

YES NO

This parameter enables or disables internal cold junction compensation. For most applications, cold junction compensation should be enabled (YES). This parameter does not appear if tYPE = UOLt.

TEMPERATURE SCALE

SCALE
°F

°F °C

Select the temperature scale. This selection applies for the Input, MAX and MIN displays. This parameter does not appear if tYPE = UOLt.

DISPLAY DECIMAL POINT

dECPt
0

0 0.0

Select the decimal point location for the desired display resolution. This selection applies for the Input, MAX and MIN displays. This parameter does not appear if tYPE = UOLt or for types R, S or B thermocouples which have a fixed 1 degree resolution.

DISPLAY OFFSET VALUE

OFSEt
0

-999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

FILTER SETTING

FILtr
1

0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bAnd
10

00 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

USER INPUT FUNCTION

USr IN
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Pr int	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN
dSP

HI HI-LO
LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

F

5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → SEL → HI-En — HI-t — LO-En — LO-t — FCS — CodE → Pro

HI-En	HI-t	LO-En	LO-t	FCS	CodE
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations

MAX DISPLAY ENABLE

HI-En
NO

NO YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
NO

NO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

F

FACTORY SERVICE OPERATIONS

FCS
NO

NO YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press **SEL** button to exit the module.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corruted data.

CALIBRATION

CodE
48

The CUB5TC uses stored voltage calibration and cold junction temperature values to provide accurate temperature and voltage measurements. Over time, the electrical characteristics of the components inside the meter could slowly change. The result is that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5TC involves a voltage calibration and a cold junction calibration. It is recommended that both calibrations be performed. The voltage calibration MUST precede the cold junction calibration. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

Calibration should only be performed by individuals experienced in calibrating electronic equipment.

CAUTION*: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5TC.*

Input Voltage Calibration

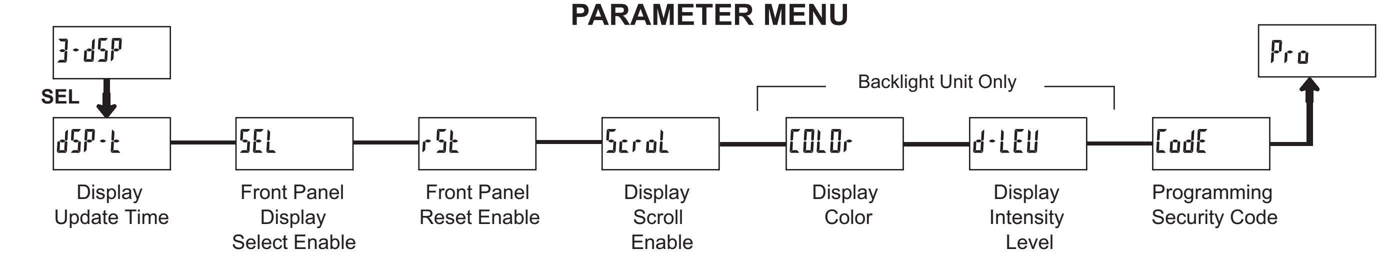
1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the TC+ (positive) and the TC- (negative) terminals of the CUB5TC. Set the output of the voltage source to zero.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL NO.
3. Press the RST button to select INP.
4. Press the SEL button. Display reads 0.0u.
5. With the voltage source set to zero, press SEL. Display reads CALC for about eight seconds.
6. When display reads 60.0u, apply 60.000 mV input signal. Press SEL. Display reads CALC for about eight seconds.
7. When display reads CAL NO, press SEL twice to exit Module 2 and return to the normal display mode.
8. Proceed to Cold Junction Calibration.

Cold Junction Calibration

1. **Install all option cards needed for your application and the rear cover, or invalid results will occur.**
2. The ambient temperature must be within 20°C to 30°C.
3. Connect a thermocouple (types T, E, J, K, or N only) with an accuracy of 1°C or better to the meter.
4. Enter programming mode and verify the following settings in Module 1:
   tYPE = thermocouple type connected to the unit
   CJC = YES; SCALE = °C; dECPt = 0.0; OFSEt = 0
5. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath of known temperature could be used in place of the thermometer.)
6. Compare the unit display with the reference temperature indicator (or calibration bath). If a difference of more than ±1.0 °C exists, note the difference (CJ error) and continue with cold junction calibration.
   CJ Error = Reference Temperature - Unit Display.
7. Enter programming mode. Step through Module 2 to the Service Access Code parameter and select CodE 48. Press and hold the SEL button until the unit displays CAL NO. Press the RST button to select CJC.
8. Press SEL. Display reads CJC followed by the current cold junction value. Calculate a new cold junction value as follows:
   New cold junction = Current cold junction + CJ Error (noted above)
9. Press RST and set the display to the new cold junction value. Press and hold SEL. Display reads CALC for about four seconds and then returns to CAL NO.
10. Press SEL twice to exit calibration and return to the normal display mode. Verify the input reading is correct. If not, repeat steps 6 through 10.

5.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t
1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

NO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

Scrol
NO

YES NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr
rEd

rEd Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

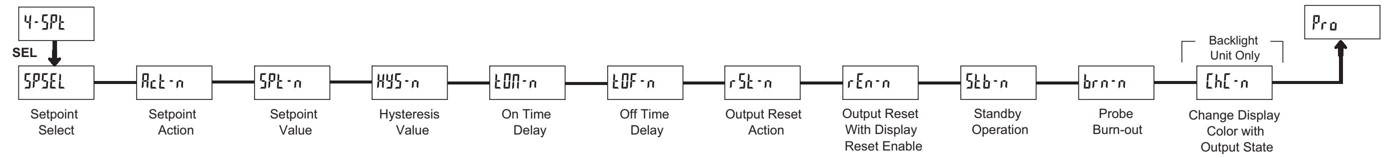
USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

F

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL ⇨ NO

NO SP-1 SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2 ⇨ NO

YES NO

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

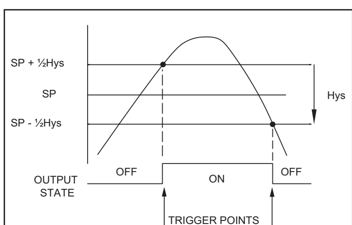
SETPOINT ACTION

Act-n ⇨ HI-Ub

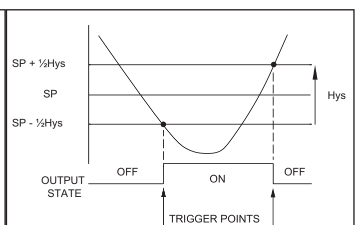
HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

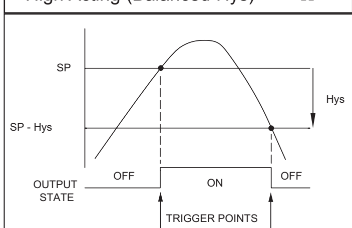
HI-bL	=	High Acting, with balanced hysteresis
LO-bL	=	Low Acting, with balanced hysteresis
HI-Ub	=	High Acting, with unbalanced hysteresis
LO-Ub	=	Low Acting, with unbalanced hysteresis



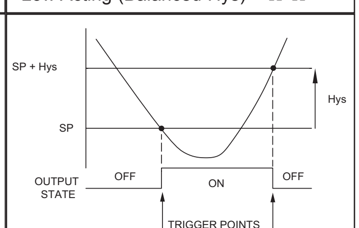
High Acting (Balanced Hys) = HI-bL



Low Acting (Balanced Hys) = LO-bL



High Acting (Unbalanced Hys) = HI-Ub



Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n ⇨ 100

-9999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n ⇨ 2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n ⇨ 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n ⇨ 0.0

0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n ⇨ Auto

Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

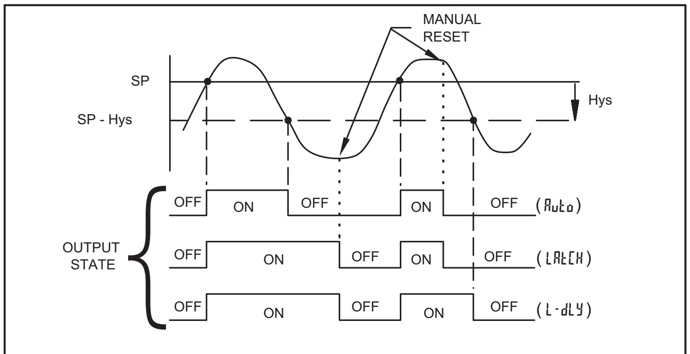
Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle.

F

When the user input or **RST** button is activated (momentary action), the corresponding "on" output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding "on" output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n
YES

NO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n
NO

NO YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and OutputReset Action.

PROBE BURN-OUT ACTION

brn-n
OFF

OFF ON

Enter the probe burn-out action. In the event of a temperature probe failure (open), the output can be programmed to be on or off.

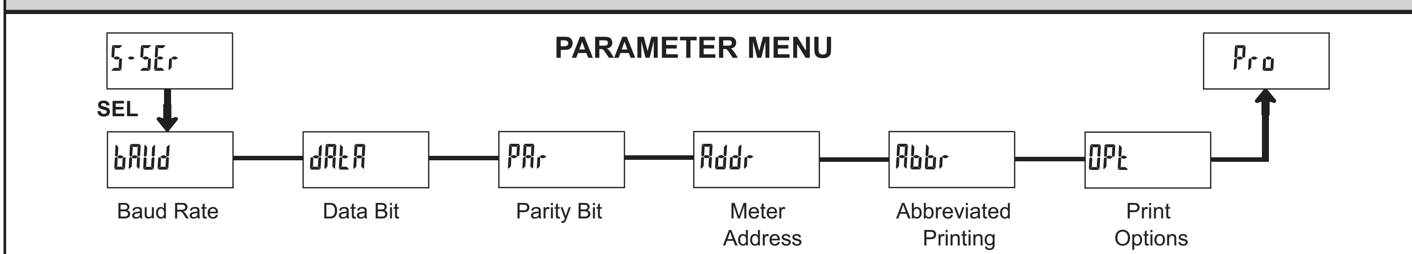
CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n
NO

NO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

5.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

F

MODEL CUB5RT - MINIATURE ELECTRONIC 5-DIGIT RTD METER

- *RTD INPUTS*
  RTD types Pt385, Pt392, Ni672, Cu427
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *SELECTABLE °F or °C WITH 1 or 0.1 DEGREE RESOLUTION*
- *°F OR °C DISPLAY ANNUNCIATORS*

- *MINIMUM AND MAXIMUM DISPLAY CAPTURE*
- *LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING*
- *0.48" (12.2 mm) HIGH DIGITS*
- *OPTIONAL SETPOINT OUTPUT CARD*
- *OPTIONAL SERIAL COMMUNICATION CARD (RS232 or RS485)*
- *OPTIONAL USB PROGRAMMING CARD*
- *OPERATES FROM 9 TO 28 VDC POWER SOURCE*
- *FRONT PANEL OR CRIMSON PROGRAMMABLE*
- *DISPLAY COLOR CHANGE CAPABILITY AT SETPOINT OUTPUT*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The CUB5 provides the user the ultimate in flexibility, from its complete user programming to the optional setpoint control and communication capability. The CUB5RT accepts an RTD input and provides a temperature display in Celcius or Farenheit. The meter also features minimum and maximum display capture, display offset, °F or °C indicator, and programmable user input. The display can be toggled either manually or automatically between the selected displays.

The CUB5 display has 0.48" (12.2 mm) high digits. The LCD is available in two versions, reflective and red/green backlight. The backlight version is user selectable for the desired color and also has variable display intensity.

The capability of the CUB5 can be easily expanded with the addition of option cards. Setpoint capability is field installable with the addition of the setpoint output cards. Serial communications capability for RS232 or RS485 is added with a serial option card.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS), which attaches directly to the back of a CUB5. The MLPS is powered from 85 to 250 VAC and provides up to 400 mA to drive the unit and sensors.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter.

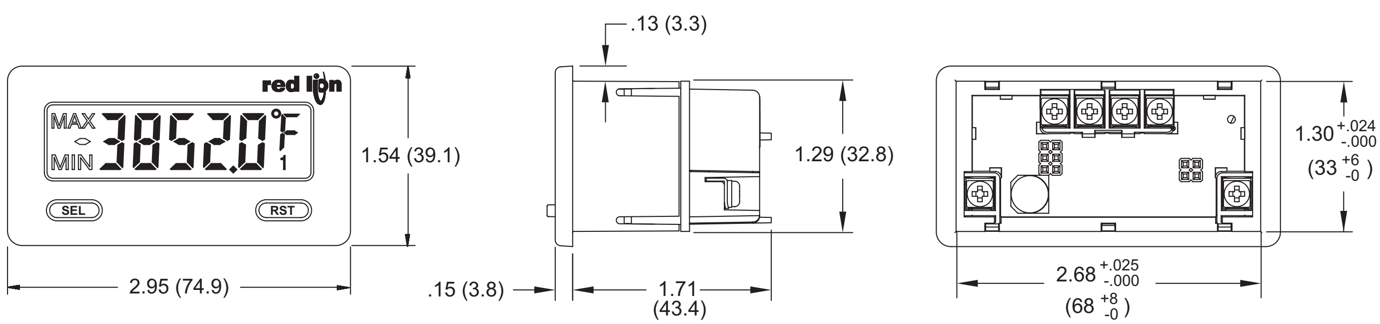
CAUTION: Risk of Danger. Read complete instructions prior to installationand operation of the unit.

CAUTION: Risk of electric shock.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15" (54.6) H x 3.00" (76.2) W.



ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
CUB5	CUB5RT	RTD Meter with Reflective Display	CUB5RTR0
		RTD Meter with Backlight Display	CUB5RTB0
Optional Plug-in Cards	CUB5RLY	Single Relay Output Card	CUB5RLY0
	CUB5SNK	Dual Sinking Output Card	CUB5SNK0
	CUB5COM	RS485 Serial Communications Card	CUB5COM1
		RS232 Serial Communications Card	CUB5COM2
	CUB5USB	USB Programming Card	CUB5USB0
Accessories	MLPS	+12 VDC Micro-Line Power Supply, 85 to 250 VAC source, 400 mA max out	MLPS1000
		+24 VDC Micro-Line Power Supply, 85 to 250 VAC source, 200 mA max out	MLPS2000
	CBLPROG	RS232 Programming Cable (DB9-RJ11)	CBLPROG0
	CBPRO	Crimson PC Configuration Software for Windows 98, ME, 2000, XP [1]	SFCRD200
	CBLUSB	USB Programming Cable	CBLUSB00

[1] Crimson software is a free download from http://www.redlion.net/

GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits
   CUB5RTR0: Reflective LCD with full viewing angle
   CUB5RTB0: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
2. **POWER**: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS or a NEC Class 2 or Limited Power Source (LPS) rated power supply.

MODEL NO.	DISPLAY COLOR	INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0	INPUT CURRENT @ 9 VDC WITH CUB5RLY0
CUB5RTR0	---	10 mA	40 mA
CUB5RTB0	Red (max intensity)	85 mA	115 mA
CUB5RTB0	Green (max intensity)	95 mA	125 mA

3. **READOUT**:
   Resolution: 1 or 0.1 degrees
   Scale: °F or °C
   Offset Range: -19999 to 19999 display units
4. **RTD INPUTS**:
   Isolation: Input and EXC terminals are not electrically isolated from the power supply or optional comms cards.
   Failed Sensor Display: OPEN or Short
   Overrange/Underrange Input: OLOL/ULUL
   Overrange/Underrange Display : "….."/"-….."
   Maximum Input Voltage: 30 VDC
   Type: 2, 3 or 4 wire
   Excitation current: 100 ohm range: 165 µA
   10 ohm range: 2.5 mA
   Lead resistance: 100 ohm range: 10 ohm/lead max.
   10 ohm range: 3 ohms/lead max.
   Balanced Lead Resistance: Automatically compensated up to max per lead.
   Unbalanced Lead Resistance: Uncompensated.

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a -35 to 75°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the -35 to 75°C operating range includes meter tempco effects. The specification includes the A/D conversion errors and linearization conformity. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RESPONSE TIME**:
   Display: 500 msec min.
   Output: 1.25 sec max (with input filter setting of 0)
6. **USER INPUT (USR):** Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistor to +9 to 28 VDC.
   Threshold Levels: V_{IL} = 0.7 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E179259
   UL Listed: File #E137808
   Type 4X Outdoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines for additional information.
8. **MEMORY**: Nonvolatile E^2PROM memory retains all programming parameters and max/min values when power is removed.
9. **CONNECTIONS**: Wire clamping screw terminals
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.
10. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range for CUB5RTR0: -35 to 75 °C
   Operating Temperature Range for CUB5RTB0 depends on display color and intensity level as per below:

	INTENSITY LEVEL	TEMPERATURE
Red Display	1 & 2	-35 to 75°C
	3	-35 to 70°C
	4	-35 to 60°C
	5	-35 to 50°C
Green Display	1 & 2	-35 to 75°C
	3	-35 to 65°C
	4	-35 to 50°C
	5	-35 to 35°C

   Storage Temperature: -35 to 85 °C
   Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
   Vibration to IEC 68-2-6: Operational 5-500 Hz, 5 g
   Shock to IEC 68-2-27: Operational 30 g
   Altitude: Up to 2000 meters
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for outdoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.
12. **WEIGHT**: 3.2 oz (100 g)

OPTIONAL PLUG-IN CARDS

ADDING OPTION CARDS

The CUB5 meters can be fitted with optional output cards and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

WARNING: Disconnect all power to the unit before installing Plug-in card.

SINGLE RELAY CARD

Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
Life Expectancy: 100,000 minimum operations

DUAL SINKING OUTPUT CARD

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
$V_{DS\ ON}$: 0.7 V @ 100 mA
$V_{DS\ MAX}$: 30 VDC
Offstate Leakage Current: 0.5 mA max.

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
***Note:** Non-grounded (isolated) RTD probes must be used when multiple units are connected in an RS485 network, or measurement errors will occur.*
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable (refer to CUB5COM bulletin)

RS232 SERIAL COMMUNICATIONS CARD

Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

USB PROGRAMMING CARD

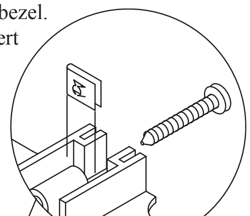
Type: USB virtual comms port
Connection: Type B
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

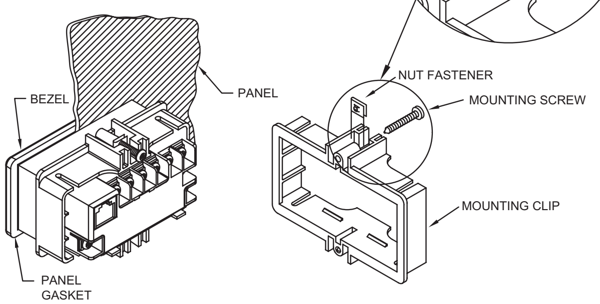
1.0 INSTALLING THE METER

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel.
The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approx. 28 to 36 in-oz [0.202 to 0.26 N-m]). Do not over-tighten the screws.



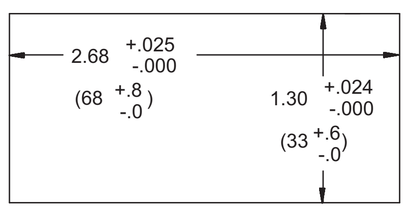


INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.



2.0 SETTING THE JUMPERS

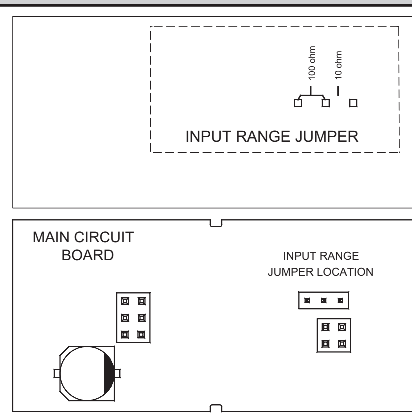
INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum input signal to avoid overloads. To access the jumper, remove the rear cover of the meter.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.



3.0 Installing Plug-In Cards

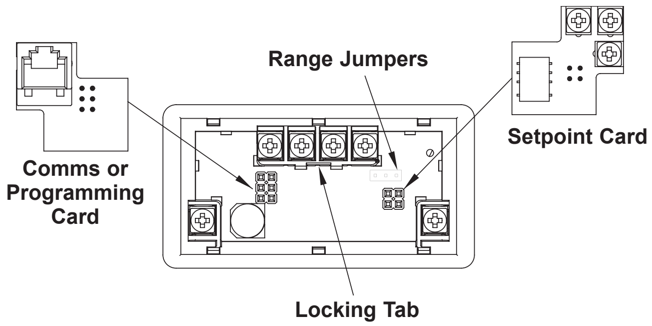
WARNING: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

REMOVING THE REAR COVER

To remove the rear cover, locate the cover locking tab below the 2nd and 3rd input terminals. To release the tab, insert a small, flat blade screwdriver between the tab and the plastic wall below the terminals. Inserting the screwdriver will provide enough pressure to release the tab locks. To replace the cover, align the cover with the input terminals and press down until the cover snaps into place.

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug in to the main circuit board of the meter.



4.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

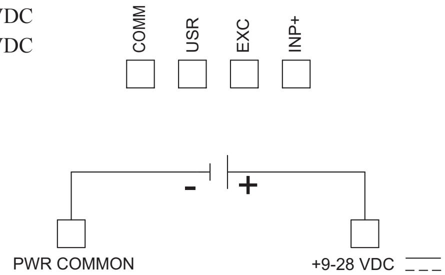
F

4.1 POWER WIRING

DC Power

+9 to +28 VDC: +VDC

Power Common: -VDC

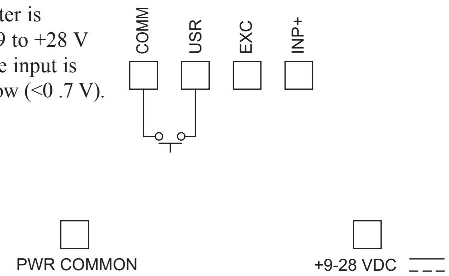


4.2 USER INPUT WIRING

Sinking Logic

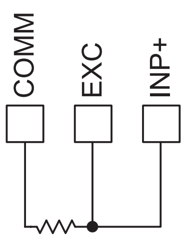
USR COMM, USR } Connect external switching device between the User Input terminal and User Input Common.

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<0 .7 V).

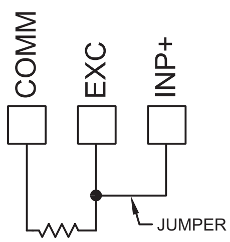


4.3 INPUT WIRING

3-WIRE RTD



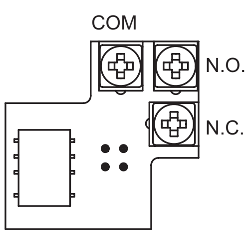
2-WIRE RTD



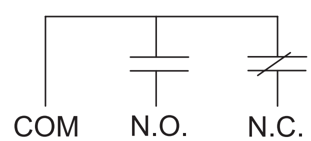
CAUTION: *Power input common and sensor input common are NOT isolated from user input common. In order to preserve the safety of the meter application, the power input common and the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 SETPOINT (OUTPUT) WIRING

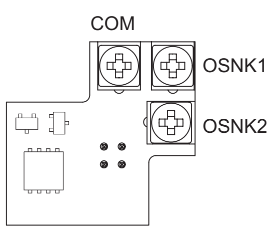
SINGLE SETPOINT RELAY PLUG-IN CARD



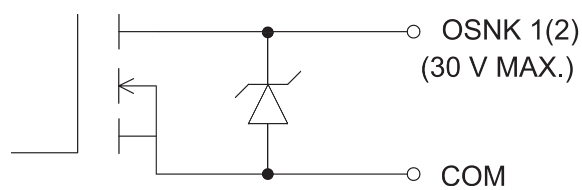
ELECTRICAL CONNECTIONS



DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD



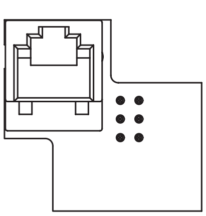
ELECTRICAL CONNECTIONS

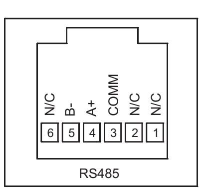


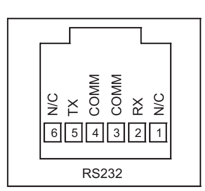
Output Common is not isolated from DC Power Common. Load must be wired between OSNK terminal and V+ of the load supply.

4.5 SERIAL COMMUNICATION WIRING

SERIAL COMMUNICATIONS PLUG-IN CARD



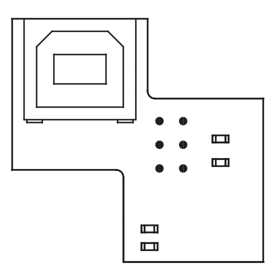




RJ11 CONNECTOR PIN OUTS

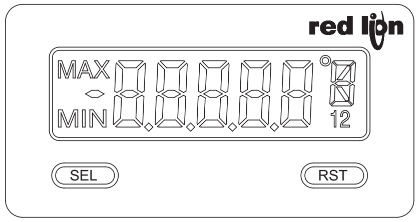
4.6 USB PROGRAMMING

USB PROGRAMING PLUG-IN CARD



F

5.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	ENTERING PROGRAM MODE	PROGRAMMING MODE OPERATION
SEL	Index display through enabled values	Press and hold for 2 seconds to activate	Store selected parameter and index to next parameter
RST	Resets values (MIN / MAX) or outputs		Advances through the program menu Increments selected parameter value or selection

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

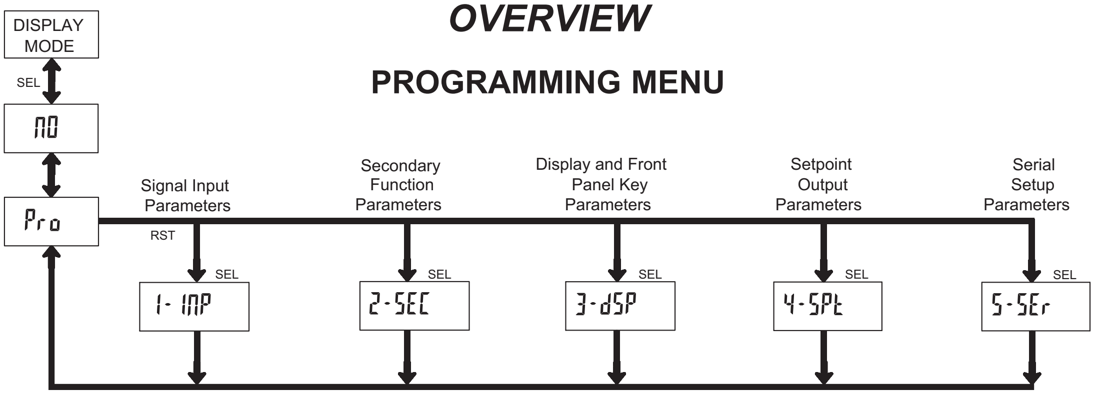
"1" - To the right of the display indicates setpoint 1 output activated.
"2" - To the right of the display indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

6.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (SEL BUTTON)

It is recommended that all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the **SEL** button. If it is not accessible then it is locked by either a security code, or a hardware lock.

MODULE ENTRY (SEL & RST BUTTONS)

The Programming Menu is organized into separate modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **RST** button is used to select the desired module. The displayed module is entered by pressing the **SEL** button.

MODULE MENU (SEL BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **SEL** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **RST** button is used to move through the selections/values for that parameter. Pressing the **SEL** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, press the **RST** button to access the value. The right hand most digit will begin to flash. Pressing the **RST** button again increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will advance to the next digit. Pressing and holding the **SEL** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (SEL BUTTON)

The Programming Mode is exited by pressing the **SEL** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

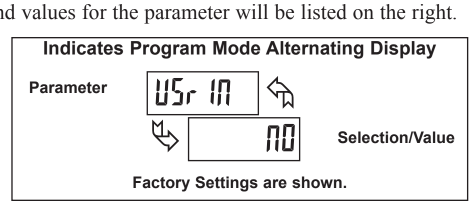
FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corrupted data.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



F

6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1- INP)

PARAMETER MENU

1- INP → SEL → tYPE (RTD Type) — SCALE (Temperature Scale) — dECPt (Display Decimal Point) — OFSEt (Display Offset Value) — FILtr (Filter Setting) — bAnd (Filter Band) — USr IN (User Input Function) — U-ASN (User Input Assignment) → Pro

RTD TYPE

tYPE
Pt385

SELECTION	TYPE	RANGE JUMPERS
Pt385	RTD Platinum 385	100 ohm
Pt392	RTD Platinum 392	100 ohm
Ni672	RTD Nickel 672	100 ohm
Cu427	RTD Copper 10 Ω	10 ohm

Select the RTD type used for the application. The appropriate curve will be automatically loaded for the selected type. The position of the Input Range Jumper must match the RTD type selected.

TEMPERATURE SCALE

SCALE
°F

°F °C

Select the temperature scale. This selection applies for the Input, MAX and MIN displays.

DISPLAY DECIMAL POINT

dECPt
0

0 0.0

Select the decimal point location for the desired display resolution. This selection applies for the Input, MAX and MIN displays.

DISPLAY OFFSET VALUE

OFSEt
0

-19999 to 19999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

F

FILTER SETTING

FILtr
1

0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bAnd
10

00 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected in the previous parameter.

USER INPUT FUNCTION

USr IN
NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation (backlight version only).
COLOr	Backlight Color (Edge Triggered)	Change backlight color with each activation (backlight version only).
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN
dSP

HI HI-LO
LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → SEL → HI-En — HI-t — LO-En — LO-t — FCS — CodE → Pro

HI-En	HI-t	LO-En	LO-t	FCS	CodE
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations

MAX DISPLAY ENABLE

HI-En   NO

NO   YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t   2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En   NO

NO   YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t   2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS   NO

NO   YES

Select YES to perform any of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE   66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press **SEL** button to exit the module.

Pressing both the **SEL** and the **RST** button on power-up will also load the factory settings and display rESEt. This allows operation in the event of a memory failure or corruted data.

CALIBRATION

CodE   48

The CUB5RT uses stored resistance calibration values to provide accurate temperature measurements. Over time, the electrical characteristics of the components inside the meter could slowly change. The result is that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the CUB5RT involves a resistance calibration. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

Calibration should only be performed by individuals experienced in calibrating electronic equipment.

***CAUTION**: The accuracy of the calibration equipment will directly affect the accuracy of the CUB5RT.*

10 OHM RTD Range Calibration

1. Set the Input Range Jumper to 10 ohm.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL NO.
3. Press the RST button. Display reads CAL r10.
4. Press the SEL button. Display reads 0.0r.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
6. When the display reads 15.0r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
7. When display reads CAL NO, press the SEL button to exit calibration, or proceed to the 100 ohm RTD Range Claibration.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm.
2. With the display at CodE 48, press and hold the SEL button for 2 seconds. Unit will display CAL NO.
3. Press the RST button until the display reads CAL r100.
4. Press the SEL button. Display reads 0.0r.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
6. When the display reads 300.0r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads CALC for about 15 seconds.
7. When display reads CAL NO, press the SEL button to exit calibration.

F

RESISTANCE DISPLAY MODE

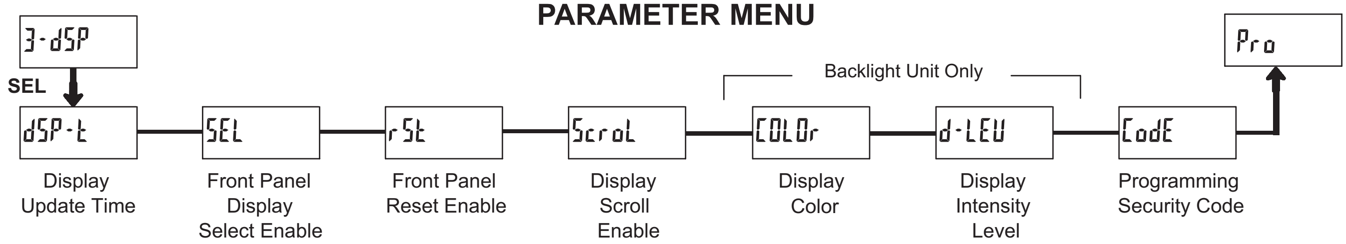
CodE   85

Entering Code 85 will place the CUB5RT in a resistance display mode. This mode is useful for diagnostic purposes before and after calibration, or to display the measured resistance of a connected RTD probe. If the RTD type is set for Cu427 with the jumper set to the 10 ohm position, the display will read resistance in 0.000 ohms resolution. For all other RTD types, with the jumper in the 100 ohm position, the display will read in 0.00 ohms resolution.

Re-entering code 85 toggles the display back to the temperature display mode without having to remove power from the meter. If power is removed, the display always returns to the temperature display mode when power is reapplied.

6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t
1

0.5   1   2   seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES   NO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

NO   LO   dSP
HI   HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

ScroL
NO

YES   NO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds.

DISPLAY COLOR (BACKLIGHT UNIT ONLY)

COLOr
rEd

rEd   Grn

Enter the desired display color, red or green. This parameter is active for backlight units only.

DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed. This parameter is active for backlight units only.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

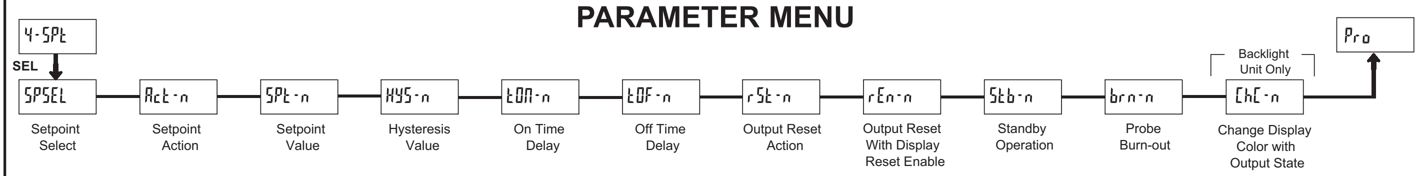
USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

F

6.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU



The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

SETPOINT SELECT

SPSEL
NO

NO SP-1 SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module. The number of setpoints available is setpoint output card dependent.

SETPOINT 2 ENABLE

Enb-2
NO

YES NO

Select YES to enable Setpoint 2 and access the setup parameters. If NO is selected, the unit returns to SPSEL and setpoint 2 is disabled.

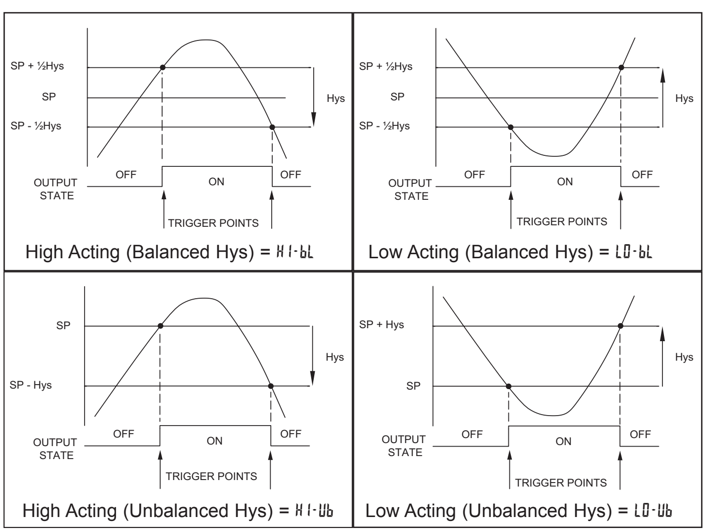
SETPOINT ACTION

Act-n
HI-Ub

HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL	=	High Acting, with balanced hysteresis
LO-bL	=	Low Acting, with balanced hysteresis
HI-Ub	=	High Acting, with unbalanced hysteresis
LO-Ub	=	Low Acting, with unbalanced hysteresis



High Acting (Balanced Hys) = HI-bL

Low Acting (Balanced Hys) = LO-bL

High Acting (Unbalanced Hys) = HI-Ub

Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n
100

-9999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n
2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n
0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n
0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n
Auto

Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

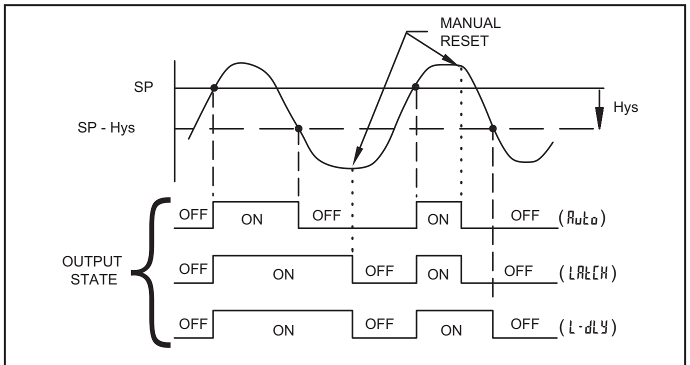
Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The “on” output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle.

F

When the user input or **RST** button is activated (momentary action), the corresponding “on” output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding “on” output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n

YES

nO YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n

nO

nO YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and OutputReset Action.

PROBE BURN-OUT ACTION

brn-n

OFF

OFF On

Enter the probe burn-out action. In the event of a temperature probe failure (open or short), the output can be programmed to be on or off.

CHANGE DISPLAY COLOR w/OUTPUT STATE

ChC-n

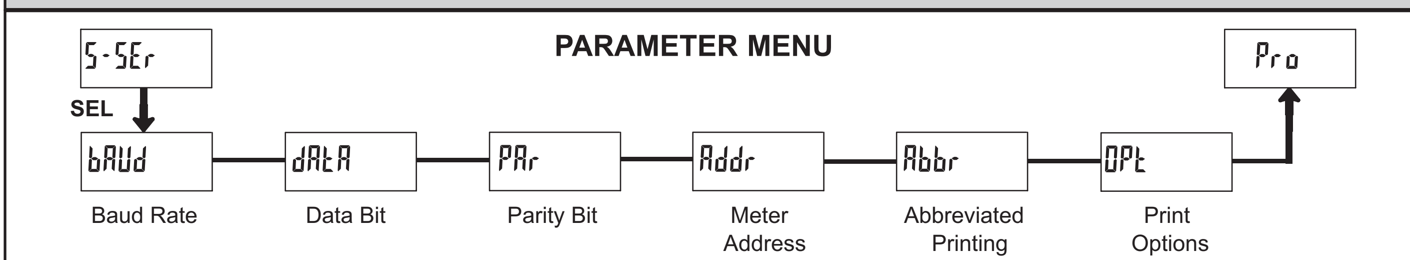
nO

nO YES

This parameter enables the backlight CUB5 to switch the backlight color when the output state changes. This parameter is only active for the backlight version.

6.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)

F



The Serial Setup Parameters are only active when one of the optional serial communications/programming cards is installed in the meter.
Refer to the CUB5COM bulletin for details and setup for the CUB5 RS232 or RS485 serial communications.
Refer to the CUB5USB bulletin for details on the CUB5 USB programming and programming requirements.

MODEL PAXLTC - PAX LITE THERMOCOUPLE METER

c UL US LISTED
IND. CONT. EQ.
51EB

- *PROGRAMMABLE TC TYPE (T, E, J, K, R, S, B, N or mV SCALE)*
- *CONFORMS TO ITS-90 STANDARDS*
- *SELECTABLE °F OR °C WITH 0.1 OR 1 DEGREE DISPLAY RESOLUTION*
- *STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY*
- *FULL 4-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE DIGITAL FILTERING ENHANCES STABILITY*
- *PEAK/VALLEY (HI/LO READING) MEMORY*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *CUSTOM UNITS OVERLAY WITH BACKLIGHT*

GENERAL DESCRIPTION

The Pax Lite Thermocouple Meter accepts inputs from standard thermocouples and precisely linearizes them. A full 4-digit display accommodates a wide range of temperature inputs. The unit automatically compensates for cold junction, NBS linearity and the meter's zero and span.

The meter features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. With a few simple steps the unit can be used as a millivolt meter by selecting "VOLt" for thermocouple type. This mode is useful in monitoring and displaying the actual voltage produced at the thermocouple probe junction and as an aid in troubleshooting for a faulty thermocouple probe.

The meter provides a Peak (HI) and Valley (LO) reading memory with selectable capture delay time. The capture delay is used to prevent detection of false Peak or Valley readings that may occur during start-up or unusual process events. The Peak and Valley readings are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.).

Programmable digital filtering enhances the stability of the reading. All set-up data is stored in EEPROM, which will hold data for a minimum of 10 years without power. The meter has several built-in diagnostic functions to alert operators of any malfunction.

Extensive testing of noise interference mechanisms and full burn-in makes the indicator extremely reliable in industrial environments. The front bezel meets NEMA 4X/IP65 requirements for wash down applications.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**:
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II.

INSTALLATION CATEGORY (overvoltage category) **II**:
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

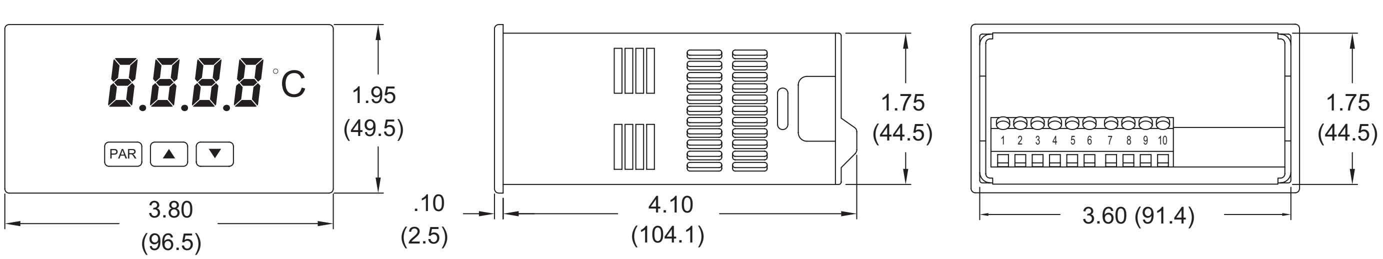


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

PAXL	TC	0	0

TC - Thermocouple Temperature Meter

Accessories Part Numbers*

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

*This meter is shipped with °F and °C overlay labels. The label kit is only needed if another units label is desired.

General Meter Specifications

1. **DISPLAY**: 4-digit, 0.56" (14.2 mm) high red LED, minus sign displayed for negative temperatures.
   Overrange/Underrange Input: Flashing "OLOL" or "ULUL"
   Overrange/Underrange Display: ". . . ." or "-. . . ."
2. **POWER**: 85 to 250 VAC, 50/60 Hz, 6 VA
   Isolation: 2300 Vrms for 1 min. between input and supply (300 V working voltage)
3. **CONTROLS**: Three front panel push buttons for meter set-up. Rear terminal input for disabling the front panel.
4. **THERMOCOUPLE TYPES**: T, E, J, K, R, S, B, N or mV scale
5. **RESOLUTION**: 1 degree for all types, or 0.1 degree for T, E, J, K and N only
6. **THERMOCOUPLE RANGE AND ACCURACY**: All errors include NBS conformity, cold junction effect and A/D conversion errors at 23°C after 60 minutes warm-up. Relative Humidity less than 85%.

TC TYPE	RANGE	ACCURACY	WIRE COLOR
T	-200 to +400ºC -328 to +752ºF	0.8ºC 1.4ºF	blue
E	-200 to +1000ºC -328 to +1832ºF	0.8ºC 1.4ºF	purple
J	-200 to +760ºC -328 to +1400ºF	0.8ºC 1.4ºF	white
K	-200 to +1250ºC -328 to +2282ºF	0.8ºC 1.4ºF	yellow
R	0 to +1768ºC +32 to +3214ºF	2.1ºC 3.8ºF	black
S	0 to +1768ºC +32 to +3214ºF	2.1ºC 3.8ºF	black
B	+150 to +1820ºC +302 to +3308ºF	2.3ºC 4.1ºF	grey
N	-200 to +1300ºC -328 to +2372ºF	0.8ºC 1.4ºF	orange
mV	-10.00 to +80.00 mV	0.01%	

7. **INPUT IMPEDANCE**: 20 MΩ, all types
8. **LEAD RESISTANCE EFFECT**: 20 µV/350 Ω
   Max Input Voltage Protection: 70 VDC continuous
9. **OPEN THERMOCOUPLE DETECTION**: Display Flashes: "OPEN"
10. **COLD JUNCTION COMPENSATION**: Automatic, 0.02 degree/degree. Disabled for linear mV scale.
11. **READING RATE**: 2.5 readings/second
12. **RESPONSE TIME**: 2 seconds to settle for step input (increases with programmable digital filtering)
13. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 45 dB @ 50/60 Hz (may be improved by programmable digital filtering)
    Common Mode Rejection: 120 dB, DC to 50/60 Hz
14. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50 °C
    Storage Temperature Range: -40 to 80 °C
    Operating and Storage Humidity: 85% max (non-condensing) from 0 to 50 °C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2g's.
    Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
    Span Drift: 40 ppm/°C
    Zero Drift: 1 µV/°C
    Altitude: Up to 2000 meters.
15. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Test Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529
    ELECTROMAGNETIC COMPATIBILITY
    Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Note:
1. Criterion A: Normal operation within specified limits.

16. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
17. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
18. **WEIGHT**: 0.65 lbs. (0.24 Kg)

Accessories

UNITS LABEL KIT (PAXLBK)

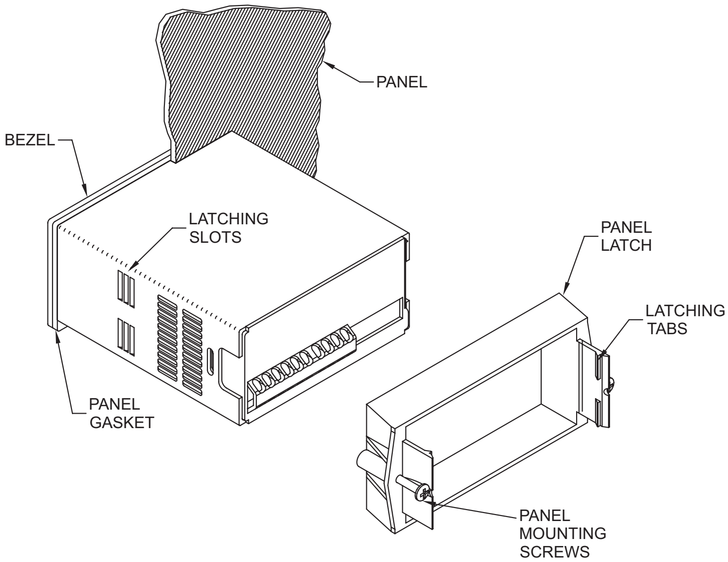
Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

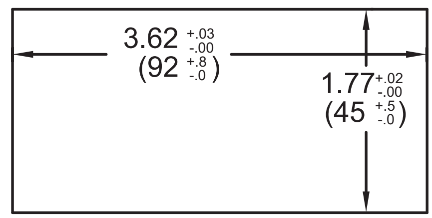
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Wiring the Meter

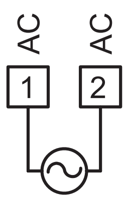
POWER WIRING

Primary AC power is connected to Terminals 1 and 2. To reduce the chance of noise spikes entering the AC line and affecting the indicator, the AC power should be relatively “clean” and within the specified limits. Drawing power from heavily loaded circuits or circuits which also power loads that cycle on and off, (contactors, relays, motors, machinery, etc.) should be avoided.

AC Power

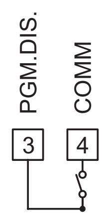
Terminal 1: VAC

Terminal 2: VAC



PROGRAM DISABLE INPUT WIRING

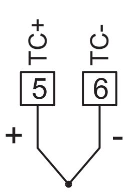
PGM.DIS. (Terminal 3) is a digital input that is active when connected to Comm (Terminal 4). Any form of mechanical switch or current sinking logic with less than 0.7 V saturation may be used. The use of shielded cable is recommended. Follow the EMC Installation Guidelines for shield connection.



SIGNAL WIRING (TC SENSOR)

Remove power and connect the negative thermocouple lead (always red) to TC- (Terminal 6) and the positive lead to TC+ (Terminal 5). Be certain that connections are clean and tight. If the thermocouple probe is to be mounted away from the meter, thermocouple extension grade wire must be used (copper wire will not work). Use the correct type and observe the correct polarity. Always refer to the sensor manufacturer’s instructions for probe wiring connections, if available. For multi-probe temperature averaging applications, two or more thermocouple probes may be connected at the meter. (Always use the same type.) In order to minimize the chances of coupling noise into the wires and subsequently causing bouncy and erroneous readings, proper guidelines for thermocouple wire routing must be followed.

Thermocouple



WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter’s voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter be protected by a fuse or circuit breaker.

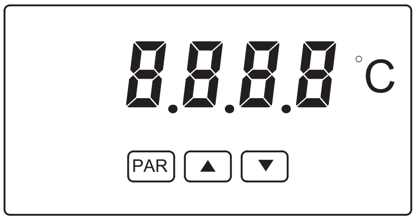
When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

3.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode or Display Input Reading	Store selected parameter and index to next parameter
▲	Display Peak (HI) Reading	Increment value or change selection
▼	Display Valley (LO) Reading	Decrement value or change selection

PEAK/VALLEY DETECTION

The meter will automatically record the highest input reading (peak) and the lowest input reading (valley) for later recall. These values are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.). A selectable capture delay time is used to prevent detection of false peak or valley readings caused by sudden short spikes or unusual process events.

The peak and valley readings can be viewed and reset using the front panel keys as described below.

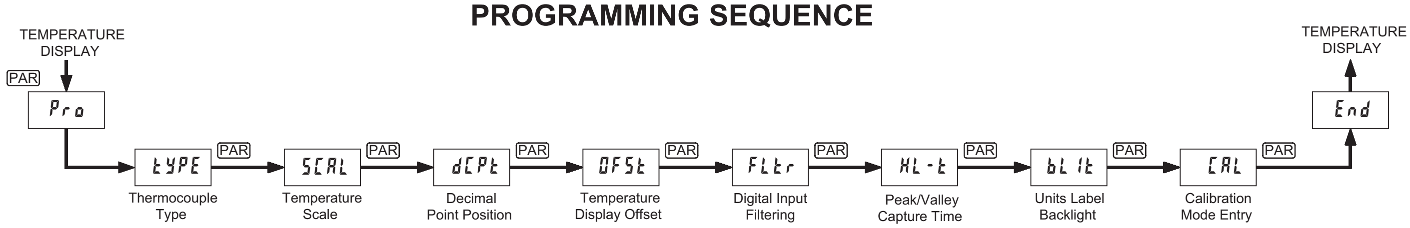
View Peak, Valley and Input readings:
   To view Peak, press ▲. Meter displays HI followed by the Peak reading.
   To view Valley, press ▼. Meter displays LO followed by the Valley reading.
   To view Input, press **PAR**. Meter displays INPt followed by the current Input reading.

Note: The decimal point to the right of digit 1 flashes while the peak or valley reading is displayed.

Reset Peak and/or Valley to the current Input reading:
   To reset Peak and Valley, press ▲ and ▼ simultaneously.
   To reset Peak only, press and hold ▲ then press **PAR**.
   To reset Valley only, press and hold ▼ then press **PAR**.
In each case, the meter displays rSEt followed by the current Input reading.

4.0 Programming the Meter

PROGRAMMING SEQUENCE



The Thermocouple Meter has up to seven programmable parameters that are entered in the sequence shown above, using the front panel push buttons. Depending on the thermocouple type selected, some parameters are not applicable and are bypassed in the sequence.

The last programming step offers the choice of entering calibration mode. From this mode, the user can restore the meter to factory default settings, or recalibrate the signal input and cold junction temperature if necessary. To prevent inadvertent entries, an access code must be keyed-in to perform any operations in calibration mode.

Note: Programming mode can be locked out using the Program Disable input terminal. With the PGM.DIS. terminal connected to COMM, the meter displays "LOC" when the **PAR** *key is pressed, and will not enter programming mode.*

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING MODE TIMEOUT

The Programming Mode has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the normal display mode. When automatic timeout occurs, any changes that were made to the parameter currently being programmed will not be saved.

PROGRAMMING PARAMETERS

In Programming Mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

THERMOCOUPLE TYPE

tYPE
tc-J

SELECTION	TC TYPE	SELECTION	TC TYPE
tc-t	T	tc-S	S
tc-E	E	tc-b	B
tc-J	J	tc-n	N
tc-K	K	VOLt	mV indicator
tc-r	R		

Select the thermocouple type by pressing the arrow keys (▲ or ▼) to sequence through the selection list. When the desired selection is displayed, press the **PAR** key to save the selection and advance to the next parameter. Refer to the thermocouple range and accuracy specification for additional TC information.

TEMPERATURE SCALE

SCAL
°F

°F °C

Select the desired temperature scale by pressing the up or down arrow keys. This setting does not change the Custom Units Overlay display (if installed). Press the **PAR** key to save the selection and advance to the next parameter.

DECIMAL POINT POSITION

dCPt
0

0 0.0

Select the decimal point position by pressing the up or down arrow keys. This sets the display resolution to 1 or 0.1 degree. This parameter is not available for thermocouple types R, S and B, where the display resolution is always 1 degree. When mV indicator mode is selected for thermocouple type, the display resolution is fixed at 0.01 mV (10 µV).

Press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE DISPLAY OFFSET

OFSt
0

-1999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors or errors due to variances in probe placement, or to adjust the readout to a reference thermometer. Set the desired display offset value by pressing (and/or holding) the up or down arrow keys. When the desired offset value is displayed, press the **PAR** key to save the selection and advance to the next parameter. The display resolution for the offset value is the same as the decimal point position programmed above. The display offset is not available when mV indicator mode is selected for thermocouple type.

DIGITAL FILTERING

FLtr
1

0 1 2 3

This parameter sets the amount of digital filtering applied to the input signal. If the temperature display is difficult to read due to small variations or noise, increased levels of filtering will help to stabilize the display. Although the digital filter features a "moving window" to help minimize response time, higher levels of filtering will result in slightly longer response times.

0 - no digital filtering
1 - normal filtering
2 - increased filtering
3 - maximum filtering

Set the desired level of input filtering by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

PEAK (HI)/ VALLEY (LO) CAPTURE DELAY TIME

HL-t
5

0 2 5 10 20 seconds

When the Input display is above the present HI value or below the present LO value for the entered delay time, the meter will capture the Input display as the new HI or LO reading. A delay time helps to avoid false captures of sudden short spikes or Input display variations that may occur during start-up.

Set the desired capture delay time by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

F

UNITS LABEL BACKLIGHT

bLIt
OFF

On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays, which can be installed in the meter bezel display assembly. The unit of measure for the meter display is then visible when the label backlight is illuminated. The two most commonly used temperature unit labels (°F and °C) are supplied with the meter. Press the up or down arrow keys to select whether the units label backlight is illuminated. Press the **PAR** key to save the selection and advance to the next parameter.

PROGRAMMING MODE EXIT

CAL
NO

YES NO

Before exiting Programming Mode, the meter offers the choice of entering Calibration Mode. To exit Programming Mode without entering Calibration Mode, select NO and press the **PAR** key. The meter briefly displays End and returns to the normal display mode. All programmed selections are now transferred to non-volatile memory and are retained if power is removed from the meter.

(If power loss occurs during Programming Mode, verify parameter changes and reprogram, if necessary, when power is restored.)

5.0 CALIBRATING THE METER

CALIBRATION MODE

CodE
50

0 to 99

To enter Calibration Mode, select CAL < > YES at the end of Programming Mode, and press the **PAR** key. In Calibration Mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary.

To prevent inadvertent entries, an access code must be entered to perform any operation in Calibration Mode. Upon entering Calibration Mode, the meter initially displays Code 50. Press the up or down arrow keys to select the access code for the desired operation. If an access code other than those shown below is entered, the meter exits Calibration Mode and returns to normal display mode.

FACTORY SETTINGS

CodE
66

The factory settings for the programming parameters are shown in the previous section in the alternating display illustrations. All programming parameters can be restored to the factory default settings by entering the access Code 66 and pressing the **PAR** key. The meter briefly displays rSEt and then returns to Code 50. This procedure resets only parameters that are accessed through Programming Mode. The Calibration Mode settings (input calibration levels) are not affected.

METER INPUT CALIBRATION

CodE
48

The meter has been fully calibrated at the factory. If the meter appears to be indicating incorrectly or inaccurately, refer to the troubleshooting section before attempting this procedure. When re-calibration is required *(generally every 2 years)*, the procedure should only be performed by qualified technicians using appropriate equipment. A precision thermometer (RTD, thermistor or similar type with an accuracy of ±0.3° C) and an accurate voltage source (0.01%) are required. The procedure consists of setting the cold junction temperature and applying accurate voltages to the meter input in a series of three steps. Allow a 60-minute warm-up before starting calibration.

COLD JUNCTION TEMPERATURE CALIBRATION

1. Connect a calibrated thermocouple (types T, E, J, K or N only) to the panel meter. Select the thermocouple type used in programming.
2. Connect the reference thermometer to the measuring end of the thermocouple. The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the PAXLTC thermocouple probe may be placed in a calibration bath of known temperature.)
3. From the normal indicator display mode, compare the display temperature to that of the reference thermometer. Allow 10 minutes for the temperature to equalize. The meter and the reference thermometer should agree to within 1° F (0.6° C).
4. If cold junction re-calibration is necessary (temperature out of tolerance), enter meter calibration mode and enter access Code 48. The meter display will alternate between CJC and the old cold junction reading. At this point, key-in the new cold junction temperature according to the formula:

WHERE:

New Cold Junction Reading = Old Cold Junction Reading + Difference
(Difference = Reference Thermometer Temperature - Meter Display Temperature)

5. Press **PAR**. The meter briefly displays ---- to acknowledge the new cold junction value.

VOLTAGE CALIBRATION

Following cold junction calibration, the display UCAL < > YES/NO appears. Enter YES if input voltage calibration is desired. If NO is entered, the meter exits calibration and returns to normal display mode.

DISPLAY	PARAMETERS	DESCRIPTION/COMMENT
0.0u	0.000 mV	Apply 0.000 mV, wait 20 seconds, press **PAR**.
30.0u	30.000 mV	Apply 30.000 mV, wait 20 seconds, press **PAR**.
60.0u	60.000 mV	Apply 60.000 mV, wait 20 seconds, press **PAR**.

The meter briefly displays End and returns to the normal display mode. Calibration is now complete.

It is recommended to check calibration by selecting mV indication mode for thermocouple type (tYPE < > UOLt) and verifying unit accuracy at various points over the range of the meter (-10 to +80 mV).

TROUBLESHOOTING

The majority of all problems with the meter can be traced to improper connections or improper programming set-ups. Be sure all connections are clean and tight and check the programming set-ups for correct data.

For further technical assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	POSSIBLE CAUSE	REMEDIES
NO DISPLAY	1. Power off, improperly connected, or brown-out.	1a. Check wiring. 1b. Verify power.
“EEEE” IN DISPLAY	1. Program data error.	1. Press **PAR** and check data set-ups.
“. . . .” or “-. . . .” IN DISPLAY	1. Input display out of range. 2. Loss of data set-ups.	1a. Change display resolution to “1” degree. 1b. Reduce offset value. 2a. Check data set-ups. 2b. Check for electrical disturbance. 2c. Disconnect and reconnect power.
DISPLAY WANDERS	1. Loss of data set-ups.	1a. Check data set-ups. 1b. Disconnect and reconnect power. 1c. Check for electrical disturbance.
JITTERY DISPLAY	1. Electrical “Noise” in process or sensor lines. 2. Process inherently unstable. 3. Corroded or dirty thermocouple wire connections.	1a. Increase digital filtering. 1b. Re-route sensor wires. 2. Dampen process to eliminate oscillations. 3. Clean and tighten connections.
“OPEN” IN DISPLAY	1. Probe unconnected. 2. Broken or burnout probe.	1. Connect probe. 2. Repair or obtain new probe.
“OLOL” IN DISPLAY	1. Excessive positive probe temperature.	1. Reduce temperature.
“ULUL” IN DISPLAY	1. Excessive negative probe temperature.	1. Increase temperature.

MODEL PAXLRT - PAX LITE RTD METER

c UL US LISTED
IND. CONT. EQ.
51EB

- *ACCEPTS STANDARD 3-WIRE 100 Ω RTD SENSORS (ALPHA = 0.00385 or ALPHA = 0.00392)*
- *CONFORMS TO ITS-90 STANDARDS*
- *SELECTABLE °F OR °C WITH 0.1 OR 1 DEGREE DISPLAY RESOLUTION*
- *STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY*
- *FULL 4-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE DIGITAL FILTERING*
- *PEAK/VALLEY (HI/LO READING) MEMORY*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *CUSTOM UNITS OVERLAY WITH BACKLIGHT*

CE

GENERAL DESCRIPTION

The Pax Lite RTD Meter accepts standard RTD inputs and precisely linearizes them into temperature readings. A full 4-digit display accommodates a wide range of temperature inputs. State-of-the-art digital circuitry virtually eliminates errors due to drift.

The meter features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. Programmable digital filtering enhances the stability of the reading. All set-up data is stored in EEPROM, which will hold data for a minimum of 10 years without power.

The meter provides a Peak (HI) and Valley (LO) reading memory with selectable capture delay time. The capture delay is used to prevent detection of false Peak or Valley readings that may occur during start-up or unusual process events. The Peak and Valley readings are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.).

The meter has several built-in diagnostic functions to alert operators of any malfunction. Extensive testing of noise interference mechanisms and full burn-in makes the meter extremely reliable in industrial environments. The front bezel meets NEMA 4X/IP65 requirements for wash down applications.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category) **I**:
Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II.

INSTALLATION CATEGORY (overvoltage category) **II**:
Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5" (127) W.

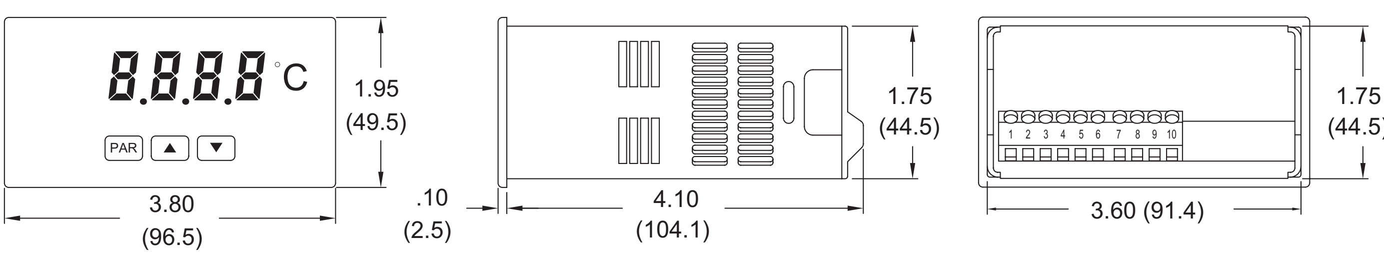


Table of Contents

Ordering Information

Meter Part Numbers

PAXL	RT	0	0

RT - RTD Temperature Meter

F

Accessories Part Numbers*

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Accessories	**PAXLBK**	Units Label Kit Accessory	PAXLBK30

*This meter is shipped with °F and °C overlay labels. The label kit is only needed if another units label is desired.

General Meter Specifications

1. **DISPLAY**: 4-digit, 0.56" (14.2 mm) high red LED, minus sign displayed for negative temperatures.
   Overrange/Underrange Input: Flashing "OLOL" or "ULUL"
   Overrange/Underrange Display: ". . . ." or "-. . . ."
2. **POWER**: 85 to 250 VAC, 50/60 Hz, 6 VA
   Isolation: 2300 Vrms for 1 min. between input and supply (300 V working voltage)
3. **CONTROLS**: Three front panel push buttons for meter set-up. Rear terminal input for disabling the front panel.
4. **RESOLUTION**: 0.1 or 1 degree
5. **RANGE**: Decimal Point Dependent
   0.1° res: -199.9° to 850.0 °C (-199.9° to 999.9 °F);
   1° res: -200° to 850 °C (-328° to 1562 °F)
6. **OPEN/SHORTED RTD DETECTION**: Display flashes: "OPEN" or "SHrt"
7. **LEAD RESISTANCE EFFECT**: 20 Ω max., 2.5 °C/Ω error for V exc. and common lead unbalance
8. **ACCURACY**: 0.3 °C, @ 23 °C and 30 min. warm-up
9. **READING RATE**: 2.5 readings/second
10. **RESPONSE TIME**: 2 seconds to settle for step input (increases with programmable digital filtering)
11. **LOW FREQUENCY NOISE REJECTION**:
    Normal Mode Rejection: 40 dB @ 50/60 Hz (may be improved by programmable digital filtering)
    Common Mode Rejection: 120 dB, DC to 50/60 Hz
12. **CERTIFICATIONS AND COMPLIANCES**:
    SAFETY
    UL Recognized Component, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    Type 4X Enclosure rating (Face only), UL50
    IECEE CB Scheme Report # 04ME11209-20041018
    Issued by Underwriters Laboratories, Inc.
    IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
    IP65 Enclosure rating (Face only), IEC 529

ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 2 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Note:
1. Criterion A: Normal operation within specified limits.

13. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50 °C
    Storage Temperature Range: -40 to 80 °C
    Operating and Storage Humidity: 85% max (non-condensing) from 0 to 50 °C
    Span Drift: 50 ppm/ °C
    Zero Drift: 0.001 °C/°C
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.
    Shock According to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
    Altitude: Up to 2000 meters.
14. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
15. **CONNECTIONS**: High compression cage-clamp terminal block
    Wire Strip Length: 0.3" (7.5 mm)
    Wire Gage: 30-14 AWG copper wire
    Torque: 4.5 inch-lbs (0.51 N-m) max.
16. **WEIGHT**: 0.65 lbs. (0.24 Kg)

Accessories

UNITS LABEL KIT (PAXLBK)

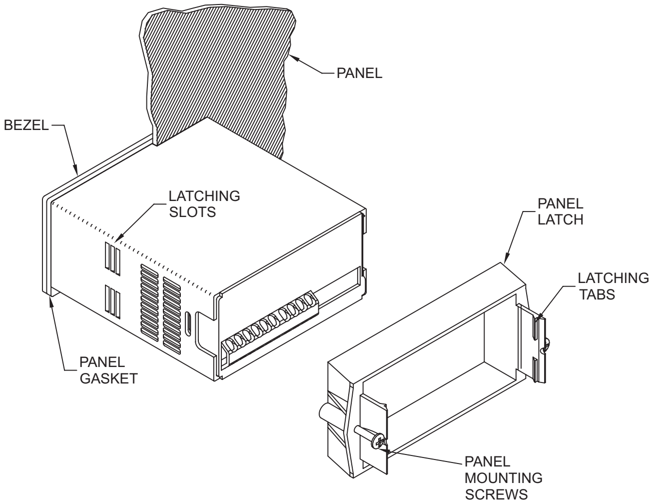
Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

Each meter is shipped with °F and °C overlay labels which can be installed into the meter's bezel display assembly.

1.0 Installing the Meter

Installation

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

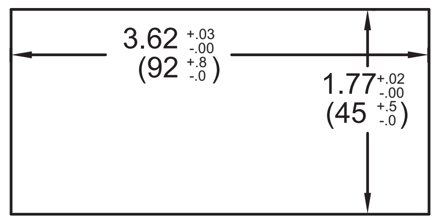
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT



2.0 Wiring the Meter

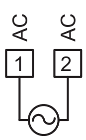
POWER WIRING

Primary AC power is connected to Terminals 1 and 2. To reduce the chance of noise spikes entering the AC line and affecting the indicator, the AC power should be relatively "clean" and within the specified limits. Drawing power from heavily loaded circuits or circuits that also power loads that cycle on and off (contactors, relays, motors, machinery, etc.) should be avoided.

AC Power

Terminal 1: VAC

Terminal 2: VAC

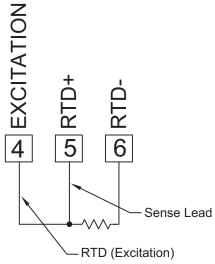


SIGNAL WIRING (RTD SENSOR)

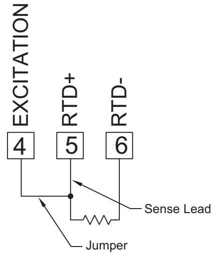
RTD sensors are used in applications where a high degree of accuracy is required. Most RTD sensors available are the 3-wire type. The 3rd additional wire is a sense lead for canceling the effects of lead resistance at the probe. The sense lead connects to Terminal 5 (RTD+), the common lead to Terminal 6 (RTD-), and the excitation lead to Terminal 4 (+ Excitation). The excitation and sense leads are generally the same color because they are functionally the same and may be interchanged at the meter. Four wire sensors have an additional sense lead connected (at the probe) to the common lead. Leave the extra sense lead disconnected when using a four wire probe with the PAXLRT meter. Always refer to the sensor manufacturer's instructions for probe wiring connections, if available. Two wire RTD sensors may be used with the PAXLRT by shorting Terminal 4 to Terminal 5, if the distance between sensor and meter is less than 30 feet. The total lead resistance can be used to predict the temperature error for 2-wire sensors, according to 2.5°C/Ω of lead resistance.

Note: Extended cable runs can be made provided the lead resistance is less than 20 Ω/lead and the resistance is equal in each lead.

3-Wire RTD

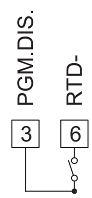


2-Wire RTD



PROGRAM DISABLE INPUT WIRING

PGM.DIS. (Terminal 3) is a digital input that is active when connected to RTD- (Terminal 6). Any form of mechanical switch or current sinking logic with less than 0.7 V saturation may be used. The use of shielded cable is recommended. Follow the EMC Installation Guidelines for shield connection.



WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

3.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode or Display Input Reading	Store selected parameter and index to next parameter
▲	Display Peak (HI) Reading	Increment value or change selection
▼	Display Valley (LO) Reading	Decrement value or change selection

PEAK/VALLEY DETECTION

The meter will automatically record the highest input reading (peak) and the lowest input reading (valley) for later recall. These values are stored at power-down to allow monitoring the process limits over any length of time (shifts, days, etc.). A selectable capture delay time is used to prevent detection of false peak or valley readings caused by sudden short spikes or unusual process events.

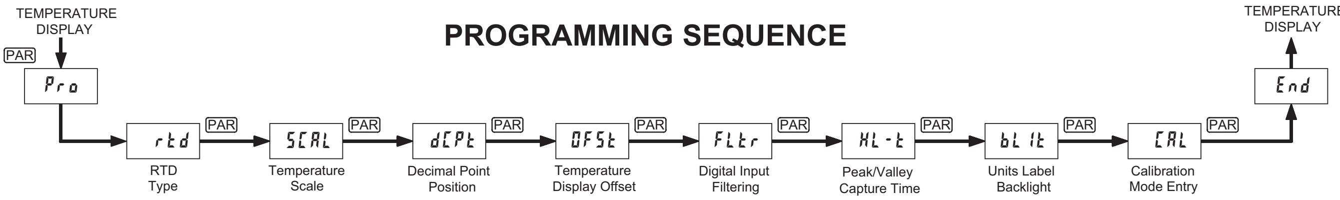
The peak and valley readings can be viewed and reset using the front panel keys as described below.

View Peak, Valley and Input readings:
   To view Peak, press ▲. Meter displays HI followed by the Peak reading.
   To view Valley, press ▼. Meter displays LO followed by the Valley reading.
   To view Input, press **PAR**. Meter displays InPt followed by the current Input reading.
Note: The decimal point to the right of digit 1 flashes while the peak or valley reading is displayed.

Reset Peak and/or Valley to the current Input reading:
   To reset Peak and Valley, press ▲ and ▼ simultaneously.
   To reset Peak only, press and hold ▲ then press **PAR**.
   To reset Valley only, press and hold ▼ then press **PAR**.
In each case, the meter displays rSEt followed by the current Input reading.

4.0 Programming the Meter

PROGRAMMING SEQUENCE



The RTD Meter has seven programmable parameters that are entered in the sequence shown above, using the front panel push buttons.

The last programming step offers the choice of entering calibration mode. From this mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary. To prevent inadvertent entries, an access code must be keyed-in to perform any operations in calibration mode.

Note: Programming mode can be locked out using the Program Disable input terminal. With the PGM.DIS. terminal connected to RTD-, the meter displays "LOC" when the **PAR** *key is pressed, and will not enter programming mode.*

PROGRAMMING MODE ENTRY

Press the **PAR** key to enter Programming Mode. The meter briefly displays Pro followed by the first programming parameter described below.

PROGRAMMING MODE TIMEOUT

The Programming Mode has an automatic timeout feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits Programming Mode. The meter briefly displays End and returns to the normal display mode. When automatic timeout occurs, any changes that were made to the parameter currently being programmed will not be saved.

PROGRAMMING PARAMETERS

In Programming Mode, the display alternates between the parameter and the current selection or value for that parameter. The dual display with arrows is used below to illustrate the alternating display. The selection choices or value range for each parameter is shown to the right of the alternating display.

RTD TYPE

rtd / 385 — 385 392

Select the RTD type by pressing the up or down arrow keys (▲ or ▼). When the desired selection is displayed, press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE SCALE

SCAL / °F — °F °C

Select the desired temperature scale by pressing the up or down arrow keys. This setting does not change the Custom Units Overlay display (if installed). Press the **PAR** key to save the selection and advance to the next parameter.

DECIMAL POINT POSITION

dCPt / 0 — 0 0.0

Select the decimal point position by pressing the up or down arrow keys. This sets the display resolution to 1 or 0.1 degree. Press the **PAR** key to save the selection and advance to the next parameter.

TEMPERATURE DISPLAY OFFSET

OFSt / 0 — -1999 to 9999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors or errors due to variances in probe placement, or to adjust the readout to a reference thermometer. Set the desired display offset value by pressing (and/or holding) the up or down arrow keys. When the desired offset value is displayed, press the **PAR** key to save the selection and advance to the next parameter. The display resolution for the offset value is the same as the decimal point position programmed above.

DIGITAL FILTERING

FLtr / 1 — 0 1 2 3

This parameter sets the amount of digital filtering applied to the input signal. If the temperature display is difficult to read due to small variations or noise, increased levels of filtering will help to stabilize the display. Although the digital filter features a "moving window" to help minimize response time, higher levels of filtering will result in slightly longer response times.

0 - no digital filtering
1 - normal filtering
2 - increased filtering
3 - maximum filtering

Set the desired level of input filtering by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

PEAK (HI)/ VALLEY (LO) CAPTURE DELAY TIME

HL-t / 5 — 0 2 5 10 20 seconds

When the Input display is above the present HI value or below the present LO value for the entered delay time, the meter will capture the Input display as the new HI or LO reading. A delay time helps to avoid false captures of sudden short spikes or Input display variations that may occur during start-up.

Set the desired capture delay time by pressing the up or down arrow keys. Press the **PAR** key to save the selection and advance to the next parameter.

UNITS LABEL BACKLIGHT

bLIt / OFF — On OFF

The Units Label Kit Accessory contains a sheet of custom unit overlays, which can be installed in the meter bezel display assembly. The unit of measure for the meter display is then visible when the label backlight is illuminated. The two most commonly used temperature unit labels (°F and °C) are supplied with the meter. Press the up or down arrow keys to select whether the units label backlight is illuminated. Press the **PAR** key to save the selection and advance to the next parameter.

PROGRAMMING MODE EXIT

CAL / NO — YES NO

Before exiting Programming Mode, The meter offers the choice of entering Calibration Mode. To exit Programming Mode without entering Calibration Mode, select NO and press the **PAR** key. The meter briefly displays End and returns to the normal display mode. All programmed selections are now transferred to non-volatile memory and are retained if power is removed from the meter.

(If power loss occurs during Programming Mode, verify parameter changes and reprogram, if necessary, when power is restored.)

F

5.0 Calibrating the Meter

CALIBRATION MODE

CodE
50

0 to 99

To enter Calibration Mode, select CAL < > YES at the end of Programming Mode, and press the **PAR** key. In Calibration Mode, the user can restore the meter to factory default settings or recalibrate the signal input if necessary.

To prevent inadvertent entries, an access code must be entered to perform any operation in Calibration Mode. Upon entering Calibration Mode, the meter initially displays Code 50. Press the up or down arrow keys to select the access code for the desired operation. If an access code other than those shown below is entered, the meter exits Calibration Mode and returns to normal display mode.

FACTORY SETTINGS

CodE
66

The factory settings for the programming parameters are shown in the previous section in the alternating display illustrations. All programming parameters can be restored to the factory default settings by entering the access Code 66 and pressing the **PAR** key. The meter briefly displays rSEt and then returns to Code 50. This procedure resets only parameters that are accessed through Programming Mode. The Calibration Mode settings (input calibration levels) are not affected.

METER INPUT CALIBRATION

CodE
48

The meter has been fully calibrated at the factory. If the meter appears to be indicating incorrectly or inaccurately, refer to the troubleshooting section before attempting this procedure. When re-calibration is required *(generally every 2 years)*, the procedure should only be performed by qualified technicians using appropriate equipment. Resistance source accuracies of 0.02% or better are required.

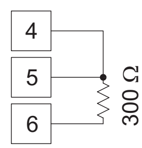
The procedure consists of applying accurate signal levels to the meter input in a series of two steps. Allow a 30-minute warm-up period before starting calibration. To begin the input calibration, enter access Code 48 and press the **PAR** key.

ENTER ZERO REFERENCE

Meter displays 0r. Apply 0 ohms to the meter input by shorting Terminals 4, 5, and 6. Allow the meter to stabilize at least 20 seconds after shorting the terminals, and then press **PAR**.

APPLY PRECISION RESISTANCE

Meter displays 300r. Connect a precision 300 ohm resistor across Terminals 5 and 6. Terminals 4 and 5 remain shorted. *(Note: Be certain to short Terminals 4 and 5 at the resistor as shown in the drawing below. Shorting terminals may lead to incorrect calibration.)*



Allow the meter to stabilize at least 20 seconds after making the connections, and then press **PAR**. The meter briefly displays End and returns to the normal display mode. Calibration is now complete. It is recommended to check calibration by comparing the displayed temperature with a precision thermometer.

TROUBLESHOOTING

The majority of all problems with the meter can be traced to improper connections or improper programming set-ups. Be sure all connections are clean and tight and check the programming set-ups for correct data.

For further technical assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	POSSIBLE CAUSE	REMEDIES
NO DISPLAY	1. Power off, improperly connected, or brown-out.	1a. Check wiring. 1b. Verify power.
“EEEE” IN DISPLAY	1. Program data error.	1. Press **PAR** and check data set-ups.
“. . . .” or “-. . . .” IN DISPLAY	1. Input display out of range. 2. Loss of data set-ups.	1a. Change display resolution to “1” degree. 1b. Reduce offset value. 2a. Check data set-ups. 2b. Check for electrical disturbance. 2c. Disconnect and reconnect power.
DISPLAY WANDERS	1. Loss of data set-ups.	1a. Check data set-ups. 1b. Disconnect and reconnect power. 1c. Check for electrical disturbance.
JITTERY DISPLAY	1. Electrical “Noise” in process or sensor lines. 2. Process inherently unstable.	1a. Increase digital filtering. 1b. Re-route signal wires. 2. Dampen process to eliminate oscillations.
“OPEN” IN DISPLAY	1. Probe unconnencted. 2. Broken or burnout probe. 3. Excessive probe temperature. 4. Input overload.	1. Connect probe. 2. Repair or obtain new probe. 3. Reduce temperature. 4. Check input levels.
“SHrt” IN DISPLAY	1. Input shorted.	1. Check input connections.

MODEL PAXLT - PAX LITE TEMPERATURE METER

- *5 DIGIT, 0.56" HIGH RED LED DISPLAY*
- *DISPLAYS °C OR °F WITH 1° OR 0.1° RESOLUTION*
- *BACKLIGHT OVERLAYS INCLUDED (°C AND °F)*
- *MAX AND MIN READING MEMORY*
- *TC COLD JUNCTION COMPENSATION (ON/OFF)*
- *PROGRAMMABLE TEMPERATURE OFFSET*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAYS*
- *UNIVERSALLY POWERED*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*
- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*

C UL US LISTED
IND. CONT. EQ.
51EB

For Model No. PAXLT0U0 Only

GENERAL DESCRIPTION

The PAXLT is a versatile meter that accepts a variety of thermocouple and RTD inputs and provides a temperature display in Celsius or Fahrenheit. The readout conforms to ITS-90 standards, with 1° or 0.1° resolution. The 5-digit display has 0.56" high digits with adjustable intensity. Backlight overlay labels for °F and °C are included.

The meter features a Maximum and Minimum reading memory, with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events. Either value can be displayed if desired. The display can be toggled manually or automatically between the selected values.

Other features include thermocouple cold junction compensation, display offset and a programmable user input to perform a variety of meter control functions. Two setpoint outputs are provided, each with a Form C relay. Output modes and setup options are fully programmable to suit a variety of control requirements.

The PAXLT can be universally powered from a wide range of AC or DC voltage. The meter has been specifically designed for harsh industrial environments. With a NEMA 4X/IP65 sealed bezel and extensive testing to meet CE requirements, the meter provides a tough yet reliable application solution.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this meter to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the meter

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **DISPLAY**: 5 digit, 0.56" (14.2 mm) intensity adjustable Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 12 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs
   DC POWER: 21.6 to 250 VDC, 6 W
3. **READOUT:**
   Display Range: -19999 to 99999
   Scale: °F or °C
   Resolution: 1° or 0.1°
   Response Time: 500 msec min.
   Display Overrange/Underrange Indication: "….." / "-…."
   Input Overrange/Underrange Indication: OLOL / ULUL

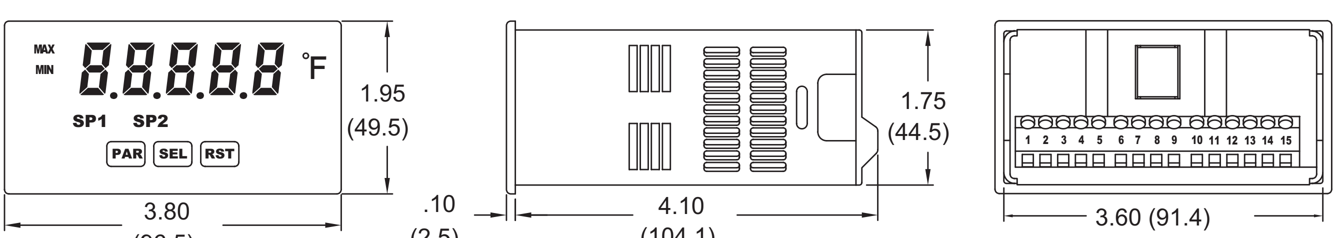
F

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXLT	TC/RTD Temperature Meter with Dual Relay Output	PAXLT000
	UL Listed TC/RTD Temperature Meter with Dual Relay Output	PAXLT0U0

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W.



4. **THERMOCOUPLE INPUTS:**
Input Impedance: 20 MΩ
Max. Continuous Overvoltage: 30 VDC
Failed Sensor Indication: OPEN

TC TYPE	RANGE	ACCURACY @ 23°C ±°C *	ACCURACY @ 0 to 50°C ±°C *	WIRE COLOR	
				ANSI	BS 1843
T	-200 to 400°C -328 to 752°F	2.3	5.8	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -328 to 1600°F	2.7	4.9	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C -328 to 1400°F	1.9	4.3	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -328 to 2502°F	2.3	5.8	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
S	-50 to 1768°C -58 to 3214°F	4.5	15.0	no standard	(+) white (-) blue
B	200 to 1820°C 392 to 3308°F	9.1<540°C 4.5>540°C	42.6<540°C 15.0>540°C	no standard	no standard
N	-200 to 1300°C -328 to 2372°F	2.8	8.1	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C 32 to 4199°F	1.9	6.1	no standard	no standard
mV	-10.00 to 65.00	0.02 mV	0.08 mV	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a 0 to 50 °C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50 °C operating range includes meter tempco and cold junction tracking effects.

The specification includes the A/D conversion errors, linearization conformity, and thermocouple cold junction compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

5. **RTD INPUTS**:
Type: 2, 3 or 4 wire
Excitation Current:
100 ohm range: 165 µA; 10 ohm range: 2.5 mA
Lead Resistance:
100 ohm range: 10 Ω/lead max.; 10 ohm range: 3 Ω/lead max.
Balanced Lead Resistance: Automatically compensated up to max per lead
Unbalanced Lead Resistance: Uncompensated
Max. Continuous Overvoltage: 30 VDC
Failed Sensor Indication: OPEN or Short

RTD TYPE	RANGE	ACCURACY* @ 23°C	ACCURACY* @0 to 50°C	STANDARD
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy at 23°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco effects.

The specification includes the A/D conversion errors and linearization conformity. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

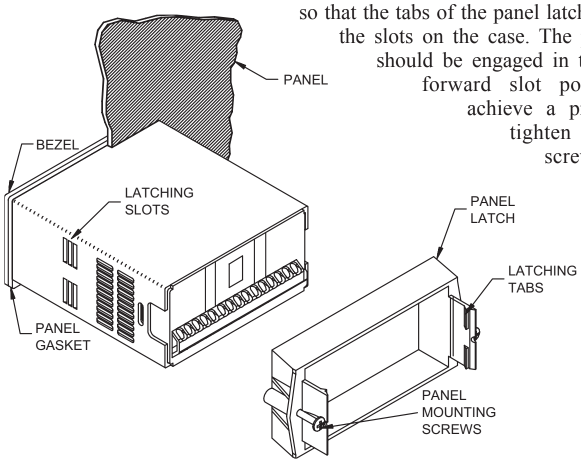
6. **USER INPUT**: Programmable input
Software selectable for active logic state: active low, pull-up (24.7 KΩ to +5 VDC) or active high, pull-down resistor (20 KΩ).
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 10 msec typ.; 50 msec debounce (activation and release)
7. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and max/min values when power is removed.
8. **OUTPUTS**:
Type: Dual Form C contacts
Isolation to Sensor & User Input Commons: 1400 Vrms for 1 min. Working Voltage: 150 Vrms
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads.
Response Time: Turn On or Off: 4 msec max.
9. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 50 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
Shock to IEC 68-2-27: Operational 30 g (10 g relay).
Altitude: Up to 2,000 meters
10. **CONNECTIONS**: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gage: 30-14 AWG copper wire
Torque: 4.5 inch-lbs (0.51 N-m) max.
11. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 outdoor use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
12. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
Type 4X Outdoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)
For Model No. PAXLT0U0 Only: UL Listed: File #E137808
Refer to EMC Installation Guidelines section of the bulletin for additional information.
13. **WEIGHT**: 10.4 oz. (295 g)

1.0 Installing the Meter

Installation

The PAX Lite meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



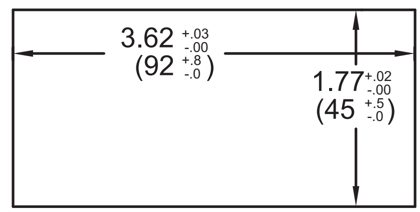
Installation Environment

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

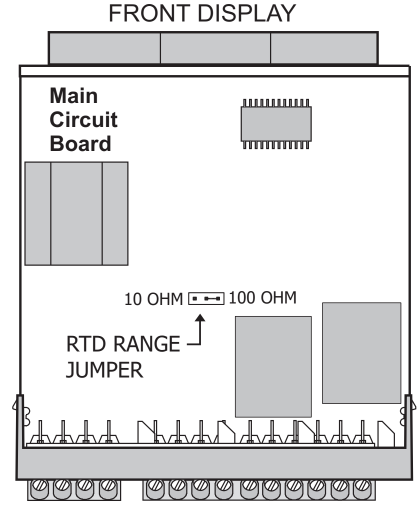


2.0 Setting the Jumper

INPUT RANGE JUMPER (RTD ONLY)

This jumper is used to select the proper input range for the RTD probe being used (10 ohm or 100 ohm). For thermocouple inputs, this jumper has no effect and can be left in either position.

To access the jumper, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start on the other side latch.



F

3.0 Wiring the Meter

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.

a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.

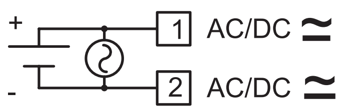
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

3.1 POWER WIRING

Power

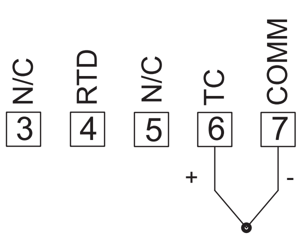
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -



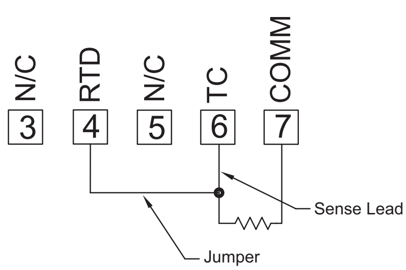
3.2 INPUT SIGNAL WIRING

CAUTION: Sensor input common (Terminal 7) is NOT isolated from user common (Terminal 9). In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common and user common must be at protective earth ground potential. If not, hazardous live voltage may be present at the user input and user common terminals. Appropriate considerations must then be given to the potential of the sensor input common and the user common with respect to earth ground.

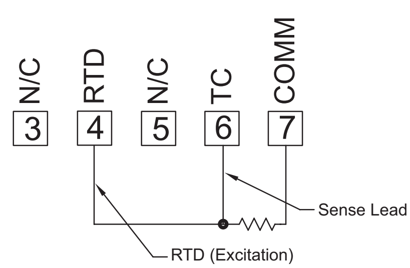
THERMOCOUPLE



2-WIRE RTD



3-WIRE RTD

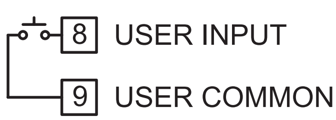


F

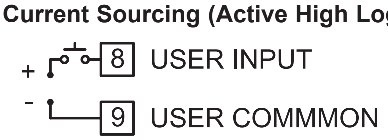
3.3 USER INPUT WIRING

Terminal 8: User Input
Terminal 9: User Common

Current Sinking (Active Low Logic)

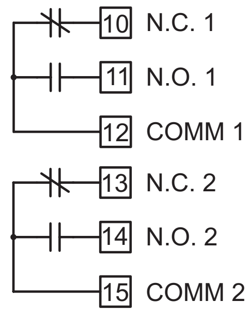


Current Sourcing (Active High Logic)

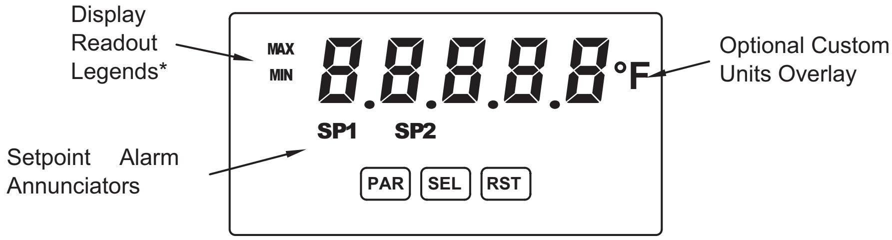


3.4 SETPOINT (OUTPUT) WIRING

Terminal 10: NC 1
Terminal 11: NO 1
Terminal 12: Relay 1 Common
Terminal 13: NC 2
Terminal 14: NO 2
Terminal 15: Relay 2 Common



4.0 Reviewing the Front Buttons and Display



BUTTON	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL	Index display through enabled values	Advance through selection list/select digit position in parameter value
RST	Resets values (min/max) or outputs	Increment selected digit of parameter value

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

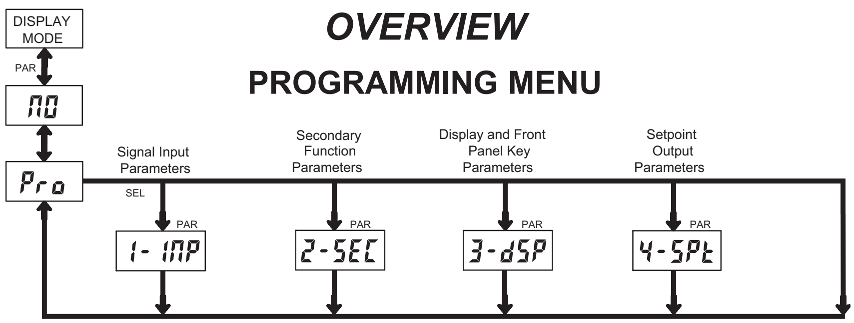
"SP1" - Indicates setpoint 1 output activated.
"SP2" - Indicates setpoint 2 output activated.

Pressing the **SEL** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** button. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL & PAR BUTTONS)

The Programming Menu is organized into four modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL** button is used to select the desired module. The displayed module is entered by pressing the **PAR** button.

MODULE MENU (PAR BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL** and **RST** buttons are used to move through the selections/values for that parameter. Pressing the **PAR** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST** button increments the digit by one or the user can hold the **RST** button and the digit will automatically scroll. The **SEL** button will select the next digit to the left. Pressing the **PAR** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR BUTTON)

The Programming Mode is exited by pressing the **PAR** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

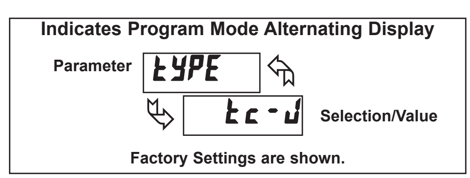
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



F

5.1 MODULE 1 - INPUT SETUP PARAMETERS (1-INP)

PARAMETER MENU

1-INP → PAR → tYPE — CJC — SCALE — dECPt — OFSEt — FILtr — bAnd — USr IN — U-ASN — U-Act → Pro

Display	Parameter
tYPE	Input Type
CJC	Cold Junction Compensation
SCALE	Temperature Scale
dECPt	Display Decimal Point
OFSEt	Display Offset Value
FILtr	Filter Setting
bAnd	Filter Band
USr IN	User Input Function
U-ASN	User Input Assignment
U-Act	User Input Active Level

INPUT TYPE

tYPE

tc-J

SELECTION	INPUT TYPE	SELECTION	INPUT TYPE
tc-t	T	tc-n	N
tc-E	E	tc-C	C
tc-J	J	UOLt	mV
tc-K	K	Pt385	Platinum 385 100 Ω
tc-r	R	Pt392	Platinum 392 100 Ω
tc-S	S	Ni672	Nickel 672 100 Ω
tc-b	B	Cu427	Copper 427 10 Ω

Select the thermocouple or RTD type used for the application. For RTDs, position the Input Range Jumper to match the RTD type (10Ω or 100Ω).

Selecting UOLt displays a millivolt signal readout with 10 μV resolution.

COLD JUNCTION COMPENSATION

CJC

ON

ON OFF

This parameter enables or disables internal cold junction compensation for thermocouples. For most applications, cold junction compensation should be enabled (ON). This parameter only appears for thermocouple input selections.

TEMPERATURE SCALE

SCALE

°F

°F °C

Select the desired temperature scale. This selection applies for the Input, MAX and MIN displays. This parameter does not appear when mV or RTD resistance display is enabled.

DISPLAY DECIMAL POINT

dECPt

0

0 0.0

Set the decimal point for the desired display resolution. This selection applies for the Input, MAX and MIN displays, and also affects the Setpoint and Display Offset values. For mV or RTD resistance displays, the decimal point location is fixed and this parameter does not appear.

DISPLAY OFFSET VALUE

OFSEt

0

-19999 to 99999

The temperature display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

FILTER SETTING

FILtr

1

0 1 2 3

If the displayed temperature is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display.

Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bAnd

10

0 to 199 display units

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

USER INPUT FUNCTION

USr IN

NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
rESEt	Reset *	Reset the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select *	Advance once for each activation.
d-LEU	Display Intensity Level *	Increase intensity one level for each activation.
rSt-1	Setpoint 1 Reset *	Reset setpoint 1 output.
rSt-2	Setpoint 2 Reset *	Reset setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset *	Reset both setpoint 1 and 2 outputs.

** Indicates Edge Triggered function. All others are Level Active functions.*

USER INPUT ASSIGNMENT

U-ASN

dSP

HI HI-LO

LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset or display hold is selected in the User Input Function menu.

USER INPUT ACTIVE LEVEL

U-Act

LO

HI LO

Select whether the user input is configured as active low or active high.

F

5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

2-SEC → PAR

HI-En	HI-t	LO-En	LO-t	FCS	CodE	→ Pro
Max Display Enable	Max Capture Delay Time	Min Display Enable	Min Capture Delay TIme	Factory Service Operations	Access Code For Service Operations	

MAX DISPLAY ENABLE

HI-En
nO

nO YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
nO

nO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS
nO

nO YES

Select YES to perform any of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** button to exit the module

VIEW MODEL AND VERSION DISPLAY

CodE
50

Entering Code 50 will display the version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** button to exit the module.

TOGGLE RTD INPUT DISPLAY MODE

CodE
85

Entering Code 85 toggles the selected RTD input display mode between a temperature or resistance readout. The resistance readout is useful for diagnostic purposes before and after calibration, or to display the measured resistance of a connected RTD probe.

For RTD type Cu427 (Input Range Jumper in 10Ω position), resistance is displayed in 0.000 ohms resolution. For all other RTD types (100Ω position), resistance is displayed in 0.00 ohms resolution.

Upon entering Code 85, the meter displays either dSP-t or dSP-r to indicate temperature or resistance readout selected. The display then returns to CodE 00. Press the **PAR** button to exit the module.

CALIBRATION

CodE
48

The PAXLT uses stored calibration values to provide accurate temperature measurements. Over time, the electrical characteristics of the components inside the meter could slowly change, with the result being that the stored calibration values may no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration for thermocouple inputs involves a voltage calibration and a cold junction calibration. It is recommended that both calibrations be performed. The voltage calibration must precede cold junction calibration.

Calibration of the meter should only be performed by persons experienced in calibrating electronic equipment. Allow a minimum 30 minute warm up before performing any calibration procedures. The following procedures should be performed at an ambient temperature of 15 to 35°C (59 to 95°F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the meter.

10 OHM RTD Range Calibration

1. Set the Input Range Jumper to 10 ohm position.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL nO.
3. Press **SEL** to select 10 ohm range. Display reads CAL r 10.
4. Press **PAR**. Display reads 0.0r.
5. Apply a direct short to terminals RTD (4), TC (6) and COMM (7) using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
6. When the display reads 15.0r, apply a precision resistance of 15 ohms (with an accuracy of 0.01% or better) to terminals RTD, TC and COMM using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
7. When display reads CAL nO, press **PAR** twice to exit calibration and return to the normal display mode.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm position.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL nO.
3. Press **SEL** twice to select 100 ohm range. Display reads CAL r 100.
4. Press **PAR**. Display reads 0.0r.
5. Apply a direct short to terminals RTD (4), TC (6) and COMM (7) using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
6. When the display reads 300.0r, apply a precision resistance of 300 ohms (with an accuracy of 0.01% or better) to terminals RTD, TC and COMM using a three wire link. Press **PAR**. Display reads CALC for about 10 seconds.
7. When display reads CAL nO, press **PAR** twice to exit calibration and return to the normal display mode.

F

THERMOCOUPLE Voltage Calibration

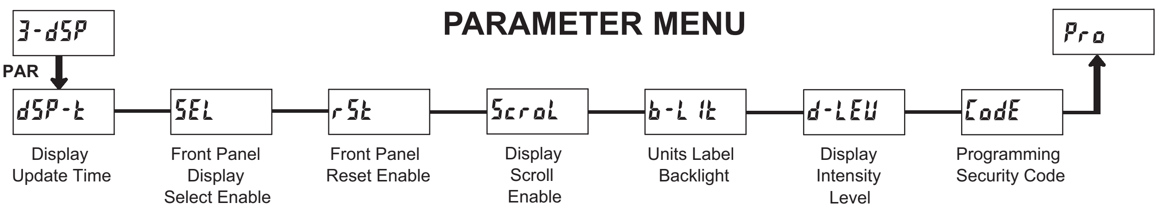
1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the TC and COMM terminals. Set the voltage source to zero.
2. With the display at CodE 48, press the **PAR** key. Unit displays CAL NO.
3. Press **SEL** until the display reads CAL tc to select thermocouple input.
4. Press **PAR**. Display reads 0.0u.
5. With the voltage source set to zero, press **PAR**. Display reads CALC for about 6 seconds.
6. When the display reads 60.0u, set the voltage source output to 60.000 mV. Press **PAR**. Display reads CALC for about 6 seconds.
7. When display reads CAL NO, press **PAR** twice to exit calibration and return to the normal display mode. Proceed to Cold Junction Calibration.

THERMOCOUPLE Cold Junction Calibration

1. The ambient temperature must be between 20°C and 30°C.
2. Connect a thermocouple (types T, E, J, K or N only) with an accuracy of 1°C or better to the meter.
3. Enter programming mode and verify the following settings in Module 1:
   tYPE = thermocouple type connected to the meter
   CJC = ON; SCALE = °C; dECPt = 0.0; OFSEt = 0.0
4. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25°C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath of known temperature could be used in place of the thermometer.)
5. Compare the unit display with the reference temperature indicator (or calibration bath). If a difference of more than +/- 1.0°C exists, note the difference (CJ Error) and continue with cold junction calibration.
   CJ Error = Reference Temperature - Unit Display
6. Enter programming mode and proceed through Module 2 to the Service Access Code. Select CodE 48 and press **PAR**. Unit displays CAL NO. Press **RST** to select CJC.
7. Press **PAR**. Display reads CJC followed by the current cold junction value. Calculate a new cold junction value as follows:
   New cold junction = Current cold junction + CJ Error (noted above)
8. Press **PAR** and set the display to the new cold junction value. Press **PAR** to enter the new value. Display reads CALC for 6 seconds and returns to CAL NO.
9. Press **PAR** twice to exit calibration and return to the normal display mode. Verify the input reading is correct. If not, repeat steps 5 through 9.

5.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t — 1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL — YES

NO YES

The YES selection allows the **SEL** key to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt — dSP

NO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

DISPLAY SCROLL ENABLE

ScroL — NO

NO YES

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

UNITS LABEL BACKLIGHT

b-LIt — OFF

ON OFF

The PAXLT includes two units overlay labels (°C and °F) which can be installed into the meter's bezel display assembly. The backlight for the units label is activated by this parameter.

DISPLAY INTENSITY LEVEL

d-LEU — 3

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE — 000

0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only user selected values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Entering a Security Code from 1-99 enables Quick Programming mode, and displays a sublist to select which values appear in the Quick Programming menu. Values set to YES in the sublist are accessible in Quick Programming. These values include the Setpoints (SP-1, SP-2) and Display Intensity (d-LEU).

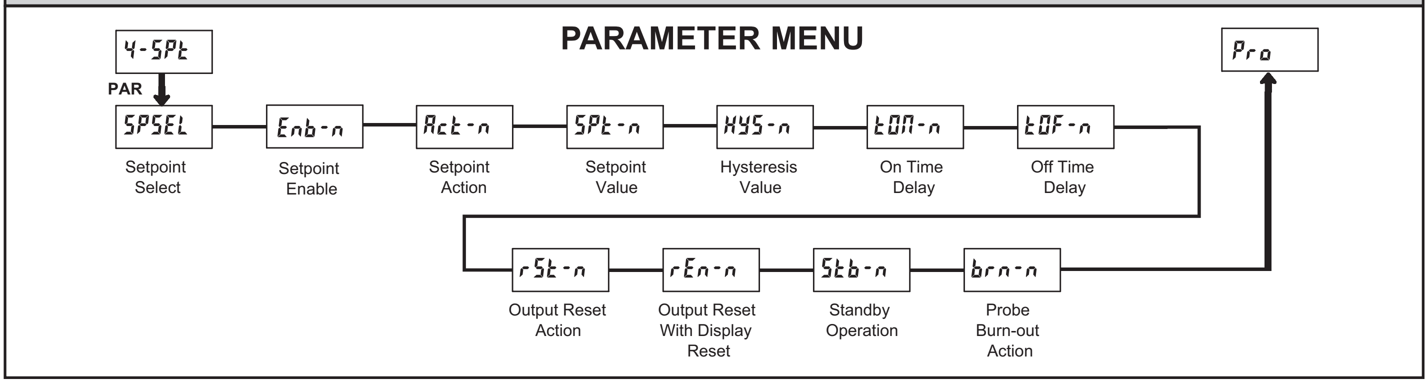
Programming any Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Quick Programming mode, if enabled, is accessed before the CodE prompt appears.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	———	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

F

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



SETPOINT SELECT

SPSEL — NO

NO
SP-1
SP-2

Select the Setpoint Output to be programmed, starting with Setpoint 1. The "n" in the following parameters reflects the chosen Setpoint number. After the selected setpoint is completely programmed, the display returns to SPSEL. Repeat steps for Setpoint 2 if both Setpoints are being used. Select NO to exit the Setpoint programming module.

SETPOINT ENABLE

Enb-n — NO

NO YES

Select YES to enable Setpoint n and access the setup parameters. If NO is selected, the unit returns to SPSEL and Setpoint n is disabled.

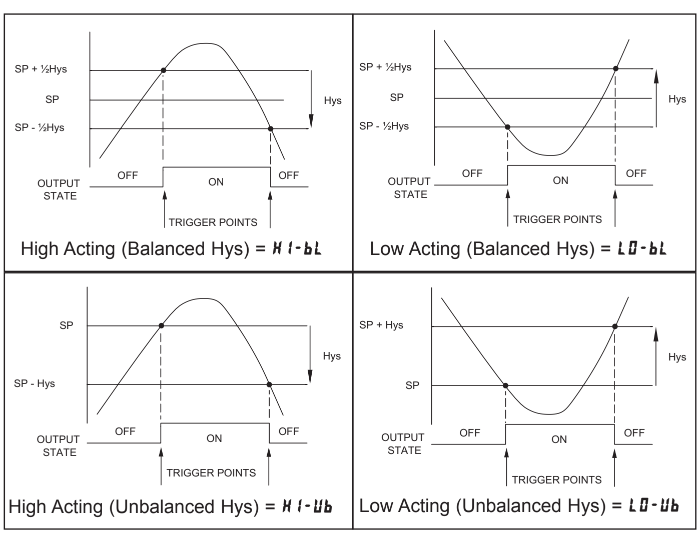
SETPOINT ACTION

Act-n — HI-Ub

HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

HI-bL = High Acting, with balanced hysteresis
LO-bL = Low Acting, with balanced hysteresis
HI-Ub = High Acting, with unbalanced hysteresis
LO-Ub = Low Acting, with unbalanced hysteresis



High Acting (Balanced Hys) = HI-bL
Low Acting (Balanced Hys) = LO-bL
High Acting (Unbalanced Hys) = HI-Ub
Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n — 00100

-19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n — 2

1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n — 0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n — 0.0

0.0 to 599.9 Sec

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

rSt-n — Auto

Auto LAtCH L-dLY

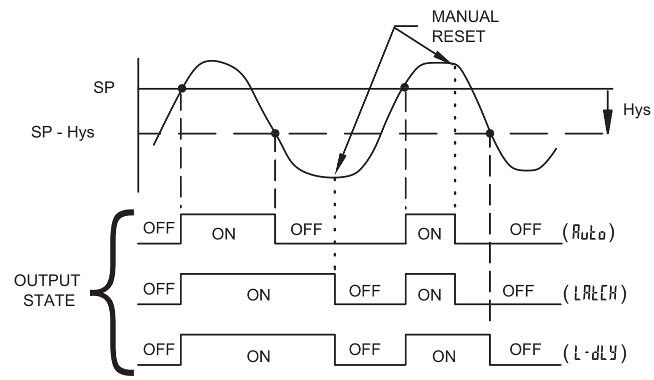
Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

F

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding “on” output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding “on” output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous **L-dLY** reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n — **YES**

nO **YES**

This parameter enables the **RST** button or user input to reset the output when the display is reset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to **dSP** and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n — **nO**

nO **YES**

When **YES**, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

PROBE BURN-OUT ACTION

brn-n — **OFF**

On **OFF**

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the output can be programmed to be on or off.

MODEL DP5T - THERMOCOUPLE AND RTD INPUT

This is a brief overview of the DP5T. For complete specifications and programming information, see the **DP5 Analog Input Panel Meters Bulletin** starting on **page 283**.

- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *TIME-TEMPERATURE INTEGRATOR*
- *5-DIGIT 0.56" HIGH RED LED DISPLAY*
- *PROGRAMMABLE FUNCTION KEYS/USER INPUT*
- *9 DIGIT TOTALIZER (INTEGRATOR) WITH BATCHING*

c UL US LISTED
IND. CONT. EQ.
51EB

DP5T SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degree
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03 µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200°C is a function of temperature, ranging from 1°C at -200°C and degrading to 7°C at -270°C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

DIRECT READOUT:
Input range: -10 to 65 mV
0 to 400 ohms, high range
0 to 25 ohms, low range
Display range: -19999 to 99999

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)
Direct mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Direct 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Direct 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

F

MODEL PAXT - THERMOCOUPLE AND RTD INPUT

This is a brief overview of the PAXT. For complete specifications and programming information, see the **PAX Analog Input Panel Meters Bulletin** starting on **page 301**.

c UL US LISTED
IND. CONT. EQ.
51EB

- *THERMOCOUPLE AND RTD INPUTS*
- *CONFORMS TO ITS-90 STANDARDS*
- *CUSTOM SCALING FOR NON-STANDARD PROBES*
- *TIME-TEMPERATURE INTEGRATOR*
- *5-DIGIT 0.56" RED SUNLIGHT READABLE OR STANDARD GREEN DISPLAY*
- *VARIABLE INTENSITY DISPLAY*
- *OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT*
- *FOUR SETPOINT ALARM OUTPUTS (W/OPTION CARD)*
- *COMMUNICATION AND BUS CAPABILITIES (W/OPTION CARD)*
- *RETRANSMITTED ANALOG OUTPUT (W/OPTION CARD)*
- *CRIMSON PROGRAMMING SOFTWARE*

PAXT SPECIFICATIONS

READOUT:
Resolution: Variable: 0.1, 0.2, 0.5, or 1, 2, or 5 degrees
Scale: F or C
Offset Range: -19,999 to 99,999 display units

THERMOCOUPLE INPUTS:
Input Impedance: 20 MΩ
Lead Resistance Effect: 0.03 µV/ohm
Max. Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C -270 to -200°C	1.2°C **	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 871°C -270 to -200°C	1.0°C **	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1372°C -270 to -200°C	1.3°C **	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	-50 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	100 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C -270 to -200°C	1.3°C **	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90***	no standard	no standard

*After 20 min. warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28°C and 15 to 75% RH environment; and Accuracy over a 0 to 50°C and 0 to 85% RH (non condensing) environment. Accuracy specified over the 0 to 50°C operating range includes meter tempco and ice point tracking effects. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** The accuracy over the interval -270 to -200°C is a function of temperature, ranging from 1°C at -200°C and degrading to 7°C at -270°C. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

*** These curves have been corrected to ITS-90.

RTD INPUTS:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 165 µA
10 ohm range: 2.6 mA
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)	STANDARD ***
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .003919	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 260°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-100 to 260°C	0.4°C	0.9°C	no official standard

CUSTOM RANGE: Up to 16 data point pairs
Input range: -10 to 65 mV
0 to 400 ohms, high range
0 to 25 ohms, low range
Display range: -19999 to 99999

INPUT TYPE	RANGE	ACCURACY* (18 to 28°C)	ACCURACY* (0 to 50°C)
Custom mV range	-10 to 65mV (1 µV res.)	0.02% of reading + 4µV	0.12% of reading + 5µV
Custom 100 ohm range	0 to 400 Ω (10 MΩ res.)	0.02% of reading + 0.04 Ω	0.12% of reading + 0.05 Ω
Custom 10 ohm range	0 to 25 Ω (1 MΩ res.)	0.04% of reading + 0.005 Ω	0.20% of reading + 0.007 Ω

F

MODEL PAX2A - 1/8 DIN ANALOG PANEL METER

This is a brief overview of the PAX2A. For complete specifications and programming information, see the **PAX2A Analog Panel Meter Bulletin** starting on **page 332**.

- *UNIVERSAL PROCESS, VOLTAGE, CURRENT, RESISTANCE AND TEMPERATURE INPUTS*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *PROGRAMMABLE UNITS DISPLAY*
- *VARIABLE CONTRAST AND INTENSITY DISPLAY*
- *UP TO 160 SAMPLES PER SECOND CONVERSION RATE*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

c UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

SPECIFICATIONS

POWER:
AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
DC Power: 21.6 to 250 VDC, 8 W
Isolation: 2300 Vrms for 1 min. to all inputs and outputs.

INPUT CAPABILITIES:
Current Input Ranges:

± 250 µADC	± 2.5 mADC	± 25 mADC
± 250 mADC	± 2 ADC	

Voltage Input Ranges:

± 250 mVDC	± 2.0 VDC	± 10 VDC
± 25 VDC	± 100 VDC	± 200 VDC

Thermocouple Inputs:
Types: T, E, J, K, R, S, B, N, C (W5/W26)
Max Continuous Overvoltage: 30 V

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Max. continuous overload: 30 VDC
Input Type:

100 ohm Pt alpha = .00385	100 ohm Pt alpha = .00392
120 ohm Nickel alpha = .00672	10 ohm Copper alpha = .00427

Resistance Inputs:
Max. continuous overload: 30 VDC

INPUT RANGE	COMPLIANCE
100 ohm	0.175 V
999 ohm	1.75 V
9999 ohm	17.5 V

EXCITATION POWER: Jumper selectable
Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
Reference Voltage: + 2 VDC, ± 2%
Compliance: 1KΩ load min (2 mA max)
Temperature Coefficient: 40 ppm/ºC max.
Reference Current: 1.05 mADC, ± 2%
Compliance: 10 KΩ load max.

USER INPUTS: Two programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.

ENVIRONMENTAL CONDITIONS:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -40 to 60 °C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 25 g (10 g relay)
Operating and Storage Humidity: 0 to 85% max. RH non-condensing
Altitude: Up to 2000 meters

CERTIFICATIONS AND COMPLIANCES:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Listed: File #E179259
Type 4X Indoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)

CONNECTIONS: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)

CONSTRUCTION: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

WEIGHT: 8 oz. (226.8 g)

MODELS T16 & P16 - TEMPERATURE/PROCESS CONTROLLERS

- *T16 ACCEPTS TC AND RTD*
- *P16 ACCEPTS 0-10 V AND 0/4-20 mA SIGNALS*
- *ON DEMAND AUTO-TUNING OF PID SETTINGS*
- *DC ANALOG OUTPUT (OPTIONAL)*
- *USER PROGRAMMABLE FUNCTION BUTTON*
- *PC OR FRONT PANEL PROGRAMMING*
- *PC CONFIGURABLE WITH TP16KIT*

UL Recognized Component,
File #E156876

GENERAL DESCRIPTION

The Model T16 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD), while the Model P16 Controller accepts either a 0 to 10 VDC or 0/4 to 20 mA DC input signal. Both controllers can provide an accurate output control signal (time proportional or DC Analog Output) to maintain a process at a setpoint value. Dual 4-digit displays allow viewing of the process/temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. The comprehensive programming allows these controllers to meet a wide variety of application requirements.

MAIN CONTROL

The controller operates in the PID Control Mode for both heating and cooling, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned through the front panel and then locked out from further modification. The controller employs a unique overshoot suppression feature, that allows the quickest response without excessive overshoot. Switching to Manual Mode provides the operator direct control of the output. The controller may also be programmed to operate in On/Off mode with adjustable hysteresis.

ALARMS

Optional alarm(s) can be configured independently for absolute high or low acting with balanced or unbalanced hysteresis. They can also be configured for deviation and band alarm. In these modes, the alarm trigger values track the setpoint value. Adjustable alarm hysteresis can be used for delaying output response. The alarms can be programmed for Automatic or Latching operation. A selectable standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region.

ANALOG OUTPUT OPTION

The optional DC Analog Output (10 V or 20 mA) can be configured and scaled for control or re-transmission purposes. The programmable output update time reduces valve or actuator activity.

PC PROGRAMMING KIT

The optional TP16KIT contains a programming module with a 9 pin RS232 connector, cable and Crimson, a Windows® based configuration software. The software allows downloading, uploading and storage of T16 and P16 program files. All controllers have a communications port that allows configuration by PC even without controller power connected. Controller calibration is also possible using the software when the proper calibration equipment and controller power is connected.

CONSTRUCTION

The controller is constructed of a lightweight, high impact, black plastic textured case and bezel with a clear display window. The front panel meets NEMA 4X/IP65 specifications when properly installed. In applications that do not require protection to NEMA 4X, multiple controllers can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

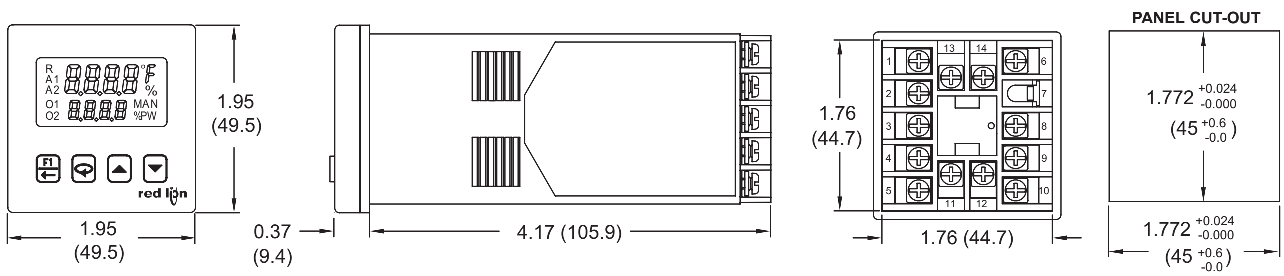
Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.

- *PID CONTROL WITH REDUCED OVERSHOOT*

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)



GENERAL SPECIFICATIONS

1. **DISPLAY**: 2 Line by 4-digit, LCD negative image transmissive with backlighting.
   Top (Process) Display: 0.3" (7.6 mm) high digits with red backlighting.
   Bottom (Parameter) Display: 0.2" (5.1 mm) high digits with green backlighting.
2. **ANNUNCIATORS**:
   Status Annunciators:
   O1 - Main control output is active.
   O2 - Cooling output is active (when Alarm 2 is used for cooling).
   A1 - Alarm 1 output is active.
   A2 - Alarm 2 output is active.
   °F, °C - Temperature units.
   %PW - Output power percentage is shown in Bottom display.
   MAN - Controller is in Manual Mode.
   R - Ramping Setpoint indicator.
   % - Percent indicator (P16 models only).
   Display Messages:
   OLOL - Measurement exceeds + sensor range
   ULUL - Measurement exceeds - sensor range
   OPEN - Open sensor is detected (T16 only)
   SHrt - Shorted sensor is detected (RTD only)
   SENS - Measurement exceeds controller limits (P16 only)
   dddd - Display value exceeds + display range
   -ddd - Display value exceeds - display range
3. **POWER**:
   Line Voltage Models:
   85 to 250 VAC, 50/60 Hz, 8 VA
   Low Voltage Models:
   DC Power: 18 to 36 VDC, 4 W
   AC Power: 24 VAC, ±10%, 50/60 Hz, 7 VA
4. **CONTROLS**: Three rubber push buttons for modification and setup of controller parameters. One additional button (F1) for user programmable function. One external user input (models with alarms) for parameter lockout or other user programmable functions.
5. **MEMORY**: Nonvolatile E^2PROM retains all programmable parameters.
6. **ISOLATION LEVEL**:
   AC power with respect to all other I/O: 250 V working (2300 V for 1 min.)
   Sensor input to analog output: 50 V working (500 V for 1 minute)
   Relay contacts to all other I/O: 300 V working (2300 V for 1 minute)
   DC power with respect to sensor input and analog output: 50 V working (500 V for 1 minute)
7. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   UL Recognized Component: File #E156876
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C
   Storage Temperature Range: -40 to 80°C
   Operating and Storage Humidity: 85% max relative humidity (non-condensing) from 0°C to 50°C
   Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
   Shock to IEC 68-2-27: Operational 20 g (10 g relay).
   Altitude: Up to 2000 meters
9. **CONNECTION**: Wire-clamping screw terminals
10. **CONSTRUCTION**: Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. Black plastic textured bezel with transparent display window. Controller meets NEMA 4X/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2.
11. **WEIGHT**: 6.3 oz (179 g)

INPUT SPECIFICATIONS

1. **SENSOR INPUT**:
   Sample Period: 100 msec (10 Hz rate)
   Step Response Time: 300 msec typical, 400 msec max to within 99% of final value with step input.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Analog Output: Upscale drive when assigned to retransmitted input.
   Normal Mode Rejection: >40 dB @ 50/60 Hz
   Common Mode Rejection: >120 dB, DC to 60 Hz
   Overvoltage Protection: 120 VAC @ 15 sec max
2. **RTD INPUTS**: (T16 only)
   Type: 2 or 3 wire
   Excitation: 150 µA typical
   Lead Resistance: 15 Ω max per input lead
   Resolution: 1° or 0.1° for all types

TYPE	INPUT TYPE	RANGE	STANDARD
385	100 Ω platinum, Alpha = .00385	-200 to +600°C -328 to +1112°F	IEC 751
392	100 Ω platinum, Alpha = .003919	-200 to +600°C -328 to +1112°F	No official standard
672	120 Ω nickel, Alpha = .00672	-80 to +215°C -112 to +419°F	No official standard
Ohms	Linear Resistance	0.0 to 320.0 Ω	N/A

3. **THERMOCOUPLE INPUTS**: (T16 only)
   Types: T, E, J, K, R, S, B, N, C, and Linear mV
   Input Impedance: 20 MΩ for all types
   Lead Resistance Effect: 0.25 µV/Ω
   Cold Junction Compensation: Less than ±1°C typical (1.5°C max) error over ambient temperature range.
   Resolution: 1° for types R, S, B and 1° or 0.1° for all other types

TYPE	DISPLAY RANGE	WIRE COLOR		STANDARD
		ANSI	BS 1843	
T	-200 to +400°C -328 to +752°F	(+) Blue (-) Red	(+) White (-) Blue	ITS-90
E	-200 to 750°C -328 to +1382°F	(+) Violet (-) Red	(+) Brown (-) Blue	ITS-90
J	-200 to +760°C -328 to +1400°F	(+) White (-) Red	(+) Yellow (-) Blue	ITS-90
K	-200 to +1250°C -328 to +2282°F	(+) Yellow (-) Red	(+) Brown (-) Blue	ITS-90
R	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
S	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
B	+149 to +1820°C +300 to +3308°F	No standard	No standard	ITS-90
N	-200 to +1300°C -328 to +2372°F	(+) Orange (-) Red	(+) Orange (-) Blue	ITS-90
C W5/W6	0 to +2315°C +32 to +4199°F	No standard	No standard	ASTM E988-96
mV	-5.00 mV to 56.00mV	N/A	N/A	N/A

4. **SIGNAL INPUT**: (P16 only)

INPUT RANGE	ACCURACY *	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.30 % of reading +0.03V	1 MΩ	50 V	10 mV
20 mA DC (-2 to 22)	0.30 % of reading +0.04V	10 Ω	100 mA	10 µA

*Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

5. **TEMPERATURE INDICATION ACCURACY**: (T16 only)
   ± (0.3% of span, +1°C) at 23 °C ambient after 20 minute warm up. Includes NIST conformity, cold junction effect, A/D conversion errors and linearization conformity.
   Span Drift (maximum): 130 PPM/°C
6. **USER INPUT**: (Only controllers with alarms have a user input terminal.)
   Internally pulled up to +7 VDC (100 KΩ), $V_{IN\ MAX}$ = 35 V, V_{IL} = 0.6 V max, V_{IH} = 1.5 V min, I_{OFF} = 40 µA max
   Response Time: 120 msec max
   Functions: Programmable

OUTPUT SPECIFICATIONS

1. **CONTROL AND ALARM OUTPUTS**:
   Relay Output:
   Type: Form A
   Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load)
   Life Expectancy: 100,000 cycles at max. load rating
   (Decreasing load and/or increasing cycle time, increases life expectancy)
   Logic/SSR Output (main control output only):
   Rating: 45 mA max @ 4 V min., 7 V nominal
2. **MAIN CONTROL**:
   Control: PID or On/Off
   Output: Time proportioning or DC Analog
   Cycle Time: Programmable
   Auto-Tune: When selected, sets proportional band, integral time, derivative time, and output dampening time. Also sets input filter and (if applicable) cooling gain.
   Probe Break Action: Programmable
3. **ALARMS**: (optional) 2 relay alarm outputs.
   Modes:
   None
   Absolute High Acting (Balanced or Unbalanced Hysteresis)
   Absolute Low Acting (Balanced or Unbalanced Hysteresis)
   Deviation High Acting
   Deviation Low Acting
   Inside Band Acting
   Outside Band Acting
   Heat (Alarm 1 on Analog Output models only)
   Cool (Alarm 2)
   Reset Action: Programmable; automatic or latched
   Standby Mode: Programmable; enable or disable
   Hysteresis: Programmable
   Sensor Fail Response: Upscale
   Annunciator: “A1” and “A2” programmable for normal or reverse acting
4. **COOLING**: Software selectable (overrides Alarm 2).
   Control: PID or On/Off
   Output: Time proportioning
   Cycle Time: Programmable
   Proportional Gain Adjust: Programmable
   Heat/Cool Deadband Overlap: Programmable
5. **ANALOG DC OUTPUT**: (optional)
   Self-powered (Active)
   Action: Control or retransmission
   Update Rate: 0.1 to 250 sec

OUTPUT RANGE **	ACCURACY *	COMPLIANCE	RESOLUTION
0 to 10 V	0.3% of FS + ½ LSD	10 kΩ min	1/8000
0 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/8000
4 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/6400

* Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.
** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 5% overrange and a small underrange (negative) signal.

ORDERING INFORMATION

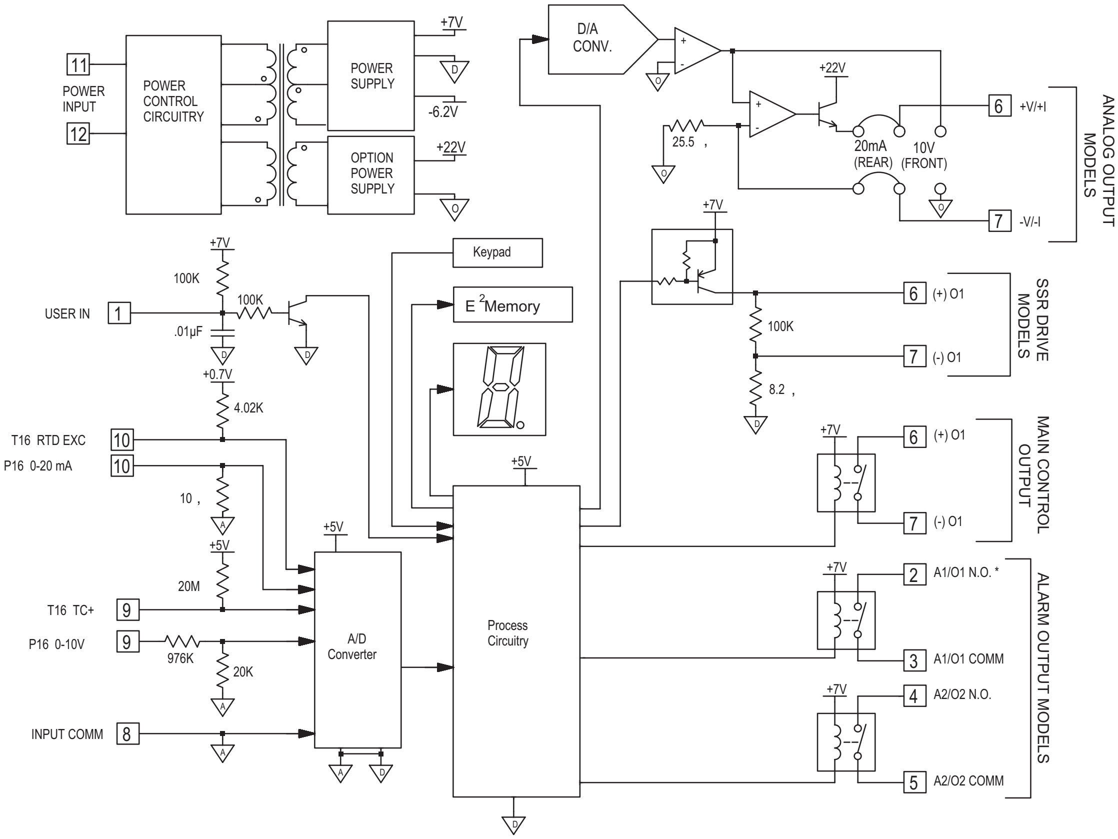
MODEL NO.	MAIN CONTROL	2 ALARMS & USER INPUT	PART NUMBERS	
			18-36 VDC/24 VAC	85 to 250 VAC
T16	Relay	—	T1610010	T1610000
	Relay	Yes	T1611110	T1611100
	Logic/SSR	—	T1620010	T1620000
	Logic/SSR	Yes	T1621110	T1621100
	Analog Out *	Yes	T1641110	T1641100
P16	Relay	—	P1610010	P1610000
	Relay	Yes	P1611110	P1611100
	Logic/SSR	—	P1620010	P1620000
	Logic/SSR	Yes	P1621110	P1621100
	Analog Out *	Yes	P1641110	P1641100

* Analog out may be used for retransmitted signals. When using analog output for retransmitted signals, AL1 becomes main control O1, if selected for heating in the analog out models.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
TP16	Programming Kit 1 : Includes Software, Comms Module w/ 9-pin connector and cable, and 115 VAC Power Adapter	TP16KIT1
	Programming Kit 2 : Includes Software, Comms Module w/ 9-pin connector and cable	TP16KIT2
RLY	External SSR Power Unit (for Logic/SSR models)	RLY50000
	25 A Single Phase Din Rail Mount Solid State Relay	RLY60000
	40 A Single Phase Din Rail Mount Solid State Relay	RLY6A000
	Three Phase Din Rail Mount Solid State Relay	RLY70000

BLOCK DIAGRAM



*A1 becomes main control O1, if selected for heating in the analog out models.

EMC INSTALLATION GUIDELINES

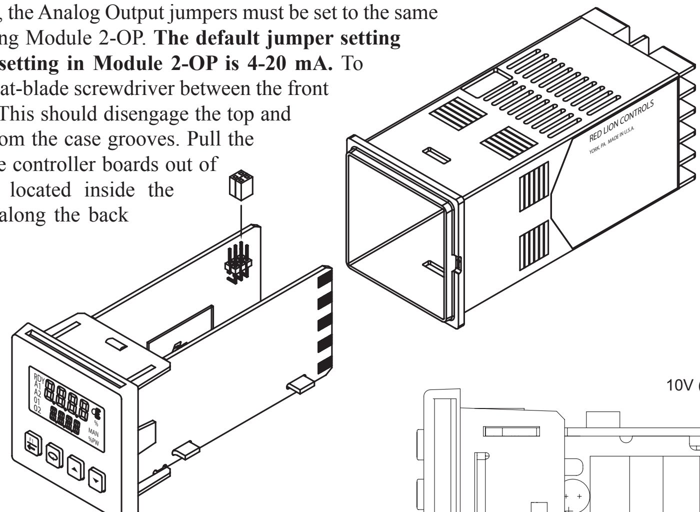
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

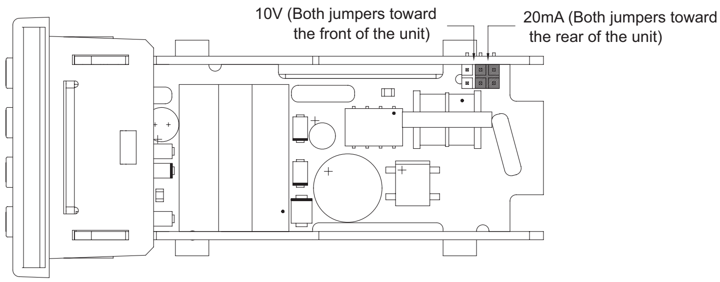
1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

1.0 Setting the Jumpers (Analog Output Models Only)

To insure proper operation, the Analog Output jumpers must be set to the same range selected in programming Module 2-OP. **The default jumper setting is for 20 mA. The default setting in Module 2-OP is 4-20 mA.** To access the jumpers, insert a flat-blade screwdriver between the front panel and the side case slot. This should disengage the top and bottom front panel latches from the case grooves. Pull the front panel assembly with the controller boards out of the case. The jumpers are located inside the controller on the left board along the back top section.

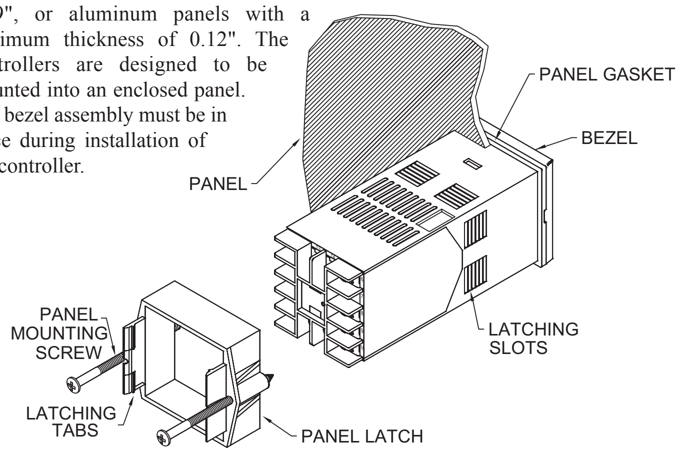




VIEW FROM TOP OF UNIT

2.0 Installing the Controller

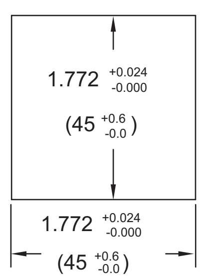
The T16 and P16 controllers meet NEMA 4X/IP65 requirements for indoor use to provide a watertight seal in steel panels with a minimum thickness of 0.09", or aluminum panels with a minimum thickness of 0.12". The controllers are designed to be mounted into an enclosed panel. The bezel assembly must be in place during installation of the controller.



Instructions:

1. Prepare the panel cutout to the proper dimensions.
2. Remove the panel latch from the controller. Discard the cardboard sleeve.
3. Carefully remove the center section of the panel gasket and discard. Slide the panel gasket over the rear of the controller, seating it against the lip at the front of the case.
4. Insert the controller into the panel cutout. While holding the controller in place, push the panel latch over the rear of the controller, engaging the tabs of the panel latch in the farthest forward slot possible.
5. To achieve a proper seal, tighten the panel latch screws evenly until the controller is snug in the panel, torquing the screws to approximately 7 in-lb (79 N-cm). Overtightening can result in distortion of the controller, and reduce the effectiveness of the seal.

Note: The installation location of the controller is important. Be sure to keep it away from heat sources (ovens, furnaces, etc.) and away from direct contact with caustic vapors, oils, steam, or any other process by-products in which exposure may affect proper operation.

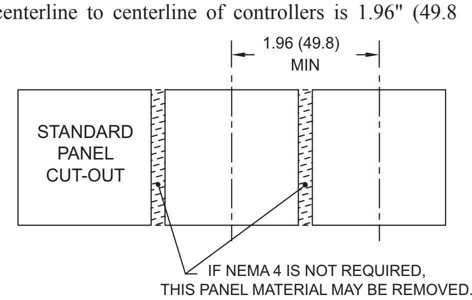


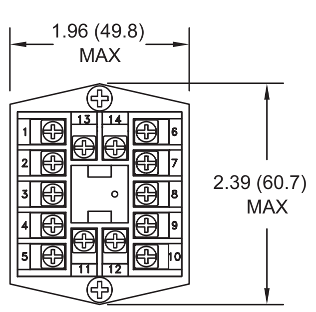
F

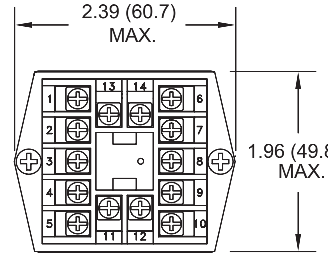
Multiple Controller Stacking

The controller is designed to allow for close spacing of multiple controllers in applications that do not require protection to NEMA 4X. Controllers can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the controller. For horizontal stacking, the panel latch screws should be at the top and bottom of the controller. The minimum spacing from centerline to centerline of controllers is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking controllers, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.







3.0 WIRING THE CONTROLLER

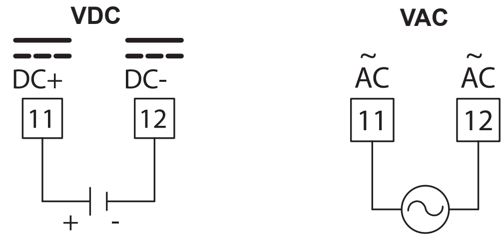
WIRING CONNECTIONS

All wiring connections are made to the rear screw terminals. When wiring the controller, use the numbers on the label and those embossed on the back of the case, to identify the position number with the proper function.

All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power (AC or DC) supplied to the controller be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" (6 mm) bare wire exposed (stranded wires should be tinned with solder). Insert the wire under the clamping washer and tighten the screw until the wire is clamped tightly.

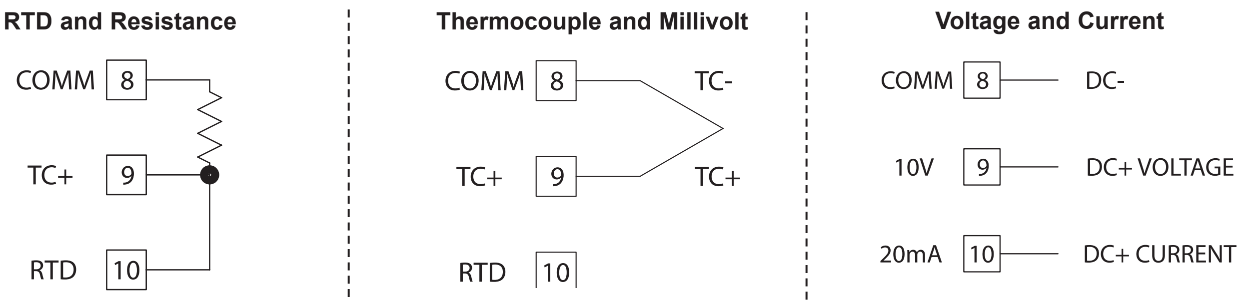
CONTROLLER POWER CONNECTIONS

For best results, the power should be relatively "clean" and within the specified limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off should be avoided. It is recommended that power supplied to the controller be protected by a fuse or circuit breaker.

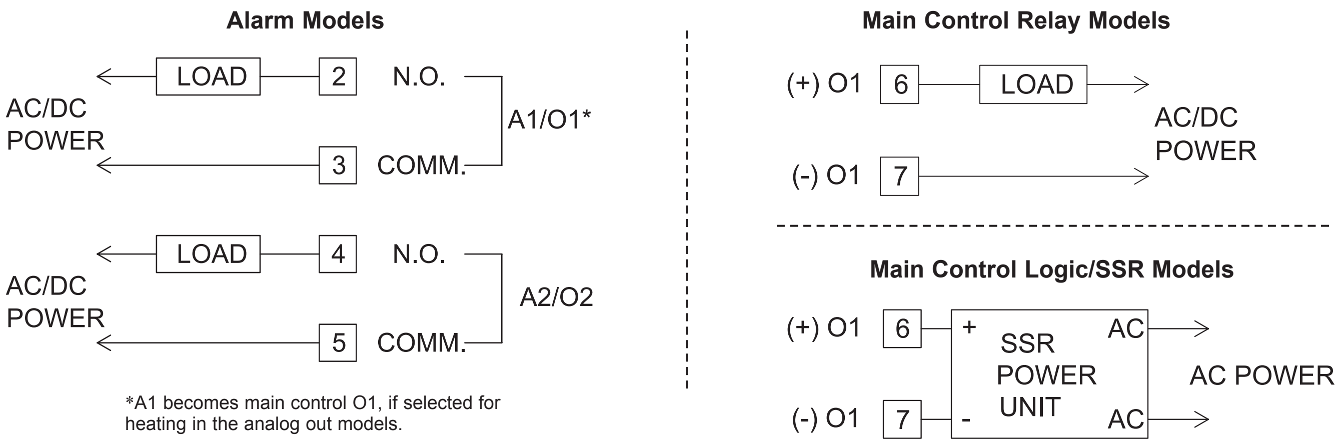


INPUT CONNECTIONS

For two wire RTDs, install a copper sense lead of the same gauge and length as the RTD leads. Attach one end of the wire at the probe and the other end to input common terminal. Complete lead wire compensation is obtained. This is the preferred method. If a sense wire is not used, then use a jumper. A temperature offset error will exist. The error may be compensated by programming a temperature offset.

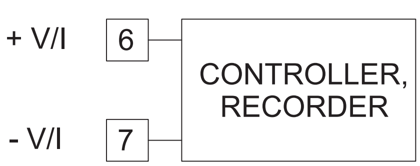


CONTROL AND ALARM OUTPUT CONNECTIONS

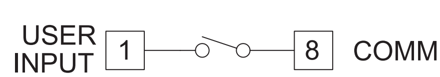


*A1 becomes main control O1, if selected for heating in the analog out models.

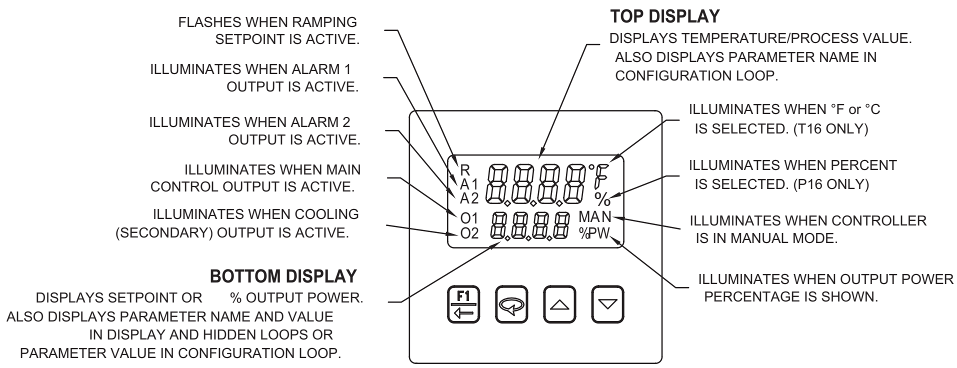
ANALOG DC OUTPUT CONNECTIONS



USER INPUT CONNECTIONS



4.0 Reviewing the Front Keys and Display



FRONT PANEL KEYS

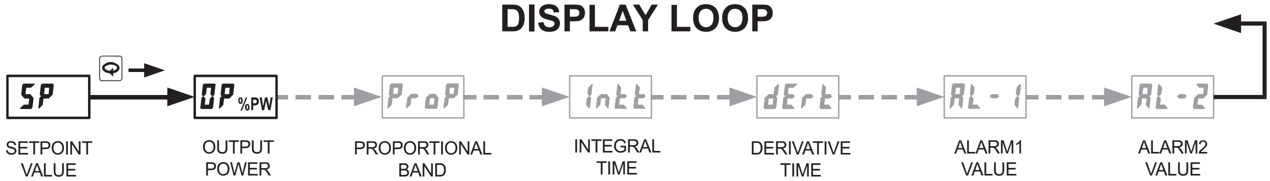
The F1 key is pressed to exit (or escape) directly to the start of the Display Loop. While in the Display Loop, the F1 key can be pressed to activate its programmed function.

The Loop key is pressed to advance to the next parameter, to activate a changed selection/value, and when held for three seconds, enter the Hidden Loop.

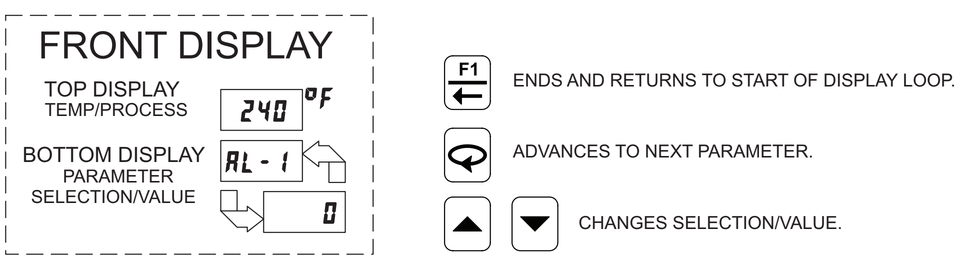
The Arrow keys are used to scroll through parameter selections/values and in the Configuration Loop they are used to scroll to the appropriate Parameter Module.

5.0 Programming: Display Loop

DISPLAY LOOP



Note: Setpoint and Output Power are the only parameters visible in the Display Loop with Factory Settings. The remaining parameters can be selected for the Display Loop within Module 3.
Parameter availability is model and programming dependent.



DISPLAY LOOP

At power up, all display segments light, and then the programmed input type and the controller's software version will flash. Then the Temperature/Process Value is shown in the top display, and the Setpoint Value is shown in the bottom display. This is the Display Loop. If the Setpoint is hidden or locked, the Display Loop will default to Output Power. If Output Power is also hidden or locked out, the bottom display is blank. During programming, the F1 key can be pressed to return the controller to this point. (Only in the Display Loop will the F1 key perform the user F1In function programmed in Input Module 1-IN.)

When the loop key is pressed the controller advances to the next parameter in the Display Loop. Except for Setpoint and % Output Power, the bottom display alternates between the parameter name and its selection/value. The arrow keys are pressed to change the selection/value for the shown parameter. The new selection/value is activated when the loop key is pressed. Display Loop parameters may be locked out or hidden in Lockout Module 3-LC. Some parameters are model and programming dependent.

F

The values shown for the displays are the factory settings.

SETPOINT VALUE (SP1) *

SP
0 T16
0.0 P16

-999 to 9999

SETPOINT VALUE (SP2) *

SP
20 T16
2.0 P16

-999 to 9999

Typically, the controller is operating with the Setpoint value in the bottom display. There is no annunciator nor parameter indication for Setpoint in the Display Loop. The parameter name alternates with the setpoint value in the Hidden Loop. The Setpoint value can be changed, activated and stored by pressing the arrow keys. This is the only parameter that can be configured as read only in the Display Loop, but read/write in the Hidden Loop. It is possible to store a second Setpoint value that can be selected in the Hidden Loop, by the F1 key or the user input. Both Setpoint values are limited by the Setpoint Low and High Limits in Input Module 1-IN.

% OUTPUT POWER *

OP
0.0

-100 to 100.0

The % Output Power is shown with the %PW annunciator. The parameter name alternates with the % Output Power value in the Hidden Loop. While the controller is in Automatic Mode, this value is read only. When the controller is placed in Manual Mode, the value can be changed, activated and stored by pressing the arrow keys. For more details on % Output Power, see Control Mode Explanations.

OUTPUT POWER OFFSET

OPOF
0.0

-100 to 100.0

When the Integral Time is set to zero and the controller is in the Automatic Mode, this parameter will appear after % Output Power. It is also shown with the %PW annunciator illuminated. The power offset is used to shift the proportional band to compensate for errors in the steady state. If Integral Action is later invoked, the controller will re-calculate the internal integral value to provide “bumpless” transfer and Output Power Offset will not be necessary.

PROPORTIONAL BAND

ProP
4.0

0.0 to 999.9
(% of full input range)

The proportional band should be set to obtain the best response to a process disturbance while minimizing overshoot. A proportional band of 0.0% forces the controller into On/Off Control with its characteristic cycling at Setpoint. For more information, see Control Mode and PID Tuning Explanations.

INTEGRAL TIME

Intt
120

0 to 9999 seconds

Integral action shifts the center point position of the proportional band to eliminate error in the steady state. The higher the integral time, the slower the response. The optimal integral time is best determined during PID Tuning. If time is set to zero, the previous Integral output power value is maintained. Offset Power can be used to provide Manual Reset.

DERIVATIVE TIME

dErt
30

0 to 9999 seconds per repeat

Derivative time helps to stabilize the response, but too high of a derivative time, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action.

ALARM 1 VALUE

AL-1
0 T16
0.0 P16

-999 to 9999

On models with alarms, the value for Alarm 1 can be entered here. The value is either absolute (absolute alarm types) or relative to the Setpoint value (deviation and band alarm types.) When Alarm 1 is programmed for HEAt or nonE, this parameter is not available. For more details on alarms, see Alarm Module 4-AL.

ALARM 2 VALUE

AL-2
0 T16
0.0 P16

-999 to 9999

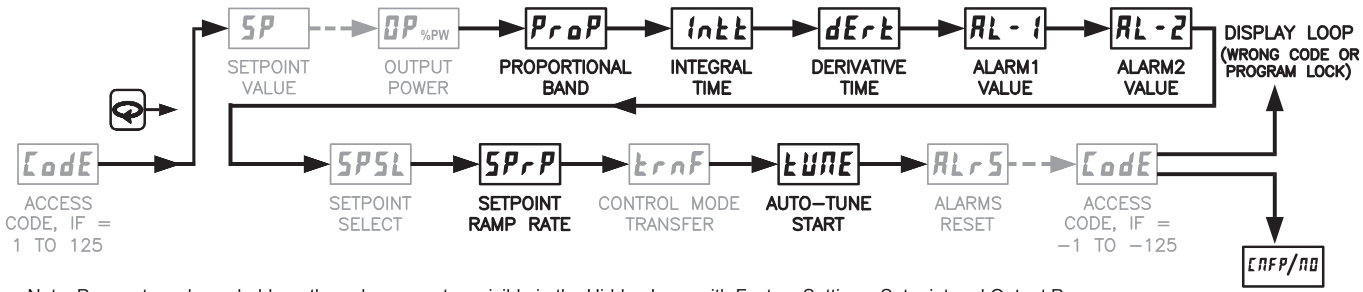
On models with alarms, the value for Alarm 2 can be entered here. The value is either absolute (absolute alarm types) or relative to the Setpoint value (deviation and band alarm types.) When Alarm 2 is programmed for CooL or nonE, this parameter is not available. For more details on alarms, see the Alarm Module 4-AL.

* Alternating indication only used in the Hidden Loop.

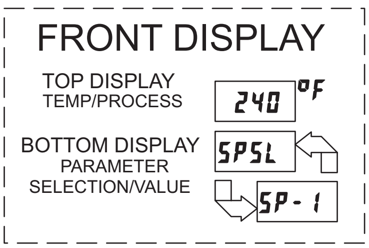
6.0 Programming: Hidden Loop

To enter Hidden Loop, press [loop key] for 3 seconds.

HIDDEN LOOP



Note: Parameters shown bold are the only parameters visible in the Hidden Loop with Factory Settings. Setpoint and Output Power are factory set for the Display Loop. The remaining parameters can be selected for the Hidden Loop within Module 3.
Parameter availability is model and programming dependent.



F1: ENDS AND RETURNS TO START OF DISPLAY LOOP.

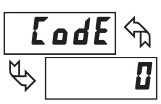
ADVANCES TO NEXT PARAMETER.

CHANGES SELECTION/VALUE.

HIDDEN LOOP

When [loop key] is pressed and held for three seconds, the controller advances to the Hidden Loop. The Temperature/Process Value is shown in the top display. The bottom display alternates between the parameter and its selection/value. [up] or [down] is pressed to change the selection/value for the shown parameter. The new selection/value is activated after [loop key] is pressed. When [F1] is pressed, the controller returns to the Display Loop and stores changed selection/values to permanent memory. Hidden Loop parameters may be locked out in Lockout Module 3-LC. Some parameters are model and programming dependent.

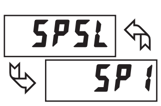
ACCESS CODE



1 to 125

If the Access Code is set from 1 to 125, in Lockout Module 3-LC, Access Code will appear here. By entering the proper Code, access to the Hidden Loop is permitted. With the factory setting of 0, Access Code will not appear in the Hidden Loop. A universal code of 111 can be entered to gain access, independent of the programmed code number.

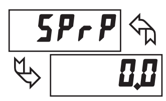
SETPOINT SELECT



SP1 or SP2

The SPSL function allows the operator to switch from or to, setpoint 1 and setpoint 2. In the Display Loop, there is no annunciator indicating the selected Setpoint, however, the selected Setpoint value is displayed and activated.

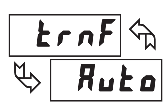
SETPOINT RAMP RATE



0.0 to 999.9

The setpoint ramp rate can reduce sudden shock to the process and reduce overshoot on startup or after setpoint changes, by ramping the setpoint at a controlled rate. R annunciator flashes while ramping. With the T16, the ramp rate is always in tenths of degrees per minute, regardless of the resolution chosen for the process display. With the P16, the ramp rate is in least-significant (display units) digits per minute. A value of 0.0 or 0 disables setpoint ramping. Once the ramping setpoint reaches the target setpoint, the setpoint ramp rate disengages until the setpoint is changed again. If the ramp value is changed during ramping, the new ramp rate takes effect. If the setpoint is ramping prior to starting Auto-Tune, the ramping is suspended during Auto-Tune and then resumed afterward. Deviation and band alarms are relative to the target setpoint, not the ramping setpoint. A slow process may not track the programmed setpoint rate. At power up, the ramping setpoint is initialized at the ambient temperature/process value.

CONTROL MODE TRANSFER

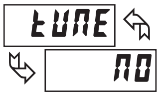


Auto USEr

In Automatic Mode, the percentage of Output Power is automatically determined by the controller. In Manual/User USEr Mode, the percentage of Output Power is adjusted manually while in the Display Loop. The Control Mode can also be transferred through the F1 Key or User Input. For more information, see Control Mode Explanations.

F

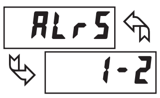
AUTO-TUNE START



NO YES

The Auto-Tune procedure of the controller sets the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Output Dampening Time, and Relative Gain (Heat/Cool) values appropriate to the characteristics of the process. This parameter allows front panel starting YES or stopping NO of Auto-Tune. For more information, see PID Tuning Explanations.

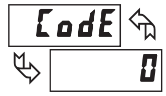
ALARMS RESET



1-2

With alarm models, the alarms can be manually reset. The up key resets Alarm 1 and the down key resets Alarm 2.

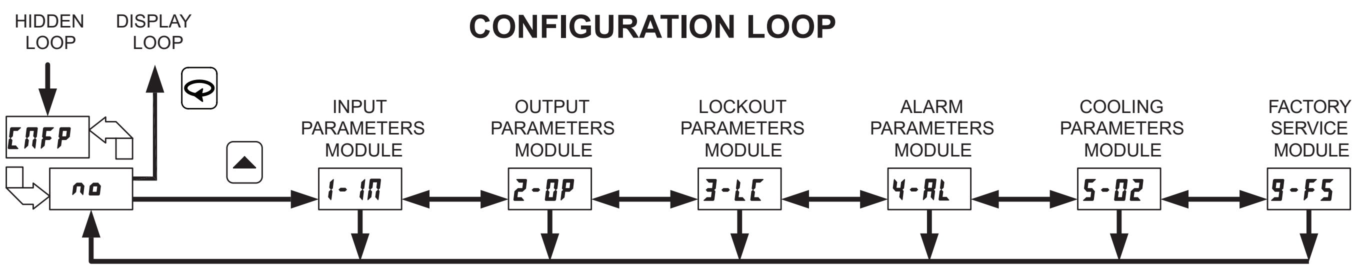
ACCESS CODE

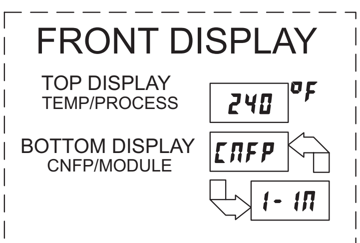


-1 to -125

If the Access Code is set from -1 to -125, in Lockout Module 3-LC, Access Code will appear here. By entering the proper Code, access to the Configuration Loop is permitted (with a negative Code value, the Hidden Loop can be accessed without the use of a code). With the factory setting of 0 or with an active User Input configured for Program Lock (PLOC), Access Code will not appear here. An active user input configured for Program Lock (PLOC) always locks out the Configuration Loop, regardless of Access Code.

7.0 Programming: Configuration Loop





F1 ENDS AND RETURNS TO START OF DISPLAY LOOP.

ENTERS MODULE OR AT CNFP/NO RETURNS TO DISPLAY LOOP.

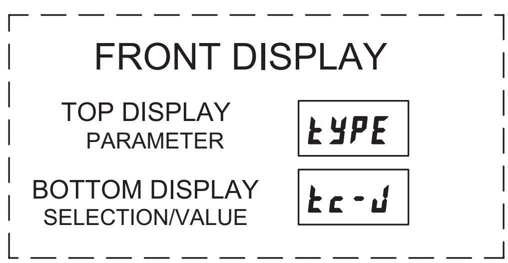
ADVANCES TO NEXT MODULE.

F

To access the Configuration Loop, press the up key when CNFP/NO is displayed in the Hidden Loop. The arrow keys are used to select the parameter module (1-9). To enter a specific module press while the module number is displayed. In the Configuration Loop, CNFP will alternate with the parameter number in the bottom display. The Temperature/Process Value is shown in the top display.

After entering a parameter module, press to advance through the parameter names in the module. To change a parameter's selection/value, press the arrow keys while the parameter is displayed. In the modules, the top display shows the parameter name, and the bottom display shows the selection/value. Use to enter any selection/values that have been changed. The change is not committed to permanent memory until the controller is returned to the Display Loop. If a power loss occurs before returning to the Display Loop, the new values must be entered again.

At the end of each module, the controller returns to CNFP/NO. At this location, pressing again returns the display to the the Display Loop. Pressing the Up key allows re-entrance to the Configuration Loop. Whenever F1 is pressed, End momentarily appears as the parameters are stored to permanent memory and the controller returns to the Display Loop.



F1 ENDS AND RETURNS TO START OF DISPLAY LOOP.

ADVANCES TO NEXT PARAMETER OR AT CNFP/NO RETURNS TO DISPLAY LOOP.

ADVANCES SELECTION/VALUE.

7.1 MODULE 1 - INPUT PARAMETERS (1-IN) T16 ONLY

PARAMETER MENU

1-INP → tYPE — SCAL — dCPt — FLtr — SHFt — SPLO — SPHI — InPt — F1In → CNFP

tYPE	SCAL	dCPt	FLtr	SHFt	SPLO	SPHI	InPt	F1In
INPUT TYPE	TEMP SCALE	DECIMAL RESOLUTION	DIGITAL FILTERING	SHIFT/ OFFSET	SETPOINT LOW LIMIT	SETPOINT HIGH LIMIT	USER INPUT	F1 KEY FUNCTION

INPUT TYPE

tYPE
tc-J

SELECTION	TYPE	SELECTION	TYPE
tc-t	T TC	tc-N	N TC
tc-E	E TC	tc-C	C TC
tc-J	J TC	LIN	Linear mV
tc-K	K TC	r385	RTD 385
tc-r	R TC	r392	RTD 392
tc-S	S TC	r672	RTD 672
tc-b	B TC	rLIN	Linear Ohms

Select the input type that corresponds to the input sensor.

TEMPERATURE SCALE

SCAL
°F

°F Fahrenheit
°C Celsius

Select either degrees Fahrenheit or Celsius. For linear mV and ohms input types, this has no effect. If changed, adjust related parameter values, as the controller does not automatically convert them.

DECIMAL RESOLUTION

dCPt
0

0 to 0.0 for temperature and resistance inputs
0.00 for mV inputs

Select whole degrees, or tenths of degrees for Temperature display, Setpoint values, and related parameters. For Linear Resistance inputs rLIN, the same parameter selections apply in ohms or tenths of an ohm. For mV inputs LIN, only hundredths of a mV resolution is available.

DIGITAL FILTERING

FLtr
1

0 = least to 4 = most

The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. If the signal is varying too greatly due to measurement noise, increase the filter value. If the fastest controller response is needed, decrease the filter value.

SHIFT/OFFSET

SHFt
0

-999 to 9999 degrees

This value offsets the controller's temperature display value by the entered amount. This is useful in applications in which the sensor cannot provide the actual temperature signal due to mounting constraints, inaccuracy, etc.

SETPOINT LOW LIMIT

SPLO
0

-999 to 9999

The controller has a programmable low setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set below the safe operating area of the process.

SETPOINT HIGH LIMIT

SPHI
9999

-999 to 9999

The controller has a programmable high setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set above the safe operating area of the process.

USER INPUT FUNCTION (OPTIONAL)

InPt
PLOC

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	SPt	Setpoint 1 or 2 Select
PLOC	Program Lock	SPrP	Setpoint Ramp Disable
ILOC	Integral Action Lock	ALrS	Reset Both Alarms
trnF	Auto/Manual Select		

The controller performs the selected User Input function (User Input available only on models with alarms), when the User terminal 1 is connected (pulled low) to Common terminal 8.

No Function: No function is performed.
Program Lock: The Configuration Loop is locked, as long as activated (maintained action).
Integral Action Lock: The integral action of the PID computation is disabled (frozen), as long as activated (maintained action).
Auto/Manual Select: This function selects (maintained action) Automatic (open) or Manual Control (activated).
Setpoint 1 or 2 Select: This function selects (maintained action) Setpoint 1(open) or Setpoint 2 (activated) as the active setpoint.
Setpoint Ramp Disable: The setpoint ramping feature is disabled, as long as activated (maintained action). Any time the user input is activated with a ramp in process, ramping is aborted.
Reset Alarms: Active alarms are reset, as long as activated (maintained action). Active alarms are reset until the alarm condition is cleared and triggered again (momentary action).

F1 KEY FUNCTION

F1In
NONE

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	A1rS	Reset Alarm 1
trnF	Auto/Manual Select	A2rS	Reset Alarm 2
SPt	Setpoint 1 or 2 Select	ALrS	Reset Both Alarms

The controller performs the selected F1 Key Function, when F1 is pressed while in the Display Loop. In any other loop or module location, pressing F1 will perform an escape to the Display Loop.

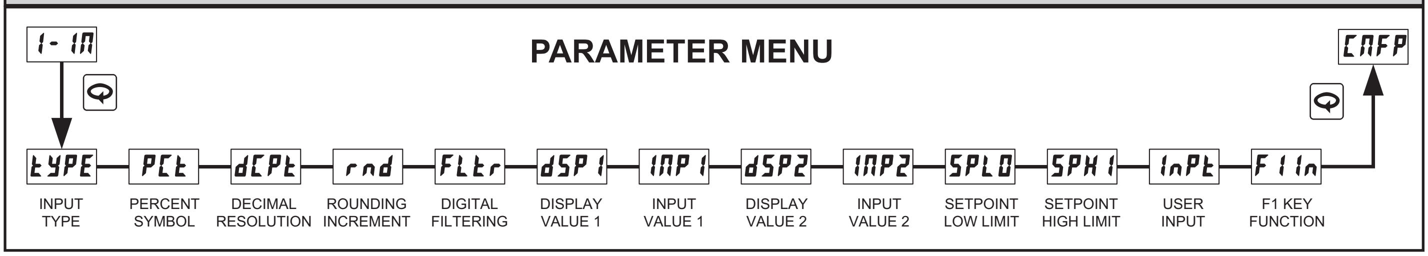
No Function: No function is performed.

Auto/Manual Select: This function toggles (momentary action) the controller between Automatic and Manual Control.

Setpoint 1 or 2 Select: This function toggles (momentary action) the controller between Setpoint 1 and Setpoint 2.

Reset Alarms: This function can be used to reset one or both of the alarms when activated (momentary action) The alarm will remain reset until the alarm condition is cleared and triggered again.

7.1 MODULE 1 - INPUT PARAMETERS (1-IN) P16 ONLY



INPUT TYPE

tYPE
Curr

SELECTION	TYPE
Curr	Current
VOLt	Voltage

Select the input type that corresponds to the input signal.

PERCENT ANNUNCIATOR

PCt
NO

YES On
NO Off

This only illuminates the % annunciator. It does not perform any type of percent function, but is useful in applications that have been scaled in percent.

DECIMAL RESOLUTION

dCPt
0.0

0 0.0 0.00 0.000

This selection affects the decimal point placement for the Process value, and related parameters.

ROUNDING INCREMENT

rnd
0.1

1 to 100
In steps of 1 least significant digit, regardless of decimal point.

Rounding selections other than 1 cause the process value display to round to the nearest rounding increment selected. (For example, rounding of 5 causes 122 to round to 120 and 123 to round to 125.) Rounding starts at the least significant digit of the process value. Setpoint values, Setpoint limits, Alarm values, Input Scaling values, and Analog Scaling values are not affected by rounding.

DIGITAL FILTERING

FLtr
1

0 = least to 4 = most

The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. If the signal is varying too greatly due to measurement noise, increase the filter value. If the fastest controller response is needed, decrease the filter value.

SCALING

To scale the controller, two scaling points are necessary. Each scaling point has a coordinate pair of Display Values and Input Values. It is recommended that the two scaling points be at the low and high ends of the input signal being measured. Process value scaling will be linear between and continue past the entered points to the limits of the input range. (Factory settings example will display 0.0 at 4.00 mA input and display 100.0 at 20.00 mA input.) Reverse acting indication can be accomplished by reversing the two signal points or the Display value points, but not both. If both are reversed, forward (normal) acting indication will occur. In either case, do not reverse the input wires to change the action.

DISPLAY VALUE SCALING POINT 1

dSP1
0.0

-999 to 9999

Enter the first coordinate Display Value by using the arrow keys.

INPUT VALUE SCALING POINT 1

INP1
4.00

0.00 to 20.00 mA
0.00 to 10.00 V

For Key-in Method, enter the first coordinate Input Value by using the arrow keys. To allow the P16 to "learn" the signal, use the Applied Method. For Applied Method, press F1. The ° annunciator is turned on to indicate the applied method. Adjust the applied signal level externally until the appropriate value appears under INP1. Using either method, press the loop key to store the value for INP1. (The controller can be toggled back to the Key-in Method by pressing F1 before the loop key.)

DISPLAY VALUE SCALING POINT 2

dSP2
100.0

-999 to 9999

Enter the second coordinate Display Value by using the arrow keys.

F

INPUT VALUE SCALING POINT 2

INP2
20.00

0.00 to 20.00 mA
0.00 to 10.00 V

For Key-in Method, enter the second coordinate Input Value by using the arrow keys. To allow the P16 to "learn" the signal, use the Applied Method. For Applied Method, press F1. The ° annunciator is turned on to indicate the applied method. Adjust the applied signal level externally until the appropriate value appears under INP2. Using either method, press the loop key to store the value for INP2. (The controller can be toggled back to the Key-in Method by pressing F1 before the loop key.)

SETPOINT LOW LIMIT

SPLO
0.0

-999 to 9999

The controller has a programmable low setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set below the safe operating area of the process.

SETPOINT HIGH LIMIT

SPHI
999.9

-999 to 9999

The controller has a programmable high setpoint limit value to restrict the setting range of the setpoint. Set the limit so that the setpoint value cannot be set above the safe operating area of the process.

USER INPUT FUNCTION (OPTIONAL)

InPt
PLOC

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	SPt	Setpoint 1 or 2 Select
PLOC	Program Lock	SPrP	Setpoint Ramp Disable
ILOC	Integral Action Lock	ALrS	Reset Both Alarms
trnF	Auto/Manual Select		

The controller performs the selected User Input function (User Input available only on models with alarms), when the User terminal 1 is connected (pulled low) to Common terminal 8.

No Function: No function is performed.

Program Lock: The Configuration Loop is locked, as long as activated (maintained action).

Integral Action Lock: The integral action of the PID computation is disabled (frozen), as long as activated (maintained action).

Auto/Manual Select: This function selects (maintained action) Automatic (open) or Manual Control (activated).

Setpoint 1 or 2 Select: This function selects (maintained action) Setpoint 1(open) or Setpoint 2 (activated) as the active setpoint.

Setpoint Ramp Disable: The setpoint ramping feature is disabled, as long as activated (maintained action). Any time the user input is activated with a ramp in process, ramping is aborted.

Reset Alarms: Active alarms are reset, as long as activated (maintained action). Active alarms are reset until the alarm condition is cleared and triggered again (momentary action).

F1 KEY FUNCTION

F1In
NONE

SELECTION	FUNCTION	SELECTION	FUNCTION
NONE	No Function	A1rS	Reset Alarm 1
trnF	Auto/Manual Select	A2rS	Reset Alarm 2
SPt	Setpoint 1 or 2 Select	ALrS	Reset Both Alarms

The controller performs the selected F1 key function, when F1 is pressed while in the Display Loop. In any other loop or module location, pressing F1 will perform an escape to the Display Loop.

No Function: No function is performed.

Auto/Manual Select: This function toggles (momentary action) the controller between Automatic and Manual Control.

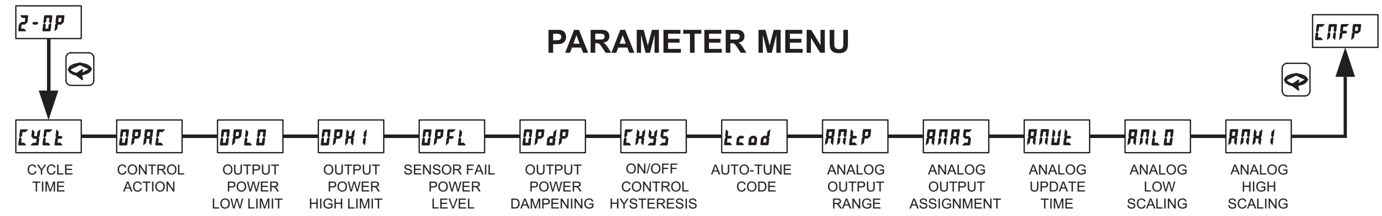
Setpoint 1 or 2 Selection: This function toggles (momentary action) the controller between Setpoint 1 and Setpoint 2.

Reset Alarms: This function can be used to reset one or both of the alarms when activated (momentary action). The alarm will remain reset until the alarm condition is cleared and triggered again.

F

7.2 MODULE 2 - OUTPUT PARAMETERS (2-OP)

PARAMETER MENU



CYCLE TIME

CYCt
2.0

0.0 to 250.0 seconds

The Cycle Time is entered in seconds with one tenth of a second resolution. It is the total time for one on and one off period of the time proportioning control output O1. With time proportional control, the percentage of power is converted into an output on-time relative to the cycle time value set. (If the controller calculates that 65% power is required and a cycle time of 10.0 seconds is set, the output will be on for 6.5 seconds and off for 3.5 seconds.) For best control, a cycle time equal to one-tenth or less, of the natural period of oscillation of the process is recommended. When using the Analog Output signal for control, the Cycle Time setting has no effect. If the O1 output is not being used, a cycle time of 0 can be entered to prevent the output and indicator from cycling.

CONTROL ACTION

OPAC
rEu

drct Direct (cooling)
rEu Reverse (heating)

This determines the control action for the PID loop. Programmed for direct action (cooling), the output power will increase if the Process value is above the Setpoint value. Programmed for reverse action (heating), the output power decreases when the Process Value is above the Setpoint Value. For heat and cool applications, this is typically set to reverse. This allows O1 or A1 (models with Analog Output) to be used for heating, and A2/O2 to be used for cooling.

OUTPUT POWER LOWER LIMIT

OPLO
0

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter may be used to limit controller power at the lower end due to process disturbances or setpoint changes. Enter the safe output power limits for the process. If Alarm 2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. When the controller is in Manual Control Mode, this limit does not apply.

OUTPUT POWER UPPER LIMIT

OPHI
100

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter may be used to limit controller power at the upper end due to process disturbances or setpoint changes. Enter the safe output power limits for the process. If Alarm 2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. When the controller is in Manual Control Mode, this limit does not apply.

SENSOR FAIL POWER LEVEL

OPFL
0

0 to 100 percent O1
-100 to 100 percent O1/O2

This parameter sets the power level for the control outputs in the event of a sensor failure. If Alarm 2 is not selected for cooling, the range is from 0% (O1 output full off) to 100% (O1 output full on). If A2 is selected for cooling, the range is from -100 to +100%. At 0%, both O1 and O2 are off; at 100%, O1 is on; and at -100%, O2 is on. The alarm outputs are upscale drive with an open sensor, and downscale drive with a shorted sensor (RTD only), independent of this setting. Manual Control overrides the sensor fail preset.

OUTPUT POWER DAMPENING

OPdP
3 T16
1 P16

0 to 250 seconds

The Dampening Time, entered as a time constant in seconds, dampens (filters) the calculated output power. Increasing the value increases the dampening effect. Generally, dampening times in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) are effective. Dampening times longer than these may cause controller instability due to the added lag effect.

ON/OFF CONTROL HYSTERESIS

CHYS
2 T16
0.2 P16

1 to 250

The controller can be placed in the On/Off Control Mode by setting the Proportional Band to 0.0%. The On/Off Control Hysteresis (balanced around the setpoint) eliminates output chatter. In heat/cool applications, the control hysteresis value affects both Output O1 and Output O2 control. It is suggested to set the hysteresis band to Factory Setting prior to starting Auto-Tune. After Auto-Tune, the hysteresis band has no effect on PID Control. On/Off Control Hysteresis is illustrated in the On/Off Control Mode section.

AUTO-TUNE CODE

tcod
0

0 fastest to 2 slowest

Prior to starting Auto-Tune, this code should be set to achieve the necessary dampening level under PID Control. This value allows customization of the PID values that Auto-Tune will calculate. For the process to be controlled aggressively (fastest process response with possible overshoot), set the Auto-Tune Code to 0. For the process to be controlled conservatively (slowest response with the least amount of overshoot), set this value to 2. If the Auto-Tune Code is changed, Auto-Tune needs to be reinitiated for the changes to affect the PID settings. For more information, see PID Tuning Explanations Section.

ANALOG OUTPUT RANGE (OPTIONAL)

AntP
4-20

0-10 V 0-20 mA
4-20 mA

Select the type of output and range. The Analog output jumpers are factory set to current. They must be changed if voltage output is desired. The Analog output can be calibrated to provide up to approximately 5% over range operation (0 mA current can only go slightly negative).

ANALOG OUTPUT ASSIGNMENT (OPTIONAL)

AnAS
OP

OP Main Control % Output Power
InP Input Signal Retransmission
SP Active Setpoint

This setting selects the parameter that the Analog Output will retransmit or track.

ANALOG UPDATE TIME (OPTIONAL)

AnUt
0

0 to 250 seconds
0 = update rate of 0.1 second

The update time of the Analog Output can be used to reduce excess valve actuator or pen recorder activity.

ANALOG LOW SCALING (OPTIONAL)

AnLO
0.0

-999 to 9999

The Analog Output assignment value that corresponds to 0 V, 0 mA or 4 mA output as selected.

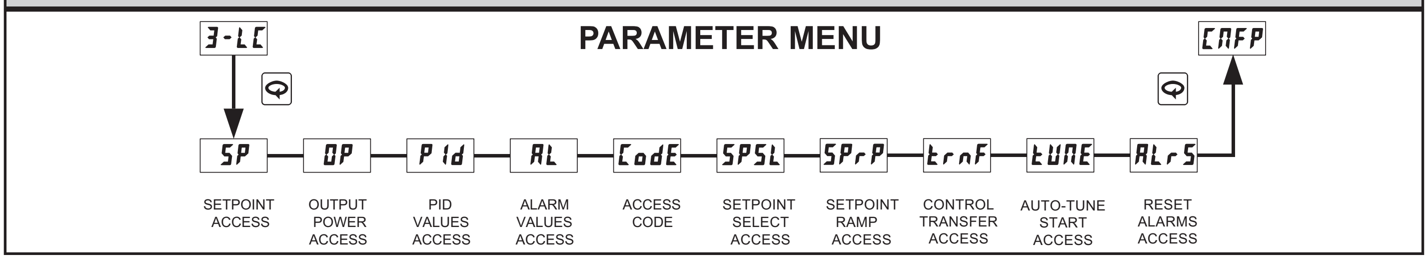
ANALOG HIGH SCALING (OPTIONAL)

AnHI
100.0

-999 to 9999

The Analog Output assignment value that corresponds to 10 V or 20 mA output as selected. An inverse acting output can be achieved by reversing the low and high scaling points.

7.3 MODULE 3 - LOCKOUT PARAMETERS (3-LC)



SELECTION	DESCRIPTION
dISP	Display: accessible in Display Loop.
HIdE	Hide: accessible in Hidden Loop.
LOC	Locked: not accessible in either loop.
dSPr (SP only)	Display/read: read only in Display Loop, but read/write in Hidden Loop.

The following parameters can be configured for LOC, HIdE, and dISP.

SETPOINT ACCESS	OUTPUT POWER ACCESS	PID VALUES ACCESS	ALARM VALUES ACCESS
SP	OP	PId	AL
dISP	dISP	HIdE	HIdE

ACCESS CODE

CodE
0

-125 to 125

0	Full access to Display, Hidden, and Configuration Loops
-1 to -125	Code necessary to access Configuration Loop only.
1 to 125	Code necessary to access Hidden and Configuration Loops.

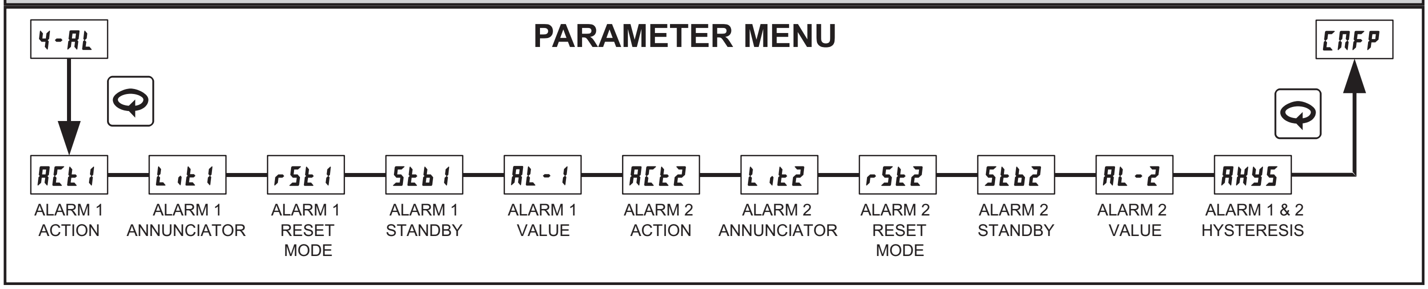
The following parameters can be configured for LOC or HIdE only.

SETPOINT SELECT ACCESS	SETPOINT RAMP ACCESS	CONTROL TRANSFER ACCESS
SPSL	SPrP	trnF
LOC	HIdE	LOC

AUTO-TUNE START ACCESS	RESET ALARMS ACCESS
tUNE	ALrS
HIdE	LOC

F

7.4 MODULE 4 - ALARM PARAMETERS (4-AL) (OPTIONAL)

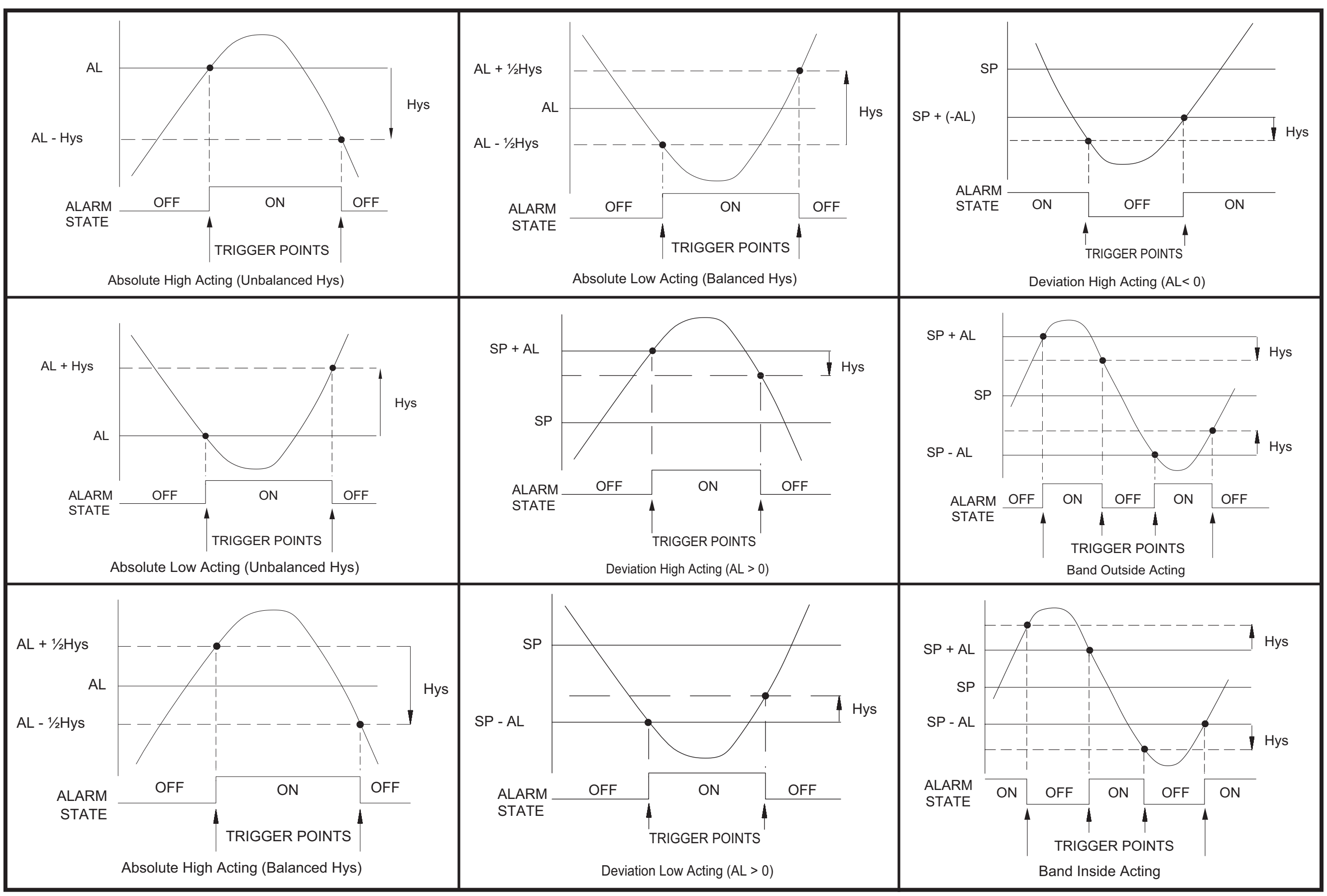


AVAILABLE ALARM ACTIONS

NONE	None	No action, the remaining Alarm parameters are not available.
AbHI	Absolute High (balanced hysteresis)	The alarm energizes when the Process Value exceeds the alarm value + 1/2 the hysteresis value.
AbLO	Absolute Low (balanced hysteresis)	The alarm energizes when the Process Value falls below the alarm value -1/2 the hysteresis value.
AuHI	Absolute High (unbalanced hysteresis)	The alarm energizes when the Process Value exceeds the alarm value.
AuLO	Absolute Low (unbalanced hysteresis)	The alarm energizes when the Process Value falls below the alarm value.

d-HI	Deviation High	Alarm 1 and 2 value tracks the Setpoint value
d-LO	Deviation Low	Alarm 1 and 2 value tracks the Setpoint value
b-IN	Band Acting (inside)	Alarm 1 and 2 value tracks the Setpoint value
b-Ot	Band Acting (outside)	Alarm 1 and 2 value tracks the Setpoint value
HEAt	Heat (A1 Analog models only)	If heating is selected, the remaining Alarm 1 parameters are not available.
CooL	Cool (A2 only)	If cooling is selected, the remaining Alarm 2 parameters are not available.

ALARM ACTION FIGURES



Absolute High Acting (Unbalanced Hys)

Absolute Low Acting (Balanced Hys)

Deviation High Acting (AL< 0)

Absolute Low Acting (Unbalanced Hys)

Deviation High Acting (AL > 0)

Band Outside Acting

Absolute High Acting (Balanced Hys)

Deviation Low Acting (AL > 0)

Band Inside Acting

Note: Hys in the above figures refers to the Alarm Hysteresis.

F

ALARM ACTION ALARM 1

ACt 1 | AuHI

nonE AbHI AbLO AuHI AuLO d-HI d-LO b-IN b-ot HEAt

Select the action for the alarms. See Alarm Action Figures for a visual explanation.

ALARM ANNUNCIATOR ALARM 1

Lit 1 | nor

nor Normal
rEu Reverse

With normal selection, the alarm annunciator indicates "on" alarm output 1. With reverse selection, the alarm annunciator indicates "off" alarm output.

ALARM RESET MODE ALARM 1

rSt 1 | Auto

Auto Automatic
LAtc Latched

In Automatic mode, an energized alarm turns off automatically after the Temperature/Process value leaves the alarm region. In Latched mode, an energized alarm requires an F1 key or user input alarm reset to turn off. After an alarm reset, the alarm remains reset off until the trigger point is crossed again.

ALARM STANDBY ALARM 1

Stb 1 | NO

YES Standby on
NO Standby off

Standby prevents nuisance (typically low level) alarms after a power up or setpoint change. After powering up the controller or changing the setpoint, the process must leave the alarm region (enter normal non-alarm area of operation). After this has occurred, the standby is disabled and the alarm responds normally until the next controller power up or setpoint change.

ALARM VALUE ALARM 1

AL-1

0 T16
0.0 P16

-999 to 9999

The alarm values are entered as process units or degrees. They can also be entered in the Display or Hidden Loops. When the alarm is configured as deviation or band acting, the associated output tracks the Setpoint as it is changed. The value entered is the offset or difference from the Setpoint.

ALARM ACTION ALARM 2

ACt2 | AuHI

nonE AbHI AbLO AuHI AuLO d-HI d-LO b-IN b-ot CooL

Select the action for the alarms. See Alarm Action Figures for a visual explanation.

ALARM ANNUNCIATOR ALARM 2

Lit2 | nor

nor Normal
rEu Reverse

With normal selection, the alarm annunciator indicates "on" alarm output 2. With reverse selection, the alarm annunciator indicates "off" alarm output.

ALARM RESET MODE ALARM 2

rSt2 | Auto

Auto Automatic
LAtc Latched

In Automatic mode, an energized alarm turns off automatically after the Temperature/Process value leaves the alarm region. In Latched mode, an energized alarm requires an F1 key or user input alarm reset to turn off. After an alarm reset, the alarm remains reset off until the trigger point is crossed again.

ALARM STANDBY ALARM 2

Stb2 | NO

YES Standby on
NO Standby off

Standby prevents nuisance (typically low level) alarms after a power up or setpoint change. After powering up the controller or changing the setpoint, the process must leave the alarm region (enter normal non-alarm area of operation). After this has occurred, the standby is disabled and the alarm responds normally until the next controller power up or setpoint change.

ALARM VALUE ALARM 2

AL-2

20 T16
2.0 P16

-999 to 9999

The alarm values are entered as process units or degrees. They can also be entered in the Display or Hidden Loops. When the alarm is configured as deviation or band acting, the associated output tracks the Setpoint as it is changed. The value entered is the offset or difference from the Setpoint.

ALARM HYSTERESIS

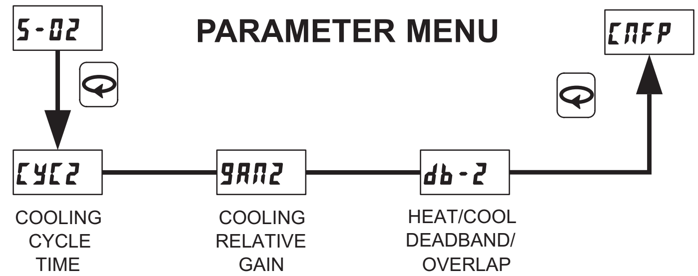
AHYS

1 T16
0.1 P16

0 to 250

The Hysteresis Value is either added to or subtracted from the alarm value, depending on the alarm action selected. The same value applies to both alarms. See the Alarm Action Figures for a visual explanation of how alarm actions are affected by the hysteresis.

7.5 MODULE 5 - Cooling (Secondary) Parameters (5-O2)



To enable Cooling in Heat/Cool applications, the Alarm 2 Action must first be set for Cooling. (For P16 Controllers, the cooling output is sometimes referred to as secondary output.) When set to cooling, the output no longer operates as an alarm but operates as a cooling output. The O2 terminals are the same as A2, however a separate O2 annunciator indicates Cooling Operation. Cooling output power ranges from -100% (full cooling) to 0% (no cooling, unless a heat/cool overlap is used). The Power Limits in Output Module 2-OP also limit the cooling power. In applications requiring only a Cooling output, the main 01 output should be used.

CYCLE TIME

CYC2
2.0

0.0 to 250.0 seconds

This cycle time functions like the O1 Output Cycle Time but allows independent cycle time for cooling. A setting of zero will keep output O2 off.

RELATIVE GAIN

GAN2
1.0

0.0 to 10.0

This defines the gain of the cooling relative to the heating. It is generally set to balance the effects of cooling to that of heating. This is illustrated in the Heat/Cool Relative Gain Figures. A value of 0.0 places the cooling output into On/Off Control.

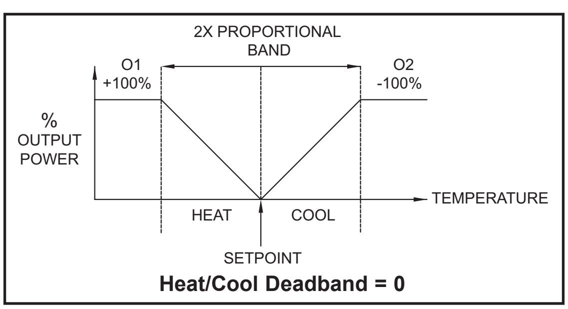
DEADBAND/OVERLAP

db-2
0

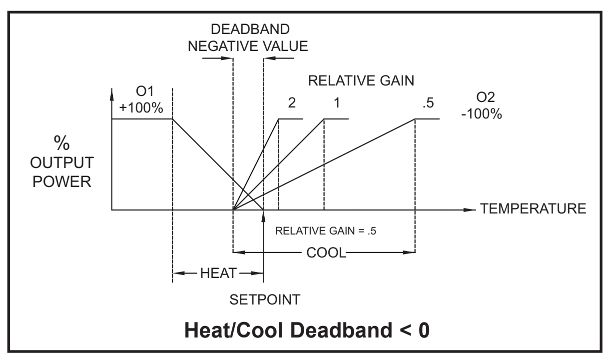
-999 to 9999

This defines the overlap area in which both heating and cooling are active (negative value) or the deadband area between the bands (positive value). If a heat/cool overlap is specified, the percent output power is the sum of the heat power (O1) and the cool power (O2). If Relative Gain is zero, the cooling output operates in the On/Off Control Mode, with the On/Off Control Hysteresis CHYS in Output Module 2-OP becoming the cooling output hysteresis. The function of Deadband is illustrated in the Control Mode Explanations. For most applications, set this parameter to 0.0 prior to starting Auto-Tune. After the completion of Auto-Tune, this parameter may be changed.

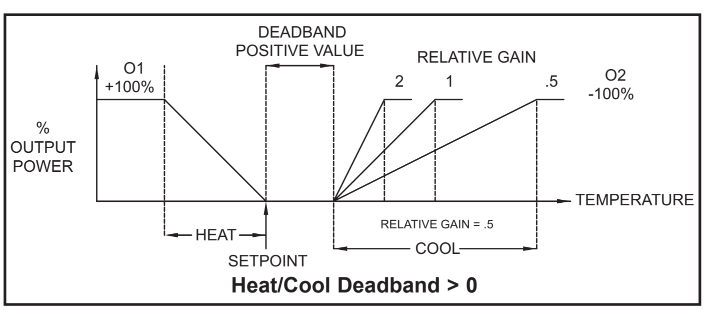
HEAT/COOL RELATIVE GAIN FIGURES



Heat/Cool Deadband = 0



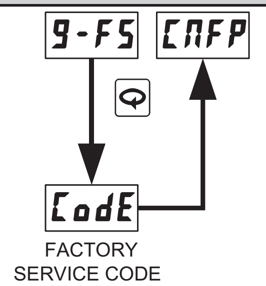
Heat/Cool Deadband < 0



Heat/Cool Deadband > 0

F

7.5 MODULE 9 FACTORY SERVICE OPERATIONS (9-FS)



PARAMETER MENU

CALIBRATION

CodE
48

The controller is fully calibrated from the factory. Recalibration is recommended every two years by qualified technicians using appropriate equipment. Calibration may be performed by using the front panel or with the TP16KIT. The front panel method is explained below. (Refer to the TP16KIT bulletin for calibration instructions using TP16KIT cable and software.)

Calibration may be aborted by disconnecting power to the controller before exiting Factory Service Module 9-FS. In this case, the existing calibration settings remain in effect.

Note: Allow the controller to warm up for 30 minutes minimum and follow the manufacturer's warm-up recommendations for the calibration source or measuring device.

Millivolt Calibration (T16)

Millivolt calibration requires a precision voltage source with an accuracy of 0.03% (or better) connected to terminals 8 (comm.) and 9 (+). When calibrating the input, the millivolt calibration must be performed first, then the Cold Junction or RTD Resistance.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press P.
CAL		Press ▲ for YES, press P.
StP1	0.0 ohm	After 5 seconds (minimum), press P.
StP2	14.0 mV	After 5 seconds (minimum), press P.
StP3	28.0 mV	After 5 seconds (minimum), press P.
StP4	42.0 mV	After 5 seconds (minimum), press P.
StP5	56.0 mV	After 5 seconds (minimum), press P.

Cold Junction (T16)

Cold Junction calibration requires a thermocouple of known accuracy of types T, E, J, K, C or N (connected to terminals 8 and 9) and a calibrated external reference thermocouple probe measuring in °C with resolution to tenths. The two probes should be brought in contact with each other or in some way held at the same temperature. They should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the T16 thermocouple may be placed in a calibration bath of known temperature.) If performing the millivolt calibration prior, verify that the correct input type is configured in Input Module 1-IN before performing the following procedure. (After the millivolt calibration the controller will default to type J.) If using RTD only, the cold junction calibration need not be performed.

PROMPT	COMPARE	FRONT PANEL ACTION
CodE		Press ▼ until 48, press P.
CAL		Press P.
CJC		Press ▲ for YES, press P.
	Top display to external reference	Press ▲ or ▼ to adjust the bottom display until the top process display matches the external reference then press P.

RTD Resistance (T16)

RTD calibration requires a precision 277.0 ohm resistor with an accuracy of 0.1 Ω (or better). Connect a jumper between terminals 9 and 10 with a 0 ohm jumper between 9 and 8 at StP1 and the 277.0 ohm resistor between 9 and 8 at StP2. If using thermocouple only, the RTD calibration need not be performed.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press P.
CAL		Press P.
CJC		Press P.
rtd		Press ▲ for YES, press P.
StP1	0.0 ohm	After 5 seconds (minimum), press P.
StP2	277.0 ohm	After 5 seconds (minimum), press P.

Input Calibration (P16)

Process calibration requires a precision signal source with an accuracy of 0.03% (or better) that is capable of generating 10.0 V connected to terminals 8 (COMM) and 9 (+10V) and 20.00 mA connected to terminals 8 (COMM) and 10 (20mA). The current calibration can be skipped by pressing P at the not applicable prompts if using the controller for process voltage only.

PROMPT	APPLY	FRONT PANEL ACTION
CodE		Press ▼ until 48, press P.
CAL		Press ▲ for YES, press P.
StP1	0.0 ohm	After 5 seconds (minimum), press P.
StP2	2.5 V	After 5 seconds (minimum), press P.
StP3	5.0 V	After 5 seconds (minimum), press P.
StP4	7.5 V	After 5 seconds (minimum), press P.
StP5	10.0 V	After 5 seconds (minimum), press P.
StPA	0.0 mA	After 5 seconds (minimum), press P.
StPb	20.0 mA	After 5 seconds (minimum), press P.

F

Analog Output Calibration (T16 and P16)

Set the controller Analog jumpers to the output type being calibrated. Connect an external meter with an accuracy of 0.05% (or better) that is capable of measuring 10.00 V or 20.00 mA to terminals 6 (+V/I) and 7 (-V/I). The voltage or current calibration that is not being used must be skipped by pressing [PAR] until End appears.

PROMPT	EXTERNAL METER	FRONT PANEL ACTION
CodE		Press [DOWN] until 48, press [PAR].
CAL		Press [PAR].
CJC		Press [PAR]. (T16 only)
rtd		Press [PAR]. (T16 only)
ANCL		Press [UP] for YES, press [PAR].
C 0u	0.00 V	Press [UP] or [DOWN] until external meter matches listing, press [PAR].
C 10u	10.00 V	Press [UP] or [DOWN] until external meter matches listing, press [PAR].
C 0c	0.0 mA	Press [UP] or [DOWN] until external meter matches listing, press [PAR].
C 20c	20.0 mA	Press [UP] or [DOWN] until external meter matches listing, press [PAR].

RESTORE FACTORY SETTINGS

CodE
66

Press and hold [UP] to display CodE 66. Press [PAR]. The controller will display rSEt and then return to CNFP. Press [F1] to return to the Display Loop. This will overwrite all user settings with Factory Settings.

NOMINAL CALIBRATION SETTINGS

CodE
77

Press and hold [UP] to display CodE 77. Press [PAR]. Press and hold [UP] to display CodE 77 again. Press [PAR]. The controller will then return to CNFP. Press [F1] to return to the Display Loop. This will not overwrite any user settings but will erase the controller calibration values. This procedure does not require any calibration signals nor external meters. This can be used to clear calibration error flag E-CL.

CAUTION: This procedure will result in up to ±10% reading error and the controller will no longer be within factory specifications. For this reason, this procedure should only be performed if meter error is outside of this range to temporarily restore operation until the unit can be accurately calibrated.

TROUBLESHOOTING

For further technical assistance, contact technical support.

PROBLEM	CAUSE	REMEDIES
NO DISPLAY	1. Power off. 2. Brown-out condition. 3. Loose connection or improperly wired. 4. Bezel assembly not fully seated into rear of controller.	1. Check power. 2. Verify power reading. 3. Check connections. 4. Check installation.
CONTROLLER NOT WORKING	1. Incorrect setup parameters.	1. Check setup parameters.
E-E2 IN DISPLAY	1. Loss of setup parameters due to noise spike or other EMI event.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
E-CL IN DISPLAY	1. Loss of calibration parameters due to noise spike or other EMI event.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
dddd or -ddd IN DISPLAY	1. Display value exceeds 4 digit display range. 2. Defective or miscalibrated cold junction circuit. 3. Loss of setup parameters. 4. Internal malfunction.	1. Press F1 to escape, then check controller accuracy. a. Recalibrate controller. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
OPEN IN DISPLAY (T16)	1. Probe disconnected. 2. Broken or burned-out probe. 3. Corroded or broken terminations. 4. Excessive process temperature.	1. Change resolution to display whole number and verify reading. 2. Perform cold junction calibration. 3. Check setup parameters. 4. Perform Input calibration.
SENS IN DISPLAY (P16)	1. Input exceeds range of controller. 2. Incorrect input wiring. 3. Defective transmitter. 4. Internal malfunction.	1. Check input parameters. 2. Check input wiring. 3. Replace transmitter. 4. Perform input calibration.
OLOL IN TOP DISPLAY	1. Input exceeds range of controller. 2. Temperature exceeds range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive high temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a higher temperature range. 3. Replace transmitter or probe. 4. Reduce temperature. 5. Perform input calibration.
ULUL IN TOP DISPLAY	1. Input is below range of controller. 2. Temperature below range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive low temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a lower temperature range. 3. Replace transmitter or probe. 4. Raise temperature. 5. Perform input calibration.
SHrt IN DISPLAY (T16)	1. RTD probe shorted.	1. Check wiring and/or replace RTD probe.
CONTROLLER SLUGGISH OR NOT STABLE	1. Incorrect PID values. 2. Incorrect probe location.	1. See PID control. 2. Evaluate probe location.
SSr IN DISPLAY	1. Control output is damaged.	1. Return controller to factory for repair.

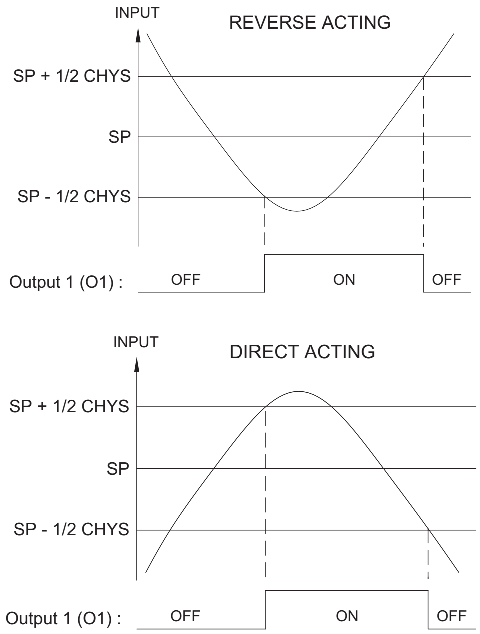
F

CONTROL MODE EXPLANATIONS

ON/OFF CONTROL

The controller operates in On/Off Control when the Proportional Band is set to 0.0%. In this control mode, the process will constantly oscillate around the setpoint value. The On/Off Control Hysteresis (balanced around the setpoint) can be used to eliminate output chatter. Output O1 Control Action can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications.

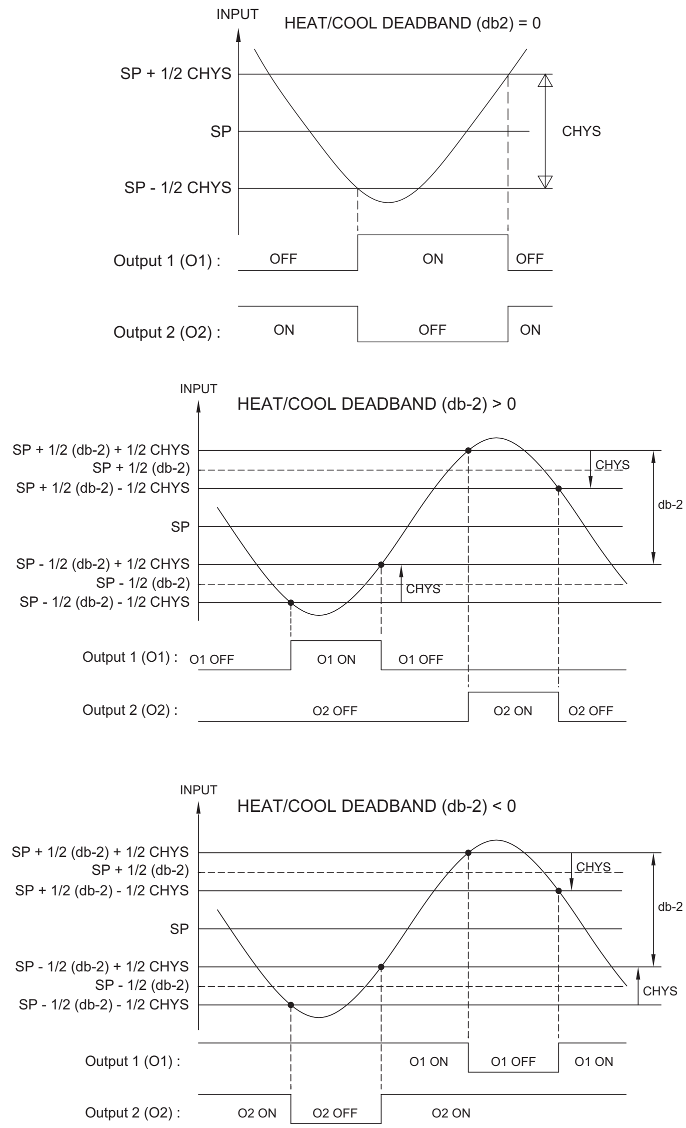
ON/OFF CONTROL - REVERSE OR DIRECT ACTING FIGURES



Note: CHYS in the On/Off Control Figures refers to the On/Off Control Hysteresis (CHYS) in parameter Module 2.

For heat and cool systems, O1 Control Action is set to reverse (heat) and the Alarm 2 Action is set to cooling (O2). The Proportional Band is set to 0.0 and the Relative Gain in Cooling to 0.0. The Deadband in Cooling sets the amount of operational deadband or overlap between the outputs. The setpoint and the On/Off Control Hysteresis applies to both O1 and O2 outputs. The hysteresis is balanced in relationship to the setpoint and deadband value.

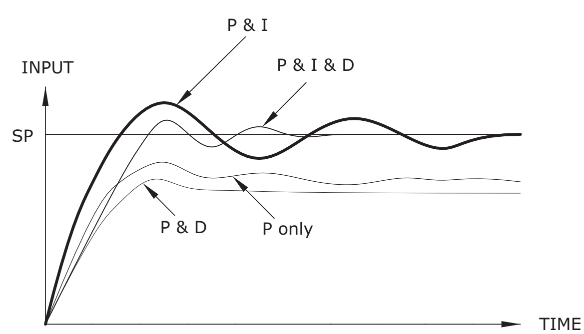
ON/OFF CONTROL - HEAT/COOL OUTPUT FIGURES



PID CONTROL

In PID Control, the controller processes the input and then calculates a control output power value by use of a modified Proportional Band, Integral Time, and Derivative Time control algorithm. The system is controlled with the new output power value to keep the process at the setpoint. The Control Action for PID Control can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications. For heat and cool systems, the heat (O1) and cool (O2) outputs are both used. The PID parameters can be established by using Auto-Tune, or they can be Manually tuned to the process.

TYPICAL PID RESPONSE CURVE



F

TIME PROPORTIONAL PID CONTROL

In Time Proportional applications, the output power is converted into output On time using the Cycle Time. For example, with a four second cycle time and 75% power, the output will be on for three seconds (4 × 0.75) and off for one second.

The cycle time should be no greater than 1/10 of the natural period of oscillation for the process. The natural period is the time it takes for one complete oscillation when the process is in a continuously oscillating state.

LINEAR PID CONTROL

In Linear PID Control applications, the Analog Output Assignment AnAS is set to % Output Power, OP. The Analog Low Scaling, AnLO , is set to 0.0 and the Analog High Scaling, AnHI , is set to 100.0. The Analog Output will then be proportional to the PID calculated % output power for Heat or Cooling per the Control Action OPAC. For example, with 0 VDC to 10 VDC (scaled 0 to 100%) and 75% power, the analog output will be 7.5 VDC.

MANUAL CONTROL MODE

In Manual Control Mode, the controller operates as an open loop system (does not use the setpoint and process feedback). The user adjusts the percentage of power through the % Power display to control the power for Output O1. When Alarm 2 is configured for Cooling (O2), Manual operation provides 0 to 100% power to O1 (heating) and -100 to 0% power to O2 (Cooling). The Low and High Output Power limits are ignored when the controller is in Manual.

MODE TRANSFER

When transferring the controller mode between Automatic and Manual, the controlling outputs remain constant, exercising true "bumpless" transfer. When transferring from Manual to Automatic, the power initially remains steady, but Integral Action corrects (if necessary) the closed loop power demand at a rate proportional to the Integral Time.

AUTOMATIC CONTROL MODE

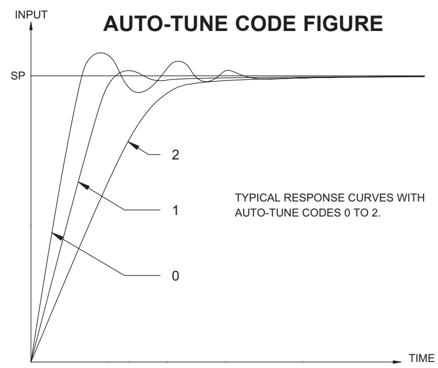
In Automatic Control Mode, the percentage of output power is automatically determined by PID or On/Off calculations based on the setpoint and process feedback. For this reason, PID Control and On/Off Control always imply Automatic Control Mode.

PID TUNING EXPLANATIONS

AUTO-TUNE

Auto-Tune is a user-initiated function that allows the controller to automatically determine the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Output Dampening Time, and Relative Gain (Heat/Cool) values based upon the process characteristics. The Auto-Tune operation cycles the controlling output(s) at a control point three-quarters of the distance between the present process value and the setpoint. The nature of these oscillations determines the settings for the controller's parameters.

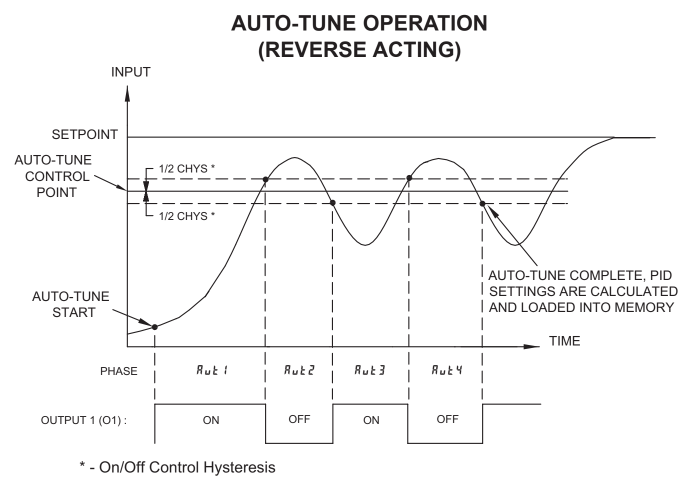
Prior to initiating Auto-Tune, it is important that the controller and system be first tested. (This can be accomplished in On/Off Control or Manual Control Mode.) If there is a wiring, system or controller problem, Auto-Tune may give incorrect tuning or may never finish. Auto-Tune may be initiated at start-up, from setpoint or at any other process point. However, ensure normal process conditions (example: minimize unusual external load disturbances) as they will have an effect on the PID calculations.



Start Auto-Tune

Below are the parameters and factory settings that affect Auto-Tune. If these setting are acceptable then Auto-Tune can be started just by performing two steps. If changes are needed, then they must be made before starting Auto-Tune.

DISPLAY	PARAMETER	FACTORY SETTING	MODULE
tYPE	Input Type	tc-J T16 Curr P16	1-IN
FLtr	Digital Filtering	1	1-IN
CHYS	On/Off Control Hysteresis	2 T16 0.2 P16	2-OP
tcod	Auto-Tune Code	0	2-OP
db-2	Deadband	0	5-O2
tUnE	Auto-Tune Access	HidE	3-LC



1. Enter the Setpoint value in the Display Loop.
2. Initiate Auto-Tune by changing Auto-Tune Start tUNE to YES in the Hidden Loop.

Auto-Tune Progress

The controller will oscillate the controlling output(s) for four cycles. The bottom display will flash the cycle phase number. Parameter viewing is permitted during Auto-Tune. The time to complete the Auto-Tune cycles is process dependent. The controller should automatically stop Auto-Tune and store the calculated values when the four cycles are complete. If the controller remains in Auto-Tune unusually long, there may be a process problem. Auto-Tune may be stopped by entering NO in Auto-Tune Start tUNE.

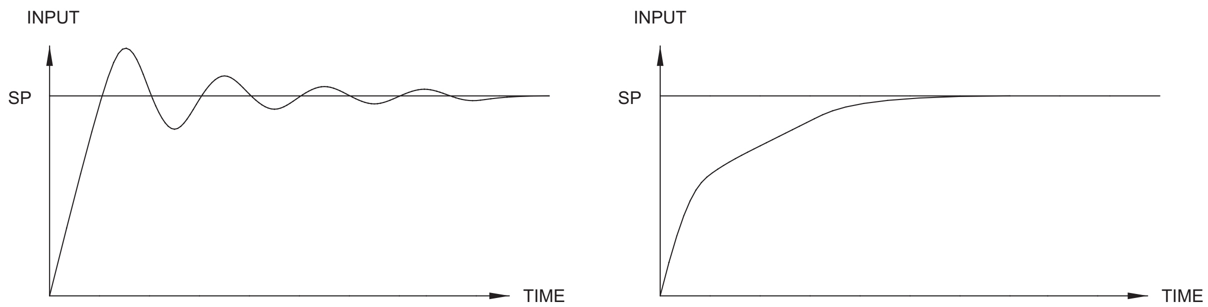
PID Adjustments

In some applications, it may be necessary to fine tune the Auto-Tune calculated PID parameters. To do this, a chart recorder or data logging device is needed to provide a visual means of analyzing the process. Compare the actual process response to the PID response figures with a step change to the process. Make changes to the PID parameters in no more than 20% increments from the starting value and allow the process sufficient time to stabilize before evaluating the effects of the new parameter settings.

In some unusual cases, the Auto-Tune function may not yield acceptable control results or induced oscillations may cause system problems. In these applications, Manual Tuning is an alternative.

PROCESS RESPONSE EXTREMES

OVERSHOOT AND OSCILLATIONS — SLOW RESPONSE



TO DAMPEN RESPONSE:
- INCREASE PROPORTIONAL BAND.
- INCREASE INTEGRAL TIME.
- USE SETPOINT RAMPING.
- USE OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A HIGHER AUTO-TUNE CODE.
- INCREASE DERIVATIVE TIME.
- CHECK CYCLE TIME.

TO QUICKEN RESPONSE:
- DECREASE PROPORTIONAL BAND.
- DECREASE INTEGRAL TIME.
- INCREASE OR DEFEAT SETPOINT RAMPING.
- EXTEND OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A LOWER AUTO-TUNE CODE.
- DECREASE DERIVATIVE TIME.

MANUAL TUNING

A chart recorder or data logging device is necessary to measure the time between process cycles. This procedure is an alternative to the controller's Auto-Tune function. It will not provide acceptable results if system problems exist.

1. Set the Proportional Band (ProP) to 10.0% for temperature models (T16) and 100.0% for process models (P16).
2. Set both the Integral Time (IntT) and Derivative Time (dErt) to 0 seconds.
3. Set the Output Dampening Time (OPdP) in Output Module 2-OP to 0 seconds.
4. Set the Output Cycle Time [CYCt] in Output Module 2-OP to no higher than one-tenth of the process time constant (when applicable).
5. Place the controller in Manual USEr Control Mode trnF in the Hidden Loop and adjust the % Power to drive the process value to the Setpoint value. Allow the process to stabilize after setting the % Power. Note: trnF must be set to HidE in Parameter Lockouts Module 3-LC.
6. Place the controller in Automatic (Auto) Control Mode trnF in the Hidden Loop. If the process will not stabilize and starts to oscillate, set the Proportional Band two times higher and go back to Step 5.
7. If the process is stable, decrease Proportional Band setting by two times and change the Setpoint value a small amount to excite the process. Continue with this step until the process oscillates in a continuous nature.
8. Fix the Proportional Band to three times the setting that caused the oscillation in Step 7.
9. Set the Integral Time to two times the period of the oscillation.
10. Set the Derivative Time to 1/8 (0.125) of the Integral Time.
11. Set the Output Dampening Time to 1/40 (0.025) the period of the oscillation.

F

MODEL T48 - 1/16 DIN TEMPERATURE CONTROLLER

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *NEMA 4X/IP65 BEZEL*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT*
- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *ACCEPTS 10 TYPES OF SENSOR INPUTS (Thermocouple or RTD)*
- *OPTIONAL HEATER CURRENT MONITOR AND HEATER BREAK ALARM*
- *OPTIONAL DUAL ALARM OUTPUTS*
- *OPTIONAL TWO LINEAR DC OUTPUTS (0 to 10 V, 0/4 to 20 mA)*
- *MANUAL/AUTOMATIC CONTROL MODES*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PROGRAMMABLE USER INPUT (Digital) FOR ADDED FLEXIBILITY*
- *SENSOR ERROR COMPENSATION (Offset) AND BREAK DETECTION*
- *HEATING AND OPTIONAL COOLING OUTPUTS*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *FIELD REPLACEABLE OUTPUT BOARD (Relay or Logic/SSR Drive)*

- *OPTIONAL TRIAC OUTPUT*
- *SECOND SETPOINT SETTING*
- *OPTIONAL REMOTE SETPOINT INPUT (0/4 to 20 mA)*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS*
- *PC SOFTWARE AVAILABLE FOR CONTROLLER CONFIGURATION*

UL Recognized Component, File # E156876

DESCRIPTION

The T48 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD elements), precisely displays the process temperature, and provides an accurate output control signal (time proportional or linear DC) to maintain the process at the desired temperature. The controller's comprehensive yet simple programming allows it to meet a wide variety of application requirements.

The controller operates in the PID control mode for both heating and cooling, with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis. A second setpoint is available on select models to allow quick selection of a different setpoint setting.

F

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

Dual 4-digit displays allow viewing of the process temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. On many models the main control output and the alarm outputs are field replaceable.

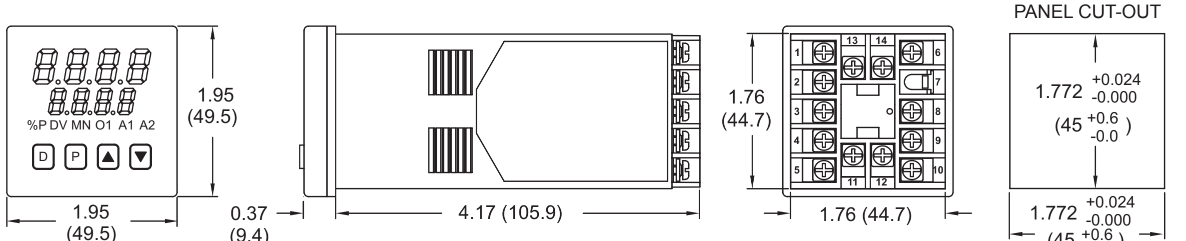
Optional alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT, and Heater Current Break) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region. The second alarm can be configured as a secondary PID output (heat/cool applications).

Optional Main Linear DC output (10 V or 20 mA) can be used for control or temperature re-transmission purposes. Programmable output update time reduces valve or actuator activity. The output range can be scaled independent of the input range.

Optional Second Linear DC output (10 V or 20 mA) provides an independent temperature re-transmission, while the main Linear DC output is being used for control. The output range can be scaled independent of the input range.

Optional Heater Current Monitor provides a direct readout of process heater current. An alarm can be programmed to signal when the heater has failed. This provides early warning of system failure before product quality is affected.

DIMENSIONS In inches (mm)



Optional Remote Setpoint input (0/4 to 20 mA) allows for cascade control loops, where tighter control is required; and allows for remotely driven setpoint signal from computers or other similar equipment. Straightforward end point scaling with independent filtering and local/remote transfer option expand the controller's flexibility.

The optional RS485 serial communication interface provides two-way communication between a T48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each T48 on the line can be programmed from 0 to 99. Data from the T48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFCRM, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the T48 to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.
   LED Status Annunciators:
   %P - Lower auxiliary display shows power output in (%).
   MN - Flashing: Controller is in manual mode.
   On: Local Setpoint (Remote Setpoint option)
   Off: Remote Setpoint
   DV - Lower auxiliary display shows deviation *(error)* from temperature setpoint or shows heater current.
   O1 - Main control output is active.
   A1 - Alarm #1 is active *(for A1 option.)*.
   A2 - Alarm #2 is active OR
   - Cooling output (O2) is active
2. **POWER:**
   AC Versions: 85 VAC min. to 250 VAC max., 50 to 60 Hz, 8 VA max.
   DC Versions:
   DC Power: 18 to 36 VDC; 7 W
   AC Power: 24 VAC ± 10%; 50 to 60 Hz, 9 VA
3. **CONTROLS:** Four front panel push buttons for modification and setup of controller functions and one external input user for parameter lockout or other functions.
4. **MEMORY:** Nonvolatile E^2 PROM retains all programmable parameters and values.
5. **MAIN SENSOR INPUT:**
   Sample Period: 100 msec
   Response Time: Less than 300 msec typ., 400 msec max. *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Normal Mode Rejection: 40 dB @ 50/60 Hz (improves with increased digital filtering.)
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Protection: Input overload 120 VAC max. for 15 seconds max.
6. **THERMOCOUPLE INPUT:**
   Types: T, E, J, K, R, S, B, N, Linear mV, software selectable
   Input Impedance: 20 MΩ all types
   Lead resistance effect: 0.25 µV/Ω
   Cold junction compensation: Less than ±1°C (±1.5°C max), error over 0 to 50°C max. ambient temperature range. Defeated for Linear mV indication mode.
   Resolution: 1° for all types, or 0.1° for T, E, J, K, and N only.

TC TYPE	RANGE	WIRE COLOR	
		ANSI	BS 1843
T	-200 to +400°C -328 to +752°F	blue (+) red (-)	white (+) blue (-)
E	-200 to +750°C -328 to +1382°F	violet (+) red (-)	brown (+) blue (-)
J	-200 to +760°C -328 to 1400°F	white (+) red (-)	yellow (+) blue (-)
K	-200 to +1250°C -328 to +2282°F	yellow (+) red (-)	brown (+) blue (-)
R	0 to 1768°C +32 to +3214°F	black (+) red (-)	white (+) blue (-)
S	0 to 1768°C +32 to 3214°F	black (+) red (-)	white (+) blue (-)
B	+149 to +1820°C +300 to +3308°F	grey (+) red (-)	no standard
N	-200 to +1300°C -328 to +2372°F	orange (+) red (-)	orange (+) blue (-)
mV	-5.00 to +56.00	no standard	no standard

7. **RTD INPUT:** 2 or 3 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.0039162
   Excitation: 150 µA typical
   Resolution: 1 or 0.1 degree
   Lead Resistance: 15 Ω max. per input lead

RTD TYPE	RANGE
385	-200 to +600°C -328 to +1100°F
392	-200 to +600°C -328 to +1100°F
OHMS	1.0 to 320.0

8. **INDICATION ACCURACY:** ±(0.3% of Span +1°C.) includes NIST conformity, cold junction effect and A/D conversion errors at 23°C after 20 min. warm-up.
9. **USER INPUT:** Internally pulled up to +5 VDC (1 MΩ).
   $V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V max., V_{IH} = 3.65 V min., I_{OFF} = 1µA max.
   Response Time: 120 msec max.
   Functions: Program Lock, Integral Action Lock, Auto/Manual Mode Select, Setpoint Ramp Enable, Reset Alarms, Setpoint 1/Setpoint 2 Select, Local/Remote Setpoint Select, Serial block print
10. **CONTROL AND ALARM OUTPUTS:** (Heating, Cooling or Alarm)
    Relay outputs with Form A contacts:
    Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load).
    Life Expectancy: 100,000 cycles at max. load rating.
    (Decreasing load and/or increasing cycle time, increases life expectancy.)
    Logic/SSR Drive Outputs:
    Rating: 45 mA @ 4 V min., 7 V nominal
    Triac Outputs:
    Type: Isolated, Zero Crossing Detection
    Rating:
    Voltage: 120/240 VAC
    Max. Load Current: 1 Amp @ 35°C
    0.75 Amp @ 50°C
    Min Load Current: 10 mA
    Offstate Leakage Current: 7 mA max. @ 60 Hz
    Operating Frequency: 20 to 400 Hz
    Protection: Internal transient snubber
11. **MAIN CONTROL:**
    Control: PID or ON/OFF
    Output: Time proportioning or Linear DC
    Cycle time: Programmable
    Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
    Probe Break Action: Programmable
12. **ALARMS:** 1 or 2 alarms (optional)
    Modes: Absolute high acting
    Absolute low acting
    Deviation high acting
    Deviation low acting
    Inside band acting
    Outside band acting

F

Heater break alarm
Reset Action: Programmable; automatic or latched
Standby Mode: Programmable; enable or disable
Hysteresis: Programmable
Probe Break Action: Upscale
Annunciator: LED backlight for “A1”, “A2”

13. **COOLING:** Software selectable (overrides alarm 2)
Control: PID or ON/OFF
Output: Time Proportioning
Cycle time: Programmable
Proportional Gain Adjust: Programmable
Heat/Cool Deadband Overlap: Programmable

14. **MAIN AND SECOND LINEAR DC OUTPUT:** (optional)
Self-powered (active)
Main: Control or Re-transmission, programmable update rate from 0.1 sec to 250 sec
Second: Re-transmission only, fixed update rate of 0.1 sec

OUTPUT ** RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	RESOLUTION
0 to 10 V	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	10k ohm min.	1/3500
0 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/3500
4 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/2800

* Accuracies are expressed as ± percentages after 20 minutes warm-up. Output accuracy is specified in two ways: Accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide temperature range reflects the temperature coeffecient of the internal circuitry.

** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 10% overrange and a small underrange (negative) signal.

15. **REMOTE SETPOINT INPUT:** (optional)
Input type:
0/4 to 20 mA
Input Resistance: 10 Ω
Overrange: -5% to 105%
Overload: 100 mA (continuous)
Scale Range: -999 to 9999 degrees or -99.9 to 999.9 degrees.
Resolution: 1 part in 10,000.
Accuracy:
At 25° C: ±(0.1 % of full scale +½ LSD)
Over 0 to 50°C range: ±(0.2% of full scale +½ LSD)
Reading Rate: 10/sec.
Setpoint Filtering: Programmable Digital
Setpoint Ramping: Programmable, 0.1 to 999.9 degrees/minute.

16. **HEATER CURRENT MONITOR INPUT:** (optional)
Type: Single phase, full wave monitoring of load currents controlled by main output (01).
Input: 100 mA AC output from current transformer (RLC #CT004001) or any CT with 100 mA AC output.
Display Scale Range: 1.0 to 999.9 Amps or 0.0 to 100.0%
Input Resistance: 5 Ω
Accuracy:
At 25° C: ±(0.5 % of full scale +½ LSD), (5 to 100% of Range)
Over 0 to 50°C range: ±(1.0% of full scale +½ LSD), (5 to 100% of Range)
Frequency: 50 to 400 Hz.
Alarm Mode: Dual acting; heater element fail detect and control device fail detect.
Overrange: 105% Capacity
Overload: 200 mA (continuous).

17. **SERIAL COMMUNICATIONS:** (optional)
Type: RS485 multipoint, balanced interface
Baud Rate: 300 to 9600
Data Format: 7O1, 7E1, 7N2, 8N1
Node Address: 0-99, max of 32 units per line
Transmit Delay: 2-100 msec or 100-200 msec
Data Encoding: ASCII
Isolation w.r.t Main Input Common: 500 Vrms for 1 min. (50 V working)
Not isolated w.r.t. Remote Setpoint or Heater Current inputs, or Analog Output common
Note: RS485 and the Analog Output commons are not internally isolated within the controller. The terminating equipment of these outputs must not share the same common (ie. earth ground).

18. **ENVIRONMENTAL CONDITIONS:**
Operating Range: 0 to 50°C
Storage Range: -40 to 80°C
Span Drift *(max.)*: 130 ppm/°C, main input
Zero Drift *(max.)*: 1µV/°C, main input
Operating and Storage Humidity:
85% max. relative humidity (non-condensing) from 0°C to 50°C.
Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
Shock to IEC 68-2-27: Operational 20 g (10 g relay).
Altitude: Up to 2000 meters

19. **ISOLATION BREAKDOWN RATINGS:**
AC line with respect to all Inputs and outputs: 250 V working (2300 V for 1 minute).
Main input with respect to Analog Outputs, Remote Setpoint Input, Heater Current Input: 50 V working (2300 V for 1 minute).
All other inputs and outputs with respect to relay contacts: 2000 VAC
Not isolated between Analog Outputs, Remote Setpoint and Heater Current commons.

20. **CERTIFICATIONS AND COMPLIANCES:**
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
Type 4X Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)
Refer to EMC Installation Guidelines section of the manual for additional information.

21. **CONNECTION:** Wire clamping screw terminals

22. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.

23. **WEIGHT:** 0.38 lbs (0.17 kgs)

BASIC OPERATION

The T48 controls a process temperature by measuring the temperature via an input probe, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process temperature at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low temperature overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the process temperature in the upper display. One of the following parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Temperature Deviation
- Heater Current
- Temperature symbol (F or C)
- Blank Display

The user scrolls through these parameters by pressing the D button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the P button and modified by use of the UP and DOWN buttons. Parameters are then entered by the P button, which advances the user to the next parameter. Pressing the D button immediately returns the controller to the normal operating mode without changing the currently selected parameter.

HARDWARE FEATURES

A fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent temperature control. Measurement accuracy of 0.3% of span ±1°C or better, provides close process control conforming to the desired control setpoint value. The T48 accepts a variety of both thermocouple and RTD temperature probes. An output board contains the Main Control output, Alarm 1 output, Alarm 2/Cooling output, and/or Linear DC output. Since the controller is serviceable from the front of the panel, the output board (on some models) may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing the output board for units without the Linear DC output option. Units with the linear output option require calibration procedure for the new linear output.

Low-drift, highly stable circuitry ensures years of reliable and accurate temperature control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

REMOTE SETPOINT INPUT

The remote setpoint input facilitates the use of a remote signal to drive the controller's setpoint. The remote signal can be scaled independent to that of the controller's range. The controller's response to local/remote setpoint transfers can be programmed. Also, the remote signal is filtered by use of an adaptive filter. With this filter, relatively large filtering time constants can be used without suffering from long settling times. The time constant and filter disable band are programmable. Additionally, the remote signal can also be velocity limited (or ramped) to slow the controller's response to changes in setpoint. This results in a steady control response with no overshoot.

HEATER CURRENT MONITOR

The T48 provides a direct readout of process heater current. This provides valuable information regarding single phase heater system integrity. It is especially useful on extruder and large oven applications where adjacent controllers mask the effect of a failed heater. The heater break alarm senses two types of heater system faults:

1) Main control output is "on" and heater current is below alarm value. This indicates failed heater or failed parts of heater, breaker trip, failed power control device, etc.
2) Main control output is "off" and heater current is above 10% of alarm value. This indicates a failed power control device, wiring fault, etc.

LINEAR DC ANALOG OUTPUTS

The Main Linear DC output has independent scaling, programmable output update time and filter (damping) time. These parameters permit flexibility in process configuration. The output can be set for 0 to 10 V, 0 to 20 mA or 4 to 20 mA ranges, and can be configured for control or for transmission of temperature or setpoint values.

A Second Linear DC output is dedicated for retransmission of input temperature. The output can be scaled and converted independent of the input and Main Linear DC output. This output is isolated from the input.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

A second setpoint value can be programmed which can be made active by a user input and/or through the front panel on selected models.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces thermal shock to the process and helps to minimize temperature overshoot.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control. A programmable temperature shift function can be used to compensate for probe errors or to have multiple T48 units indicate the same nominal temperature.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output*(s)*, transfer to second setpoint, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). Programmable output cycle time, output hysteresis and dampening can reduce output activity without degrading control accuracy. The main outputs can operate in PID, ON/OFF, or manual control modes.

CONTROL AND ALARM OUTPUTS

In addition to the Linear DC outputs, there are up to three types of ON/OFF outputs.These outputs can be relay, logic, or triac for control or alarm purposes. Relay outputs can switch user applied AC or DC voltages. Logic/SSR drive outputs supply power to external SSR power units. One Logic/SSR Drive output can control up to four SSR power units at one time. The Triac output supplies one Amp of AC current for control of an external AC relay or triac device.

AUTO-TUNE

The T48 has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into non-volatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

RS485 Communications

The RS485 communications option allows the connection of up to 32 devices on a single pair of wires with a distance of up to 4,000 feet and a maximum baud rate of 9600. Since the same pair of wires are used for both transmit and receive, only one way communication is possible at any given time. The controller has a programmable response time to allow the host device adequate time to release the communication line for a transmission.

Selected parameters from the T48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. It is also possible to invoke Auto-tune through the serial port. Serial communications used with SFCRM software allows for easy controller parameter configuration by computer.

HEATING AND COOLING SYSTEMS

The T48 is available with dual outputs to provide heating and cooling to those processes that require them. For example, many extruder applications require both heating and cooling to maintain accurate extruder barrel and die temperatures. The T48 is easily configured for these types of applications.

CONTROLLER PROGRAMMING

Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial set-up.

The following four programming modes allow the controller to adapt to any required user-interface level:

Unprotected Parameter Mode
Protected Parameter Mode
Hidden Function Mode
Configuration Parameter Mode

UNPROTECTED PARAMETERS MODE *

The Unprotected Parameters Mode is accessible from the Normal Display Mode when program disable is inactive or when the proper access code number from the Protected Parameter Mode is entered. The Configuration Parameter Modes can be accessed only from this mode.

"SP" - Enter setpoint
"OP" - Enter output power
"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CNFP" - Select configuration access point
"End" - Return to normal display mode

PROTECTED PARAMETERS MODE *

The Protected Parameters Mode is enabled when program disable is active. This mode prevents access to the Configuration Parameter Modes without the proper access code number. Only the parameters that are enabled in the Configuration 3 parameter (lock-out section) can be accessed.

"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CodE" - Enter value to access unprotected parameters and configuration parameters

HIDDEN FUNCTION MODE *

The Hidden Function Mode is accessible from the Normal Display Mode. The functions in this mode may be locked-out individually in Configuration 3 parameter (lock-out section).

"SPSL" - Select local (SP1 or SP2) or remote setpoint
"trnF" - Transfer between automatic (PID) control and manual control
"tUNE" - Invoke/cancel PID Auto-tune
"ALrS" - Reset latched alarms

CONFIGURATION PARAMETER MODE

The Configuration Parameter Mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the Configuration Access Point, allowing the user to return to the Normal Display Mode.

Configuration 1, Inputs (1-IN)

"tYPE" - Select input probe type
"SCAL" - Select temperature scale
"dCPt" - Select temperature resolution
"FLtr" - Select level of input filtering
"SHFt" - Enter input correction shift (offset)
"SPLO" - Enter setpoint lower limit
"SPHI" - Enter setpoint higher limit
"SPrP" - Enter setpoint ramp rate
"InPt" - Select user input function

Configuration 2, Outputs (2-OP) *

"CYCt" - Enter time proportioning cycle time
"OPAC" - Select output control action
"OPLO" - Enter output power low limit
"OPHI" - Enter output power high limit
"OPFL" - Enter probe fail power preset
"OPdP" - Enter output control dampening
"CHYS" - Enter ON/OFF control hysteresis
"tcOd" - Select auto-tuning dampening
"ANtP" - Main Linear DC analog output range
"ANAS" - Main Linear DC analog output source
"ANut" - Main Linear DC analog output update time
"ANLO" - Main Linear DC analog output scaling low
"ANHI" - Main Linear DC analog output scaling high

Configuration 3, Parameter Lock-Outs (3-LC) *

"SP" - Select setpoint access level
"OP" - Select power access level
"dEv" - Enable deviation display
"Hcur" - Enable heater current display
"UdSP" - Enable temperature scale display
"CodE" - Enter parameter access code
"PId" - Select PID access level
"AL" - Select alarm access level
"ALrS" - Enable alarm reset access
"SPSL" - Enable local/remote selection
"trnF" - Enable auto/manual mode selection
"tUNE" - Enable auto-tune invocation

Configuration 4, Alarms (4-AL) *

"ACt1" - Select operation mode of alarm #1, or select heat output
"rSt1" - Select reset mode of alarm #1
"Stb1" - Enable activation delay of alarm #1
"AL-1" - Enter value for alarm #1
"ACt2" - Select operation mode of alarm #2, or select cooling output
"rSt2" - Select reset mode of alarm #2
"Stb2" - Enable activation delay of alarm #2
"AL-2" - Enter value for alarm #2
"AHYS" - Enter hysteresis value for both alarms

Configuration 5, Cooling (5-O2) *

"CYC2" - Enter cooling time proportioning cycle time
"GAN2" - Enter cooling relative gain
"db-2" - Enter heat/cool deadband or overlap

Configuration 6, Serial Communications (6-SC) *

"bAUd" - Select baud rate
"ConF" - Select character frame format
"Addr" - Enter address
"Abrv" - Select abbreviated or full transmission
"PoPt" - Select print options

Configuration 7, Remote Setpoint Input (7-N2) *

"dSP1" - Enter remote setpoint display scaling value #1
"INP1" - Enter remote setpoint process scaling value #1
"dSP2" - Enter remote setpoint display scaling value #2
"INP2" - Enter remote setpoint process scaling value #2
"FLtr" - Enter remote setpoint filter time constant
"bAnd" - Enter remote setpoint filter disable band
"trnF" - Select Local/Remote setpoint transfer response

Configuration 7 - Heater Current Parameters (7-N2) *

"Hcur" - Enter full scale rating of CT

Configuration 8, Second Linear DC Analog Output (8-A2) *

"A2tP" - Second linear DC analog range
"A2LO" - Second linear DC analog scaling low
"A2HI" - Second linear DC analog scaling high

Configuration 9, Factory Service Operations (9-FS)

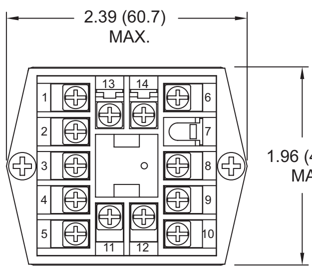
"Code 48" - Calibrate Instrument
"Code 66" - Reset parameters to factory setting

* *These parameters may not appear due to option configuration or other programming.*

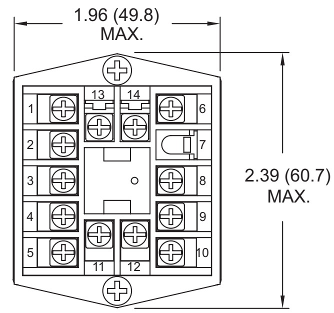
MULTIPLE UNIT STACKING

The T48 is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

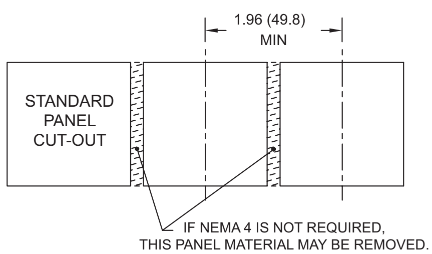


PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING



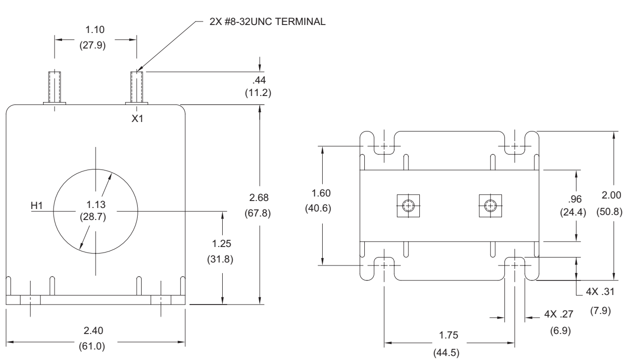
PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING.
HORIZONTAL ARRANGEMENT SHOWN.



ACCESSORY - CURRENT TRANSFORMER-50 A

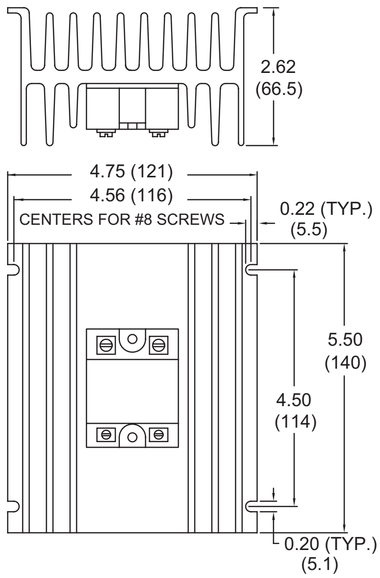
The external Current Transformer is used when specifying the T48s equipped with the Heater Current Monitor.



Part Number: CT005001
Current Ratio: 50 : 0.1 (Amperes)
Operation Frequency: 50 to 400 Hz
Insulation Class: 0.6 KV BIL, 10 KV full wave.
Terminals: Brass studs No. 8-32 UNC with flat washer and hex nuts.
Window Diameter: 1.13" (28.7 mm)
Weight: 8 oz (226.0 g)

ACCESSORY - EXTERNAL SSR POWER UNIT

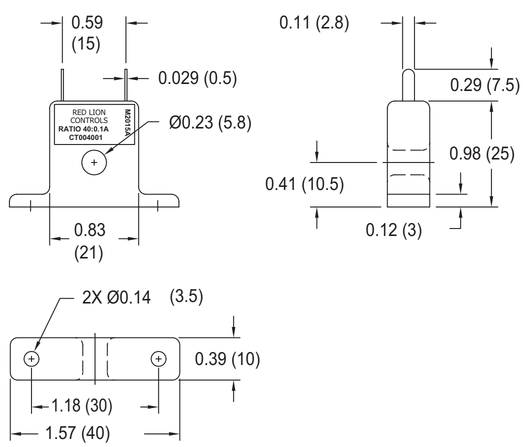
The external SSR Power Unit is used with T48s equipped with Logic/SSR Drive outputs to switch loads up to 240 VAC @ 45 Amps, 25°C ambient. The unit is operated by applying a low level DC control signal to the isolated input. The unit features zero cross detection circuits which reduces radiated RFI when switching load currents. With no contacts to wear out, the SSR Power Unit provides virtually limitless operational life. The unit is supplied with an integral heat sink for immediate installation.



External SSR Power Unit:
Part Number: RLY50000
Switched Voltage Range: 50 to 280 VAC
Load Current: 45 Amps max. @ 25°C ambient temperature
35 Amps max. @ 50°C ambient temperature
On State Input: 3 to 32 VDC @ 1500 Ω impedance. *(isolated)*
(Use Logic/SSR drive output.)
Off State Input: 0.0 to 1.0 VDC
Size: 5.5" (14 cm) L x 4.75" (12 cm) W x 2.62" (6.6 cm) H

ACCESSORY - CURRENT TRANSFORMER-40 A

The external Current Transformer is used when specifying the T48s equipped with the Heater Current Monitor.



Current Transformers:
Part Number: CT004001
Current Ratio: 40 : 0.1 (Amperes)
Max Heater Current: 50 A
Dielectric Strength: 1000 VAC (For 1 minute)
Vibration Resistance: 50 Hz (Approx 10 G)
Terminals: Solder Type
Window Diameter: 0.228" (5.8 mm)
Weight: 0.406 oz (11.5 g)

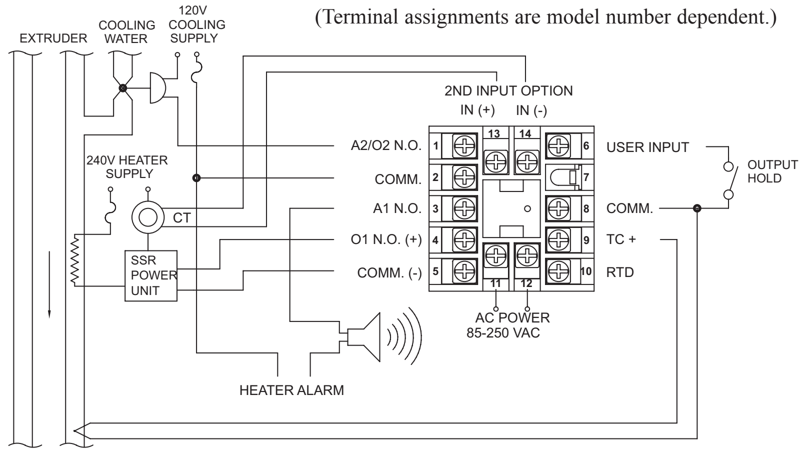
F

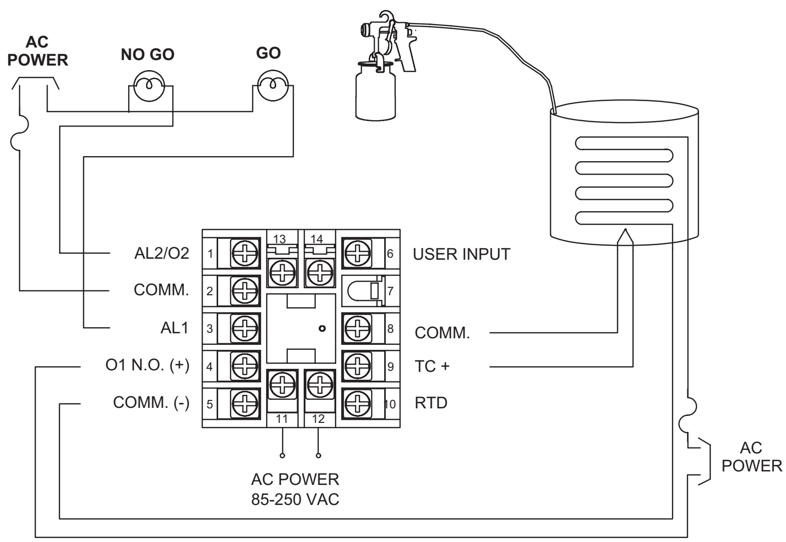
APPLICATION

PLASTICS EXTRUDER APPLICATION

Several T48 controllers are employed to control the temperature of a plastics extruder. Each T48 controls a heating element and a cooling water solenoid to maintain each extruder zone at the desired temperature. The Heater Current Monitor option is used to provide a readout of the heater current. The multi-function User Input can be programmed to allow selection of manual operation when connected to common. This allows the user to hold the control output of the controller during abnormal process conditions.

(Terminal assignments are model number dependent.)





OEM PAINT SPRAYER APPLICATION

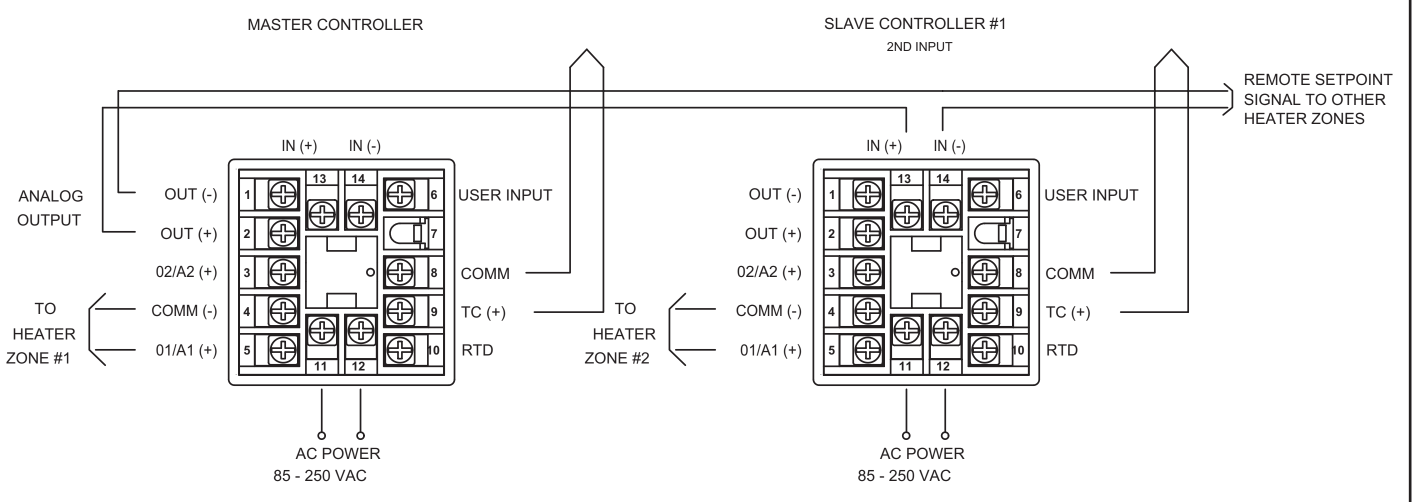
An OEM manufacturing spray painting equipment utilizes the T48 to maintain optimum paint temperature. In addition to the low cost, the 1/16 DIN package size permits the OEM to design temperature control into various sized painting equipment, from small hand sprayers to large paint booths. The heating element used to heat the paint, is connected to the Main Control Output (OP1) programmed for On/Off control. Alarm 1 is programmed as Band Inside Acting, so that as long as the paint temperature is within manufacturer's specifications for temperature, the "GO" light is on. Alarm 2 is programmed as Band Outside acting so that the "NO GO" light is lit when the paint temperature is more than 12° outside the manufacturer's specifications of 140 to 150°F.

(Terminal assignments are model number dependent.)

MULTIPLE UNIT/REMOTE SETPOINT APPLICATION

Eight T48 controllers are used in a drying oven. Each T48 controls a zone within the oven. Depending upon the material to be dried, and its initial moisture content, the drying setpoint temperature varies. A master T48 controller transmits setpoint via linear DC output. This signal is received as a remote setpoint signal by the other slave controllers. Whenever the master controller's setpoint is changed, the slave controller's setpoint changes automatically.

The remote setpoint input at each slave controller can be scaled independently.



(Terminal assignments are model number dependent.)

F

ORDERING INFORMATION

Options and Output Boards are factory configured per the part number specified. Part numbers without replacement output boards listed must be returned to the factory for output board replacement.

MODELS WITHOUT RS485 AND LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL 01 OUTPUT	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR 02 (COOL)*	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	REPLACEMENT OUTPUT BOARD	PART NUMBERS	
						18-36 VDC/24 VAC	85 TO 250 VAC
Relay					RBD48100	T4810010	T4810000
Relay	Relay				RBD48111	NA	T4811000
Relay	Relay	Relay			RBD48111	T4811110	T4811100
Relay	Relay	Relay	YES		RBD48111	T4811113	T4811103
Relay	Relay	Relay		YES	RBD48111	T4811114	T4811104
Logic/SSR					RBD48200	T4820010	T4820000
Logic/SSR	Relay				RBD48211	NA	T4821000
Logic/SSR	Relay	Relay			RBD48211	T4821110	T4821100
Logic/SSR	Relay	Relay	YES		RBD48211	T4821113	T4821103
Logic/SSR	Relay	Relay		YES	RBD48211	T4821114	T4821104
Triac	Logic/SSR	Logic/SSR			NA	T4832210	T4832200

* - This output is programmable as either Control (PID) or as an Alarm.
@ - These part numbers are equipped with a second setpoint.

Option Boards are installed at the factory for the appropriate models. These boards are only needed for field replacement.

MODELS WITH RS485 OR LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL O1 OUTPUT	MAIN CONTROL O1 OR A1 (ALARM 1) *	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR O2 (COOL) *	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	RS485 @	MAIN ANALOG OUTPUT** @	SECOND ANALOG OUTPUT** @	PART NUMBERS	
									18-36 VDC/24 VAC	85 TO 250 VAC
Relay						YES 1			NA	T4810002
	Relay		Relay				YES	YES	T481011A	T481010A
	Relay		Relay				YES		T4810111	T4810101
	Relay		Relay	YES			YES		T4810115	T4810105
	Relay		Relay		YES		YES		T4810116	T4810106
	Relay		Relay			YES	YES		T4810117	T4810107
Relay			Relay	YES		YES			T4810118	T4810108
Relay			Relay		YES	YES			T4810119	T4810109
Relay		Relay	Relay			YES 2			T4811112	T4811102
	Logic/SSR		Logic/SSR				YES		T4820211	T4820201
	Logic/SSR		Logic/SSR	YES			YES		T4820215	T4820205
	Logic/SSR		Logic/SSR		YES		YES		T4820216	T4820206
Logic/SSR			Logic/SSR	YES		YES			T4820218	T4820208
Logic/SSR			Logic/SSR		YES	YES			T4820219	T4820209
Logic/SSR		Relay	Relay			YES			T4821112	T4821102

* - This output is programmable as either Control (PID) or as an Alarm.
** - This output is jumper and program selectable for either a current or voltage Linear DC output.
@ - These part numbers are equipped with a second setpoint.
1 - Replacement Output Board RBD48100 may be used.
2 - Replacement Output Board RBD48111 may be used.

F

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
RLY	External SSR Power Unit (for Logic/SSR output models)	RLY50000
	Single Phase 25 A DIN Rail Mount SSR	RLY60000
	Single Phase 40 A DIN Rail Mount SSR	RLY6A000
	Three Phase DIN Rail Mount SSR	RLY70000
CT	40 Ampere Current Transformer (for Heater Current Input models)	CT004001
	50 Ampere Current Transformer (for Heater Current Input models)	CT005001
SFCRM	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP (for RS485 models)	SFCRM
ICM4	RS232/RS485 Serial Converter Module	ICM40030
ICM5	Three way isolated RS232/RS485 Serial Converter	ICM50000

* Crimson software is available for download from http://www.redlion.net

MODEL PAX2C – 1/8 DIN TEMPERATURE/PROCESS PID CONTROLLER

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *UNIVERSAL PROCESS, TEMPERATURE, VOLTAGE, CURRENT AND RESISTANCE iNPUT*
- *PROGRAMMABLE DUAL LINE DISPLAY WITH UNITS INDICATION AND BAR GRAPH*
- *FOUR PROGRAMMABLE UNIVERSAL ANNUNCIATORS*
- *TRI-COLOR DISPLAY, WITH 7 PROGRAMMABLE COLOR ZONES*
- *UP TO 16 ALARMS WITH BOOLEAN LOGIC FUNCTIONALITY*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

DESCRIPTION

The PAX2C Temperature/Process Controller offers many features and performance capabilities to suit a wide range of applications. The PAX2C has a universal input to handle various input signals including Temperature, DC Voltage/Current and Resistance. Optional plug-in cards allow the opportunity to configure the controller for present applications, while providing easy upgrades for future needs. The PAX2C employs a tri-color display with seven independently programmable color zones.

The controller has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel, CE compliance and extensive testing of noise effects, the controller provides a tough reliable application solution.

MAIN CONTROL

The controller operates in the PID Control Mode for both heating and cooling, with on-demand auto-tune that establishes the tuning constants. The PID tuning constants may be fine-tuned and then locked out from further modification. The controller employs a unique overshoot suppression feature, that allows the quickest response without excessive overshoot. Switching to Manual Mode provides the operator direct control of the output.

DISPLAY

The PAX2C features a dual line display with units annunciators, dual bar graphs, four universal annunciators and tri-color capability. Each of the seven display zones may be configured independently of the others, providing a visual indication of control and/or alarm status.

ALARMS

The PAX2C has up to sixteen "soft" alarms that may be configured to suit a variety of control and alarm requirements. These alarms may be used to monitor and/or actuate the controller's physical outputs as well as change display colors. Mapped "soft" alarms may be processed independently or logically combined using AND/OR Boolean logic.

OPTION CARDS

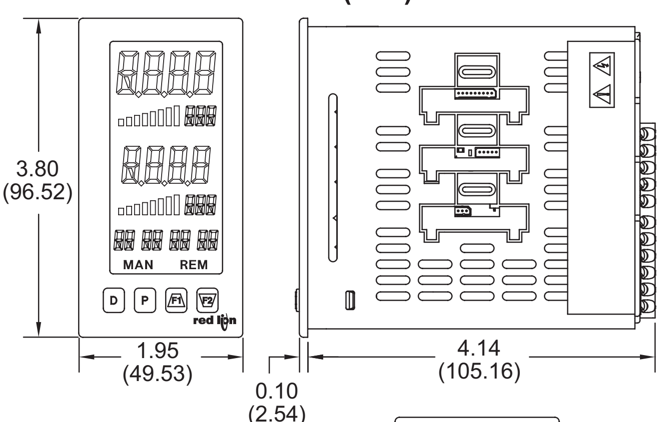
Optional plug-in cards provide dual FORM-C relays, quad FORM-A, quad sinking, or quad sourcing open collector logic outputs. These cards can be used as control outputs or for alarm indication.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track the input, max and min readings or for control.

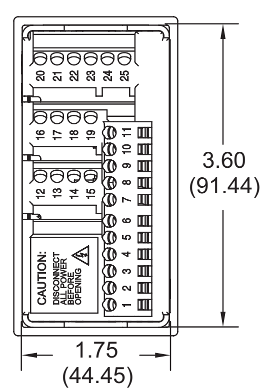
Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and ProfibusDP. The PAX2C can be programmed to utilize Modbus protocol. With Modbus, the user has access to most configuration parameters. Readout values, setpoint, process and alarm values can be controlled through the bus. Additionally, the controller has a feature that allows a remote computer to directly control the outputs of the controller.

With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2C via a built-in USB programming port.

DIMENSIONS In inches (mm)



Note: To determine dimensions for horizontal units, swap height and width. Recommended minimum clearance (behind the panel) for mounting clip installation is: 2.1" (53.4) W x 5.5" (140) H.



F

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

TABLE OF CONTENTS

ORDERING INFORMATION

Controller Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2C	Universal Input Temperature/Process Controller, Horizontal	PX2C8H00
	Universal Input Temperature/Process Controller, Vertical	PX2C8V00

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	**PAXCDS**	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Note:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.

General Controller Specifications

1. **DISPLAY**: Negative image LCD with tri-color backlight.
   The display is divided into seven independently programmable color zones:
   Line 1, Line 2, Universal Annunciators (1-4) & Mnemonics
   Line 1 and 2: 4 digits each line
   Display Range: -1999 to 9999
   Units - Programmable 3 digit units annunciator
   Bar Graph - Programmable 8 segment bar graph
   Universal Annunciator 1 thru 4: Programmable 2 digit annunciator
   Status Mnemonics: MAN - Controller is in Manual Mode
   REM – Controller is in Remote Mode
   Vertical Model Digit Size: Line 1 - 0.51" (13 mm), Line 2 - 0.44" (11.2 mm)
   Horizontal Model Digit Size: Line 1 - 0.62" (15.7 mm), Line 2 - 0.47" (12.0 mm)
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **KEYPAD**: 2 programmable function keys, 4 keys total
4. **A/D CONVERTER**: 24 bit resolution
5. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   "Shrt" - Appears when shorted sensor is detected. (RTD range only)
   "OPEN" - Appears when open sensor is detected. (TC/RTD range only)
   ". . . . " - Appears when display values exceed + display range.
   "- . . . " - Appears when display values exceed - display range.
6. **INPUT CAPABILITIES**:

Current Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 µADC	0.03% of rdg + 0.03µA	0.12% of rdg + 0.04µA	1.11 KΩ	0.1µA
± 2.5 mADC	0.03% of rdg + 0.3µA	0.12% of rdg + 0.4µA	111 Ω	1µA
± 25 mADC	0.03% of rdg + 3µA	0.12% of rdg + 4µA	11.1 Ω	10µA
± 250 mADC	0.05% of rdg + 30µA	0.12% of rdg + 40µA	1.1 Ω	0.1mA
± 2 ADC	0.5% of rdg + 0.3mA	0.7% of rdg + 0.4mA	0.1 Ω	1mA

Voltage Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 mVDC	0.03% of rdg + 30µV	0.12% of rdg + 40µV	451 KΩ	0.1mV
± 2.0 VDC	0.03% of rdg + 0.3mV	0.12% of rdg + 0.4mV	451 KΩ	1mV
± 10 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 25 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	10mV
± 100 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	0.1V
± 200 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	0.1V

Temperature Inputs:
Scale: °F or °C
Offset Range: -1999 to 9999 display units.

Thermocouple Inputs:
Input Impedance: 20MΩ
Lead Resisitance Effect: 0.03 µV/Ω
Max Continuous Overvoltage: 30 VDC

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD	WIRE COLOR ANSI	WIRE COLOR BS 1843
T	-200 to 400°C	1.2°C	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 750°C	1.0°C	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1250°C	1.3°C	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	150 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C	1.3°C	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90**	no standard	no standard

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 VDC

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD **
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 259°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-110 to 260°C	0.4°C	0.9°C	no official standard

Resistance Inputs:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	MAX CONT. OVERLOAD	‡ RESOLUTION
100 ohm	0.05% of rdg +0.03 ohm	0.2% of rdg +0.04 ohm	0.175 V	30 V	0.1 ohm
999 ohm	0.05% of rdg +0.3 ohm	0.2% of rdg +0.4 ohm	1.75 V	30 V	1 ohm
9999 ohm	0.05% of rdg +1 ohm	0.2% of rdg +1.5 ohm	17.5 V	30 V	1 ohm

‡ Higher resolution can be achieved via input scaling.

* After 20 min. warm-up, @ 5 samples per second input rate. Accuracy is specified in two ways: Accuracy over an 18 to 28ºC and 15 to 75% RH environment; and Accuracy over a 0 to 50ºC and 0 to 85% RH (non condensing) environment. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of controller and probe errors. Accuracy may be improved by field calibrating the controller readout at the temperature of interest.

**
These curves have been corrected to ITS-90.

F

7. **EXCITATION POWER**: Jumper selectable
Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
Reference Voltage: + 2 VDC, ± 2%
Compliance: 1KΩ load min (2 mA max)
Temperature Coefficient: 40 ppm/ºC max.
Reference Current: 1.05 mADC, ± 2%
Compliance: 10 KΩ load max.
Temperature Coefficient: 40 ppm/ºC max.

8. **USER INPUTS**: Two programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.
Logic State: User programmable (USrACt) for sink/source (Lo/Hi)

INPUT STATE (USrACt)	LO/SINK	HI/SOURCE
	20KΩ pull-up to +3.3V	20KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

9. **CUSTOM LINEARIZATION**:
Data Point Pairs: Selectable from 2 to 16
Display Range: -1999 to 9999
Decimal Point: 0 to 0.000

10. **MEMORY**: Nonvolatile FRAM memory retains all programmable parameters and display values.

11. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -40 to 60 °C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 25 g (10 g relay)
Operating and Storage Humidity: 0 to 85% max. RH non-condensing
Altitude: Up to 2000 meters

12. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
IEC/EN 61010-1
RoHS Compliant
UL Listed: File #E179259
Type 4X Indoor Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
IP20 Enclosure rating (Rear of unit)
Refer to EMC Installation Guidelines section of the bulletin for additional information.

13. **CONNECTIONS**: High compression cage-clamp terminal block
Wire Strip Length: 0.3" (7.5 mm)
Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)

14. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.

15. **WEIGHT**: 8 oz. (226.8 g)

Optional Plug-in Cards

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2C controllers can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint/Control (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2C controller. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC50 - Profibus-DP

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 controllers per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and controller input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® controller from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the controller. The controller's program can then be saved in a PC file for future use. The Crimson installation file is located on the included flash drive, or it can be downloaded at www.redlion.net

CONTROL/OUTPUT CARDS (PAXCDS)

The PAX2C controller has 4 available control/output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See Update Rates step response specification on page 3; add 6 msec (typical) for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

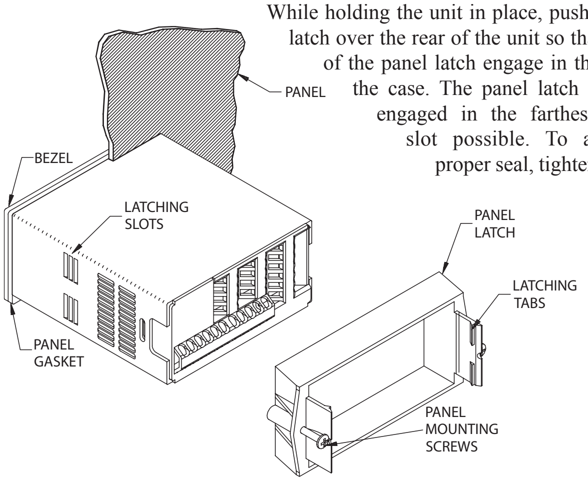
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Step Response: See Update Rates step response specification on page 3.
Update time: See ADC Conversion Rate and Update Time parameter

1.0 Installing the Controller

Installation

The PAX2C meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



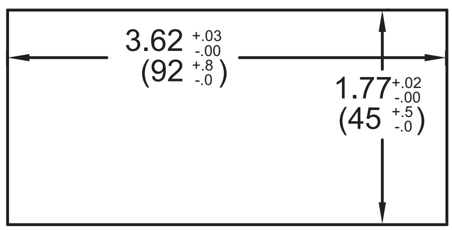
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

HORIZONTAL PANEL CUT-OUT

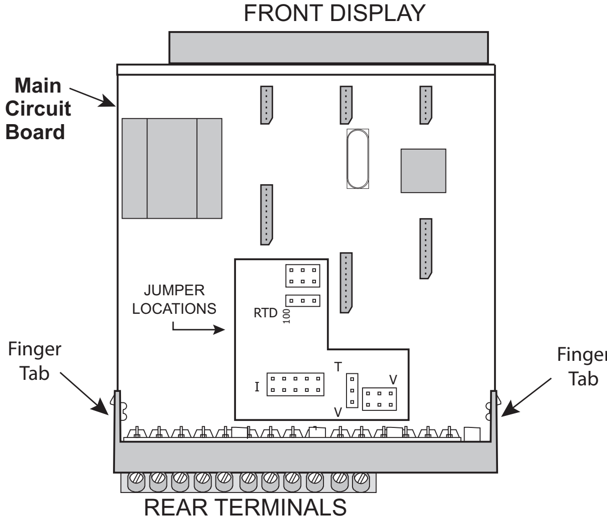


2.0 Setting the Jumpers

The PAX2C controller has four jumpers that must be checked and/or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the controller base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the controller and load circuits before accessing inside of the controller.



INPUT RANGE JUMPERS

Voltage Input

Two jumpers are used in configuring the controller for voltage/resistance. The first jumper, T/V, must be in the V (voltage) position. The second jumper is used to select the proper voltage input range. (This jumper is also used to select the current input range.) Select a range that is high enough to accommodate the maximum signal input to avoid overloads. For proper operation, the input range selected in programming must match the jumper setting.

Current Input

For current input, only one jumper must be configured to select the current range. This jumper is shared with the voltage input range. To avoid overloads, select the jumper position that is high enough to accommodate the maximum signal input level to be applied.

Note: The position of the T/V jumper does not matter when the controller is in the current input mode.

Temperature Input

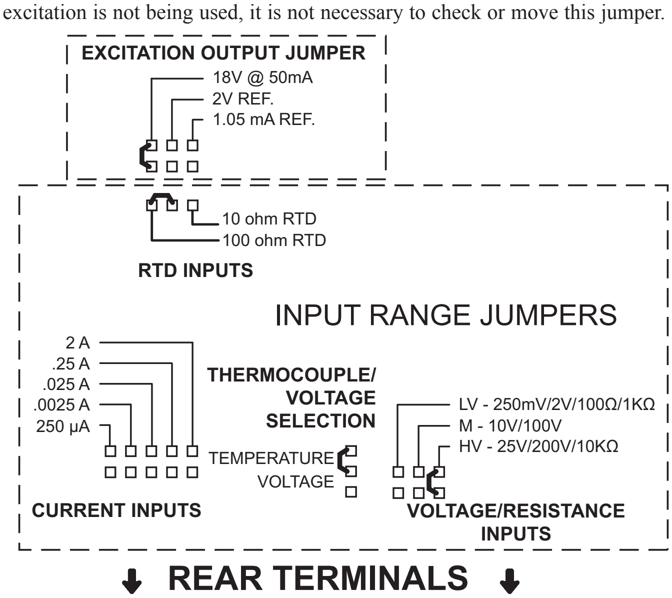
For temperature measurement the T/V jumper must be in the T (temperature) position. For RTD sensors the RTD jumper must also be set.

Resistance Input

Three jumpers are used to configure the resistance input. The T/V jumper must be in the V (voltage) position, and the excitation jumper must be in the 1.05 mA REF position. The voltage/resistance jumper position is determined by the input range.

Excitation Output Jumper

This jumper is used to select the excitation range for the application. If excitation is not being used, it is not necessary to check or move this jumper.

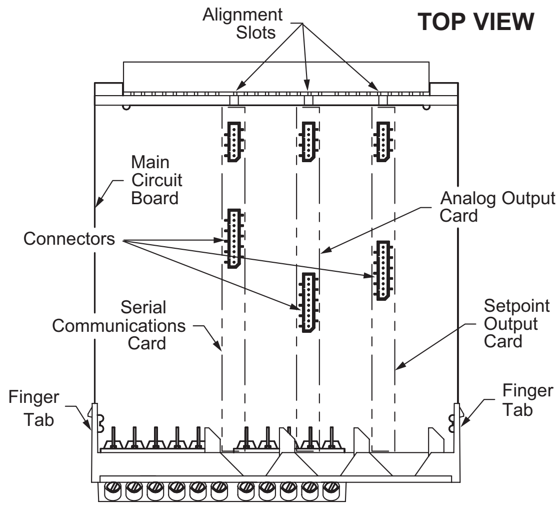


F

3.0 Installing Plug-In Cards

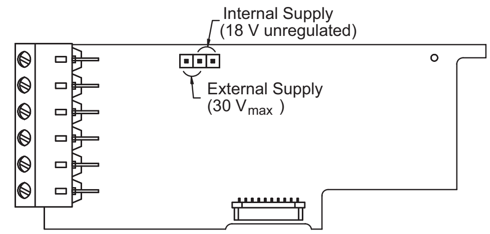
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the controller. The plug-in cards have many unique functions when used with the PAX2C.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the controller removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the controller by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the controller base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the controller in the designated area. Do Not Cover the vents on the top surface of the controller. The surface of the case must be clean for the label to adhere properly.

4.0 Wiring the Controller

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the controller. All conductors should conform to the controller's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the controller (DC or AC) be protected by a fuse or circuit breaker.

When wiring the controller, compare the numbers embossed on the back of the controller case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

F

EMC INSTALLATION GUIDELINES

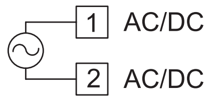
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

AC Power



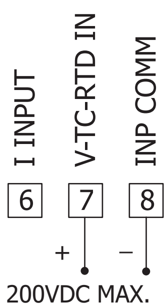
DC Power

The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

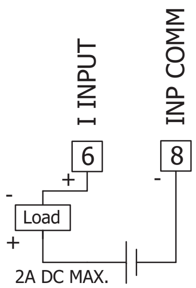
4.2 VOLTAGE/RESISTANCE/CURRENT INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, the Input Range Jumpers and Excitation Jumper should be verified for proper position.

Voltage Signal

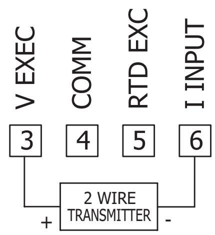


Process/Current Signal (external powered)



Process/Current Signal (2 wire requiring 18V excitation)

Excitation Jumper: 18 V

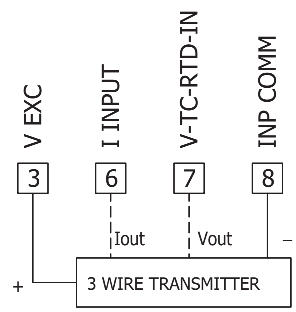


Current Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 6: +ADC (signal)
Terminal 8: -ADC (common)
Excitation Jumper: 18 V

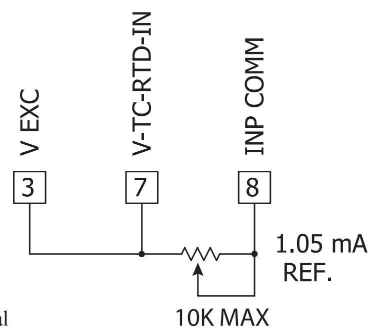
Voltage Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 7: +VDC (signal)
Terminal 8: -VDC (common)
Excitation Jumper: 18 V



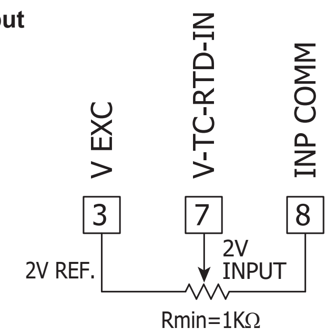
Resistance Signal (2 wire requiring excitation)

Terminal 3: Jumper to terminal 7
Terminal 7: Resistance
Terminal 8: Resistance
Excitation Jumper: 1.05 mA REF.
T/V Jumper: V position
Voltage/Resistance Input Jumper: Set per input signal



Potentiometer Signal as Voltage Input (3 wire requiring excitation)

Terminal 3: High end of pot.
Terminal 7: Wiper
Terminal 8: Low end of pot.
Excitation Jumper: 2 V REF.
T/V Jumper: V
Voltage/Resistance Input Jumper: 2 Volt
Module 1 Input Range: 2 Volt
Note: The Apply signal scaling style should be used because the signal will be in volts.



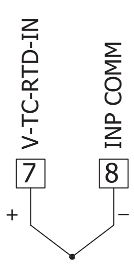
***CAUTION:** Sensor input common is NOT isolated from user input common. In order to preserve the safety of the controller application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

F

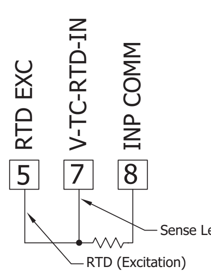
4.3 TEMPERATURE INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, verify the T/V Jumper is in the T position.

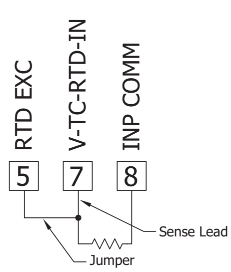
Thermocouple



3-Wire RTD



2-Wire RTD



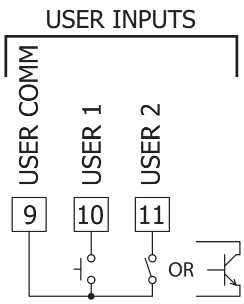
***CAUTION**: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the controller application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 USER INPUT WIRING

If not using User Inputs, then skip this section. User Input terminal does not need to be wired in order to remain in the inactive state.

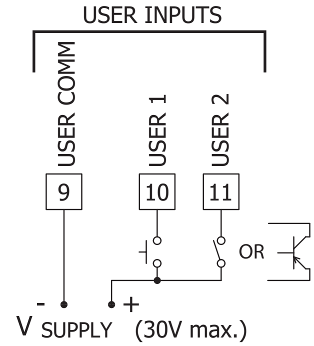
Sinking Logic (uACt Lo)

When the uACt parameter is programmed to Lo, the user inputs of the controller are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (uACt Hi)

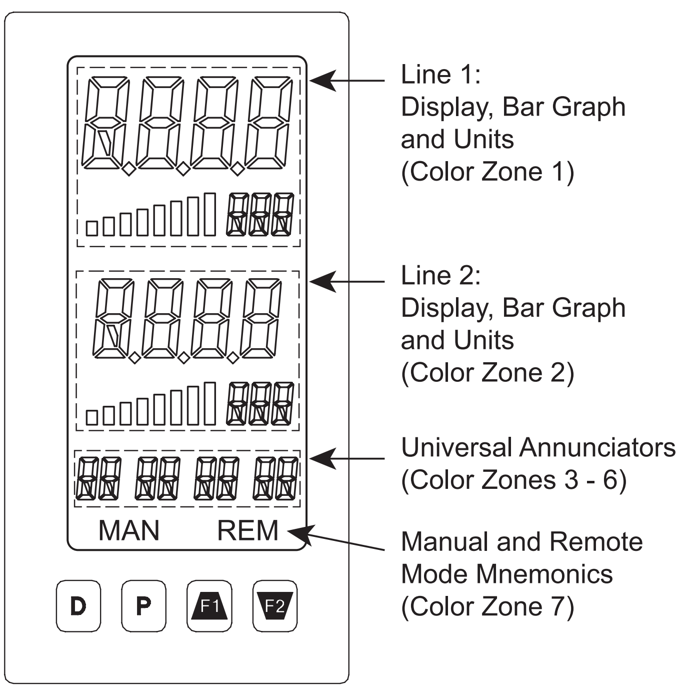
When the uACt parameter is programmed to Hi, the user inputs of the controller are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



4.5 SETPOINT (ALARMS) WIRING
4.6 SERIAL COMMUNICATION WIRING
4.7 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION
D	Index Line 2 through enabled Line 2 display values
P	Enter full programming mode or access the parameter and hidden display loops; Press and hold to skip parameters and go directly to Code or Programming Menu
F1	User programmable Function key 1; hold for 3 seconds for user programmable second function 1*
F2	User programmable Function key 2; hold for 3 seconds for user programmable second function 2*

**Factory setting for F1 and F2 and second function F1/F2 is no mode*

KEY	PROGRAMMING MODE OPERATION
D	Return to the previous menu level (momentary press) Quick exit to Display Mode (press and hold)
P	Access the programming parameter menu, store selected parameter and index to next parameter
F1	Increment selected parameter value; Hold F1 and momentarily press F2 key to increment next decade or D key to increment by 1000's
F2	Decrement selected parameter value; Hold F2 and momentarily press F1 key to decrement next decade or D key to decrement by 1000's

DISPLAY LINE 1

Line 1 consists of a large 4-digit top line display, eight segment bar graph and a three digit units mnemonic: Values such as Input, Max(HI) & Min (LO) may be shown on Line 1. The eight segment bar graph may be mapped to values such as Output Power, Deviation or Setpoints. The three digit units mnemonic characters can be used to indicate which Line 1 display value is shown. Line 1 is a tri-colored display and may be configured to change color based on specified alarm/logic configurations.

DISPLAY LINE 2

Line 2 consists of a 4-digit bottom line display, eight segment bar graph and a three digit units mnemonic. Values such as Setpoints, Output Power, Deviation, PID Parameters/Tuning Status, List A/B Status, and Alarm Values may be shown on the Line 2 display. The eight segment bar graph may be mapped to values such as Output Power, Deviation or Setpoints. The three digit units mnemonic characters can be used to indicate which Line 2 display value is shown. Line 2 is a tri-colored display and may be configured to change color based on specified alarm/logic configurations.

The display loops described in the next section are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value. See Line 2 parameters in the Display Parameters programming section for configuration details.

Universal Annunciator Zones

The PAX2C has four programmable universal annunciator zones. Each zone has a user-defined two digit annunciator mnemonic to suit a variety of applications. Universal annunciator zones are tri-colored and may be configured to change color based on specified alarm/logic configurations.

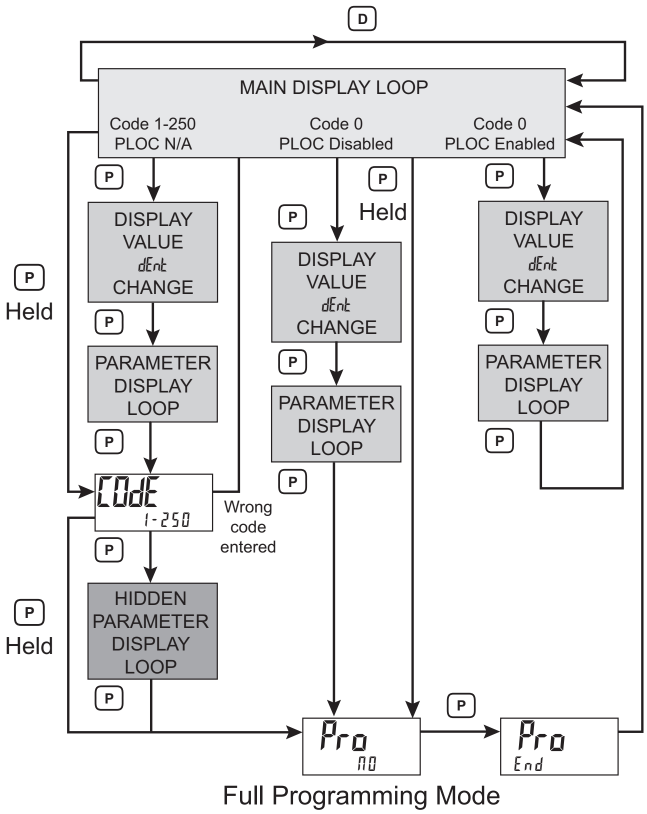
Manual Mnemonic

'MAN' - Flashes when the unit is in manual mode

The Mnemonic zone is tri-colored and may be configured to change color based on specified alarm/logic configurations.

LINE 2 DISPLAY LOOPS

The PAX2C offers three display loops to allow users quick access to needed information.



Main Display Loop

In the Main display loop, the D key is pressed to sequence through the selected Line 2 values. The Line 2 units mnemonics are used to indicate which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the user functions programmed in the User Input parameter section.

Parameter and Hidden Parameter Display Loops

Display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming mode. These values may include: input, max/min, List A/B selection, output power, PID parameters/control, alarm parameters, setpoint values/selection, and display intensity and contrast settings. To utilize the Parameter or Hidden Parameter display loops, a security code (1-250) must be programmed. (See Programming Security Code in the Display Parameters programming section for details.)

The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter display loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on the application needs.

While in the Parameter and Hidden Parameter loops, pressing the **D** key will return the meter to the Main display loop. To directly access the Code prompt, press and hold the **P** key. This can be done from the Main display loop or at any point during the Parameter display loop. Also, to directly access Full Programming mode while in the Hidden Parameter loop, press and hold the **P** key to bypass any remaining Hidden Parameter loop values.

6.0 PROGRAMMING THE PAX2C

It is recommended that program settings be recorded as programming is performed. A blank Parameter Value Chart is provided at the end of this bulletin.

BASIC/ADVANCED MODE

The PAX2C incorporates two different configuration modes that are user selectable via the Display Configuration Menu:

Basic Mode (bSiC)

When the PAX2C is configured in this mode, a maximum of four alarms are supported and no mapped backlignt color changes are available. Default backlight colors are still user selectable.

Advanced Mode (AdUC)

A maximum of sixteen alarms are supported and all backlight color configuration menu parameters are enabled. Select this mode when you require more than four alarms or where display color changes are desired.

PROGRAMMING MODE ENTRY

The Programming Mode is entered by pressing the **P** key. Full Programming Mode will be accessible unless the controller is programmed to use the Parameter loop or Hidden Parameter loop on the Line 2 display. In this case, programming access will be limited by a security code and/or a hardware program lock. (Refer to the previous section for details on Line 2 display loops and limited programming access.) Full Programming Mode permits all parameters to be viewed and modified. In this mode, the front panel keys change to Programming Mode Operations and certain user input functions are disabled.

MODULE ENTRY

The Programming Menu is organized into seven modules. These modules group together parameters that are related in function. The F1 and F2 keys are used to select the desired module. The displayed module is entered by pressing the **P** key.

MODULE MENU

Upon entering a module, a parameter selection sub-menu is provided to choose the specific parameter type for programming. For example, this includes analog and user input under the Input Parameter menu. Use the F1 and F2 keys to select the desired parameter type, and press the **P** key to enter the parameter menu.

PARAMETER MENU

Upon entering the Parameter Menu, the **P** key is pressed to advance to a specific parameter to be changed. After completing the parameter menu, or upon pressing the **D** key, the display returns to the initial entry point for the parameter menu. For each additional press of the **D** key, the display returns to the previous level within the module until exiting the module entirely.

SELECTION/VALUE ENTRY

For each parameter, the top line display shows the parameter while the bottom line shows the selections/value for that parameter. The F1 and F2 keys are used to move through the selections/values for the parameter. Pressing the **P** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

Numerical Value Entry

If the parameter is programmed for enter (Entr), the F1 and F2 keys are used to change the parameter values in any of the display loops.

The F1 and F2 keys will increment or decrement the parameter value. When the F1 or F2 key is pressed and held, the value automatically scrolls. The longer the key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the opposite arrow key (F2 or F1) to shift decades (10's 100's, etc), or momentarily press the **D** key and the value scrolls by 1000's as the arrow key is held. Releasing the arrow key removes the decade or 1000's scroll feature. The arrow keys can then be used to make small value changes as described above.

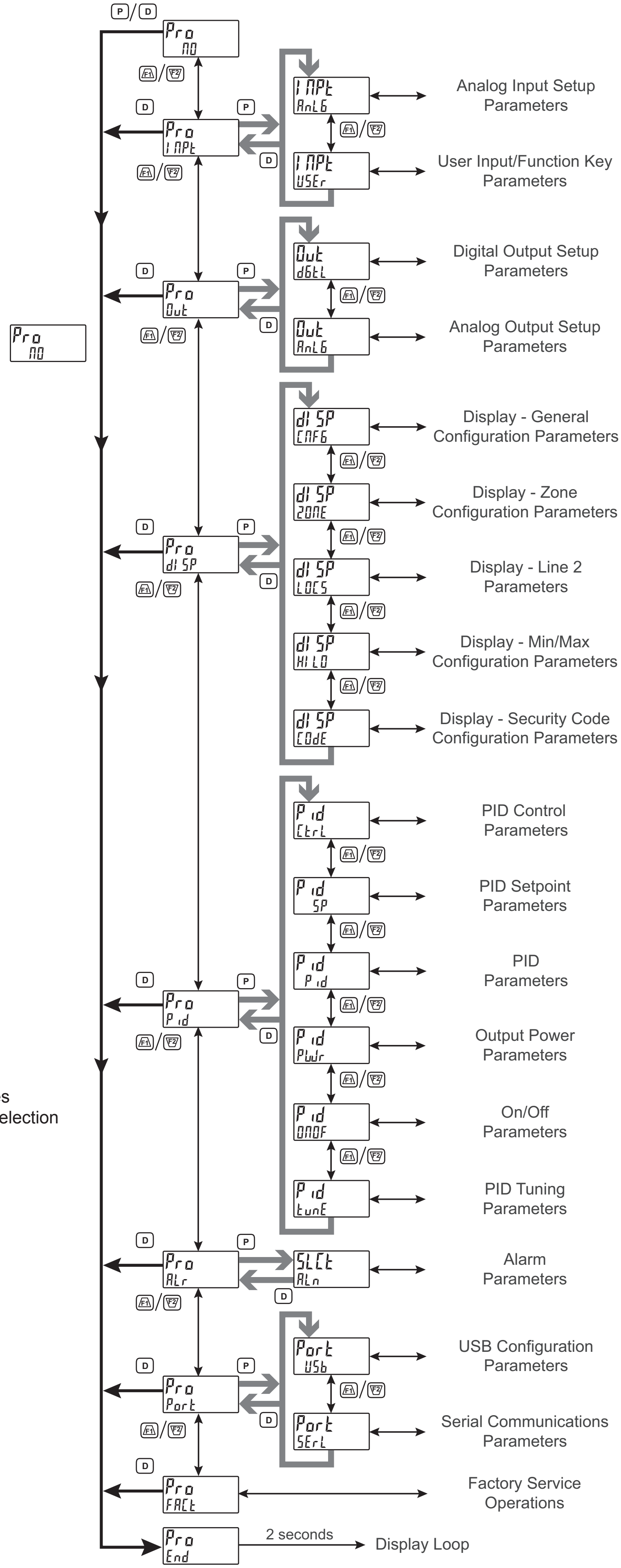
PROGRAMMING MODE EXIT

To exit the Programming Mode, press and hold the **D** key (from anywhere in the Programming Mode) or press the **P** key with Pro NO displayed. This will commit stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **P** key must be pressed to store the change before pressing the **D** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with the Input Parameters and proceed through each module in sequence. If lost or confused while programming, press and hold the **D** key to exit programming mode and start over. It is recommended that program settings be recorded as programming is performed. When programming is complete lock out programming with a user input or lock-out code.

Factory Settings may be completely restored in the Factory Service Operations module. This is useful when encountering programming problems.



In Programming Menu:
Top line is green to indicate top level programming modules
Top line is orange to indicate module menu or sub-menu selection
Top line is red to indicate a changeable parameter.

F

INPUT PARAMETERS (INPt)

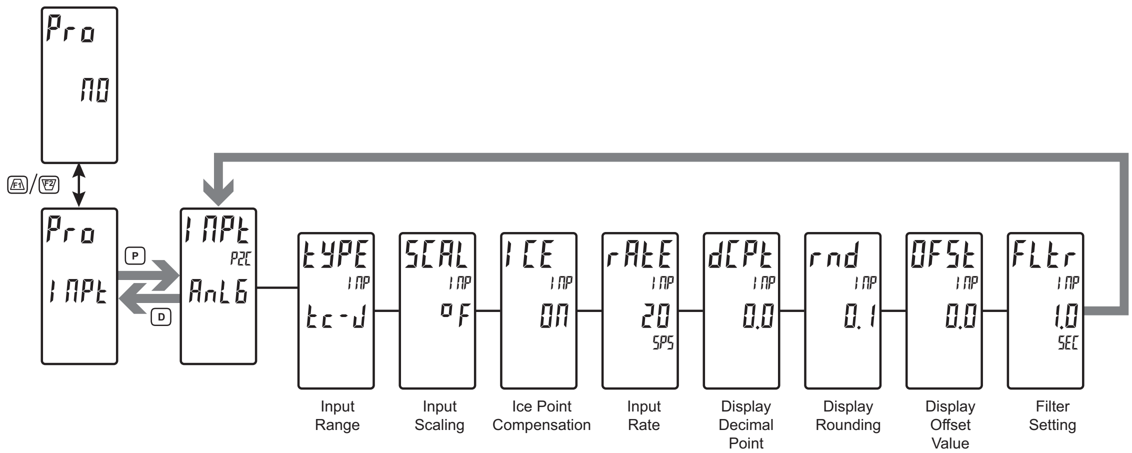
INPUT SELECT

AnLG USEr

Select the Input to be programmed.

ANALOG INPUT PARAMETERS: TEMPERATURE MODE (AnLG)

This section details the programming for the analog input.



TEMPERATURE INPUT TYPE

250 uA	2 V	1K RES	tc-r	r392
25 mA	10 V	10K RES	tc-S	r672
25 mA	25 V	tc-t	tc-b	r427
250 mA	100 V	tc-E	tc-n	
2 A	200 V	tc-J	tc-C	
250 mV	100 RES	tc-K	r385	

Shaded selections indicate the available temperature input types. Select the desired input type.

TEMPERATURE SCALE

°F °C

Select the temperature scale. If changed, those parameters that relate to the temperature scale should be checked.

ICE POINT COMPENSATION

For TC Input Range Selection only.

ON OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter.

INPUT UPDATE RATE (/SEC)

5 10 20

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect alarm and analog output response time. The default factory setting of 20 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

0 to 0.0 (temp)
0 to 0.000 (curr/volt/ohm)

Select desired display resolution. The available selections are dependent on the Input Type selected (tYPE).

ROUNDING INCREMENT

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

- 1999 to 9999

The display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer.

DIGITAL FILTERING

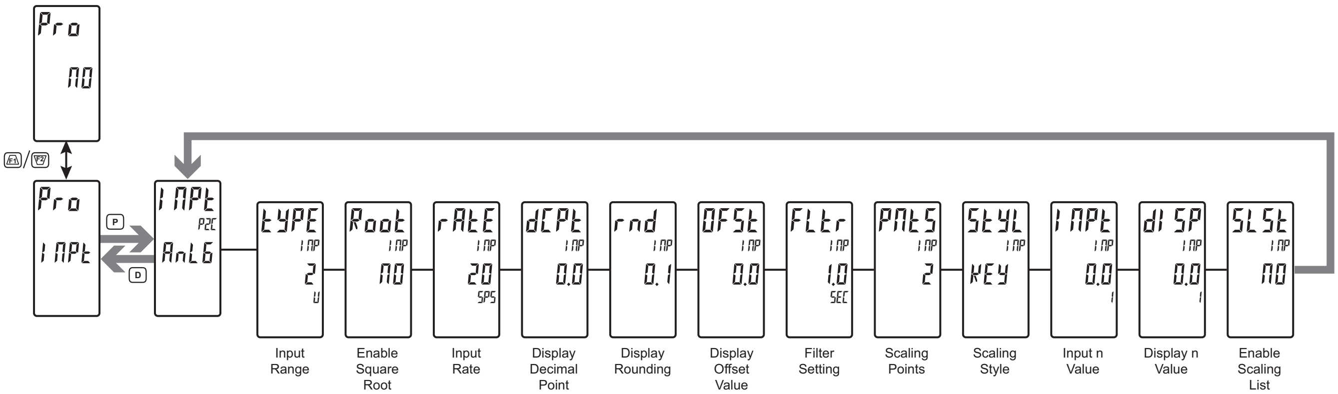
0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

F

ANALOG INPUT PARAMETERS: PROCESS MODE (AnLG)

This section details the programming for the analog input.



PROCESS INPUT TYPE

tYPE INP 2 U

250 uA	2 U	1k RES	tc-r	r392
25 mA	10 U	10k RES	tc-S	r672
25 mA	25 U	tc-t	tc-b	r427
250 mA	100 U	tc-E	tc-n	
2 A	200 U	tc-J	tc-C	
250 mU	100 RES	tc-K	r385	

Shaded selections indicate the available process input types. Select the desired input type.

SQUARE ROOT

Root INP NO

YES NO

This parameter allows the unit to be used in applications in which the measured signal is the square of the PV. This is useful in applications such as the measurement of flow with a differential pressure transducer.

Example: It is necessary to square root linearize the output of a differential pressure transmitter to indicate and control flow. The defining equation is F = 278 $\sqrt{\Delta P}$, where ΔP = 0 - 500 PSI, transmitted linearly by a 4 - 20 mA transducer. At full flow rate (ΔP = 500 PSI), the flow is 6216 ft^3/h. The following scaling information is used with the controller:

dCPt = 0	INPt 1 = 400 mA
Root = YES	dISP2 = 6216 ft^3/hr
dISP1 = 0 ft^3/hr	INPt2 = 2000 mA

As a result of the scaling and square root linearization, the following represents the readings at various inputs:

Delta P (PSI)	Transmitter (mA)	Flow (ft^3 /hr)
0.00	4.00	0
15.63	4.50	1099
31.25	5.00	1554
62.50	6.00	2198
125.00	8.00	3108
187.50	10.00	3807
250.00	12.00	4396
312.50	14.00	4914
375.00	16.00	5383
437.50	18.00	5815
500.00	20.00	6216

INPUT UPDATE RATE (/SEC)

rAtE INP 20 SPS

5 10 20 40

Select the ADC conversion rate (conversions per second). The selection does not affect the display update rate, however it does affect alarm and analog output response time. The default factory setting of 5 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

dCPt INP 0.0

0 to 0.000 (curr/volt/ohm)
0 to 0.0 (temp)

Select desired display resolution. The available selections are dependent on the Input Type selected (tYPE).

ROUNDING INCREMENT

rnd INP 0.1

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

OFSt INP 0.0

- 1999 to 9999

The display can be corrected with an offset value. This can be used to compensate for sensor errors, errors due to variances in sensor placement or adjusting the readout to a reference source. A value of zero will remove the affects of offset.

DIGITAL FILTERING

FLtr INP 1.0 SEC

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

SCALING POINTS

PNtS INP 2

2 to 16

Linear - Scaling Points (2)

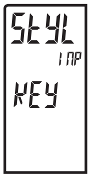
For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair consisting of an Input Value (INPt n) and an associated desired Display Value (dISP n).

F

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair consisting of an Input Value (INPt n) and an associated desired Display Value (dISP n). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs. In the Crimson software, several linearization equations are provided to help calculate scaling points.

SCALING STYLE



KEY key-in data
APLY apply signal

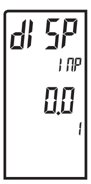
If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

-1999 to 9999

For Key-in (KEY), enter the known first Input Value by using the F1 or F2 arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (APLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 1, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter.

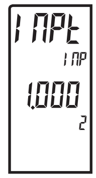
DISPLAY VALUE FOR SCALING POINT 1



-1999 to 9999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. The decimal point follows the dCPt selection.

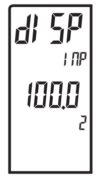
INPUT VALUE FOR SCALING POINT 2



-1999 to 9999

For Key-in (KEY), enter the known second Input Value by using the F1 or F2 arrow keys. For Apply (APLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 2, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter. (Follow the same procedure if using more than 2 scaling points.)

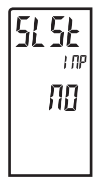
DISPLAY VALUE FOR SCALING POINT 2



-1999 to 9999

Enter the second coordinating Display Value by using the F1 or F2 arrow keys. This is the same for KEY and APLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

ENABLE SCALE LIST



NO YES

When enabled, a second list of scaling points is active in the selected parameter list for List A and List B.

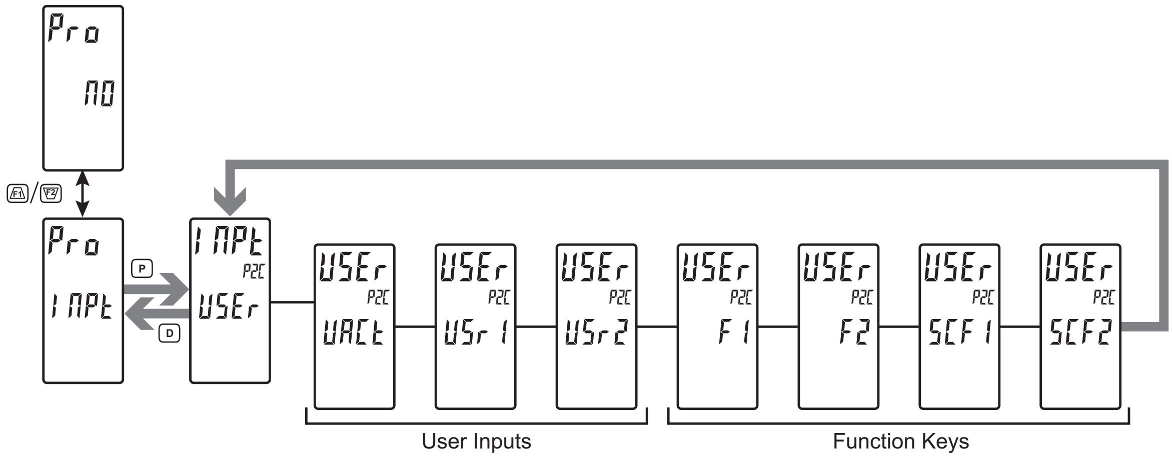
F

USER INPUT/FUNCTION KEY PARAMETERS (USEr)

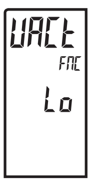
The two user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state. The front panel function keys, F1 and F2, are also individually programmable to perform specific control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USEr-n will represent both user inputs. Fn will represent both function keys and second function keys.



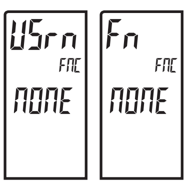
USER INPUT ACTIVE STATE



Lo Hi

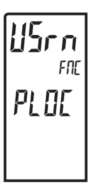
Select the desired active state for the User Inputs. Select Lo for sink input, active low. Select Hi for source input, active high.

NO FUNCTION



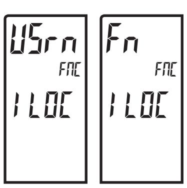
No function is performed if activated. This is the factory setting for all user inputs and function keys.

PROGRAMMING MODE LOCK-OUT



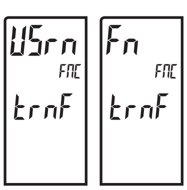
Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

INTEGRAL ACTION LOCK



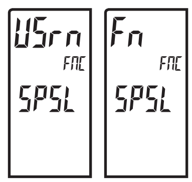
Integral Action of the PID computation is disabled as long as activated (USr = maintained action; Fn = toggle).

AUTO/MANUAL MODE



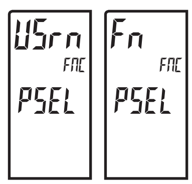
Places the controller in manual (user) mode as long as activated (USr = maintained action; Fn = toggle). The output is "bumpless" when transferring to/from either operating mode.

SETPOINT SELECTION



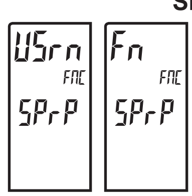
When activated (USr = maintained action; Fn = toggle), the controller uses Setpoint 2 (SP2) as the active setpoint value.

PID PARAMETER SELECTION



When activated (USr = maintained action; Fn = toggle), the controller uses the Alternate P, I, D, and filter values for control. The controller initiates a "bumpless" transfer during each transfer in an effort to minimize any output power fluctuation.

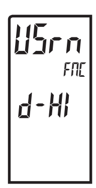
SETPOINT RAMPING DISABLE



When activated (USr = maintained action), setpoint ramping is terminated and unit will operate at the target setpoint. When user input is released, setpoint ramping will resume at the next setpoint change.

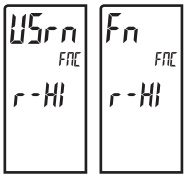
When Function key is pressed (Fn = toggle), setpoint ramping is terminated and unit will operate at the target setpoint. A second press of the function key resumes setpoint ramping at the next setpoint change.

SELECT MAXIMUM DISPLAY



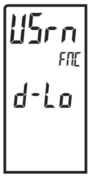
The Maximum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Maximum continues to function independent of the selected display.

RESET MAXIMUM DISPLAY



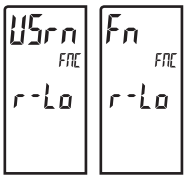
When activated (momentary action), rSEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

SELECT MINIMUM DISPLAY



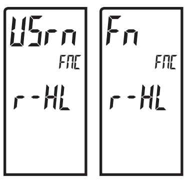
The Minimum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Minimum continues to function independent of the selected display.

RESET MINIMUM DISPLAY



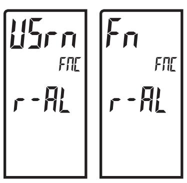
When activated (momentary action), rSEt flashes and the Minimum resets to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM DISPLAY



When activated (momentary action), rSEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

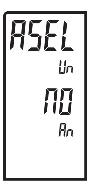
RESET ALARMS



When activated (momentary action), the controller will reset any active alarms that are selected in the User/Function Alarm Selection Menu (ASEL).

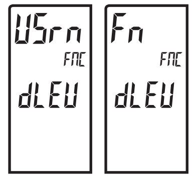
Basic Mode: 4 Alarms Max
Advanced Mode: 16 Alarms Max

ALARM MASK SELECTION



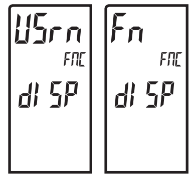
Selects the alarms that will be reset when the User Input/Function keys are activated. Any alarms configured as "YES" will be reset depending on the alarms configuration. Please see the Alarms section of the manual for more information on the alarm reset operation.

ADJUST DISPLAY INTENSITY



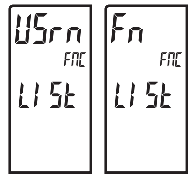
When activated (momentary action), the display intensity changes to the next intensity level.

DISPLAY SELECT



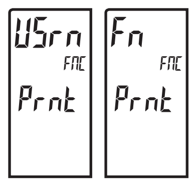
When activated (momentary action), Line 2 advances to the next display that is not locked out from the Display Mode.

SELECT PARAMETER LIST



Two lists of input scaling points and alarm values (including band and deviation) are available. The two lists are named LStA and LStb. If a user input is used to select the list then LStA is selected when the user input is not active and LStb is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed. To program the values for List-A and List-B, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the desired values for the input scaling points, alarms, band, and deviation if used.

PRINT REQUEST



The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

OUTPUT PARAMETERS (Out)

OUTPUT SELECT

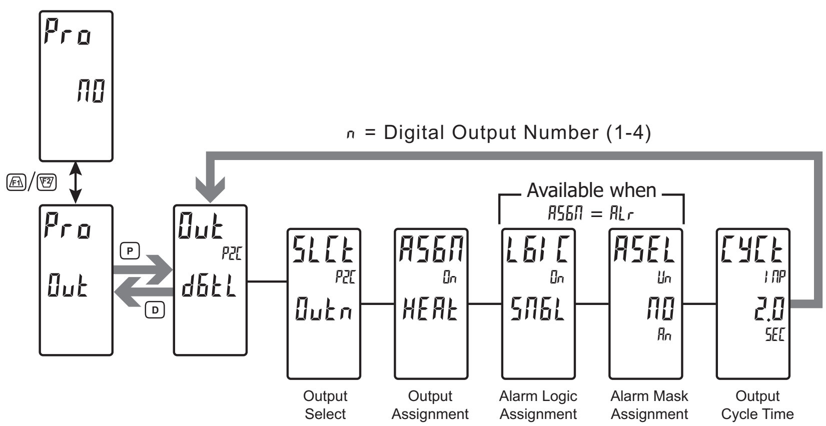
Out
INP
dGtL

dGtL   AnLG

Select the Digital or Analog output to be programmed. The Analog output selection only appears if an analog output and/or digital output plug-in card is installed in the meter. When there is no output card installed, "No Card" will be displayed on the display when trying to enter the Output Configuration.

DIGITAL OUTPUT PARAMETERS (dGtL)

To have digital output capabilities, a digital output Plug-in card needs to be installed into the PAX2C (see Ordering Information). Depending on the output card installed, there will be two or four digital outputs available.



DIGITAL OUTPUT SELECTION

SLCt
P2C
Outn

Out1 Out2 Out3 Out4

Selects the digital output to be programmed. The "Outn" in the following parameters will reflect the chosen output number. After the chosen output is completely programmed, the display returns to the Output Select menu. Repeat steps for each output to be programmed. The number of outputs available is digital output card (PAXCDS) dependent (2 or 4).

DIGITAL OUTPUT ASSIGNMENT

ASGN
On
HEAt

NONE HEAt COOL ALr MAN

This selection is used to assign the controller's digital outputs to various internal values or conditions. It is possible to assign the same properties to more than one output.

NONE = Digital Output is disabled
HEAt = Heat Output Power
COOL = Cool Output Power
ALr = Alarm
MAN = Manual Control Mode

ALARM LOGIC MODE

LGIC
On
SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm. Selecting YES to any selection will change other alarm selections to NO.

And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 and AL2 are active, the output will energize.

Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 or AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL
Un
NO
An

NO YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as "YES" will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), only one alarm may be selected at a time.

Basic Mode: 4 Alarms Max
Advanced Mode: 16 Alarms Max

DIGITAL OUTPUT CYCLE TIME

CYCt
INP
2.0
SEC

0.0 to 60.0 seconds

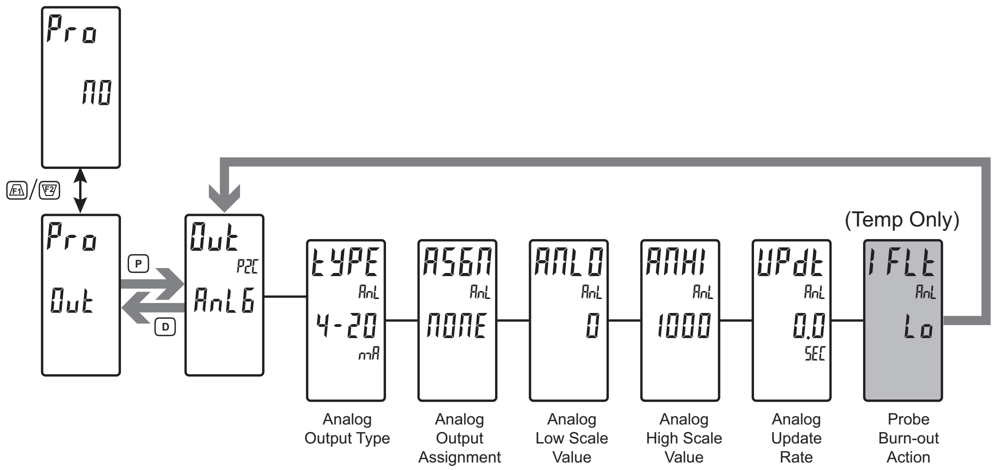
The Cycle Time value is the sum of a time-proportioned output's on and off cycles. With time proportional outputs, the percentage of output power is converted into output on time of the cycle time value eg. if the controller's algorithm calls for 65% power, and has a Cycle Time of 10 seconds, the output will be on for 6.5 seconds and off for 3.5 seconds. A Cycle Time equal to, or less than, one-tenth of the process time constant is recommended.

This parameter is only available when the digital output assignment is configured as HEAt or COOL.

F

ANALOG OUTPUT PARAMETERS (AnLG)

This section is only accessible with the optional PAXCDL Analog card installed (see Ordering Information).



ANALOG OUTPUT TYPE

tYPE AnL 4-20

4-20   0-10   0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

ASGN AnL NONE

NONE   1NPt   HI   LO   OP
SP   dEv

Enter the source for the analog output to retransmit:

- NONE = Manual Mode operation. (See Serial RLC Protocol in the Communications Port module).
- 1NPt = Input Value
- HI = Maximum Display Value
- LO = Minimum Display Value
- OP = Output Power
- SP = Active Setpoint Value
- dEv = Deviation from the Setpoint value

ANALOG LOW SCALE VALUE

ANLO AnL 0

-1999 to 9999

Enter the Display Value that corresponds to 0 mA (0-20 mA), 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

ANHI AnL 1000

-1999 to 9999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

UPdt AnL 0.0 SEC

0.0 to 10.0 seconds

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

The following programming step is only available when Input Type in the Input Menu is set for a temperature input (TC/RTD).

PROBE BURN-OUT ACTION

1FLt AnL Lo

Lo   Hi

Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

F

DISPLAY PARAMETERS (dISP)

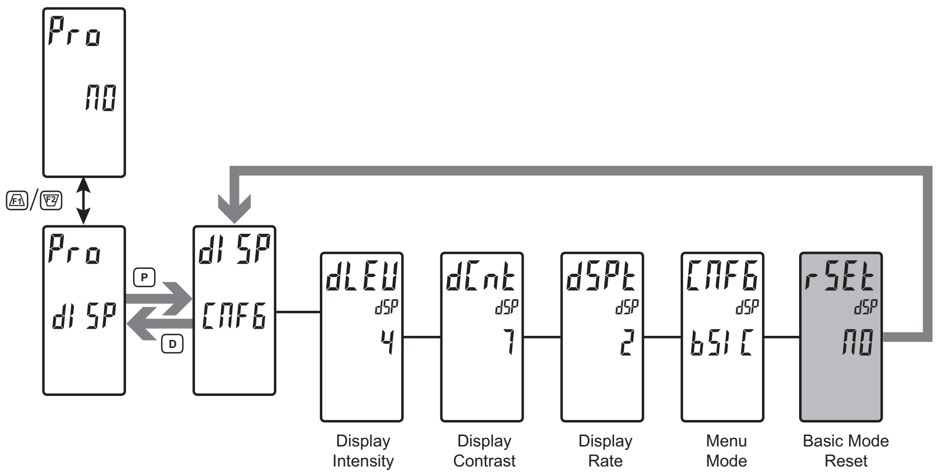
DISPLAY SELECT

dISP
CNFG

CNFG ZONE LOCS HILO COdE

Select the display parameters to be programmed.

DISPLAY PARAMETERS: GENERAL CONFIGURATION (CNFG)



DISPLAY INTENSITY LEVEL

dLEV dSP 4

0 to 4

Enter the desired Display Intensity Level (0-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter can also be accessed in the Display, Parameter or Hidden Loops when enabled.

DISPLAY CONTRAST LEVEL

dCnt dSP 7

0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively adjust up or down as the levels are changed. This parameter can also be accessed in the Display, Parameter or Hidden Loops when enabled.

DISPLAY UPDATE RATE (/SEC)

dSPt dSP 2

1 2 5 10 20

This parameter configures the display update rate. It does not affect the response time of the setpoint output or analog output option cards.

OPERATING MODE

CNFG dSP bSIC

bSIC AdVC

This parameter configures the unit to operate in Basic or Advanced Mode. Basic mode offers a reduced menu structure geared towards simpler applications that may not require the more advanced features of the PAX2C.

Basic Mode (bSIC):
- Maximum of four alarms
- Configuration of Display Color Zones is limited to a default color (no dynamic changing of zone colors based on mapped parameters)

Advanced Mode(AdVC):
- Maximum of sixteen alarms
- Full configuration on all seven Display Color Zones

The following programming step is only available when switching from Advanced Operating Mode to Basic Operating Mode. The PAX2C Factory default is Basic Operating Mode.

BASIC MODE RESET

rSEt dSP NO

NO YES

Resets the unit back to Basic Operating Mode factory defaults.

Warning: Any Advanced Operating Mode configuration in the unit that is not supported in Basic Operating Mode will be cleared and reset back to factory defaults.

F

DISPLAY PARAMETERS: ZONE SELECT (ZONE)

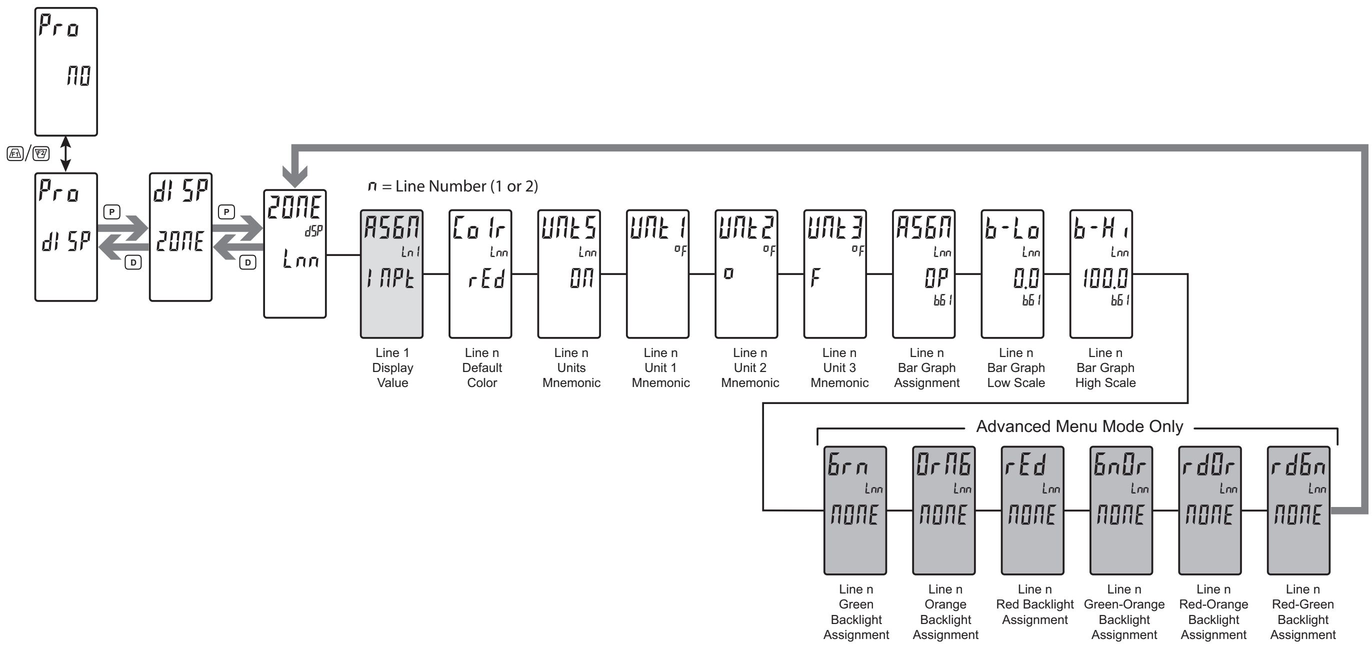
ZONE SELECT

ZONE P2C Ln1

Ln1 Ln2 VAn1 VAn2
VAn3 VAn4 Mn

Select the zone to be programmed.

DISPLAY PARAMETERS: ZONE CONFIGURATION - LINE 1 & LINE 2 (Ln1 & Ln2)



LINE 1 ASSIGNMENT

ASGN Ln1 INPt

NONE INPt HI LO

Select the value to be assigned to the primary or top line of the controller display.

NONE = Line 1 is Disabled
INPt = Input/Process Value
HI = Maximum Display Value
LO = Minimum Display Value

LINE n DISPLAY COLOR

Colr Lnn rEd

Grn OrNG rEd

Enter the desired Display Line, Bar Graph, and Programmable Units Display color.

Grn = Green
OrNG = Orange
rEd = Red

LINE n UNITS MNEMONIC

UNtS F ON

OFF ON

This parameter allows programming of the display mnemonics characters. Three individual characters may be selected from a preprogrammed list.

The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P Q R S t U V W Y Z 0 1
2 3 4 5 6 7 8 9 a c e g h i m n o q r u w - = [ ] / ° _ blank

Two character spaces are required to display this character.

LINE n BAR GRAPH ASSIGNMENT

ASGN Lnn OP bGn

NONE OP dEv SP

Select the parameter to be assigned to Display Line n bar graph.

NONE = Bar Graph is disabled
OP = Output Power
dEv = Deviation from the Setpoint Value
SP = Active Setpoint

LINE n BAR GRAPH LOW SCALING POINT

b-Lo Ln1 0.0 bG1

-1999 to 9999

Enter the desired Display Line n Bar Graph Low Scaling Point by using the arrow keys.

LINE n BAR GRAPH HIGH SCALING POINT

b-Hi Ln1 100.0 bG1

-1999 to 9999

Enter the desired Display Line n Bar Graph High Scaling Point by using the arrow keys.

F

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow Line n backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, Or9, REd, GnOr, RdOr, RdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out 1 = Output 1
Out 2 = Output 2
Out 3 = Output 3
Out 4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (A lr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

LGIC
Lnn
SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm

And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.

Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL
Lnn
NO
An

NO YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), the last alarm selected as YES will be used.

LINE n GREEN BACKLIGHT ASSIGNMENT

Grn
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Green Backlight.

LINE n ORANGE BACKLIGHT ASSIGNMENT

OrNG
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Orange Backlight.

LINE n RED BACKLIGHT ASSIGNMENT

rEd
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Red Backlight.

LINE n GREEN-ORANGE BACKLIGHT ASSIGNMENT

GnOr
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Green-Orange Backlight.

LINE n RED-ORANGE BACKLIGHT ASSIGNMENT

rdOr
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Red-Orange Backlight.

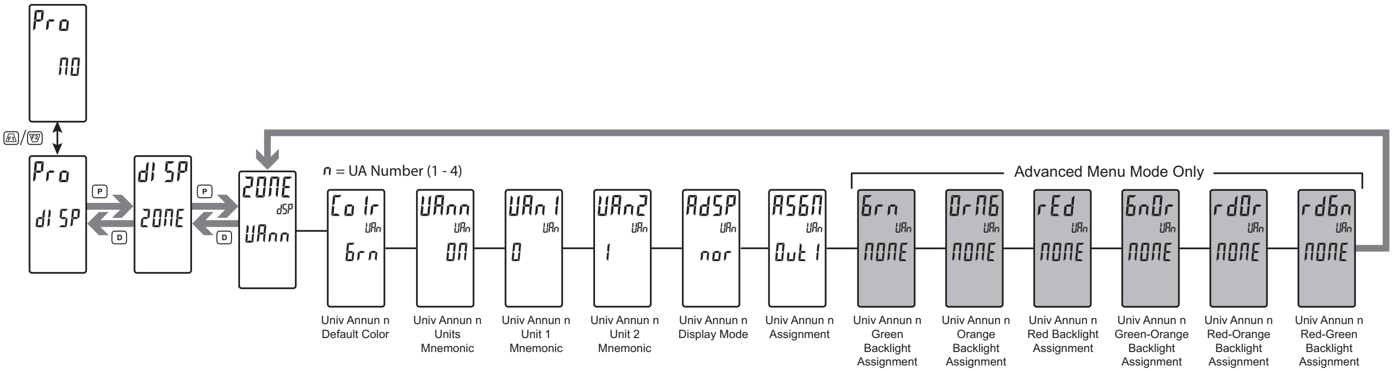
LINE n RED-GREEN BACKLIGHT ASSIGNMENT

rdGn
Lnn
NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be assigned to Line n Red-Green Backlight.

F



UNIVERSAL ANNUNCIATOR n DISPLAY COLOR

Colr / UAn / rEd

Grn OrNG rEd

Enter the desired Universal Annunciator Display color.

Grn = Green
OrNG = Orange
rEd = Red

UNIVERSAL ANNUNCIATOR n UNITS MNEMONIC

UNtS / UAn / ON

OFF ON

This parameter allows programming of the display mnemonics characters. Two individual characters may be selected from a preprogrammed list.

The characters available for the programmable modes include:

A b C d E F G H I J K L M N O P Q R S t U V W Y Z 0 1
2 3 4 5 6 7 8 9 a c e g h i m n o q r u w - = [ ] / ° _ blank

Two character spaces are required to display this character.

UNIVERSAL ANNUNCIATOR n DISPLAY MODE

AdSP / UAn / nor

nor rEu FLSh

Enter the desired Universal Annunciator Display Mode. This parameter is available when the Universal Annunciator is in List (LISt) Mode.

nor = Displays the configured universal annunciator when the mapped parameter is activated (on).
rEu = Displays the configured universal annunciator when the mapped parameter is deactivated (off).
FLSh = Flashes the configured universal annunciator when the mapped parameter is activated (on).

UNIVERSAL ANNUNCIATOR n ASSIGNMENT

ASGN / UAn / NONE

NONE Out1 Out2 Out3 Out4 ALr MAN

Selects the parameter that enables the Universal Annunciator mnemonic to be displayed. If the mapped parameter is active, the mnemonic is displayed. If the mapped parameter is not active, the mnemonic will be disabled (off).

NONE = Universal Annunciator text is disabled
Out1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow Universal Annunciator n backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, OrG, rEd, GnOr, rdOr, rdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out1 = Output 1
Out2 = Output 2
Out3 = Output 3
Out4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (Alr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

LGIC / UAn / SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm
And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.
Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL / UAn / NO / An

NO YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), the last alarm selected as YES will be used.

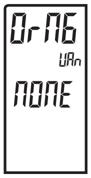
F

UNIVERSAL ANNUNCIATOR n GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Green backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n ORANGE BACKLIGHT ASSIGNMENT



NONE Out1 Out2 Out3 Out4 ALr MAN

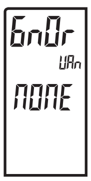
Select the parameter to be used to activate the Orange backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n RED BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Red backlight on Universal Annunciator n.

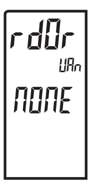
UNIVERSAL ANNUNCIATOR n GREEN-ORANGE BACKLIGHT ASSIGNMENT



NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Green-Orange backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n RED-ORANGE BACKLIGHT ASSIGNMENT



NONE Out1 Out2 Out3 Out4 ALr MAN

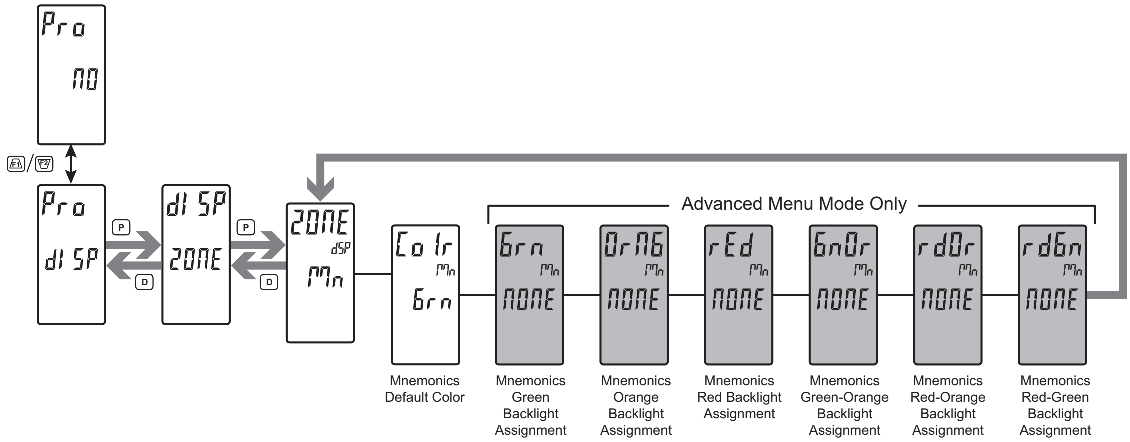
Select the parameter to be used to activate the Red-Orange backlight on Universal Annunciator n.

UNIVERSAL ANNUNCIATOR n RED-GREEN BACKLIGHT ASSIGNMENT

NONE Out1 Out2 Out3 Out4 ALr MAN

Select the parameter to be used to activate the Red-Green backlight on Universal Annunciator n.

DISPLAY PARAMETERS: ZONE CONFIGURATION - MNEMONICS (Mn)



MNEMONICS DISPLAY COLOR

CoLr / rEd

Grn OrNG rEd

Enter the desired Mnemonics Display color.

Grn = Green
OrNG = Orange
rEd = Red

The following programming steps are only available in the Advanced Operating Mode.

These parameters allow the mnemonic backlights to change color, or alternate between two colors when the mapped parameter is activated. When multiple backlight assignments are programmed for a particular zone, the color priority is defined as follows (from Lowest to Highest): Grn, OrG, rEd, GnOr, rdOr, rdGn

BACKLIGHT ASSIGNMENT SELECTIONS

NONE = Backlight color change disabled
Out 1 = Output 1
Out 2 = Output 2
Out 3 = Output 3
Out 4 = Output 4
ALr = Alarm
MAN = Manual Control Mode

The following two programming steps are only available when the Backlight Assignment is configured as an Alarm (ALr). These steps apply to each of the six different backlight color assignment parameters.

ALARM LOGIC MODE

LGIC / SNGL

SNGL And Or

The PAX2C supports three different modes when an output is assigned as an alarm:

SNGL = Any single alarm
And = Allows multiple alarms to be mapped to an output using AND Boolean logic. For example: If AL1 **and** AL2 are active, the output will energize.
Or = Allows multiple alarms to be mapped to an output using OR Boolean logic. For example: If AL1 **or** AL2 are active, the output will energize.

ALARM MASK ASSIGNMENT

ASEL / NO

NO YES

Selects the alarms to be logically combined per the Alarm Logic Mode selection. Any alarms configured as YES will be used in the Boolean logic calculation. If the Alarm Logic Mode is assigned as Single (SNGL), only one alarm may be selected at a time.

MNEMONICS GREEN BACKLIGHT ASSIGNMENT

Grn / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Green backlight.

MNEMONICS ORANGE BACKLIGHT ASSIGNMENT

OrNG / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Orange backlight.

MNEMONICS RED BACKLIGHT ASSIGNMENT

rEd / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Red backlight.

MNEMONICS GREEN-ORANGE BACKLIGHT ASSIGNMENT

GnOr / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Green-Orange backlight.

MNEMONICS RED-ORANGE BACKLIGHT ASSIGNMENT

rdOr / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Red-Orange backlight.

MNEMONICS RED-GREEN BACKLIGHT ASSIGNMENT

rdGn / NONE

NONE Out 1 Out 2 Out 3 Out 4 ALr MAN

Select the parameter to be used to activate the mnemonic Red-Green backlight.

F

DISPLAY PARAMETERS: LINE 2 PARAMETERS (LOCS)

This section details programming for the Line 2 (Bottom Line) Display. Various Input, Display, PID, Alarm, and Function Parameters can be shown on the Line 2 display. The display loops described below are used to view, reset and modify the selected display values, based on the Line 2 Value Access setting programmed for each available value.

Main Display Loop

In the Main display loop, the selected values can be consecutively read on Line 2 by pressing the **D** key. The lower 3-character units mnemonic indicates which Line 2 value is currently shown. When in the Main display loop, the Function keys F1 and F2 perform the User functions programmed in the User Input program section.

Parameter Display Loop and Hidden Parameter Loop

These display loops provide quick access to selected parameters that can be viewed and modified on Line 2 without having to enter Full Programming Mode. To utilize the Hidden Parameter display loop, a security code (1-250) must be programmed. (See Security Code Configuration at the end of this section.)The Parameter display loop is accessed by pressing the **P** key. The selected Parameter display loop values can be viewed and/or changed per the Line 2 Value Access setting programmed for each available value. The Hidden Parameter loop follows the Parameter display loop, and can only be accessed when the correct security code is entered at the Code prompt.

Line 2 Value Access Configuration

Line 2 values can be made accessible in either the Main (**D** key), Parameter (**P** key) or Hidden (**P** key following code entry) display loops. When the List parameter is configured for an Ent setting, a List assignment submenu will follow. Refer to Input module, User sub-menu section for a description of the function. Each parameter must be configured for one of the following settings. Not all settings are available for each parameter, as shown in the Parameter Value Access table.

SELECTION	DESCRIPTION
LOC	Not viewed on Line 2 Display (Factory Default Setting).
drEd	View in Main display loop. Cannot change or reset.
dEnt	View and change in Main display loop.
PrEd	View in Parameter display loop. Cannot change or reset.
PEnt	View and change in Parameter display loop.
HrEd	View in Hidden display loop. Cannot change or reset.
HEnt	View and change in Hidden display loop.

LINE 2 PARAMETER VALUE ACCESS

DISPLAY	DESCRIPTION	NOT VIEWED	MENU DISPLAY LOOP (D KEY)		PARAMETER DISPLAY LOOP (P KEY)		HIDDEN LOOP	
		LOC	drEd	dEnt	PrEd	PEnt	HrEd	HEnt
INPt	Input	x	x		x		x	
HI	Max Value	x	x	x	x	x	x	x
LO	Min Value	x	x	x	x	x	x	x
dLEU	Display Intensity Level	x	x	x	x	x	x	x
dCnt	Display Contrast Level	x	x	x	x	x	x	x
SP	Actual Setpoint Value	x	x	x	x	x	x	x
SP1	Setpoint 1 Value	x	x	x	x	x	x	x
SP2	Setpoint 2 Value	x	x	x	x	x	x	x
OP	Output Power (must be in manual mode to edit)	x	x	x	x	x	x	x
dEu	Deviation	x	x		x		x	
SPrP	Setpoint Ramping	x	x	x	x	x	x	x
Pid ACt	Actual PID Values: P, I & D	x	x	x	x	x	x	x
Pid Pri	Primary PID Values: P, I & D	x	x	x	x	x	x	x
Pid ALt	Alternate PID Values: P, I & D	x	x	x	x	x	x	x
ALn	Alarm Values: Basic Mode (1-4), Advanced Mode (1-16)	x	x	x	x	x	x	x
bdn	Band/Deviation	x	x	x	x	x	x	x
SPSL	Setpoint Selection	x	x	x	x	x	x	x
SPrP	Setpoint Ramping	x	x	x	x	x	x	x
ILOC	Integral Lock	x	x	x	x	x	x	x
trnF	Manual/Auto Control Mode	x	x	x	x	x	x	x
PSEL	PID Parameter Selection	x	x	x	x	x	x	x
tunE	Tuning Enable	x	x	x	x	x	x	x
r-HI	Reset Maximum Value	x		x		x		x
r-Lo	Reset Minimum Value	x		x		x		x
r-HL	Reset Max and Min Values	x		x		x		x
r-AL	Reset Alarms	x		x		x		x
LISt	Parameter List A/B Access	x	x	x	x	x	x	x
Prnt	Print Request	x		x		x		x

F

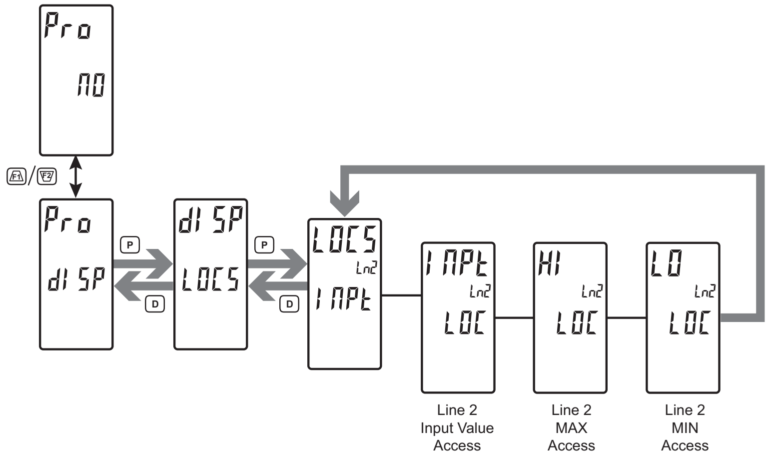
LINE 2 VALUE ACCESS PARAMETER SELECTION

LOCS Ln2 INPt

INPt dISP PId ALr FNCt

Select the display parameters to be displayed.

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - INPUT (INPt)



LINE 2 INPUT ACCESS

INPt Ln2 LOC

LOC drEd PrEd HrEd

Displays the controller process input reading on Line 2.

LINE 2 MAX ACCESS

HI Ln2 LOC

LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Max Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Hi value on Line 2. The display will show rHI NO. Press the F1 key to select YES and then press **P** key. The display will indicate rSEt and then return to the Hi value parameter.

LINE 2 MIN ACCESS

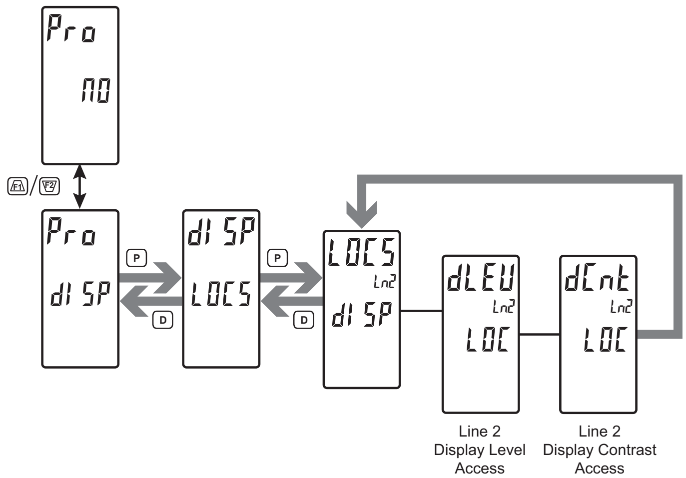
LO Ln2 LOC

LOC drEd dEnt PrEd PEnt HrEd HEnt

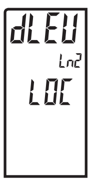
When configured for dEnt, PEnt or HEnt, the Min Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Lo value on Line 2. The display will show rLo NO. Press the F1 key to select YES and then press **P** key. The display will indicate rSEt and then return to the Lo value parameter.

F

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - DISPLAY (dISP)



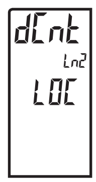
LINE 2 DISPLAY INTENSITY LEVEL



LOC dREd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the display intensity can be adjusted in the selected display loop by using the F1 and F2 keys while viewing dLEV.

LINE 2 DISPLAY CONTRAST LEVEL

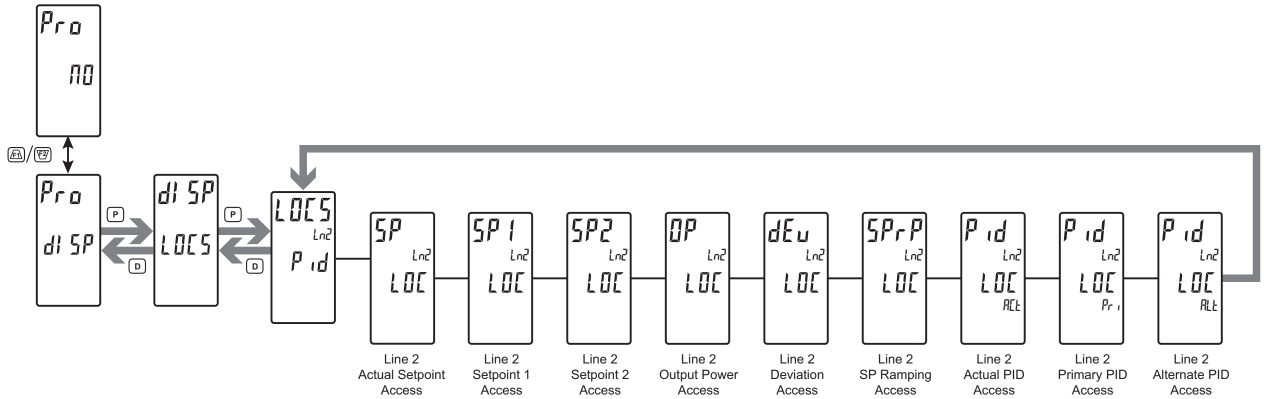


LOC dREd dEnt PrEd PEnt HrEd HEnt

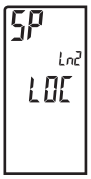
When configured for dEnt, PEnt or HEnt, the display contrast can be adjusted in the selected display loop by using the F1 and F2 keys while viewing dCnt.

F

Display Parameters: Line 2 Parameter Value Access - PID (Pid)



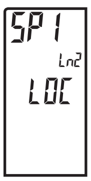
LINE 2 ACTIVE SETPOINT VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the active setpoint value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP. When configured for d-ENt, the P key must be pressed to select the item prior to changing the value.

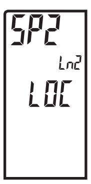
LINE 2 SETPOINT 1 VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Setpoint 1 value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP1. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

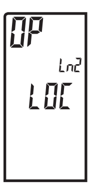
LINE 2 SETPOINT 2 VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Setpoint 2 value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SP2. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

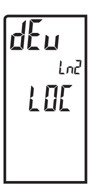
LINE 2 OUTPUT POWER VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

Displays the Output Power value on Line 2 in the selected display loop. In manual mode, the value can be adjusted in the selected display loop by using the F1 and F2 keys. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

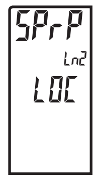
LINE 2 DEVIATION VALUE



LOC drEd PrEd HrEd

Displays the difference between Temp/Process and the Actual Setpoint value on Line 2 in the selected display loop.

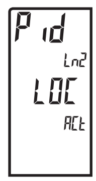
LINE 2 SETPOINT RAMPING VALUE



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Setpoint Ramping value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing SPrP. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

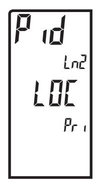
LINE 2 ACTUAL PID VALUES



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Actual PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

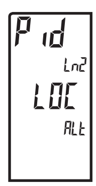
LINE 2 PRIMARY PID VALUES



LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Primary PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

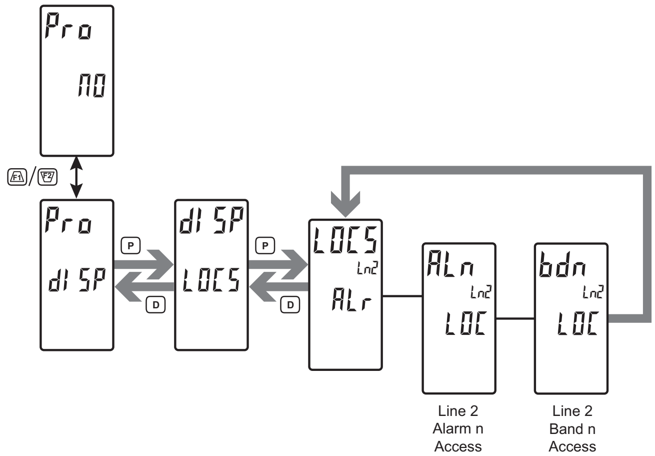
LINE 2 ALTERNATE PID VALUES



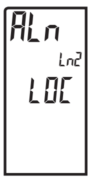
LOC drEd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Alternate PID values (P, I & D) can be adjusted in the selected display loop by using the F1 and F2 keys while viewing the selected parameter. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

DISPLAY PARAMETERS: LINE 2 PARAMETER VALUE ACCESS - ALARMS (ALr)



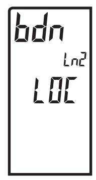
LINE 2 ALARM ACCESS



LOC dREd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Alarm n value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing ALn. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

LINE 2 BAND/DEVIATION ACCESS

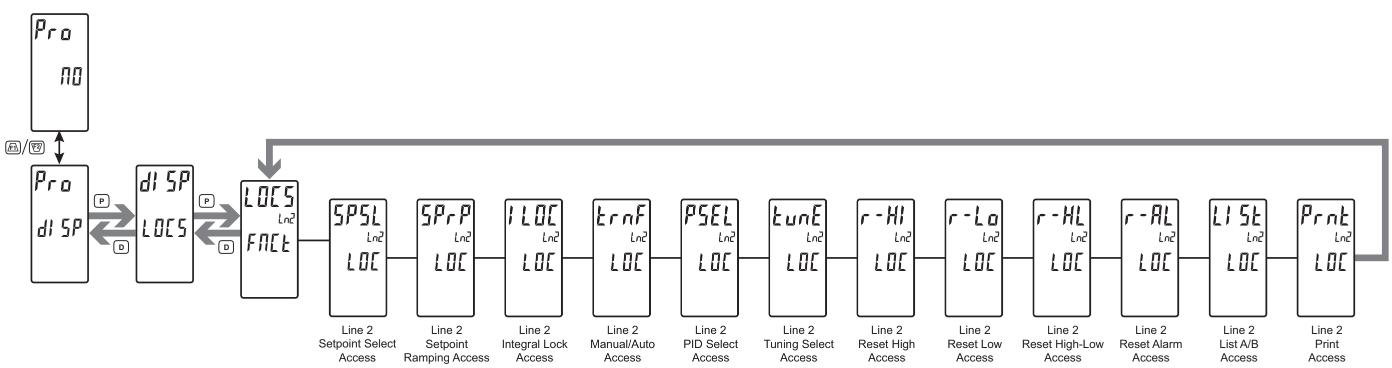


LOC dREd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Band/Deviation n value can be adjusted in the selected display loop by using the F1 and F2 keys while viewing bdn. When configured for dEnt, the **P** key must be pressed to select the item prior to changing the value.

Basic Mode: 4 alarms max
Advanced Mode: 16 alarms max

DISPLAY PARAMETERS: LINE 2 USER FUNCTION ACCESS - FUNCTIONS (FnCt)



F

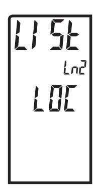
LINE 2 USER FUNCTION ACCESSIBLE ITEMS

The following list of User functions can be made available in the Display (dEnt), Parameter (PEnt) or Hidden (HEnt) display loops. The more critical and frequently used Functions should be first assigned to the User Inputs and User Function keys. If more functions are needed than what can be obtained with User Inputs, this feature will provide a means to provide that access. Please refer to the USER INPUT / FUNCTION KEY PARAMETERS (USEr) section for a detailed description of the available functions.

SPSL	ILOC	PSEL	r-HI	r-HL	LISt*
SPrP	trnF	tunE	r-Lo	r-AL	Prnt

* Also available as a read-only item in the Display (drEd), Parameter (PrEd) or Hidden (HrEd) Display loops.

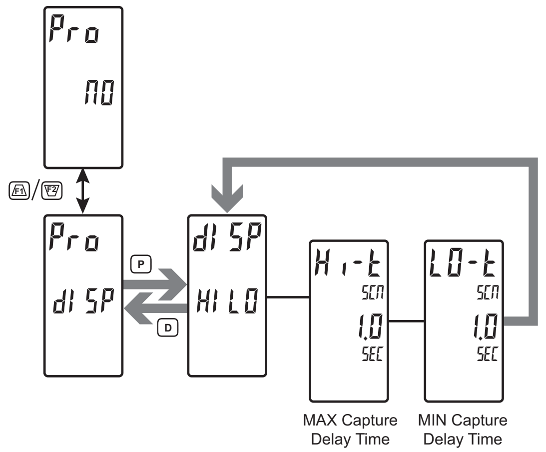
LINE 2 PARAMETER LIST A/B ACCESS



LOC dREd dEnt PrEd PEnt HrEd HEnt

When configured for dEnt, PEnt or HEnt, the Parameter list can be selected using a front keypad sequence. To select, push the **P** key while viewing LISt x". "x" will begin to flash, press the F1 key to select "A" or "b" and then press **P** key. The selected Parameter List will become active and the display will advance to the next available item or menu loop. See User Functions "Select Parameter List" for a description of the list function. The Line 2 Parameter List provides a means of setting or viewing the active parameter list.

DISPLAY PARAMETERS: DISPLAY MIN/MAX CONFIGURATION (HI LO)



MAX CAPTURE DELAY TIME

HI -t SCN 1.0 SEC

0.0 to 25.0 seconds

When the Input Display is above the present MAX value for the entered delay time, the controller will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

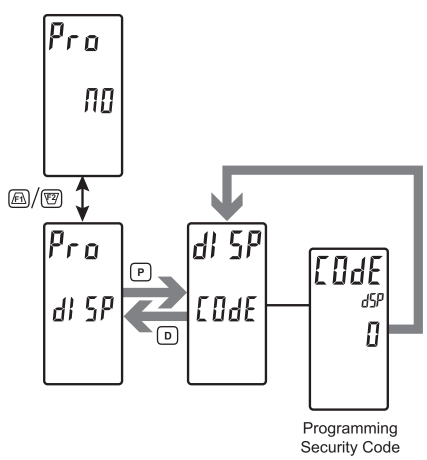
MIN CAPTURE DELAY TIME

LO-t SCN 1.0 SEC

0.0 to 25.0 seconds

When the Input Display is below the present MIN value for the entered delay time, the controller will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY PARAMETERS: SECURITY CODE CONFIGURATION (CODE)



PROGRAMMING SECURITY CODE

CODE dSP 0

0 to 250

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Input [User] module).

To activate the Hidden Parameter display loop, a security code (1-250) must be entered. If a "0" security code is programmed, Full Programming Mode is available following the Parameter Loop. Pressing the **P** key takes you into, and is used to step through the Parameter Loop. Two modes are available. Full Programming mode allows all parameters to be viewed and modified. Parameter display loop mode provides access to those selected parameters that can be viewed and/or modified without entering the Full Programming mode.

The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	HIDDEN AND FULL PROGRAMMING MODE ACCESS
>0	PLOC or Not Active	Any State	After Parameter Display Loop with correct code # at CODE prompt.
0	PLOC	Active	No Access
0	PLOC or Not Active	Not Active	Access after Parameter Display Loop

F

PID Parameters (Pid)

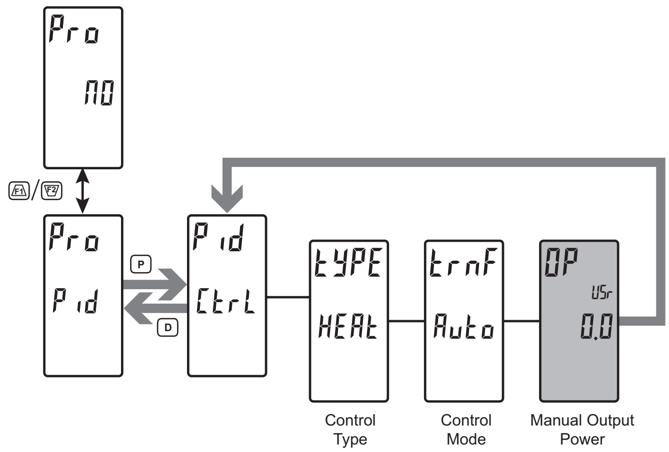
PID PARAMETER MENU SELECTION

Pid P2C CtrL

CtrL SP Pid PWr ONOF tunE

Select the PID parameter menu to be programmed.

PID Parameters: Control Parameters (CtrL)



PID CONTROL TYPE

tYPE HEAt

HEAt COOL botH

Select the type of PID control desired. When programmed for Heating action (reverse), the output power decreases when the Process Value is above the setpoint value. When programmed for Cooling (direct), the output power will increase if the Process value is above the Setpoint Value.

PID CONTROL MODE

trnF Auto

Auto MAN

Select Automatic or Manual Operation. In Automatic (Auto) mode (closed loop; On/Off, or PID Control), the controller calculates the required output to reach and maintain setpoint, and acts accordingly. In manual mode (MAN), the calculated PID algorithm heat and cool output percentages are not used to control the controller outputs. The unit is instead placed into an open loop mode where the control does not work from a setpoint or process feedback.

The following programming step is only available when PID Control Mode is set to Manual Mode (MAN).

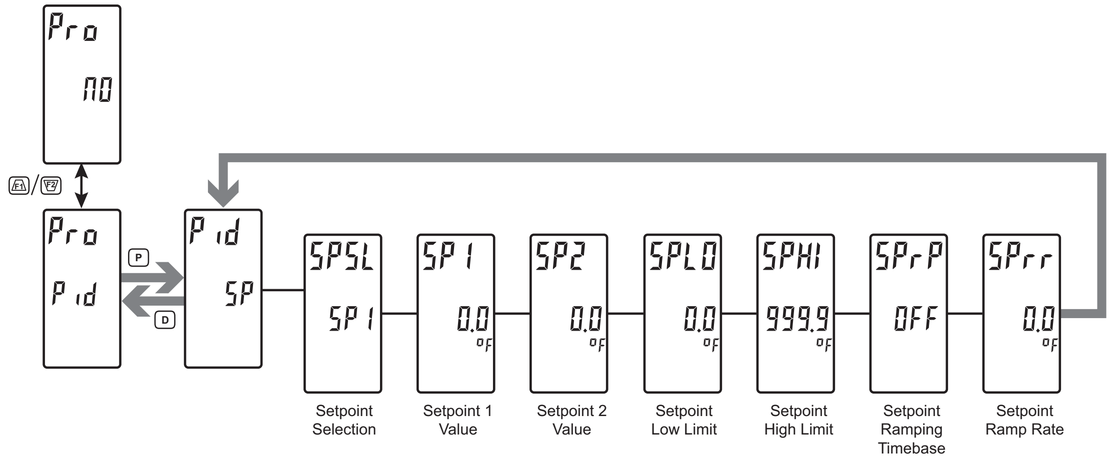
OUTPUT POWER

OP USr 0.0

- 100.0 to 100.0 %

Manual Output Power is the level the PID module will assume in manual mode.

F



SETPOINT SELECTION

SPSL
SP1

SP1 SP2

Select the desired Setpoint Value (SP1 or SP2) to use as the control point. The SP Select function can also be configured in the Display Parameter LOCS Menu (Pid LOCS) or a User Input or Function Key can be assigned to the Setpoint Select Function.

SETPOINT 1 VALUE

SP1
0.0 °F

-1999 to 9999

One of the two values that may be selected as the target setpoint of the process.

SETPOINT 2 VALUE

SP2
0.0 °F

-1999 to 9999

One of the two values that may be selected as the target setpoint of the process.

SETPOINT LOW LIMIT

SPLO
0.0 °F

-1999 to 9999

Select the desired Setpoint Low Limit value. This value should be selected so that the controller setpoint value cannot be set outside the safe operating range of the process.

SETPOINT HIGH LIMIT

SPHI
999.9 °F

-1999 to 9999

Select the desired Setpoint High Limit value. This value should be selected so that the controller setpoint value cannot be set outside the safe operating range of the process.

SETPOINT RAMPING TIMEBASE

SPrP
OFF

OFF SEC MIN hour

Select the desired unit of time for ramping of the process:

OFF = Off
SEC = Seconds
MIN = Minutes
hour = Hours

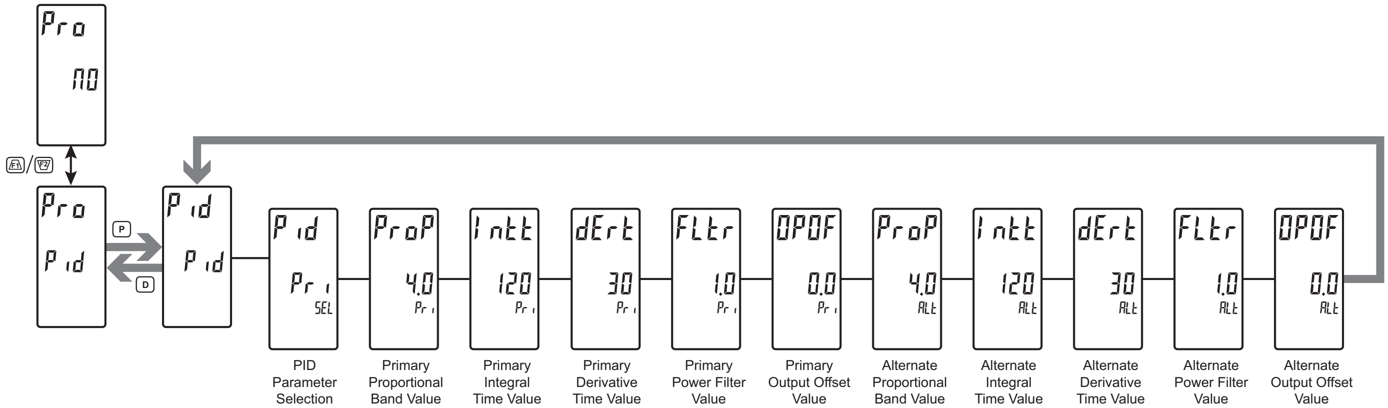
SETPOINT RAMP RATE

SPrr
0.0 °F

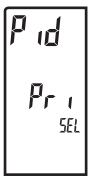
0 to 9999

The Ramp Rate property is used to reduce sudden shock to a process during setpoint changes and system startup, a setpoint ramp rate can be used to increase or decrease the Target Setpoint at a controlled rate. The value is entered in units/time. A value of 0 disables setpoint ramping. If the Setpoint Ramp Rate is a non-zero value, and the Actual Setpoint is changed or the controller is powered up, the controller sets the Target Setpoint to the current process measurement, and uses that value as its setpoint. It then adjusts the Target Setpoint according to the setpoint Ramp Rate. When the Target Setpoint reaches the Actual Setpoint, the controller resumes use of the Actual Setpoint value. (In a properly designed and functioning system, the process will have followed the Target Setpoint value to the Actual Setpoint value.)

PID PARAMETERS: PID PARAMETERS (Pid)



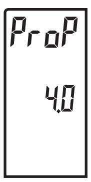
PID PARAMETER SELECTION



Pri ALt

Select the desired set of PID Values (Primary or Alternate) that will be used in the PID calculation. The PID Parameter Selection function can also be configured in the Display Parameter LOCS Menu (Pid LOCS) or a User Input or Function Key can be assigned to the PID Parameter Selection Function.

PRIMARY/ALTERNATE PROPORTIONAL BAND



0 to 999.9 %

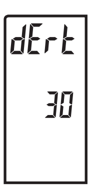
The Proportional Band property, entered as a percentage of the full input range, is the amount of input change required to vary the output full scale. For temperature inputs, the input range is fixed per the entered thermocouple or RTD type. For process inputs, the input range is the difference between the Process at 0%, and Process at 100% values. The Proportional Band is adjustable from 0.0% to 999.9%, and should be set to a value that provides the best response to a process disturbance while minimizing overshoot. A Proportional Band of 0.0% forces the controller into On/Off Control with its characteristic cycling at setpoint. The optimal value may be established by invoking Auto-tune.

PRIMARY/ALTERNATE INTEGRAL TIME

0 to 65000 seconds

The Integral Time is the time in seconds that it takes the integral action to equal the proportional action, during a constant process error. As long as the error exists, integral action is repeated each Integral Time. The higher the value, the slower the response. The optimal value may be established by invoking autotune.

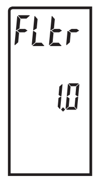
PRIMARY/ALTERNATE DERIVATIVE TIME



0 to 9999 seconds

The Derivative Time is the seconds per repeat that the controller looks ahead at the ramping error to see what the proportional contribution will be and then matches that value every Derivative Time. As long as the ramping error exists, the derivative contribution is repeated every derivative time. Increasing the value helps to stabilize the response. Too high of a value, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action. The optimal Derivative Time may be established by invoking auto-tune.

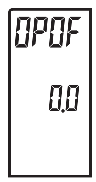
PRIMARY/ALTERNATE POWER FILTER



0 to 60.0 seconds

The Power Filter is a time constant, entered in seconds, that dampens the calculated output power. Increasing the value increases the dampening effect. Generally, a Power Filter in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) is effective. Values longer than these may cause controller instability due to the added lag effect.

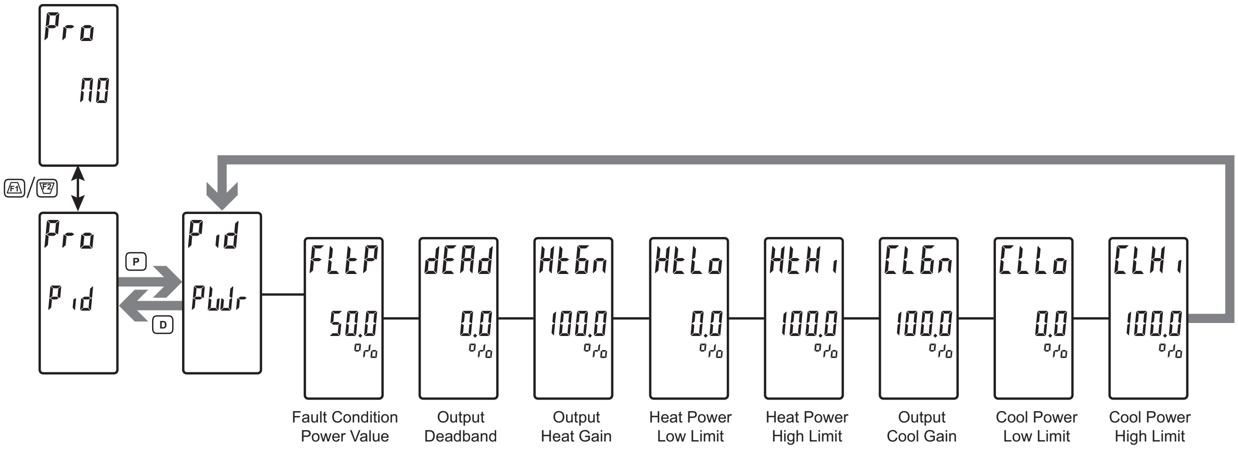
PRIMARY/ALTERNATE OUTPUT OFFSET



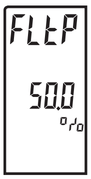
-100.0 to 100.0

This value effectively shifts the zero output point of the module's output power calculation. This feature is most commonly used in proportional-only applications to remove steady-state error.

PID Parameters: Output Power Parameters (PWr)



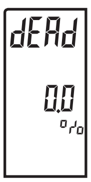
FAULT CONDITION POWER VALUE



- 199.9 to 200.0 %

Enter the desired control output value for the controller to assume in the event that the input sensor fails. You may enter values in excess of 100% and -100% to overcome limitations caused by Power Transfer Values, such as Gains and Offsets, that would otherwise limit the output to less than their maximums.

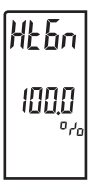
OUTPUT DEADBAND



- 100.0 to 100.0 %

The Output Deadband property defines the area in which both the heating and cooling outputs are inactive, known as deadband, or the area in which they will both be active, known as overlap. A positive value results in a deadband, while a negative value results in an overlap.

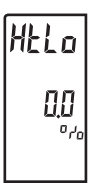
OUTPUT HEAT GAIN



0 to 500.0 %

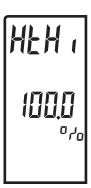
The Output Heat Gain defines the gain of the heating output relative to the gain established by the Proportional Band. A value of 100% causes the heat gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the heater is oversized, while a value greater than 100% can be used when the heater is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

HEAT POWER LOW AND HIGH LIMITS

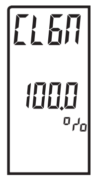


0 to 200.0 %

The Heat Low Limit and Heat High Limit properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.



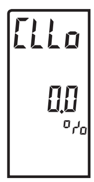
OUTPUT COOL GAIN



0 to 500.0 %

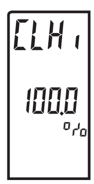
The Output Cool Gain defines the gain of the cooling output relative to the gain established by the Proportional Band. A value of 100% causes the cool gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the cooling device is oversized, while a value greater than 100% can be used when the cooling device is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

COOL POWER LOW AND HIGH LIMITS



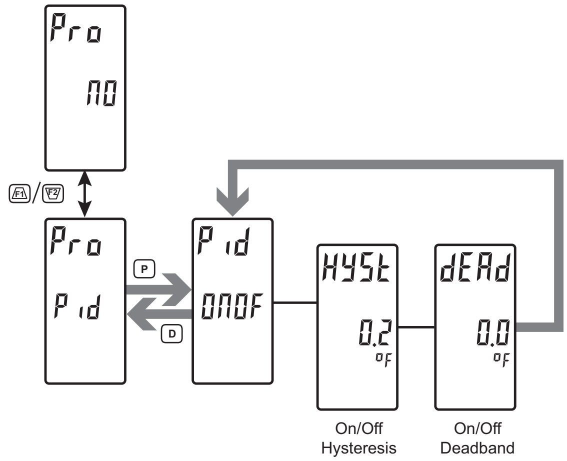
0 to 200.0 %

The Cool Low Limit and Cool High Limit properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of –100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.



F

PID PARAMETERS: ON/OFF PARAMETERS (ONOF)



ON/OFF HYSTERESIS

HYSt 0.2

0 to 50.0 units

The On/Off Hysteresis property is used to eliminate output chatter by separating the on and off points of the output(s) when performing on/off control. The hysteresis value is centered around the setpoint, that is, the transition points of the output will be offset above and below the setpoint by half of the On/Off Hysteresis value. This value effects outputs programmed for Heat or Cool. During auto-tune, the controller cycles the process through 4 on/off cycles, so it is important to set the On-Off Hysteresis to an appropriate value before initializing auto-tune.

ON/OFF DEADBAND

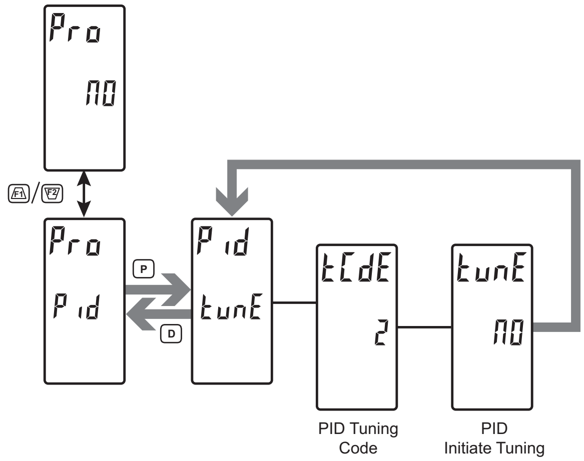
dEAd 0.0

- 199.9 to 999.9 units

The On-Off Deadband property provides a means of offsetting the on-points of heat and cool outputs programmed for on/off operation. This results in a deadband if the value is positive, and overlap if the value is negative. When determining the actual transition points of the outputs, the On/Off Hysteresis value must also be taken into consideration.

F

PID PARAMETERS: PID TUNING PARAMETERS (tunE)



PID TUNING CODE

tCdE 2

0 to 4

The Tune Response property is used to ensure that an auto-tune yields the optimal P, I, and D values for various applications. A setting of Very Aggressive (0) results in a PID set that will reach setpoint as fast as possible, with no concern for overshoot, while a setting of Very Conservative sacrifices speed in order to prevent overshoot. Note: If the Tune Response property is changed, auto-tune needs to be reinitiated for the changes to affect the PID settings. See the PID Tuning Explanations Section for more information.

0 = Very Aggressive
1 = Aggressive
2 = Default
3 = Conservative
4 = Very Conservative

PID INITIATE TUNING

tunE NO

NO YES

The PID Initiate Tuning is used to initiate an auto-tune sequence. Auto-tune may be used to establish the optimal P, I, D, and Power Filter values for a particular process. See the PID Tuning Explanations Section for more information

F

ALARM PARAMETERS (ALr)

ALARM PARAMETER MENU SELECTION

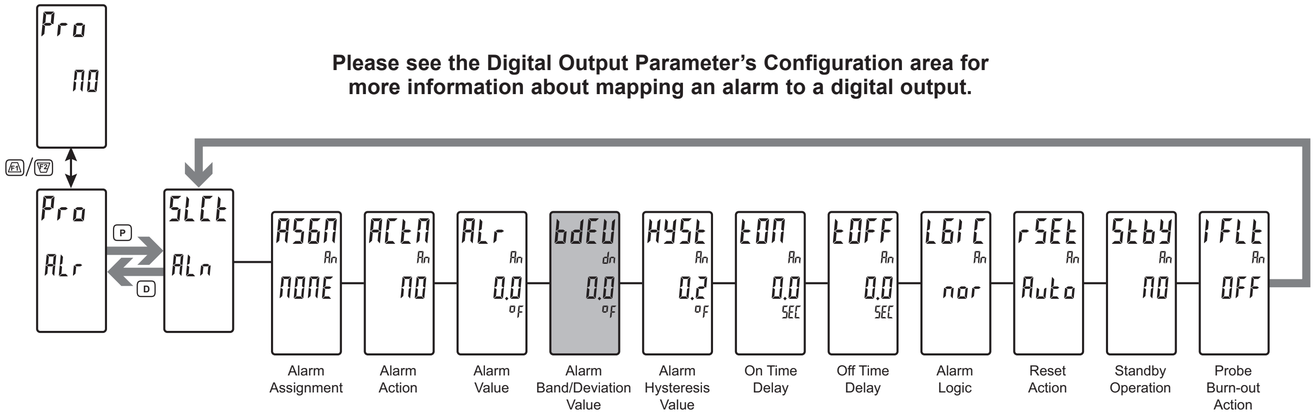
SLCt P2C AL 1

AL 1 AL 2 AL 3 AL 4 } Basic Mode
AL 5 through AL 16 } Advanced Mode

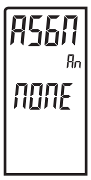
Select the Alarm parameter to be programmed.

ALARM PARAMETERS (ALn)

Please see the Digital Output Parameter's Configuration area for more information about mapping an alarm to a digital output.



ALARM ASSIGNMENT

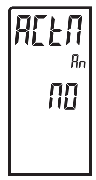


NONE PU

Selects the parameter to be used to trigger the Alarm.

NONE = No Alarm Assignment (alarm disabled)
PU = Input Process Value

ALARM ACTION



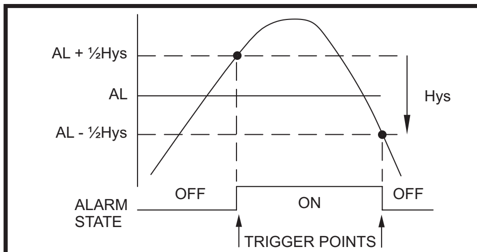
nO AbHI AbLO AUHI AULO
dEHI dELO bAnd bdIn

Enter the action for the selected alarm. See Alarm Figures for a visual detail of each action.

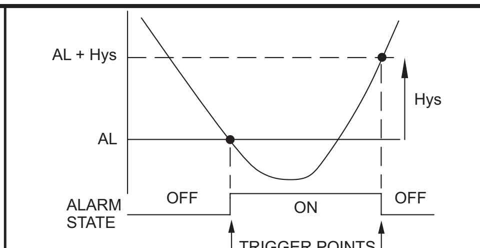
nO = No Alarm Action
AbHI = Absolute high, with balanced hysteresis
AbLO = Absolute low, with balanced hysteresis
AUHI = Absolute high, with unbalanced hysteresis
AULO = Absolute low, with unbalanced hysteresis
dEHI = deviation high, with unbalanced hysteresis
dELO = deviation low, with unbalanced hysteresis
bAnd = Outside band, with unbalanced hysteresis
bdIn = Inside band, with unbalanced hysteresis

Setpoint Alarm Figures

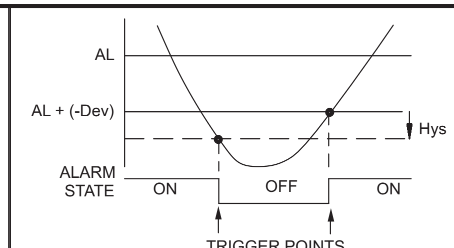
With reverse logic rEv, the below alarm states are opposite.



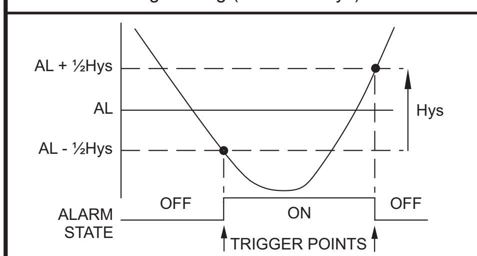
Absolute High Acting (Balanced Hys) = AbHI



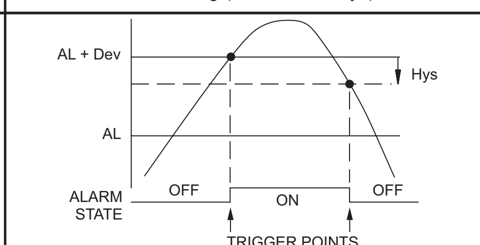
Absolute Low Acting (Unbalanced Hys) = AULO



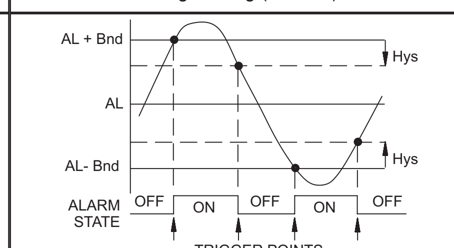
Deviation High Acting (Dev < 0) = dEHI



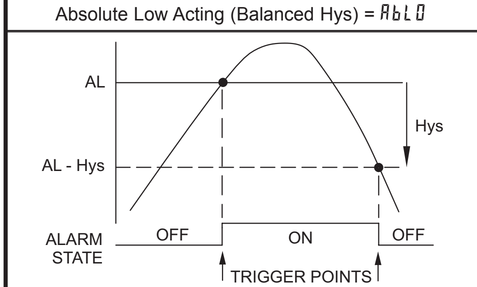
Absolute Low Acting (Balanced Hys) = AbLO



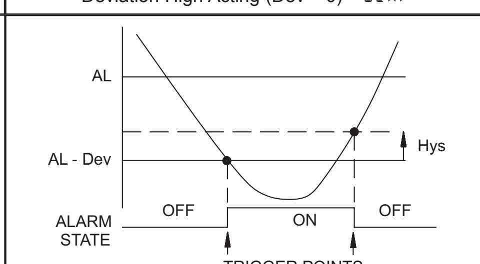
Deviation High Acting (Dev > 0) = dEHI



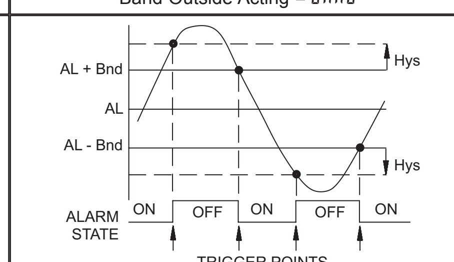
Band Outside Acting = bAnd



Absolute High Acting (Unbalanced Hys) = AUHI



Deviation Low Acting (Dev > 0) = dELO



Band Inside Acting = bdIn

ALARM VALUE

ALr An 0.0 °F

-1999 to 9999

Enter desired alarm value. Alarm values can also be entered when the alarm is programmed as dEnt, PEnt or HEnt. The decimal point position is determined by the Decimal Resolution setting in the Analog Input Parameter Menu.

BAND/DEVIATION VALUE

bdEU dn 0.0 °F

-1999 to 9999

This parameter is only available in band and deviation alarm actions. Enter desired alarm band or deviation value. When the Alarm Action is programmed for Band, this value can only be a positive value.

HYSTERESIS VALUE

HYSt An 0.2 °F

1 to 9999

Enter desired hysteresis value. See Alarm Figures for visual indication or representation of how alarm actions (balanced and unbalanced) are affected by the hysteresis. When the alarm is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting alarms and functions on the high side for low acting alarms. Note: Hysteresis eliminates output chatter at the switch point, while on/off time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON An 0.0 SEC

0 to 9999 seconds

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the controller to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

tOFF An 0.0 SEC

0 to 9999 seconds

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the controller to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

ALARM LOGIC

LGIC An nor

nor rEu

Enter the logic of the alarm. The nor logic leaves the alarm operation as normal. The rEu logic reverses the alarm logic. In rEu, the alarm states in the Alarm Figures are reversed.

RESET ACTION

rSEt An Auto

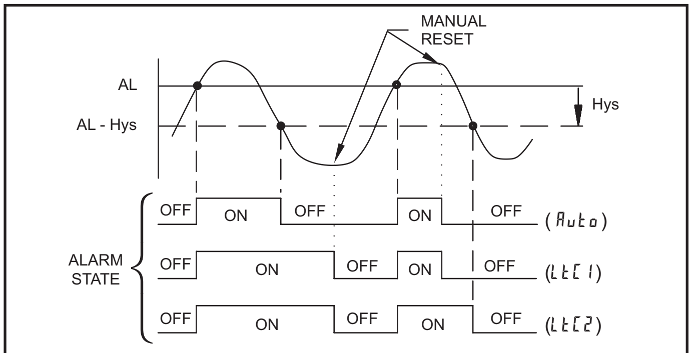
Auto LtC1 LtC2

Enter the reset action of the alarm.

Auto = Automatic action; This action allows the alarm to automatically reset off at the trigger points per the Alarm Action shown in Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input. The alarm remains reset off until the trigger point is crossed again.

LtC1 = Latch with immediate reset action; This action latches the alarm on at the trigger point per the Alarm Action shown in Alarm Figures. Latch means that the alarm can only be turned off by front panel function key or user input manual reset, serial reset command or controller power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm is reset immediately and remains off until the trigger point is crossed again. Any alarms that are latched at power down will be reset.

LtC2 = Latch with delay reset action; This action latches the alarm on at the trigger point per the Alarm Action shown in Alarm Figures. Latch means that the alarm can only be turned off by front panel function key or user input manual reset, serial reset command or controller power cycle. When the user input or function key is activated (momentary or maintained), the controller delays the event until the corresponding "on" alarm crosses the trigger off point. Any alarms that are latched at power down will be reset.



Alarm Reset Actions

ALARM STANDBY OPERATION

Stby An NO

NO YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. After the alarm trigger is reached, the alarm operates normally per the Alarm Action and Reset Mode.

The following programming step is only available when Input Type in the Input Menu is set for a temperature input (TC/RTD).

BURN-OUT ACTION

IFLt An OFF

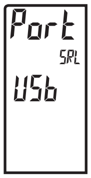
OFF ON

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the alarm output can be programmed to be on or off.

F

Port Parameters (Port)

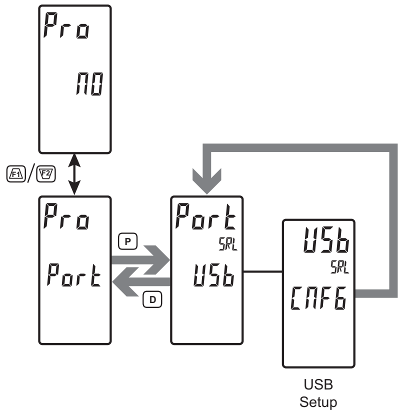
PORT PARAMETER MENU SELECTION



USb SErL

Select the Communication Port Mode.

USB Port Parameters (USb)



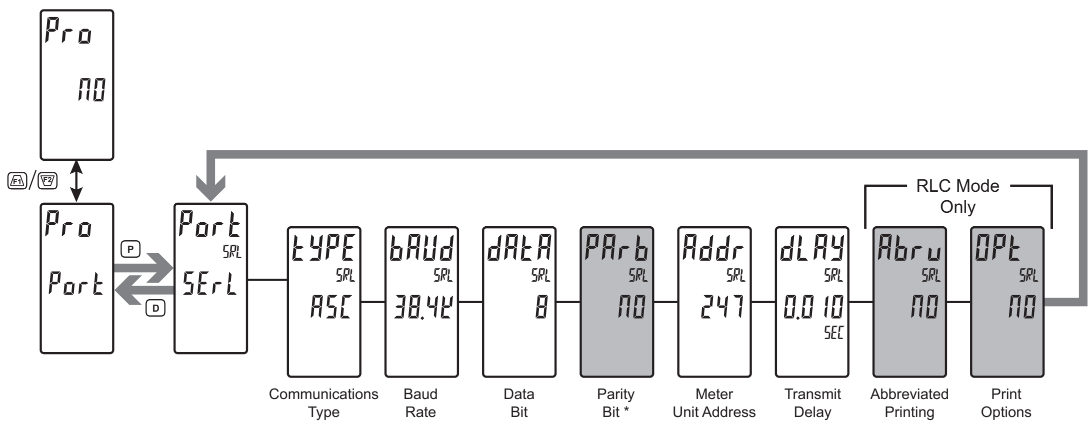
USB SETUP

CNFG SErL

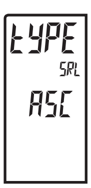
CNFG = Configures USB with settings required to operate with Crimson configuration software. This will automatically internally configure the PAX2C USB port to use Modbus RTU protocol, 38400 baud, 8 bits, and unit address of 247. The serial port settings in the Serial Parameters (SErL) will not change, or show this.

SErL = Configures USB to utilize serial settings and protocol as configured in the Serial Parameters.

Serial Port Parameters (SErL)



COMMUNICATIONS TYPE



ASC = Modbus ASCII
rLC = RLC Protocol (ASCII)
rtu = Modbus RTU

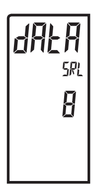
Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2C, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

1200 2400 4800 9600 19.2K 38.4K

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

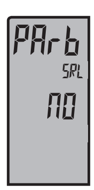
DATA BIT



7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT *



NO EUEN Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

* Available when Data Bit = 7.

F

METER UNIT ADDRESS

Addr
SRL
247

0 to 99 = RLC Protocol
1 to 247 = Modbus

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

dLAY
SRL
0.010
SEC

0.000 to 0.250 seconds

Following a transmit value ("*" terminator) or Modbus command, the PAX2C will wait this minimum amount of time in seconds before issuing a serial response.

The following programming steps are only available when Communications Type(tYPE) is programmed for rLC.

ABBREVIATED PRINTING

Abrv
SRL
NO

NO YES

Select NO for full print or Command T transmissions (meter address, mnemonics and parameter data) or YES for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, the address will not be sent during a full transmission.

PRINT OPTIONS

OPt
SRL
NO

NO YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INPt	Signal Input	YES	INP
SP	*Setpoint	NO	SET
SPrr	Setpoint Ramp Rate	NO	RMP
OP	Output Power	NO	PWR
ProP	*Proportional Band	NO	PBD
Int	*Integral Time	NO	INT
dEr	*Derivative Time	NO	DER
ALr	Alarm Status (1-4)	NO	ALR
AL 1	*Alarm Value 1	NO	AL1
AL 2	*Alarm Value 2	NO	AL2
AL 3	*Alarm Value 3	NO	AL3
AL 4	*Alarm Value 4	NO	AL4
CtrL	Control Parameters	NO	CTL

* Active values

F

SERIAL COMMUNICATIONS

The PAX2 supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 PAX option cards, the PAX2 supports both the RLC protocol and also supports Modbus communications. The PAX Modbus option card should not be used with the PAX2, as the PAX2 internal Modbus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2 with the Crimson programming software. It can also be used as a virtual serial communications port following installation of the PAX2 USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2 and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2 CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2.
3. Insure USB Setup in USB Port Parameters is set to CNFG (factory default setting).
4. Attach USB cable (USB A to Mini-B) between PC and PAX2.
5. Create a new file (File, New) or open an existing PAX2 database within Crimson.
6. Configure Crimson Link options (Link, Options) to the PC port which the USB cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communications Type Parameter (tYPE) be set to Modbus RTU (rtu) or Modbus ASCII (ASC).

PAX2 CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2 to PC.
3. Supply power to PAX2.
4. Configure serial parameters as Modbus RTU (rtu), 38,400 baud, address 247.
5. Create a new file (File, New) or open an existing PAX2 database within Crimson.
6. Configure Crimson 2 Link options (Link, Options) to the serial port which the communication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 64 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 64 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 64 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41711).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAX2. "Total Good Comms" is the total messages received by the PAX2 with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PX2C ab<0100h><40h><40h><10h>
a = SP Card, "0"-No SP, "2" or "4" SP
b = Linear Card "0" = None, "1" = Yes
<0100> Software Version Number (1.00)
<20h>Max Register Reads (64)
<20h>Max Register Writes (64)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAX2C FREQUENTLY USED MODBUS REGISTERS

Only frequently used registers are shown below. The entire Modbus Register Table can be found at www.redlion.net and on the included flash drive.
Values less than 65,535 will be in (LO word). Values greater than 65,535 will continue into (Hi word). Negative values are represented by two's complement of the combined (Hi word) and (LO word).
Note 1: The PAX2C should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FREQUENTLY USED REGISTERS					
40001	Process Value	N/A	N/A	N/A	Read	1 = 1 Display Unit
40002	Maximum Value	-1999	9999	N/A	Read	1 = 1 Display Unit
40003	Minimum Value	-1999	9999	N/A	Read	1 = 1 Display Unit
40004	Active Setpoint Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40005	Setpoint 1 Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40006	Setpoint 2 Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40007	Setpoint Deviation	N/A	N/A	N/A	Read Only	
40008	Output Power	-1000	1000	N/A	Read/Write	Output Power: Heat/Cool; * writable only in manual mode; 1 = 0.1%
40009	Active Proportional Band	0	9999	40	Read/Write	1 = 0.1 Display Unit
40010	Active Integral Time	0	65000	120	Read/Write	1 = 1 Display Unit
40011	Active Derivative Time	0	9999	30	Read/Write	1 = 0.1 Display Unit
40012	Active Power Filter	0	600	10	Read/Write	1 = 1 Display Unit
40013	Auto-Tune Code	0	4	2	Read/Write	0 = Very Aggressive, 1 = Aggressive, 2 = Default, 3 = Conservative, 4 = Very Conservative
40014	Auto-Tune Request	0	1	0	Read/Write	0 = Off, 1 = Invoke Auto-Tune
40015	Auto-Tune Phase	0	4	0	Read	0 = Off, 4 = Last Phase of Auto-Tune
40016	Auto-Tune Done	0	1	0	Read	1 = Successful Auto-Tune since last power cycle.
40017	Auto-Tune Fail	0	1	0	Read/Write	
40018	Control Mode	0	1	0	Read/Write	0 = Automatic, 1 = Manual Mode
40019	Setpoint Selection	0	1	0	Read/Write	0 = Setpoint 1, 1 = Setpoint 2
40020	Remote/Local Setpoint Selection	0	1	0	Read/Write	0 = Local, 1 = Remote
40021	PID Parameter Selection	0	1	0	Read/Write	0 = Primary PID Values, 1 = Alternate PID Values
40022	Disable Integral Action	0	1	0	Read/Write	0 = Enabled, 1 = Disabled
40023	Disable Setpoint Ramping	0	1	0	Read/Write	0 = Enabled, 1 = Disabled
40024	Setpoint Ramping In Process	0	1	0	Read/Write	0 = Off, 1 = In Process
40025	Setpoint Ramp Rate Value	-1999	9999	0	Read/Write	1 = 1 Display Unit
40026	Alarm (1-16) Status Register	0	65535	0	Read	Bit 15 = A16, Bit 0 = A1
40027	Input Range Alarm	0	1	0	Read	
40028	User Input Status	0	2	0	Read	Bit 1 = User Input 2, Bit 0 = User Input 1
40029	Digital Output Status	0	15	N/A	Read/Write	Status of Digital Outputs. Bit State: 0 = Off, 1 = On Bit 3 = Out1, Bit 2 = Out2, Bit 1 = Out3, Bit 0 = Out4 Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40030	Output Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = DO1, Bit 3 = DO2, Bit 2 = DO3, Bit 1 = DO4, Bit 0 = Linear Output
40031	Reset Output Register	0	15	0	Read/Write	Bit State: 1 = Reset Output, bit is returned to zero following reset processing; Bit 3 = DO1, Bit 2 = DO2, Bit 1 = DO3, Bit 0 = DO4
40032	Analog Output Register (AOR)	0	4095	0	Read/Write	Functional only if Linear Output is in Manual Mode. (MMR bit 0 = 1) Linear Output Card written to only if Linear Out (MMR bit 0) is set.
40033	Active Alarm 1 Value	-1999	9999	0	Read/Write	Active List (A or B)
40034	Active Alarm 2 Value	-1999	9999	0	Read/Write	Active List (A or B)
40035	Active Alarm 3 Value	-1999	9999	0	Read/Write	Active List (A or B)
40036	Active Alarm 4 Value	-1999	9999	0	Read/Write	Active List (A or B)
40037	Active Alarm 5 Value	-1999	9999	0	Read/Write	Active List (A or B)
40038	Active Alarm 6 Value	-1999	9999	0	Read/Write	Active List (A or B)
40039	Active Alarm 7 Value	-1999	9999	0	Read/Write	Active List (A or B)
40040	Active Alarm 8 Value	-1999	9999	0	Read/Write	Active List (A or B)
40041	Active Alarm 9 Value	-1999	9999	0	Read/Write	Active List (A or B)
40042	Active Alarm 10 Value	-1999	9999	0	Read/Write	Active List (A or B)
40043	Active Alarm 11 Value	-1999	9999	0	Read/Write	Active List (A or B)
40044	Active Alarm 12 Value	-1999	9999	0	Read/Write	Active List (A or B)
40045	Active Alarm 13 Value	-1999	9999	0	Read/Write	Active List (A or B)
40046	Active Alarm 14 Value	-1999	9999	0	Read/Write	Active List (A or B)
40047	Active Alarm 15 Value	-1999	9999	0	Read/Write	Active List (A or B)
40048	Active Alarm 16 Value	-1999	9999	0	Read/Write	Active List (A or B)
40049	Active Alarm 1 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40050	Active Alarm 2 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.

F

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40051	Active Alarm 3 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40052	Active Alarm 4 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40053	Active Alarm 5 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40054	Active Alarm 6 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40055	Active Alarm 7 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40056	Active Alarm 8 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40057	Active Alarm 9 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40058	Active Alarm 10 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40059	Active Alarm 11 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40060	Active Alarm 12 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40061	Active Alarm 13 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40062	Active Alarm 14 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40063	Active Alarm 15 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.
40064	Active Alarm 16 Band/Dev. Value	-1999	9999	0	Read/Write	Active List (A or B). Only for Band or Deviation Alarm Action.

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to "rLC".

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node (Meter) Address Specifier	Address a specific meter. Must be followed by a two digit node address. Not required when address = 00.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.
*, $	Terminator	Signifies end of transmission

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters *, or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	APPLICABLE COMMANDS/COMMENTS
A	Signal Input	INP	T, P
B	Active Setpoint	SET	T, V, P
C	Setpoint Ramp Rate	RMP	T, V, P
D	Output Power	PWR	T, V, P (V only in manual mode)
E	Proportional Band	PBD	T, V, P
F	Integral Time	INT	T, V, P
G	Derivative Time	DER	T, V, P
H	Alarm Status (1-4)	ALR	T, R, P
I	Alarm Value 1	AL1	T, V, R, P (Reset command resets Alarm Outputs)
J	Alarm Value 2	AL2	
K	Alarm Value 3	AL3	
L	Alarm Value 4	AL4	
M	Control Parameters	CTL	T, V, P
O	Auto/Manual Register	MMR	T, V
Q	Analog Output Register	AOR	T, V
S	Digital Output Register	DOR	T, V

Command String Examples:

1. Node address = 17, Write 350 to Alarm 1.
   String: N17VI350$
2. Node address = 5, Read Input value.
   String: N5TA*
3. Node address = 0, Reset Alarm 4 output.
   String: RL*

Sending Numeric Data

Numeric data sent to the controller must be limited to 4 digits (-1999 to 9999). Leading zeros are ignored. Negative numbers must have a minus sign. The controller ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the controller does not issue a reply to value change commands, follow with a transmit value command for readback verification.

RECEIVING DATA FROM THE CONTROLLER

Data is transmitted by the controller in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the controller is either a full field transmission or an abbreviated transmission. The controller response mode is selected via the Abru parameter in the Serial Port Parameters.

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	2 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Controller Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Alarm 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Alarm 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: O

This register sets the controlling mode for the outputs. In Auto Mode (0) the controller controls the digital outputs and analog output. In Manual Mode (1) the outputs are defined by the registers DOR and AOR. When transferring from auto mode to manual mode, the controller holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VO), any character besides 0 or 1 in a field will not change the corresponding output mode.

O abcde
e = Analog Output
d = DO4
c = DO3
b = DO2
a = DO1

Example: VO00011* places DO4 and Analog in manual.

Analog Output Register (AOR) ID: Q

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VQ) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the controller controls the analog output signal level. Reading from this register (TQ) will show the present value of the analog output signal.

Example: VQ2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Digital Output Register (DOR) ID: S

This register stores the states of the setpoint outputs. Reading from this register (TS) will show the present state of all the digital outputs. A "0" in the setpoint location means the output is off and a "1" means the output is on.

S abcd
d = DO4
c = DO3
b = DO2
a = DO1

In Automatic Mode, the controller controls the digital output state. In Manual Mode, writing to this register (VS) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VS10* will result in output 1 on and output 2 off.

COMMAND RESPONSE TIME

The controller can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the controller, a delay must be imposed before sending another command. This allows enough time for the controller to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the controller. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \text{\# of characters}) / \text{baud rate}$$

At the start of time interval t_2, the controller starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the controller is expected, the controller is ready to accept another command.

If the controller is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the (Serial Transmit Delay parameter (dLAY)). The standard command line terminating character is "*". This terminating character results in a response time window of the Serial Transmit Delay time (dLAY) plus 15 msec. maximum. The dLAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with "$" results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

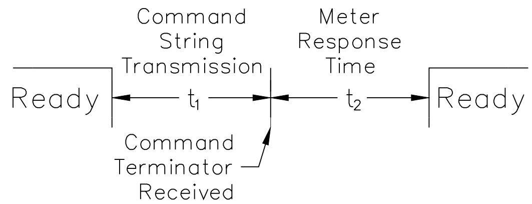
At the beginning of time interval t_3, the controller responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \text{\# of characters}) / \text{baud rate}.$$

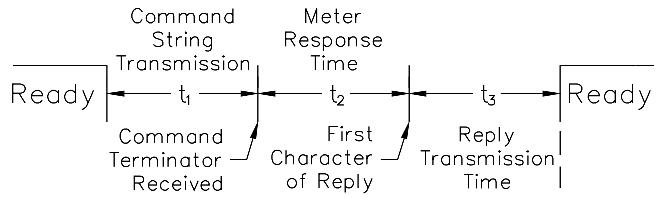
At the end of t_3, the controller is ready to receive the next command. The maximum serial throughput of the controller is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM CONTROLLER



RESPONSE FROM CONTROLLER



COMMUNICATION FORMAT

Data is transferred from the controller through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

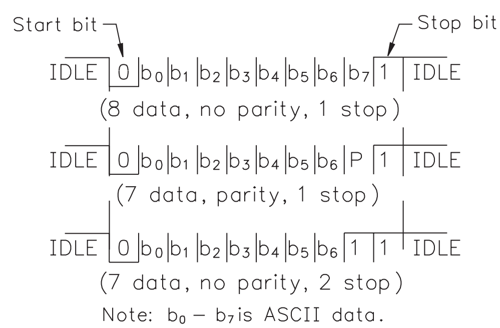
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the controller.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

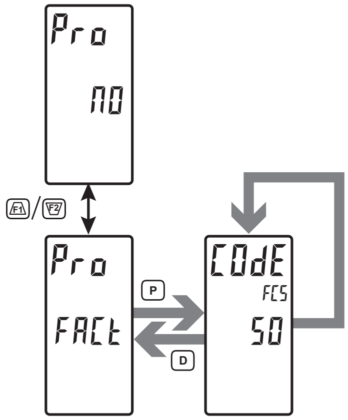
Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX controller ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

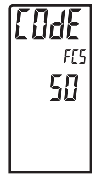
Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX controller.

Factory Service Operations (FACt)



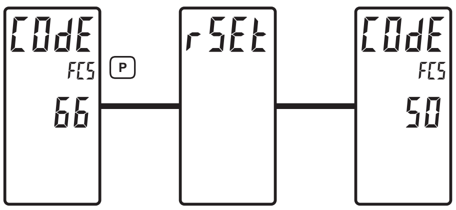
FACTORY SERVICE CODE



0 to 250

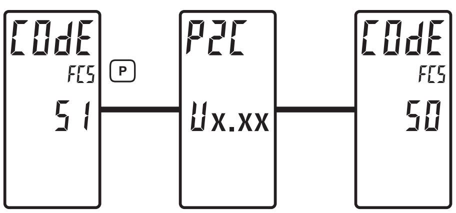
Enter the Service Code for the desired operation.

RESTORE FACTORY DEFAULTS



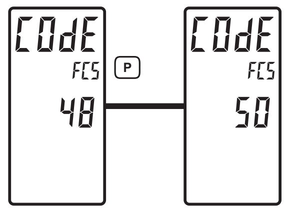
Use the F1 and F2 keys to display CODE 66 and press **P**. The controller will flash rSEt and then return to CODE 50. This will overwrite all user settings with the factory settings.

MODEL AND CODE VERSION



The controller will briefly display the model (P2C) on Line 1, and the current firmware version (VEr x.xx) on Line 2, and then return to CODE 50.

CONTROLLER CALIBRATION



NO Curr VoLt rES
tc ICE rtd AnLG

The controller has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Input Parameters. If the controller appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the controller. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it will affect the accuracy of the input signal and the values previously stored using the Apply (APLY) Scaling Style.

Preparation for Current, Volt, and Ohm Input Calibration

Warning: Input Calibration of this controller requires a signal source capable of producing a signal greater than or equal to the range being calibrated with an accuracy of 0.01% or better.

Before starting, verify that the Input Range, T/V, and Excitation Jumper is set for the range to be calibrated. Verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing the **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

Current, Volt and Ohm Calibration Procedure

1. After entering CodE 48, select the input signal type (Curr, VoLt, rES) to be calibrated.
2. Press the **P** key until the desired range along with ZER is displayed in the Line 2 units mnemonic.
3. Apply the zero input limit of the range indicated on Line 1 of the controller.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with FUL in the Line 2 units mnemonic
7. Apply the signal level indicated on Line 1 of the controller.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

F

Preparation for TC calibration

TC calibration parameters will affect RTD calibration. If using an RTD, it is recommended that the RTD calibration be performed after completing the TC calibration.

Warning: TC Input Calibration of this controller requires a signal source capable of producing a 60 mV signal with an accuracy of 0.01% or better.

Before starting, verify the T/V jumper is in the T position. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

TC Calibration Procedure

1. After entering CodE 48, select the tc.
2. Press the **P** key. Display will indicate 60mV with ZER displayed in the Line 2 units mnemonic.
3. Apply 0 mV to input.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate 60mV with FUL displayed in the Line 2 units mnemonic.
7. Apply 60 mV to input.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. TC Calibration complete.

Preparation for RTD Input Calibration

RTD calibration is dependent on TC calibration parameters. Therefore, the TC calibration should be performed prior to attempting the RTD calibration.

Warning: RTD Input Calibration of this controller requires a signal source capable of producing a 300 ohm resistance with an accuracy of 0.01% or better.

Before starting, verify that the T/V Jumper is in the T position. Verify the RTD jumper is in the proper range. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the controller. Selecting NO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

RTD Calibration Procedure

1. After entering Code 48, select rtd.
2. Press the **P** key until the desired range along with 0 is displayed in the Line 2 units mnemonic.
3. Apply zero ohms to the input of the controller.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with a value in the upper right corner, in ohms, to be applied in the next step in the Line 2 units mnemonic of the controller.
7. Apply the signal level, in ohms, as indicated by the Line 2 units mnemonic on the controller.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Ice Point Calibration Procedure

1. Remove all option cards.
2. Verify ambient temperature of controller environment is between 20°C and 30°C.
3. Set T/V jumper in the T position.
4. Connect a thermocouple with an accuracy of 1°C or better to the controller.
5. In the Analog Input Parameters, verify Input Type (tYPE) is set to the type of thermocouple connected in step 4, Temperature Scale (SCAL) is °C, Ice Point Compensation (ICE) is turned ON, Decimal Resolution (dECPt) is 0.0, Rounding Increment (rnd) is 0.1 and Display Offset (OFSt) is set to 0.
6. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25% °C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
7. If a difference exits between PAX2C display and reference thermometer, continue calibration.
8. Note the PAX2C display reading as the "Display Mode" reading to be used in Step 12.
9. Enter the Factory Service Operations, select CodE 48 and press **P**.
10. Select ICE and press **P**.
11. Display will indicate the Existing ICE Point Value.
12. Calculate a new ICE Point Value using: Existing ICE Point Value + (reference temperature – Display Mode reading). All values are in °C.
13. Using F1 and F2 change Existing ICE Point Value to indicate the new ICE Point Value calculated in Step 12.
14. Press **P** and return to Display Mode. Verify the Display Mode reading (with 0 Display Offset) matches the reference temperature. If not, repeat steps 8 thru 14.

Preparation for Analog Output Card Calibration

Warning: Calibration of this controller requires an external meter with an accuracy of 0.005% or better.

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure.

1. After entering CodE 48, select AnLG.
2. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2C F1 and F2 keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if the particular range is not in need of calibration, press the **P** key to advance to the next range.

PAX2C DISPLAY	EXTERNAL METER	ACTION
0.0 mA	0.00 mA	F1 and F2 to adjust External Meter
4.0 mA	4.00 mA	F1 and F2 to adjust External Meter
20.0 mA	20.00 mA	F1 and F2 to adjust External Meter
0.0 V	0.00 V	F1 and F2 to adjust External Meter
10.0 V	10.00 V	F1 and F2 to adjust External Meter

3. Calibration Complete.

OPERATION OVERVIEW

CONTROLLER POWER-UP

Upon applying power, the controller delays control action and temperature indication for several seconds to perform several self-diagnostic tests and display basic controller information. Initially, the controller illuminates both displays and all annunciators to verify that all display elements are functioning. The controller then displays the unit model type on the top display as well as the current firmware revision number on the bottom display. The controller then checks for correct internal operation and displays an error message (E-XX) if an internal fault is detected (see Troubleshooting for further information). Upon completion of this sequence, the controller begins control action by displaying the temperature/process value and updating the output(s) based on the PID control calculation.

PROCESS START-UP

After starting the process, the controller's PID settings must be initially "tuned" to the process for optimum control. Minimal tuning consists of adjusting the Proportional Band, Integral Time, and Derivative Time parameters to achieve the optimum response to a process disturbance. The controller can be tuned once, but must be re-tuned if the process has been changed significantly. Several options exist for tuning these parameters:

A) Use the controller's built-in Auto-Tune feature (see Auto-Tune).
B) Use a manual tuning technique (see Manual Tuning).
C) Use a third party tuning software package (generally expensive and not always precise).
D) Use values based on control loop experience, calculated values or values from a similar process.

If the controller is a replacement, the PID settings from the unit being replaced may be used as good initial values. Be sure to consider any differences in the units and the PID settings when replacing. The PID settings may be fine tuned by using the techniques outlined in the PID Control section. After tuning the controller to the process, it is important to power the load and the controller at the same time for best start-up response.

CONTROLLER POWER-DOWN

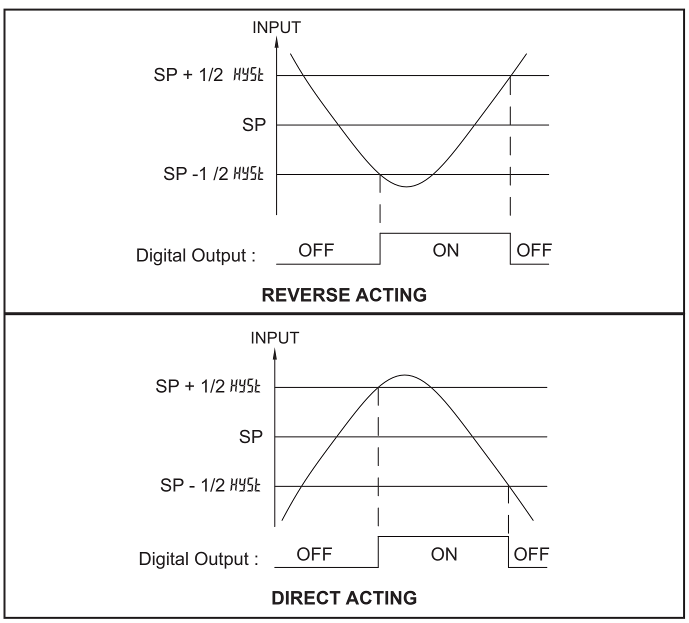
At power down, all parameters and control modes are saved to provide a quick and predictable process response on the next power-up. When powering down the process, it is important to power down the controller at the same time. This prevents the reset action of the controller from shifting the proportional band while the temperature/process value is dropping and prevents excessive overshoot on the next process start-up.

CONTROL MODE EXPLANATIONS

ON/OFF CONTROL

The controller operates in On/Off Control when the Proportional Band is set to 0.0%. In this control mode, the process will constantly oscillate around the setpoint value. The On/Off Control Hysteresis (balanced around the setpoint) can be used to eliminate output chatter. The Output Assignment can be set for heating (reverse - output on when below the setpoint) or for cooling(direct - output on when above the setpoint) applications.

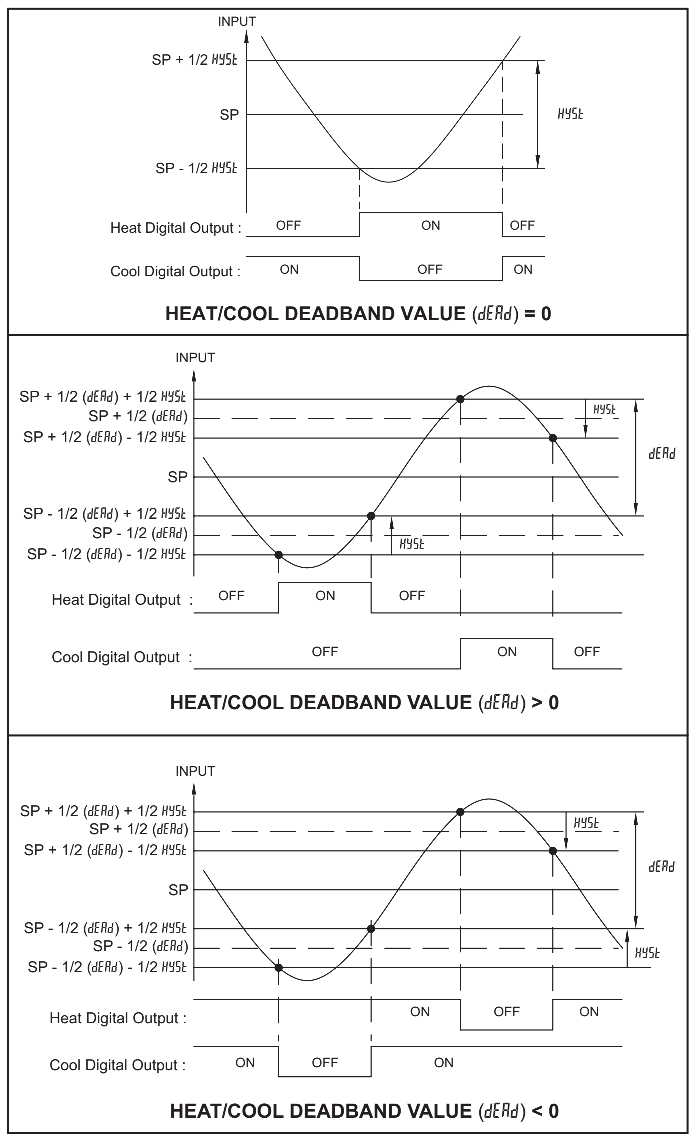
ON/OFF CONTROL - FIGURES



Note: HYSt in the On/Off Control Figures is a user defined value in the PID Configuration Parameters.

For heat and cool systems, one Digital Output is assigned as HEAt (reverse) and another Digital Output is assigned as COOL (direct). The Proportional Band is set to 0.0 and the Relative Gain in Cooling to 0.0. The Deadband in Cooling sets the amount of operational deadband or overlap between the outputs. The setpoint and the On/Off Control Hysteresis applies to both O1 and O2 outputs. The hysteresis is balanced in relationship to the setpoint and deadband value.

ON/OFF CONTROL - HEAT/COOL OUTPUT FIGURES

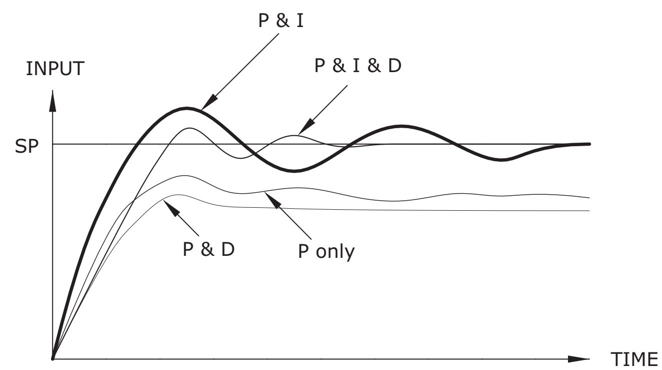


F

PID CONTROL

In PID Control, the controller processes the input and then calculates a control output power value by use of a specialized Proportional Band, IntegralTime, and Derivative Time control algorithm. The system is controlled with the new output power value to keep the process at the setpoint. The Control Action for PID Control can be set to reverse for heating (output on when below the setpoint) or direct for cooling (output on when above the setpoint) applications.For heat and cool systems, the heat and cool outputs are both used. The PID parameters can be established by using Auto-Tune, or they can be Manually tuned to the process.

TYPICAL PID RESPONSE CURVE



TIME PROPORTIONAL PID CONTROL

In Time Proportional applications, the output power is converted into output On time using the Cycle Time. For example, with a four second cycle time and 75% power, the output will be on for three seconds (4 × 0.75) and off for one second.

The cycle time should be no greater than 1/10 of the natural period of oscillation for the process. The natural period is the time it takes for one complete oscillation when the process is in a continuously oscillating state.

LINEAR PID CONTROL

In Linear PID Control applications, the Analog Output Assignment AnAS is set to % Output Power, OP. The Analog Low Scaling, AnLO , is set to 0.0 and the Analog High Scaling, AnHI , is set to 100.0. The Analog Output will then be proportional to the PID calculated % output power for Heat or Cooling per the Control Action OPAC. For example, with 0 VDC to 10 VDC (scaled 0 to 100%) and 75% power, the analog output will be 7.5 VDC.

MANUAL CONTROL MODE

In Manual Control Mode, the controller operates as an open loop system (does not use the setpoint or process feedback). The user adjusts the percentage of power through the % Power display to control the output power. Manual operation provides 0 to 100% power to the HEAt output and -100 to 0% power to the COOL output. The Low and High Output Power limits are ignored when the controller is in Manual.

MODE TRANSFER

When transferring the controller mode between Automatic and Manual, the controlling outputs remain constant, exercising true "bumpless" transfer. When transferring from Manual to Automatic, the power initially remains steady, but Integral Action corrects (if necessary) the closed loop power demand at a rate proportional to the Integral Time.

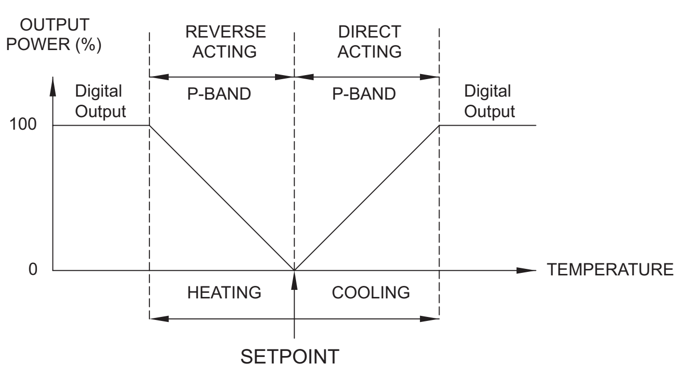
AUTOMATIC CONTROL MODE

In Automatic Control Mode, the percentage of output power is automatically determined by PID or On/Off calculations based on the setpoint and process feedback.

PID CONTROL

PROPORTIONAL BAND

Proportional band is defined as the "band" of temperature the process changes to cause the percent output power to change from 0% to 100%. The band may or may not be centered about the setpoint value depending upon the steady state requirements of the process. The band is shifted by manual offset or integral action (automatic reset) to maintain zero error. Proportional band is expressed as percent of input sensor range.



Example: Thermocouple type T with a temperature range of 600°C is used and is indicated in degrees Celsius with a proportional band of 5%. This yields a band of 600°C X 5% = 30°C.

The proportional band should be set to obtain the best response to a disturbance while minimizing overshoot. Low proportional band settings (high gain) result in quick controller response at expense of stability and increased overshoot. Settings that are excessively low produce continuous oscillations at setpoint. High proportional band settings (low gain) result in a sluggish response with long periods of process "droop". A proportional band of 0.0% forces the controller into ON/OFF control mode with its characteristic cycling at setpoint (See ON/OFF Control for more information).

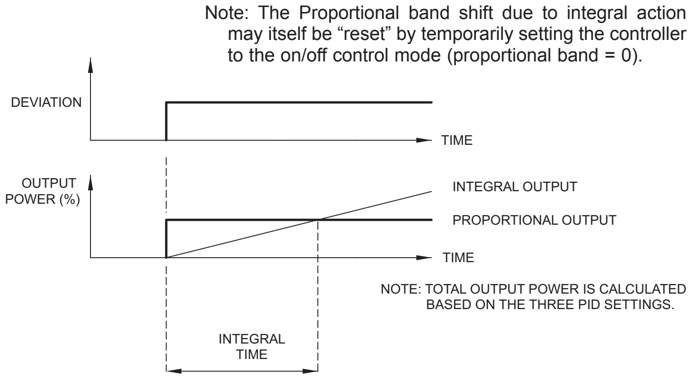
INTEGRAL TIME

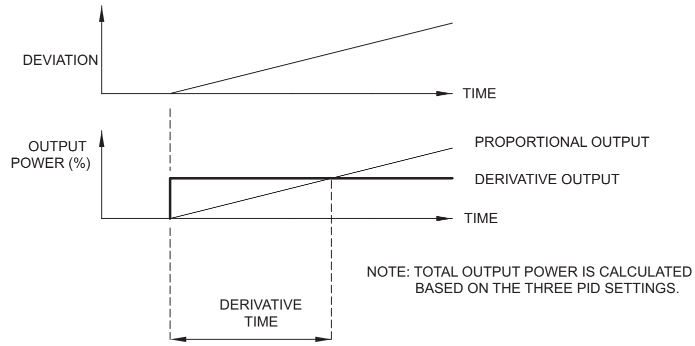
Integral time is defined as the time, in seconds, in which the output due to integral action alone equals the output due to proportional action with a constant process error. As long as a constant error exists, integral action repeats the proportional action every integral time. Integral action shifts the center point position of the proportional band to eliminate error in the steady state. The units of integral time are seconds per repeat.

Integral action (also known as "automatic reset") changes the output power to bring the process to setpoint. Integral times that are too fast (small times) do not allow the process to respond to the new output value. This causes over compensation and leads to an unstable process with excessive overshoot. Integral times that are too slow (large times) cause a slow response to steady state errors. Integral action may be disabled by setting the time to zero. If time is set to zero, the previous integral output power value is maintained.

If integral action is disabled, manual reset is available by modifying the output power offset (OPOF initially set to zero) to eliminate steady state errors. This parameter appears in unprotected parameter mode when integral time is set to zero. The controller has the feature to prevent integral action when operating outside the proportional band. This prevents "reset wind-up".

F





DERIVATIVE TIME

Derivative time is defined as the time, in seconds, in which the output due to proportional action alone equals the output due to derivative action with a ramping process error. As long as a ramping error exists, the derivative action is “repeated” by proportional action every derivative time. The units of derivative time are seconds per repeat.

Derivative action is used to shorten the process response time and helps to stabilize the process by providing an output based on the rate of change of the process. In effect, derivative action anticipates where the process is headed and changes the output before it actually “arrives”. Increasing the derivative time helps to stabilize the response, but too much derivative time coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. None or too little derivative action usually results in decreased stability with higher overshoots. No derivative action usually requires a wider proportional and slower integral times to maintain the same degree of stability as with derivative action. Derivative action is disabled by setting the time to zero.

PRIMARY/ALTERNATE PID VALUES

The PAX2C incorporates two different groups of PID parameters in memory. These are designated as the Primary (Pri) and Alternate (Alt) PID values. It is possible to toggle between these values using the PID Selection parameter which is available in the PID configuration menu. This functionality (PSEL) is also available via the user inputs, function keys or Line 2 user function.

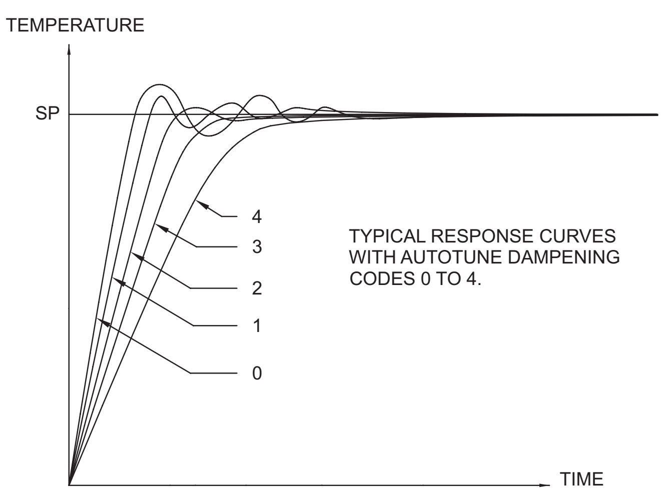
The Active PID parameters reflect the PID values that are selected via the PSEL parameter. If a change is made to an active PID value, such as a user change or after an Auto-tune, the values will automatically be copied into the Primary or Alternate group depending on which group is selected by the PSEL parameter.

PID TUNING EXPLANATIONS

AUTO-TUNE

Auto-Tune is a user-initiated function where the controller automatically determines the Proportional Band, Integral Time, Derivative Time, Digital Filter, Control Ouput Dampening Time, and Relative Gain (Heat/Cool) values based upon the process characteristics. The Auto-Tune operation cycles the controlling output(s) at a control point three-quarters of the distance between the present process value and the setpoint. The nature of these oscillations determines the settings for the controller’s parameters.

Prior to initiating Auto-Tune, it is important that the controller and system be verified. (This can be accomplished in On/Off Control or Manual Control Mode.) If there is a wiring, system or controller problem, Auto-Tune may give incorrect tuning or may never finish. Auto-Tune may be initiated at start-up, from setpoint or at any other process point. However, insure normal process conditions (example: minimize unusual external load disturbances) as they will have an effect on the PID calculations.



AUTO-TUNING CODE FIGURE

INITIATE AUTO-TUNE

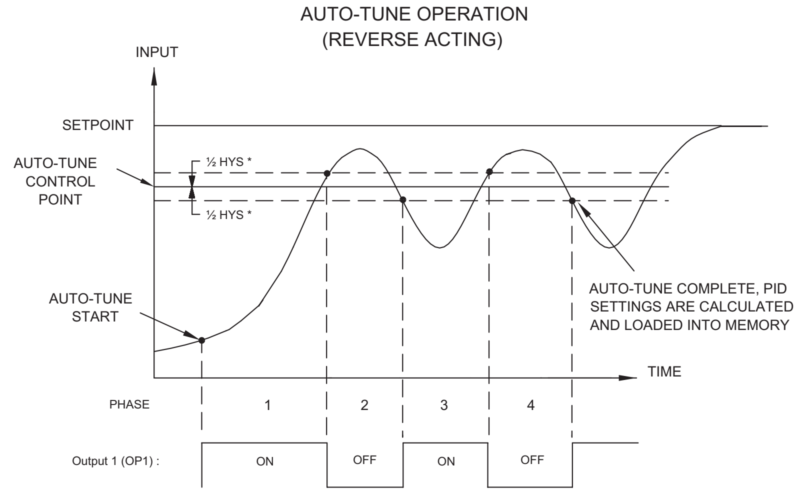
Below are the parameters and factory settings that affect Auto-Tune calculations. If changes are needed, then they must be made before starting Auto-Tune. Please note that it is necessary to configure the input and control outputs prior to initiating auto-tune.

DISPLAY	PARAMETER	FACTORY SETTING	MENU
FLtr	Digital Filtering	1.0	INPt
CHYS	On/Off Control Hysteresis	2 (Temperature Mode) 0.2 (Process Mode)	Pid
tCod	Auto-Tune Code	2	Pid
dEAd	Deadband	0.0	Pid
tUNE	Auto-Tune Access	LOC	Pid

1. Enter the Setpoint value via the PID Menu or via the Display, Parameter or Hidden Menu Loop Menu (if enabled).
2. Initiate Auto-Tune by changing Auto-Tune tUNE to YES via the PID Menu or via the Display, Parameter or Hidden Menu Loop Menu (if enabled).

AUTO-TUNE PROGRESS

The controller will oscillate the controlling output(s) for four phases. The bottom display will flash the phase number. Parameter viewing is permitted during Auto-Tune. The time to complete the Auto-Tune cycles is process dependent. The controller should automatically stop Auto-Tune and store the calculated values when the four phases are complete. If the controller remains in Auto-Tune unusually long, there may be a process problem. Auto-Tune may be stopped by entering nO in Auto-Tune Start tUNE.



* - On/Off Control Hysteresis

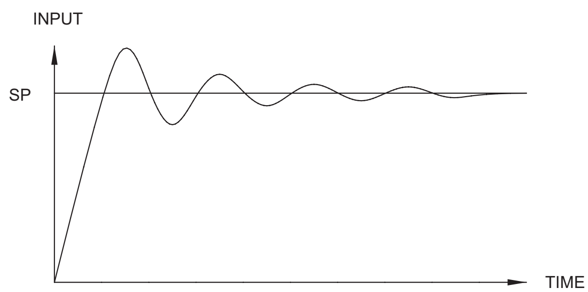
PID ADJUSTMENTS

In some applications, it may be necessary to fine tune the Auto-Tune calculated PID parameters. To do this, a chart recorder or data logging device is needed to provide a visual means of analyzing the process. Compare the actual process response to the PID response figures with a step change to the process. Make changes to the PID parameters in no more than 20% increments from the starting value and allow the process sufficient time to stabilize before evaluating the effects of the new parameter settings.

In some unusual cases, the Auto-Tune function may not yield acceptable control results or induced oscillations may cause system problems. In these applications, Manual Tuning is an alternative.

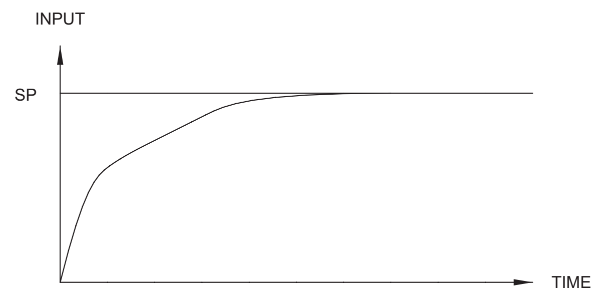
PROCESS RESPONSE EXTREMES

OVERSHOOT AND OSCILLATIONS



TO DAMPEN RESPONSE:
- INCREASE PROPORTIONAL BAND.
- INCREASE INTEGRAL TIME.
- USE SETPOINT RAMPING.
- USE OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A HIGHER AUTO-TUNE CODE.
- INCREASE DERIVATIVE TIME.

SLOW RESPONSE



TO QUICKEN RESPONSE:
- DECREASE PROPORTIONAL BAND.
- DECREASE INTEGRAL TIME.
- INCREASE OR DEFEAT SETPOINT RAMPING.
- EXTEND OUTPUT POWER LIMITS.
- RE-INVOKE AUTO-TUNE WITH A LOWER AUTO-TUNE CODE.
- DECREASE DERIVATIVE TIME.

F

MANUAL TUNING

A chart recorder or data logging device is necessary to measure the time between process cycles. This procedure is an alternative to the controller's Auto-Tune function. It will not provide acceptable results if system problems exist.

1. Set the Proportional Band (ProP) to 10.0% for temperature models (Temperature) and 100.0% for process models (Voltage/Current).
2. Set both the Integral Time (Intt) and Derivative Time (dErt) to 0 seconds.
3. Set the active PID Power Filter (FLtr) in the PID Menu to 0 seconds.
4. Set the Output Cycle Time (CYCt) in the Digital Output Menu to no higher than one-tenth of the process time constant (when applicable).
5. Place the controller into Manual Control Mode (MAN) via the trnF parameter in the PID Menu and adjust the % Power to drive the process value to the Setpoint value. Allow the process to stabilize after setting the % Power.
6. Place the controller in Automatic (Auto) Control Mode via the trnF parameter in the PID Menu. If the process will not stabilize and starts to oscillate, set the Proportional Band two times higher and go back to Step 5.
7. If the process is stable, decrease Proportional Band setting by two times and change the Setpoint value a small amount to excite the process. Continue with this step until the process oscillates in a continuous nature.
8. Fix the Proportional Band to three times the setting that caused the oscillation in Step 7.
9. Set the Integral Time to two times the period of the oscillation.
10. Set the Derivative Time to 1/8 (0.125) of the Integral Time.
11. Set the Output Dampening Time to 1/40 (0.025) the period of the oscillation.

TROUBLESHOOTING GUIDE

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections
No Display After Power-Up	Check dLEV and dCnt program settings in the Display menu.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CodE 0 prompt.
No Line 1 Display	Check program settings for Line 1 Display Assignment.
No Line 2 Display	Check program settings for Line 2 Value Access. Confirm at least one Line 2 Parameter Value is enabled in Main Display Loop.
No Programmable Units Display	Check program settings for Line 1/2 Units Mnemonic(s).
Incorrect Process Display Value	Check Input Jumper Setting, Input Level, and Input Connections.
	Verify Input Menu settings.
	Contact factory
Display of OLOL, ULUL, Short, OPEN, or ". . . ."	See General Controller Specifications, Display Messages.
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: EKEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EPAr Error Code: EdYn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ECAL	Calibration Data Validation Error. Contact factory.
Error Code: ELin	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

F

MODEL TCU - TEMPERATURE CONTROL UNIT

c UL US LISTED
IND. CONT. EQ.
51EB

- 100 msec SAMPLING PERIOD WITH 0.15% ACCURACY
- ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS
- DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT, SECOND ANALOG INPUT OR HEATER CURRENT
- ACCEPTS 10 DIFFERENT TYPES OF SENSOR INPUTS (Thermocouple or RTD)
- SELF-DIAGNOSTICS
- FULL PID CONTROL WITH REDUCED OVERSHOOT
- OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE
- OPTIONAL DUAL ALARM OUTPUTS (USES OUTPUT MODULES)
- OPTIONAL COOLING OUTPUT (USES OUTPUT MODULE)
- OPTIONAL LINEAR 4 to 20 mA or 0 to 10 VDC OUTPUT FOR CONTROL OR TEMPERATURE RE-TRANSMISSION
- OPTIONAL HEATER CURRENT MONITOR AND BREAK ALARM
- OPTIONAL MOTORIZED VALVE POSITION CONTROL AND VALVE FAIL ALARM
- OPTIONAL SECOND ANALOG INPUT FOR REMOTE SETPOINT AND CASCADE CONTROL
- OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL
- STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES
- PROGRAMMABLE USER INPUT (DIGITAL) FOR ADDED FLEXIBILITY
- SENSOR ERROR COMPENSATION (Slope and Offset) AND BREAK DETECTION
- MANUAL/AUTOMATIC AND LOCAL/REMOTE SETPOINT CONTROL MODES
- SETPOINT RAMPING FOR PROCESS STARTUP
- PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS
- FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR Drive and Triac)

DESCRIPTION

The TCU Controller accepts signals from a variety of temperature sensors *(thermocouple or RTD elements)*, precisely displays the process temperature, and provides an accurate output control signal *(time proportional or linear)* to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to solve various application requirements.

The controller can operate in the PID control mode for both heating and cooling, with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis.

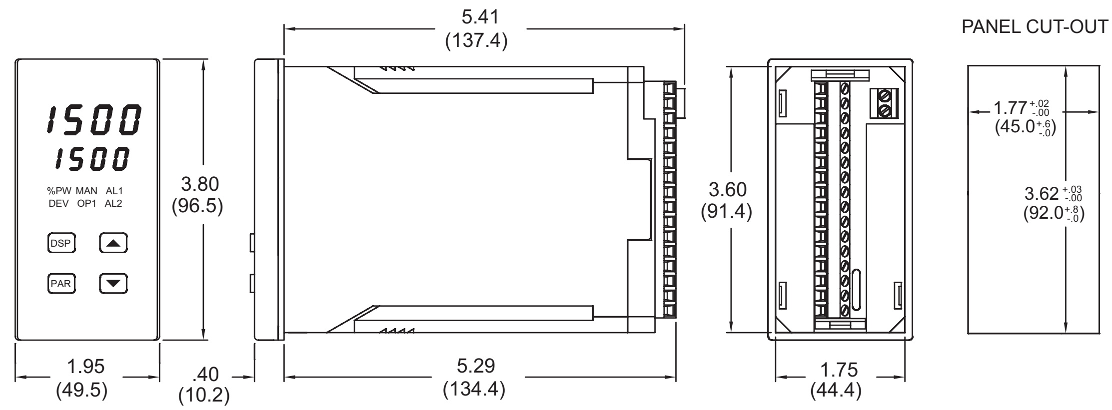
Dual 4-digit displays allow viewing of the process temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. Replaceable and interchangeable output modules *(relay, SSR drive, or triac)* can be installed for the main control output, alarm output(s) and cooling output.

Optional dual alarms can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT, Heater Break and Valve Fail Detect) with adjustable hysteresis. A standby feature suppresses the output during power-up until the temperature stabilizes outside the alarm region. An optional secondary output is available *(for processes that require cooling)* which provides increased control accuracy and response.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

OPTIONS

A linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following: % output power, process temperature value, process temperature value deviation or setpoint value. For Linear DC control applications, the adjustable output demand dampening, output deadband and output update time parameters expand the versatility of the TCU with final control devices.

The optional Heater Current Monitor serves as a digital ammeter for heater current monitoring. Current transformer accessory (CT005001), is required. An alarm event output can be programmed to signal when the heater or heater control devices have failed, before damage to process material occurs. The Heater Break alarm triggers under two conditions:

1) The main output (OP1) is "on" and the heater current is below the heater current alarm value, indicating an aged or failed heater.
2) Output (OP1) is "off" and the heater current is more than 10% of the alarm value, indicating a shorted heater control device or other problem.

The optional Motorized Valve Positioner directly controls the position of a valve by the use of twin outputs *(open and close)* to control the direction of motor rotation. The motor position defines the opening position of the valve. Two control modes are possible: position control, which makes use of the slidewire feedback signal supplied with the positioner and velocity control, in which no slidewire feedback signal is used. Parameters are provided to adjust the operation of the valve. These include:

Valve activity hysteresis
Valve update time
Variable control dampening
Slidewire signal fail action
Adjustable valve position limits.

The valve positioner TCU achieves tight process control, yet minimizes unnecessary valve activity. An alarm event output or display alarm can be programmed under loss of slidewire feedback or under valve fail detection.

The optional Second Analog Input (0-20 mA DC) can be configured as a remote setpoint signal or as a secondary process signal. Configuration of the second analog input as a remote setpoint signal allows ratio control, master setpoint/multiple slave operation, and the ability to cascade the TCU with another controller (external cascade). Configuration of the second input as a secondary process signal allows operation as a two-process cascade controller within a single unit (internal cascade). In either control mode, parameters are provided to scale, configure, communicate and monitor the activity of both analog inputs. A square law linearizer function can be used to linearize signals derived from flow transmitters.

The optional RS485 multidrop serial communication interface provides two-way communication between a TCU unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0-99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output*(s)* may also be reset via the serial communications interface option.

An optional Type 4X/IP65 rated bezel is available for wash down and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TCU to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY**: Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages (Model dependent):
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*
   "...." - Appears when display values exceed + display range.
   "-..." - Appears when display values exceed - display range.
   "SLid" - Appears when loss of slidewire signal is detected.
   "VALV" - Appears when valve actuator error is detected.
2. **POWER**: Switch selectable for 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA
3. **ANNUNCIATORS**:
   LED Backlight Status Indicators (Model dependent):
   %PW - Lower auxiliary display shows power output in (%).
   DEV - Lower auxiliary display shows deviation *(error)* from temperature setpoint.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Cooling output is active *(for Cooling Option)*.
   OPN - Valve positioner OPEN output is active *(for Valve Positioner option)*.
   CLS - Valve positioner CLOSE output is active *(for Valve Positioner option)*.
   CUR - Lower auxiliary display shows heater current *(for Heater Current Monitor option)*.
   SEC - Lower auxiliary display shows second analog input *(For Second Analog Input option)*.
   MAN - Flashing: Controller is in manual mode.
   REM - ON: controller is in remote setpoint mode *(Second Analog Input option)*.
   - OFF: controller is in local setpoint mode *(Second Analog Input option)*.
   - Flashing: controller is in Manual control mode *(Second Analog Input optional)*.
4. **CONTROLS**: Four front panel push buttons for modifying and setup of controller functions and one external input for parameter lockout or other functions.
5. **MAIN SENSOR INPUT**:
   Sample Period: 100 msec
   Response Time: 300 msec *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   DC Linear: Programmable preset output
   Normal Mode Rejection: 40 dB @ 50/60 Hz *(improves with increased digital filtering.*
   Common Mode Rejection: 100 dB, DC to 60 Hz
   Protection: Input overload 120 VAC for 30 seconds.
6. **THERMOCOUPLE**:
   Types: T, E, J, K, R, S, B, N, Linear mV
   Input Impedance: 20 M Ω all types
   Lead resistance effect: 20 µV/350 Ω
   Cold junction compensation: Less than ±1°C error over 0 - 50°C ambient temperature range. Disabled for Linear mV type.
   Resolution: 1°C/F all types, or 0.1°C/F for T, E, J, K, and N only.
7. **RTD**: 2, 3 or 4 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.003916
   Excitation: 0.175 mA
   Resolution: 1 or 0.1 degree
   Lead Resistance: 7 Ω maximum
8. **RANGE AND ACCURACY**:
   Errors include NIST conformity and A/D conversion errors at 23°C after 20 min. warm-up. Thermocouple errors include cold junction effect. Errors are expressed as ±percent of reading and ± $^3/_4$ LSD unless otherwise noted.

TC TYPE	RANGE	ACCURACY	WIRE COLOR (ANSI)
T	-200 to +400°C -328 to +752°F	0.20% + 1.5°C 0.20% + 2.7°F	blue
E	-200 to 750°C -328 to +1382°F	0.20% + 1.5°C 0.20% + 2.7°F	violet
J	-200 to +760°C -328 to +1400°F	0.15% + 1.5°C 0.15% + 2.7°F	white
K	-200 to +1250°C -328 to +2282°F	0.20% + 1.5°C 0.20% + 2.7°F	yellow
R	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
S	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
B	+200 to +1820°C +300 to +3308°F	0.15% + 2.5°C 0.15% + 4.5°F	grey
N	-200 to +1300°C -328 to +2372°F	0.20% + 1.5°C 0.20% + 2.5°F	orange
mV	-5.00 to 56.00	0.15% + 1 LSD	—
RTD (385)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
RTD (392)	-160 to +600°C -256 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
OHMS	1.0 to 320.0	0.15% + 1 LSD	—

F

9. **OUTPUT MODULES [Optional] (For All Output Channels)**:
Relay:
Type: Form-C *(Form-A with some models. See Ordering Information.)*
Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)*
Life Expectancy: 100,000 cycles at max. load rating. *(Decreasing load and/or increasing cycle time, increases life expectancy).*
Logic/SSR Drive: Can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical
Drive: 45 mA max.
Triac:
Type: Isolated, Zero Crossing Detection
Rating:
Voltage: 120/240 VAC
Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C
Min. Load Current: 10 mA max.
Offstate Leakage Current: 7mA max. @ 60 Hz
Operating Frequency: 20 to 400 Hz
Protection: Internal Transient Snubber, Fused

10. **MAIN CONTROL OUTPUT (Heating or Cooling)**:
Control: PID or ON/OFF
Output: Time proportioning or linear DC
Hardware: Plug-in, replaceable output modules
Cycle time: Programmable
Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
Probe Break Action: Programmable

11 . **COOLING OUTPUT (Optional)**:
Control: PID or ON/OFF
Output: Time proportioning or linear DC
Hardware: Plug-in, replaceable output modules
Cycle time: Programmable
Proportional Gain Adjust: Programmable
Heat/Cool Deadband Overlap: Programmable

12. **LINEAR DC OUTPUT (Optional)**: With digital scale and offset, programmable deadband and update time.
4 to 20 mA:
Resolution: 1 part in 3500 typ.
Accuracy: ±*(0.1% of reading + 25 µA)*
Compliance: 10 V *(500 Ω max. loop impedance)*
0 to 10 VDC:
Resolution: 1 part in 3500 typ.
Accuracy: ±*(0.1% of reading + 35 mV)*
Min. Load Resistance: 10 KΩ *(1 mA max.)*
Source: % output power, setpoint, deviation, or temperature *(Available for heat or cool, but not both.)*

13. **HEATER CURRENT MONITOR (Optional)**:
Type: Single phase, full wave monitoring of load currents controlled by main output (OP1)
Input: 100 mA AC output from current transformer RLC part number CT005001 or any current transformer with 100 mA AC output
Display Scale Range: 1.0 to 999.9 amperes or 100.0%
Input resistance: 5 Ω
Accuracy: 1% of full scale ±1 LSD (10 to 100% of range)
Frequency: 50 to 400 Hz
Alarm mode: Dual acting; heater element fail detect and control device fail detect
Overload: 200 mA *(steady state)*
Min. output "on" time for Heater break alarm detect: 400 msec

14. **MOTORIZED VALVE POSITIONER (Optional)**:
Two Outputs: Valve open and valve close or Linear DC *(optional)*
Hardware: Plug-in, replaceable output modules
Three Inputs: Slidewire feedback, signal fail detect *(Isolated from main input)*
Slidewire Resistance: 100 to 100 KΩ
Slidewire Exciting Voltage: 0.9 VDC
Slidewire Fail Action: programmable
Control Mode: Position mode *(with slidewire)* and velocity mode *(w/o slidewire)*.
Control Deadband: 1% to 25.0% *(position mode)*
0.1 to 25.0 seconds *(velocity mode)*
Update Time: 1 to 250 seconds
Motor Time (open, close): 1 to 9999 seconds
Position Limits: Adjustable 0.0 to 100.0% of valve stroke
Valve Fail Time: Off to 9999 seconds
Alarm mode: Dual acting; loss of slidewire feedback signal and valve fail detection

15. **SECOND ANALOG INPUT**:
Range: 0 to 20 mA (Isolated from main input)
Overload: 100 mA (steady state)
Input Resistance: 10 Ω
Voltage Drop (@ 20 mA): 0.2 V
Accuracy: 0.15% of reading ±10 µA ±1 LSD
Scale Range: -999 to 9999

16. **SERIAL COMMUNICATION**:
Type: RS485 Multi-point, Balanced Interface
Communication Format:
Baud Rate: Programmable from 300 to 9600
Parity: Programmable for odd, even, or no parity
Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit
Unit Address: Programmable from 0 to 99, max. of 32 units per line
Transmit Delay: 100 msec min., 200 msec max.
RS485 Common: Isolated from signal input common
Auto Print Time: Off to 9999 seconds between print-outs

17. **USER INPUT (Optional)**: Internally pulled up to +5 VDC.
$V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 3.0 V_{MIN},
Available on all second input (HCM, MVP & ANA) models, and on models with RS485.
Response Time: 100 msec max.
Functions: Program Lock
Integral Action Lock
Auto/Manual Mode Select
Setpoint Ramp Select
Reset Alarms
Print Request
Local/Remote Setpoint Select

18. **ALARMS (Optional)**:
Hardware: Plug-in, replaceable output module
Modes: Absolute high acting
Absolute low acting
Deviation high acting
Deviation low acting
Inside band acting
Heater break
Valve fail
Second Analog Input monitoring
Reset Action: Programmable; automatic or latched
Standby Mode: Programmable; enable or disable
Hysteresis: Programmable
Probe Break Action: Upscale
Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with cooling output or motorized valve position option.)*

19. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: 0 to 50°C
Storage Temperature Range: -40 to 80°C
Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
Shock to IEC 68-2-27: Operational 5 g
Span Drift *(maximum)*: 100 ppm/°C, main input; 150 ppm/°C, second input
Operating and Storage Humidity:
85% max. (non-condensing) from 0 to 50°C
Zero Drift *(maximum)*: 1 µV/°C, main input;2 µA/°C, second input
Altitude: Up to 2000 meters

20. **ISOLATION BREAKDOWN RATINGS**:
All inputs and outputs with respect to AC line: 2300 V
Analog Outputs, Second Analog Input, Heater Current Input or Slidewire Input with respect to main input: 500 V

21. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
EN 61010-1
RoHS Compliant
UL Recognized Component: File #E156876
UL Listed: File #E137808
Type 2 Enclosure rating (Face only) for TCU0
Type 4X/IP65 Enclosure rating (Face only) for TCU1
Refer to EMC Installation Guidelines section of the manual for additional information.

22. **CONNECTION**: Jaw-type terminal block
Wire Range: 12-30 AWG copper wire
Torque: 5-7 inch-lbs (56-79 N-cm)

F

23. **CONSTRUCTION**:
Front Panel: Flame and scratch resistant tinted plastic
Case: High impact black plastic. (Mounting collar included)
Type 4X/IP65 model only: Sealed bezel utilizing two captive mounting screws (panel gasket included). This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2
24. **WEIGHT**: 1.3 lbs (0.6 kgs)

ACCESSORIES:

External SSR Power Unit:
Switched Voltage Range: 50 to 280 VAC *(Nominal: 240 VAC)*
Load Current: 45 Amps @ 25°C ambient temperature
35 Amps @ 50°C ambient temperature
On State Input: 3 to 32 VDC @ 1500 Ω impedance. *(isolated)*
(Use Logic/SSR drive output module.)
Off State Input: 0.0 to 1.0 VDC
Size: 5.5" (14 cm) L x 4.75" (12 cm) W x 2.62" (6.6 cm) H
Current Transformer:
Current Ratio: 50:0.1 (Amperes)
Accuracy: ±5.0%
Operating Frequency: 50 to 400 Hz
Insulation Class: 0.6 Kv BIL 10 Kv full wave
Terminals: Brass studs No. 8-36, (flat washer, washer, nut)
Weight: 8.0 oz (226 g)
Approvals: UL recognized component

BASIC OPERATION

The TCU controls a process temperature by measuring the temperature via an input probe, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process temperature at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low temperature overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit will display the process temperature in the upper display. One of six other parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Temperature Deviation
- Heater Current
- Second Input Process Value
- Temperature Symbol (F or C)

The six parameters can be scrolled through by pressing the DSP button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode when making a parameter change. The controller's configuration and parameter settings are stored in an internal E^2PROM device.

HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent temperature control. Measurement accuracy of 0.15% or better, provides closer process control conforming to the desired control setpoint value. One model accepts a variety of both thermocouple or RTD temperature probes. The AC input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing modules.

The optional Type 4X/IP65 rated model utilizes two bezel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed. The standard model simply requires pressing a latch to remove the unit.

Low-drift, highly stable circuitry ensures years of reliable and accurate temperature control. The recommended two-year re-calibration interval is easily accomplished via the programming menu.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces thermal shock to the process and helps to minimize temperature overshoot.The setpoint may also be transmitted by the optional linear DC output for slave control loops.

The second analog input may be configured as a remote setpoint. As such, the controller is easily switched from local/remote setpoint operation via the front panel or user input. Ratio and bias parameters provide on-line scaling of the remote setpoint. Absolute limit values and maximum rate of change of the remote setpoint further enhance controller flexibility.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control. A programmable temperature shift and slope function can be used to compensate for probe errors or to have multiple TCU units indicate the same nominal temperature.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output(s), etc.

The second analog input has independent scaling parameters to match the units of other processes or transmitters, or to match the controller's range.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). With adjustable time proportioning-cycle time, and programmable DC linear output, the controller can satisfy a wide variety of output requirements.

Programmable dampening output hysteresis and output update time parameters can dramatically reduce actuator activity without degrading control accuracy.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

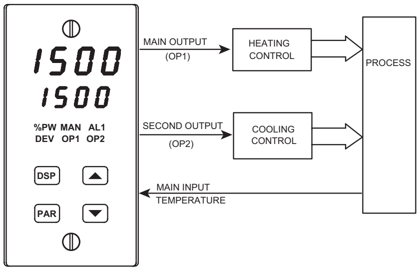
AUTO-TUNE

The TCU has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

OPTIONS

HEATING AND COOLING CONTROL

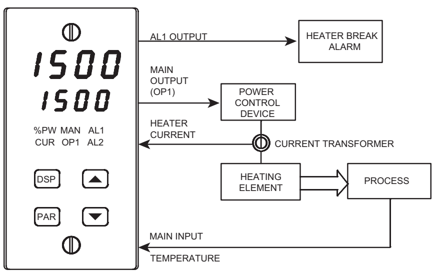


The TCU has dual outputs for providing heating and cooling to those processes that require them. Many extruder applications require both heating and cooling to maintain accurate extruder barrel and die temperatures. The TCU is easily configured for these applications.

Cooling Configuration Parameters

"CYC2"	- Enter cooling time proportioning cycle time
"GAN2"	- Enter cooling relative gain
"db-2"	- Enter heat/cool deadband or overlap

HEATER CURRENT MONITOR

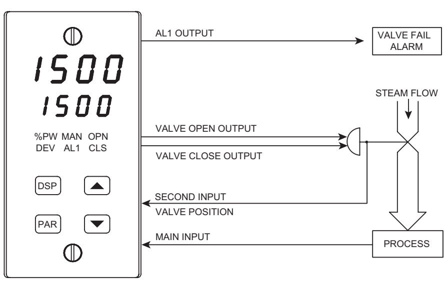


The Heater Current Monitor serves as a heater element fail sentry, so operators can take corrective action before significant process errors occur in the event of a failure. The actual heater current can be viewed in the secondary display and/or a heater break alarm output can be programmed.

Heater Current Monitor Configuration Parameters

"HCur"	- Enter full scale current of current transformer
ACt1", "ACt2"	- Program alarm(s) as heater break alarm

MOTORIZED VALVE POSITIONER

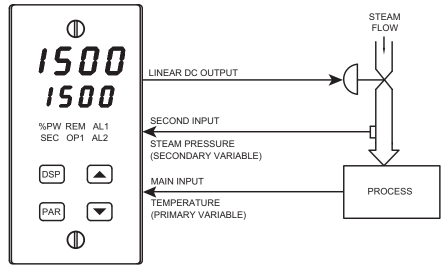


The motorized valve positioner controls the position of a valve directly, by use of "open" and "close" control outputs. The slidewire feedback signals of the valve may optionally be connected to the controller. Alternatively, the controller may be configured for linear input valve control using the 4 to 20 mA DC output.

Motorized Valve Positioner Configuration Parameters

Position mode:	"VPS1"	- Enter or measure valve closed position
	"VPS2"	- Enter or measure valve open position
	"VUdt"	- Enter Valve update time
	"VPdb"	- Enter valve control deadband
	"VFAL"	- Enter valve fail detect time
	"Act1"	- Program alarm as valve fail output
Velocity mode:	"VUdt"	- Enter Valve update time
	"VOPt"	- Enter valve open time
	"VCLt"	- Enter valve close time
	"VONt"	- Enter valve control deadband *(minimum on time)*

INTERNAL CASCADE



Cascade control allows the process to be divided into two control loops: the primary control loop and the secondary control loop. The secondary loop receives it's setpoint from the primary loop to control an intermediate variable (steam pressure). The control level of the intermediate variable is the input to the primary process. The primary loop (temperature) controller maintains loop regulation by manipulating the setpoint of the secondary controller. The setpoint of the secondary controller, in turn, changes the intermediate variable. The secondary loop can react faster to disturbances of the intermediate variable, thereby minimizing the effects to the primary control loop. Control loops cascaded in such a manner provide greater control quality than would be possible with single loop control. A single TCU can accomplish two-process cascade control.

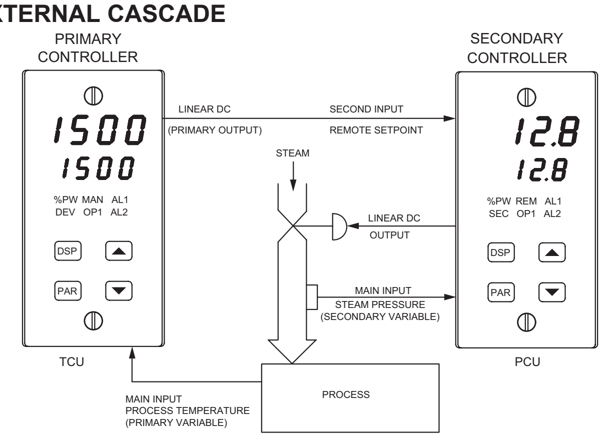
Internal Cascade Configuration Parameters

"OPer"	- Select cascade mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1"	- Enter scaling units of second input
"INP1"	- Enter scaling units of second input
"dSP2"	- Enter scaling units of second input
"INP2"	- Enter scaling units of second input
"OPd2"	- Output dampening of secondary

Internal Cascade Operational Parameters

"SP-2"	- View secondary setpoint value
"Pb-2"	- Enter secondary proportional band
"It-2"	- Enter secondary integral time
"dt-2"	- Enter secondary derivative time

EXTERNAL CASCADE



Similar to internal cascade control, external cascade control differs by the employment of two controllers, one of which is equipped with a second analog input configured as a remote setpoint. A PCU controls the secondary loop, while a TCU controls the primary loop.

External Cascade Configuration Parameters

"OPEr"	- Select ratio mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1"	- Enter scaling units of second input
"INP1"	- Enter scaling units of second input
"dSP2"	- Enter scaling units of second input
"INP2"	- Enter scaling units of second input
"SPtr"	- Local/Remote select options

External Cascade Operational Parameters

"rtio"	- Remote setpoint ratio
"bIAS"	- Remote setpoint bias

F

SETPOINT MASTER CONTROL

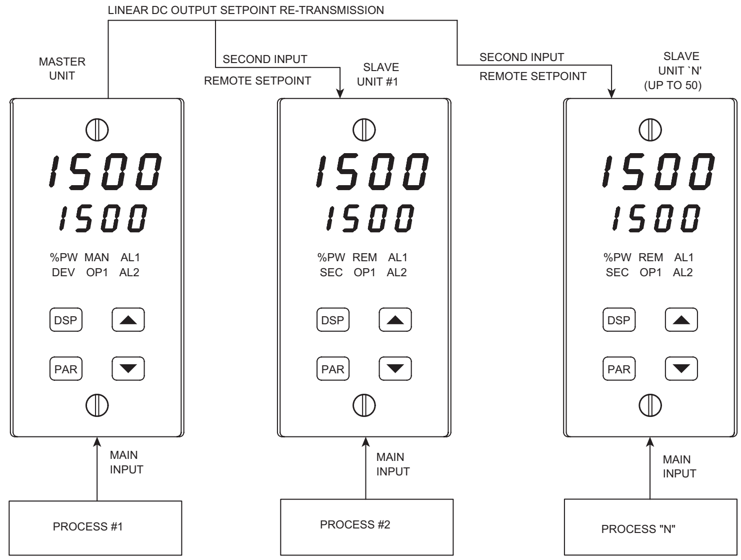
Setpoint Master Control allows automatic setpoint changes to slave controller units (up to 50 units total) from a master TCU controller. The linear DC output of the master is looped with the second analog input of the slave TCU controllers. Each slave unit can have unique remote setpoint ratio and bias values.

Setpoint Slave Configuration Parameters

- "OPEr" - Select remote setpoint mode
- "root" - Select second input square root Linearization
- "dPt2" - Select second input decimal point
- "dSP1" - Enter scaling units of second input
- "INP1" - Enter scaling units of second input
- "dSP2" - Enter scaling units of second input
- "INP2" - Enter scaling units of second input
- "SPLO" "SPHI" - Limit range of remote setpoint
- "SPrP" - Limit rate of change of remote setpoint

Setpoint Slave Operational Parameters

- "rtio" - Second input ratio
- "bIAS" - Second input bias



CONTROLLER PROGRAMMING

The TCU has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:
Unprotected Parameter Mode
Configuration Parameter Mode
Protected Parameter Mode
Hidden Function Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE *

The unprotected parameter mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered.The configuration parameter modes can be accessed only from this mode.

- "SP" - Enter Setpoint
- "OP" - Enter output power
- "ProP" - Enter proportional band
- "Intt" - Enter integral time
- "dErt" - Enter derivative time
- "rtio" - Enter Remote Setpoint ratio value
- "bIAS" - Enter Remote Setpoint bias value
- "SP-2" - View internal cascade secondary setpoint demand
- "Pb-2" - Enter internal cascade, secondary proportional band
- "It-2" - Enter internal cascade, secondary integral time
- "dt-2" - Enter internal cascade, secondary derivative time
- "AL-1" - Enter value for alarm #1
- "AL-2" - Enter value for alarm #2
- "CNFP" - Select basic configuration mode
- "End" - Return to normal display mode

* *These parameters may not appear due to option configuration or other programming.*

CONFIGURATION PARAMETER MODE

The configuration parameter mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage allowing the user to return to the normal display mode.

Configuration 1, Inputs

- "tYPE" - Select input probe type
- "SCAL" - Select temperature scale
- "dCPt" - Select temperature resolution
- "FLtr" - Select level of input filtering
- "SPAN" - Enter input correction span (slope)
- "SHFt" - Enter input correction shift (offset)
- "SPLO" - Enter setpoint lower limit
- "SPHI" - Enter setpoint higher limit
- "SPrP" - Enter setpoint ramp rate
- "InPt" - Select user input function *
- "HCur" - Enter full scale heater current *

Configuration 2, Outputs

- "CYCt" - Enter time proportioning cycle time
- "OPAC" - Select control action
- "OPLO" - Enter output power low limit
- "OPHI" - Enter output power high limit
- "OPFL" - Enter probe fail power preset
- "OPdP" - Enter output control dampening
- "CHYS" - Enter ON/OFF control hysteresis
- "tcod" - Select auto-tuning dampening
- "ANAS" - Select linear DC output assignment *
- "ANLO" - Enter linear DC output low scaling value *
- "ANHI" - Enter linear DC output high scaling value *
- "ANdb" - Enter linear DC output control deadband *
- "ANUt" - Enter linear DC output update time *

Configuration 3, Parameter lock-outs

- "SP" - Select degree of setpoint access
- "OP" - Select degree of power access
- "dEv" - Enable deviation display *
- "IN-2" - Enable second input display *
- "HCur" - Enable heater current display
- "UdSP" - Enable temperature scale display
- "CodE" - Enter parameter access code
- "PId" - Select degree of PID access
- "PId2" - Select degree of secondary PID access *
- "rtbS" - Select degree of ratio/bias access *
- "AL" - Select degree of alarm access *
- "ALrS" - Enable alarm reset access *
- "SPSL" - Enable local/remote setpoint selection *
- "trnF" - Enable auto/manual mode selection
- "tUNE" - Enable auto-tune invocation

Configuration 4, Alarms *

- "Act1" - Select operation mode of alarm #1
- "rSt1" - Select reset mode of alarm #1
- "Stb1" - Enable activation delay of alarm #1
- "AL-1" - Enter value for alarm #1
- "Act2" - Select operation mode of alarm #2
- "rSt2" - Select reset mode of alarm #2
- "Stb2" - Enable activation delay of alarm #2
- "AL-2" - Enter value for alarm #2
- "AHYS" - Enter hysteresis value for both alarms

Configuration 5, Cooling *

- "CYC2" - Enter cooling time proportioning cycle time
- "GAN2" - Enter cooling relative gain
- "db-2" - Enter heat/cool deadband or overlap

Configuration 6, Serial Communications *

- “bAUd” - Select baud rate
- “PArb” - Select parity bit
- “Addr” - Enter unit address number
- “Abrv” - Select abbreviated or full mnemonic transmissions
- “PrAt” - Enter automatic print rate
- “PoPt” - Select parameters to be included in print-out

Configuration 7, Second Input *

- “OPEr” - Select remote setpoint or internal cascade mode
- “root” - Select second input square root linearization
- “dPt2” - Select second input decimal point
- “dSP1” - Enter scaling parameters of second input
- “INP1” - Enter scaling parameters of second input
- “dSP2” - Enter scaling parameters of second input
- “INP2” - Enter scaling parameters of second input
- “SPtr” - Enter local/remote select options
- “OPd2” - Enter Secondary output control dampening

Configuration 8, Motorized Valve Positioner *

Position mode:

- “VPS1” - Enter or measure valve closed position
- “VPS2” - Enter or measure valve open position
- “VUdt” - Enter valve update time
- “VPdb” - Enter valve control deadband
- “VFAL” - Enter valve fail detect time

Velocity mode:

- “VUdt” - Enter valve update time
- “VOPt” - Enter valve open time
- “VCLt” - Enter valve close time
- “VONt” - Enter valve control deadband *(minimum on time)*

HIDDEN FUNCTION MODE *

The hidden function mode is accessible from the normal operating mode. The four functions in this mode may be locked-out individually in configuration 3 parameter lock-out section.

- “SPSL” - Select Local/Remote Setpoint
- “trnF” - Transfer between automatic (PID) control and manual control
- “tUNE” - Invoke/cancel PID Auto-tune
- “ALrS” - Reset latched alarms

PROTECTED PARAMETERS MODE *

The protected parameters mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-out section can be accessed.

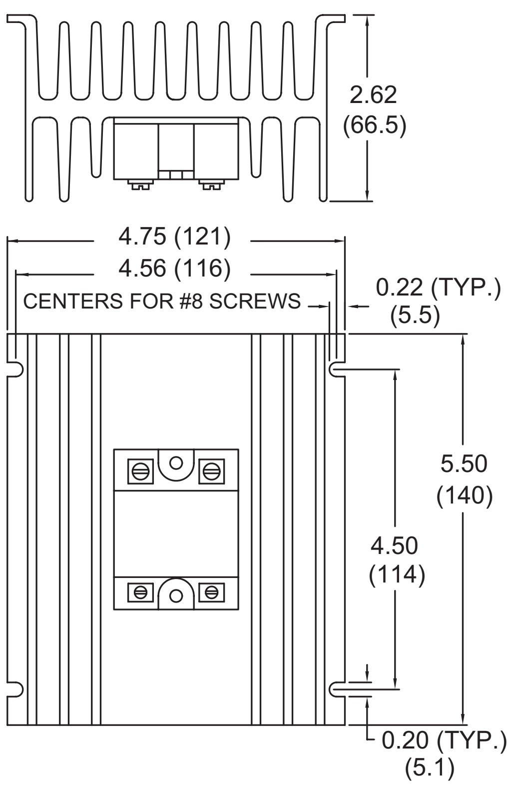
- “ProP” - Enter Proportional band
- “Intt” - Enter integral time
- “dErt” - Enter derivative time
- “rtio” - Enter remote setpoint ratio value
- “bIAS” - Enter remote setpoint bias value
- “SP-2” - Enter internal cascade, secondary setpoint
- “Pb-2” - Enter internal cascade, secondary proportional band
- “It-2” - Enter internal cascade, secondary integral time
- “dt-2” - Enter internal cascade, secondary derivative time
- “AL-1” - Enter value for alarm #1
- “AL-2” - Enter value for alarm #2
- “CodE” - Enter access value to unprotected parameters & configuration parameters

* *These parameters may not appear due to option configuration or other programming.*

ACCESSORY - EXTERNAL RLY50000 SSR POWER UNIT SHOWN

(External DIN Rail mount SSR power units available)

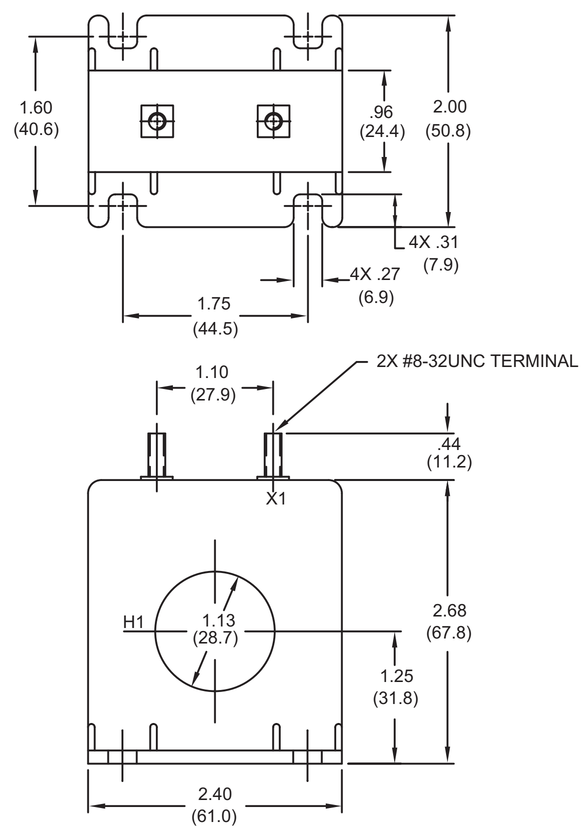
The external SSR Power Unit is used with the Logic/SSR Drive Module (OMD00003) to switch loads up to 240 VAC @ 45 amps, 25°C ambient. The unit is operated by applying a low level DC control signal to the isolated input. The unit features zero cross detection circuits which reduces radiated RFI when switching load currents. With no contacts to wear out, the SSR Power Unit provides virtually limitless operational life. The unit is supplied with an integral heat sink for immediate installation.



ACCESSORY - CT005001 CURRENT TRANSFORMER SHOWN

(Lower current CT available)

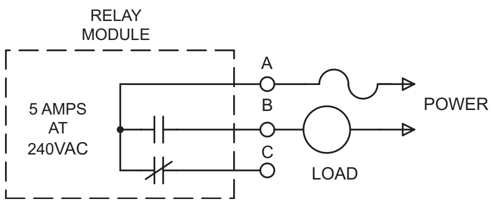
The external Current Transformer is used when specifying TCUs equipped with the Heater Current Monitor. The primary current rating is 50 amperes.



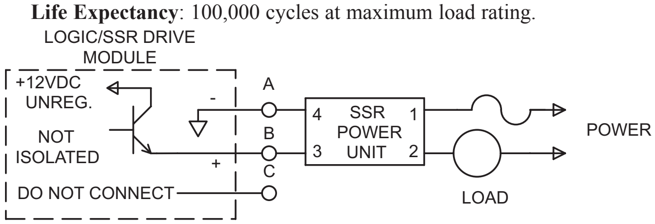
F

OUTPUT MODULES

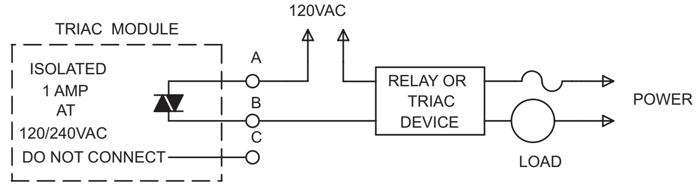
TYPICAL CONNECTIONS



Relay:
 Type: Form-C (Form-A with some models. See ordering information.)
 Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).
 Life Expectancy: 100,000 cycles at maximum load rating.

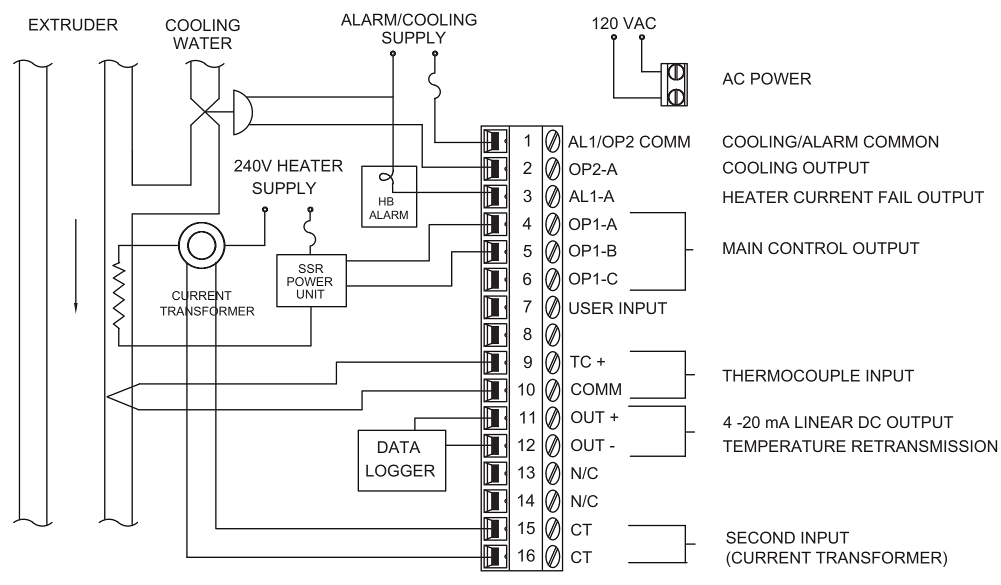


(Decreasing load and/or increasing cycle time, increases life expectancy).
Logic/SSR Drive: Can drive multiple SSR Power Units.



 Type: Non-isolated switched DC, 12 VDC typical
 Drive: 45 mA maximum.

Triac:
 Type: Isolated, Zero Crossing Detection
 Rating:
  Voltage: 120/240 VAC
  Max. Load Current: 1 ampere @ 35°C
  0.75 ampere @ 50°C
  Min. Load Current: 10 mA
 Off State Leakage Current: 7 mA max. @ 60 Hz
 Operating Frequency: 20 to 400 Hz
 Protection: Internal Transient Snubber, Fused



APPLICATION

Several TCU controllers are employed to control the temperature of a plastics extruder. Each TCU controls a heating element and a cooling water solenoid to maintain each extruder zone at a desired temperature. The heater current monitor of the TCU is used for early detection of heater element failure. The linear DC output is used to retransmit the process temperature to a control computer for data logging purposes.

ORDERING INFORMATION

MODELS WITHOUT SECOND INPUT OPTIONS

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER 115/230 VAC
NO	NO	NO	NO	NO	NO	TCU00000
NO	NO	NO	2	NO	NO	TCU00001
NO	NO	NO	1	YES	NO	TCU00002
NO	YES	NO	2	NO	NO	TCU01001
NO	YES	NO	2	NO	YES	TCU01004
NO	YES	NO	1	YES	YES	TCU01005
YES	NO	NO	NO	NO	NO	TCU10000
YES	NO	NO	2	NO	NO	TCU10001
YES	NO	NO	1	YES	NO	TCU10002
YES	YES	NO	2	NO	NO	TCU11001
YES	YES	NO	1	YES	NO	TCU11002
YES	YES	NO	2	NO	YES	TCU11004
YES	YES	NO	1	YES	YES	TCU11005
YES	NO	YES	2	NO	NO	TCU12001
YES	NO	YES	2	NO	YES	TCU12004
YES	NO	YES	1	YES	YES	TCU12005
These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.						

HEATER CURRENT MONITOR MODELS (HCM)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	TCU10204
YES	YES	NO	2	NO	NO	TCU11208
These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.						

SECOND ANALOG INPUT MODELS (ANA)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	TCU10104
YES	YES	NO	2	NO	NO	TCU11108
YES	NO	YES	2	NO	NO	TCU12108
These models have dual alarm outputs, or single alarm with cooling outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.						

MOTORIZED VALVE POSITIONER MODELS (MVP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	1	NO	YES	TCU10307
YES	YES	NO	1	NO	NO	TCU11306
YES	NO	YES	1	NO	NO	TCU12306

F

ACCESSORIES

DESCRIPTION	PART NUMBER
Relay Module	OMD00000
Triac Module	OMD00001
Logic/SSR Drive Module	OMD00003
45 A Single Phase Panel Mount SSR	RLY50000
25 A Single Phase DIN Rail Mount SSR	RLY60000
40 A Single Phase DIN Rail Mount SSR	RLY6A000
25 A Three Phase DIN Rail Mount SSR	RLY70000
50:0.1 Ampere Current Transformer	CT005001
40:0.1 Ampere Current Transformer	CT004001

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s), the cooling output, and valve positioner outputs. The controller can be fitted with any combination of output modules.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to line voltage.

All output modules are packaged separately and must be installed by the user.

MODEL TSC - TEMPERATURE SETPOINT CONTROLLER

c UL US LISTED
IND. CONT. EQ.
51EB

- *SETPOINT PROGRAM CONTROLLER FOR TIME VS. TEMPERATURE (RAMP/SOAK) AND SPECIAL BATCH/RECIPE APPLICATIONS*
- *ADVANCED PROGRAM PROFILING IN A 1/8 DIN PACKAGE*
- *ON-LINE MONITORING AND CONTROL OF PROGRAM STATUS, TIME, AND SETPOINT VALUE (Program Run, Pause, Stop, Advance, Modify Time, & Setpoint Value)*
- *AUTOMATIC PROGRAM DELAY FOR PROFILE CONFORMITY, PLUS PROGRAM LINKING, REPEATING AND AUTO POWER-ON FUNCTIONS FOR ENHANCED CAPABILITY*
- *DUAL EVENT OUTPUTS FOR TIMED ACTIVATION OF PROCESS EQUIPMENT SUCH AS STIRRERS, FANS, HEATERS, ETC. (Uses Alarm Output Channels)*
- *FOUR SETPOINT & PID PARAMETER SETS FOR QUICK RECALL OF SETPOINTS AND/OR GAIN VALUES DURING BATCH OR PROCESS CHANGEOVER*
- *PROGRAMMABLE USER INPUT FOR CONTROLLER AND SETPOINT PROGRAM CONTROL*
- *100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT OR TEMPERATURE AND PROFILE STATUS*
- *ACCEPTS ANY ONE OF 10 DIFFERENT TYPES OF SENSOR INPUTS (Thermocouple or RTD)*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR drive, and Triac)*
- *OPTIONAL DUAL ALARM OUTPUTS (Uses Output Modules)*
- *OPTIONAL COOLING OUTPUT (Uses Output Module)*
- *OPTIONAL LINEAR 4 to 20 mA or 0 to 10 VDC OUTPUT FOR CONTROL OR TEMPERATURE RE-TRANSMISSION*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The TSC is a setpoint controller suitable for time vs. temperature, process control applications. The TSC accepts signals from a variety of temperature sensors (thermocouple and RTD elements), precisely displays the process temperature, and provides an accurate output control signal (time proportional or linear) to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to satisfy various applications. The user input can be programmed to perform a variety of controller functions.

Dual 4-digit displays allow viewing of the measured temperature value and setpoint or temperature and profile status simultaneously. Front panel indicators inform the operator of controller status and output states. Replaceable output modules (Relay, logic/SSR drive or Triac) can be fitted to the main control output, alarm output(s) or timed event output(s), and cooling output.

The TSC has been designed to simplify the set-up and operation of a controlled setpoint profile program. The setpoint program is easily entered and controlled through the front panel. Full display capabilities keep the operator informed of the process temperature, profile status, output states, and setpoint value.

The controller can operate in the standard PID control mode for both heating or cooling with on-demand auto-tune which establishes the PID gain set. The PID gain set can be fine tuned by the operator at any time or may be locked from further modification. The unit can be transferred to the manual control mode providing the operator with direct control of the output.

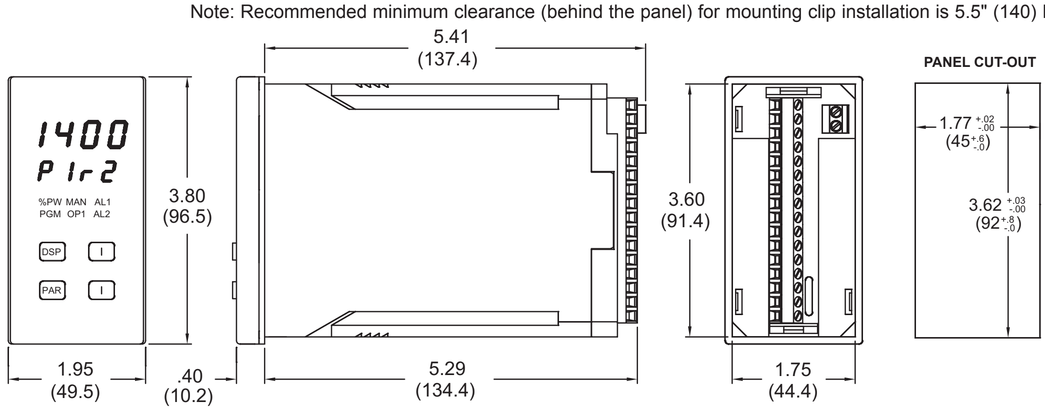
The TSC features four programs or profile recipes, each with up to eight ramp/soak segments, which can be easily stored and executed at any time. Longer profiles can be achieved by linking one or more profiles together, creating a single profile of up to 32 ramp/soak segments. Temperature profile conformity is assured during either soak (hold) phases or both ramp and hold phases by an adjustable error band parameter. The program repeat function cycles the profile either continuously or a set number of times. Power-on options automatically re-start, stop, or resume a running profile. The profile can be controlled via the front panel buttons, the user input, or the optional serial communications port.

Four control points, each having a setpoint and PID parameter set, are available for instant front panel implementation during batch changeover, or

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

other process conditions. A control point may have its PID gain set values disabled when implementing the control point.

The optional RS485 multidrop serial communications interface provides the capability of two-way communication between a TSC unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0-99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output(s) may also be reset via the serial communications interface option.

Optional alarm output(s) may be configured to operate as a timed event output or as a standard alarm output. As an alarm output it may be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, or Band IN or OUT) with adjustable hysteresis. Also, a standby feature suppresses the output(s) on power-up until the temperature stabilizes outside the alarm region. Timed event output(s) allow the controller to activate other equipment while a programmed profile is running. Each profile can define up to 16 event states (phases), for each output(s).

An optional secondary output is available for processes that require cooling which provides increased control accuracy and response.

The optional linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with final actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following:

% Output Power
Measurement Value
Measurement Value Deviation
Setpoint Value

An optional Type 4X/IP65 rated bezel is available for washdown and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference, makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TSC to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Temperature Display: 0.4" (10.2 mm) Red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) Green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected *(RTD only)*.
   "...." - Appears when display value exceeds + display range.
   "-..." - Appears when display value exceeds - display range.
2. **POWER:** Switch selectable for 115/230 VAC (+10%, -15%) no observable line variation effect, 48-62 Hz, 10 VA.
3. **ANNUNCIATORS:**
   6 LED Backlight Status Indicators:
   %PW - Lower auxiliary display shows power output in (%).
   PGM - Lower auxiliary display shows profile status or profile time remaining.
   MAN - Controller is in manual mode.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*
   OP2 - Cooling output is active *(for Cooling Option)*.
4. **CONTROLS:** Four front panel push buttons for setup and modification of controller functions and one external input.
5. **SETPOINT PROFILE:**
   Profiles: 4
   Segments Per Profile: 8 ramp/hold segments *(linkable to 32 segments)*.
   Ramp Rate: 0.1 to 999.9 degrees/minute or no ramp.
   Hold Time: Off or from 0.1 to 999.9 minutes, can be extended to 500 hours by linking.
   Error Band Conformity: Off or from 1 to 9999 degrees deviation, + value for hold phases, - value for both ramp and hold phases.
   Power-On Modes: Stop, auto-start, or profile resume.
   Start Mode: Ramps from process temperature.
   Program Auto Cycle: 1 to 249, or continuous.
   Event Outputs: 2, time activated with profile [uses Alarm output(s)].
   Control: Front panel buttons, user input, or RS485 communications.
6. **CONTROL POINTS:**
   Setpoints: 4
   PID gain sets: 4
   Control: Front panel buttons or user input.
7. **SENSOR INPUT:**
   Sample Period: 100 msec
   Response Time: 300 msec *(to within 99% of final value w/step input; typically, response is limited to response time of probe)*.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output.
   Display: "OPEN".
   Alarms: Upscale drive.
   DC Linear: Programmable preset output.
   Normal Mode Rejection: 40 db @ 50/60 Hz *(improves with increased digital filtering)*.
   Common Mode Rejection: 100 db, DC to 50/60 Hz.
   Protection: Input overload voltage; 240 VAC @ 30 sec max.
8. **THERMOCOUPLE:**
   Types: T, E, J, K, R, S, B, N or Linear mV.
   Input Impedance: 20 MΩ, all types.
   Lead Resistance Effect: 20 µV/350 Ω.
   Cold Junction Compensation: Less than ±1°C error over 0-50°C ambient temperature range. Disabled for linear mV type.
   Resolution: 1°C/F all types, or 0.1°C/F for T, E, J, K, and N only.
9. **RTD:** 2, 3 or 4 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.003916
   Excitation: 0.175 mA
   Resolution: 1 or 0.1 degree
   Lead Resistance: 7 Ω max.
10. **RANGE AND ACCURACY:**
    Errors include NIST conformity and A/D conversion errors at 23°C after 20 minutes warm-up. Thermocouple errors include cold junction effect. Errors are expressed as ±(% of reading) and ±3/4 LSD unless otherwise noted.

TC TYPE	RANGE	ACCURACY	WIRE COLOR (ANSI)
T	-200 to +400°C -328 to +752°F	0.20% + 1.5°C 0.20% + 2.7°F	blue
E	-200 to 750°C -328 to +1382°F	0.20% + 1.5°C 0.20% + 2.7°F	violet
J	-200 to +760°C -328 to +1400°F	0.15% + 1.5°C 0.15% + 2.7°F	white
K	-200 to +1250°C -328 to +2282°F	0.20% + 1.5°C 0.20% + 2.7°F	yellow
R	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
S	0 to +1768°C +32 to +3214°F	0.15% + 2.5°C 0.15% + 4.5°F	black
B	+200 to +1820°C +300 to +3300°F	0.15% + 2.5°C 0.15% + 4.5°F	grey
N	-200 to +1300°C -328 to +2372°F	0.20% + 1.5°C 0.20% + 2.5°F	orange
mV	-5.00 to 56.00	0.15% + 1 LSD	—
RTD (385)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
RTD (392)	-200 to +600°C -328 to +1100°F	0.10% + 0.5°C 0.10% + 0.9°F	—
OHMS	1.0 to 320.0	0.15% + 1 LSD	—

11. **OUTPUT MODULES [Optional] (For All Output Channels):**
    Relay:
    Type: Form-C *(Form-A with RS485 option)*
    Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)*.
    Life Expectancy: 100,000 cycles at max. rating.*(Decreasing load and/or increasing cycle time, increases life expectancy)*.
    Logic/SSR Drive: Can drive multiple SSR Power Units.
    Type: Non-isolated switched DC, 12 VDC typical.
    Drive: 45 mA max.
    Triac:
    Type: Isolated, Zero Crossing Detection.
    Ratings:
    Voltage: 120/240 VAC
    Max Load Current: 1 AMP @ 35°C
    0.75 AMP @ 50°C
    Min Load Current: 10 mA
    Off State Leakage Current: 7 mA max. @ 60 Hz
    Operating Frequency: 20 to 500 Hz
    Protection: Internal Transient Snubber, Fused.

F

SPECIFICATIONS (Cont'd)

12. **MAIN CONTROL OUTPUT (Heating or Cooling):**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC.
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Auto-tune: When performed, sets proportional band, integral time, and derivative time values.
    Probe Break Action: Programmable.
13. **COOLING OUTPUT (Optional):**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Proportional Gain Adjust: Programmable.
    Heat/Cool DeadBand: Programmable.
14. **LINEAR DC DRIVE (Optional):** With digital scale and offset, programmable deadband and update time.
    4 to 20 mA:
    Resolution: 1 part in 3500 typ.
    Accuracy: ±*(0.1% of reading + 25 μA)*.
    Compliance: 10 V *(500 Ω max. loop impedance)*.
    0 to 10 VDC:
    Resolution: 1 part in 3500 typ.
    Accuracy: ±*(0.1% of reading + 35 mV)*.
    Min. Load Resistance: 10 KΩ *(1 mA max.)*
    Source: % output power, setpoint, deviation, or temperature. (Available for heat or cool, but not both.)
15. **ALARMS (Optional):**
    Hardware: Plug-in, replaceable output module.
    Modes: Absolute high acting
    Absolute low acting
    Deviation high acting
    Deviation low acting
    Inside band acting
    Outside band acting
    Timed event output(s)
    Reset Action: Programmable; automatic or latched.
    Delay: Programmable; enable or disable.
    Hysteresis: Programmable.
    Probe Break Action: Upscale.
    Annunciator: LED backlight for "AL1", "AL2", (Alarm #2 not available with cooling output).
16. **SERIAL COMMUNICATIONS (Optional):**
    Type: RS485 Multi-point, Balanced Interface.
    Communication Format:
    Baud Rate: Programmable from 300-9600.
    Parity: Programmable for odd, even, or no parity.
    Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit.
    Unit Address: Programmable from 0-99, max. of 32 units per line.
    Transmit Delay: 100 msec min., 200 msec max.
    RS485 Common: Isolated from signal input common.
    Auto Print Time: Off to 9999 seconds between print-outs.
17. **USER INPUT:** V_{IN} max = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 2.0 V_{MIN}, Response time 100 msec max.
    Functions:

Program Lock	Print Request
Integral Action Lock	Load Control Point
Auto/Manual Transfer	Run/Hold Profile 1
Setpoint Ramp Select	Run/Stop Profile 1
Reset Alarms	

18. **ENVIRONMENTAL CONDITIONS:**
    Operating Temperature: 0 to 50°C
    Storage Temperature: -40 to 80°C
    Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
    Shock to IEC 68-2-27: Operational 5 g
    Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
    Span Drift: ≤ 100 ppm/°C
    Zero Drift: ≤ 1 μ V/°C
    Altitude: Up to 2000 meters
19. **CERTIFICATIONS AND COMPLIANCES:**
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E156876
    UL Listed: File #E137808
    Type 2 Enclosure rating (Face only) for TSC0
    Type 4X/IP65 Enclosure rating (Face only) for TSC1
    Refer to EMC Installation Guidelines section of the manual for additional information.
20. **CONNECTION:** Jaw-type terminal block.
21. **CONSTRUCTION:**
    Front Panel: Flame and scratch resistant tinted plastic.
    Case: High impact black plastic. (Mounting collar included).
    Type 4X/IP65 model only: Sealed bezel utilizing 2 captive mounting screws (panel gasket included).This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2.
22. **WEIGHT:** 1.3 lbs. (0.6 kgs)

BASIC OPERATION

The TSC controls the temperature profile of a system by measuring the temperature via an input probe, compares the actual temperature to the setpoint profile in progress, and calculates the new output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value so the process temperature conforms to the programmed profile. The PID control algorithm incorporates features which provide minimum overshoot and excellent temperature control accuracy for a process.

FRONT PANEL FEATURES

In the normal display mode, the unit will display the process temperature in the upper display. One of five other parameters may be selected for viewing in the lower display:

Target Setpoint	Profile Phase Time Remaining
% Output Power	Temperature Symbol (F/C)
Profile Status	

The program profile status display indicates the active profile number with the current ramp or hold phase of the profile. The profile can be started, stopped, advanced, etc. from the front panel when the profile status display is viewed, if not locked from access.

The phase time remaining display, shows the time remaining in a ramp or hold phase and, if not locked from access, may be changed on-line to effect temporary changes to the program. Additionally, the target setpoint and % output power (manual mode only) may also be changed on-line or locked from operator access.

From the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode from any parameter module. The controller configuration and parameter settings are stored in an internal E^2PROM device.

F

CONFIGURATION MODE

The configuration modules serve to provide the basic set-ups required by the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage, which allows the user to return to the normal display mode, or advance to a later configuration stage.

Configuration 1, Inputs

- "tYPE" - Select input probe type
- "SCAL" - Select temperature scale
- "dCPt" - Select temperature resolution
- "FLtr" - Select degree of input filtering
- "SPAN" - Enter input correction span (slope)
- "SHFt" - Enter input correction shift (offset)
- "SPLO" - Enter setpoint lower limit
- "SPHI" - Enter setpoint higher limit
- "SPrP" - Enter setpoint ramp rate
- "InPt" - Select user input function

Configuration 2, Outputs

- "CYCt" - Enter time proportioning cycle time
- "OPAC" - Select control action
- "OPLO" - Enter output power low limit
- "OPHI" - Enter output power high limit
- "OPFL" - Enter probe fail power preset
- "CHYS" - Enter ON/OF control hysteresis
- "tcod" - Select auto-tuning damping
- "ANAS" - Select linear DC output assignment *
- "ANLO" - Enter linear DC low scaling value *
- "ANHI" - Enter linear DC high scaling value *

Configuration 3, Parameter lock-outs

- "SP" - Select degree of setpoint access
- "OP" - Select degree of power access
- "P-CS" - Select degree of profile status access
- "P-tr" - Select degree of phase time remaining access
- "UdSP" - Enable temperature units display
- "CodE" - Enter parameter access code
- "PId" - Select degree of PID access
- "AL" - Select degree of alarm access *
- "ALrS" - Enable manual reset of alarms *
- "CPAC" - Enable control point access
- "PrAC" - Enable ramp/hold program access
- "trnF" - Enable automatic/manual transfer
- "tUNE" - Enable auto-tune invocation

Configuration 4, Alarms *

- "Act 1" - Select operation mode of alarm #1
- "rSt1" - Select reset mode of alarm #1
- "Stb1" - Enable activation delay of alarm #1
- "AL-1" - Enter value for alarm #1
- "Act2" - Select operation mode of alarm #2
- "rSt2" - Select reset mode of alarm #2
- "Stb2" - Enable activation delay of alarm #2
- "AL-2" - Enter value for alarm #2
- "AHYS" - Enter hysteresis value for both alarms

Configuration 5,.Cooling *

- "CYC2" - Enter cooling time proportioning cycle time
- "GAN2" - Enter cooling relative gain
- "db-2" - Enter heat/cool deadband or overlap

Configuration 6, Serial Communications *

- "bAUd" - Select baud rate
- "PArb" - Select parity bit
- "Addr" - Enter unit address number
- "Abrv" - Select abbreviated or full mnemonic transmissions
- "PrAt" - Enter automatic print rate
- "PoPt" - Select parameters to be included in print-out

Configuration 7, Control Points

- "CSEt" - Select control point number for set-up 1, 2, 3, & 4
- "SP-x" - Enter setpoint value for selected control point
- "PId" - Select if PID gain set to be loaded with setpoint
- "PB-x" - Enter proportional band for selected control point *
- "It-x" - Enter integral time for selected control point *
- "dt-x" - Enter derivative time for selected control point *

Configuration 8, Profiles

- "PSEt" - Select profile or event output for set-up 1, 2, 3, or 4
- "PnCC" - Enter program-repeat cycle count for selected profile
- "PnLn" - Select link option for selected profile
- "PnEb" - Enter error band for temperature conformity for selected profile
- "PnPC" - Enter power-down resume status for selected profile
- "Pnr1" - Enter ramp rate 1 for selected profile *
- "PnL1" - Enter setpoint level 1 for selected profile *
- "PnH1" - Enter hold time 1 for selected profile *
- . .
- . .
- "Pnr8" - Enter ramp rate 8 for selected profile *
- "PnL8" - Enter setpoint level 8 for selected profile *
- "PnH8" - Enter hold time 8 for selected profile *
- "Pn 1" - Select event outputs at phase 1 for selected profile *
- . .
- . .
- "Pn16" - Select event outputs at phase 16 for selected profile *

Configuration 9, Factory Service Operations

(Detailed in the operator's manual)

* These parameters may not appear due to option configuration or other programming

F

HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance for excellent temperature control. Measurement accuracy of 0.15% provides closer process control conforming to the desired control setpoint value.

The unit accepts a variety of both thermocouple or RTD temperature probes. The A.C. input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel and NO re-programming is required. The standard model simply requires pressing a latch to remove the unit. The Type 4X/IP65 rated model utilizes two panel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed.

Low-drift, highly stable circuit design ensures years of reliable and accurate temperature control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

Type 4X/IP65 BEZEL

SETPOINT FEATURES

The controller's setpoint can be protected from out of range values, by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can also be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate, independent of a programmed profile. This feature reduces thermal shock to the process and also helps to minimize temperature overshoot.

The active setpoint, which can be a running profile, may also be transmitted by the linear DC output for slave control loops.

Four control points are available which can be implemented at any time. Each control point is programmed independently, with each having a setpoint and a PID gain set value. With gain value changes, the output power control signal will not "bump" resulting in a smooth control transition.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating temperature characteristics, helping to provide better temperature control.

A programmable temperature shift and slope function can be used to compensate for probe errors or to have multiple TSC units indicate the same nominal temperature.

A programmable User Input is available to control a variety of controller functions, such as profile control, auto/manual transfer, serial communication print requests, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where too much power can cause damage. Automatic sensor probe break detection, for fail-safe operation, causes the controller to default to a programmed output power *(upscale or downscale burnout)*. With adjustable time proportioning-cycle time and programmable D.C. Linear output, the controller can satisfy a wide variety of output requirements.

During execution of a profile, two independent, timed event outputs are available to control or signal other equipment. The event outputs use the alarm channels.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

AUTO-TUNE

The model TSC has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular thermal process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked at start-up, while ramping, or at setpoint, depending on the process requirements. A programmable auto-tune damping factor produces various levels of process control and response characteristics.

PROFILE PROGRAMMING

Profiles are programmed independently of each other and are separate from the configuration of other controller parameters. Each profile has parameters for error band (profile conformity), linking, auto-start and program repeat cycles. Profiles may be altered during execution, so changes take effect as the programmed profile advances.

CONTROLLER PROGRAMMING

The model TSC has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front panel program disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

Hidden Mode
Protected Mode
Unprotected Mode
Configuration Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE

The unprotected mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. Only from this mode can the configuration modes be accessed.

"SP"	-	Enter setpoint *
"OPOF"	-	Enter %output power offset *
"OP"	-	Enter output power *
"ProP"	-	Enter proportional band
"Intt"	-	Enter integral time *
"dErt"	-	Enter derivative time *
"AL-1"	-	Enter value for alarm #1 *
"AL-2"	-	Enter value for alarm #2 *
"CNFP"	-	Select basic configuration module
"End"	-	Return to normal display mode

PROTECTED PARAMETER MODE *

The protected mode is accessible when program disable is active, also this mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-outs section can be accessed.

"ProP"	-	Enter proportional band
"Intt"	-	Enter integral time
"dErt"	-	Enter derivative time
"AL-1"	-	Enter value for alarm #1
"AL-2"	-	Enter value for alarm #2
"CodE"	-	Enter access value to unprotected mode
"End"	-	Return to normal display mode

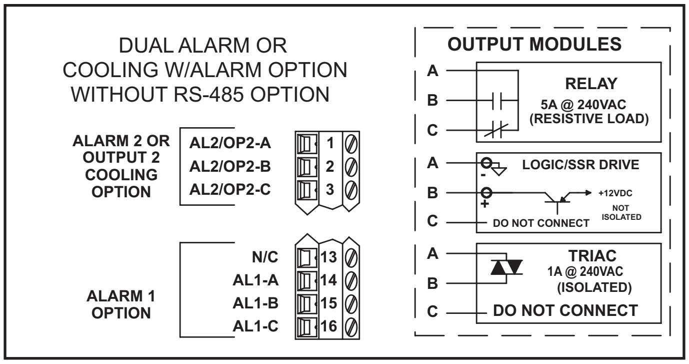
HIDDEN FUNCTIONS MODE *

The hidden mode is accessible from the normal operating mode by holding the PAR button for 3 seconds. The five functions in this mode may be locked-out individually in configuration 3 parameter lock-outs section.

" CP"	-	Load control point x
"Prun"	-	Control ramp/hold profile state
"trnF"	-	Transfer between automatic (PID) control and Manual control
"tUNE"	-	Invoke/Cancel PID auto-tune
"ALrS"	-	Reset latched alarms

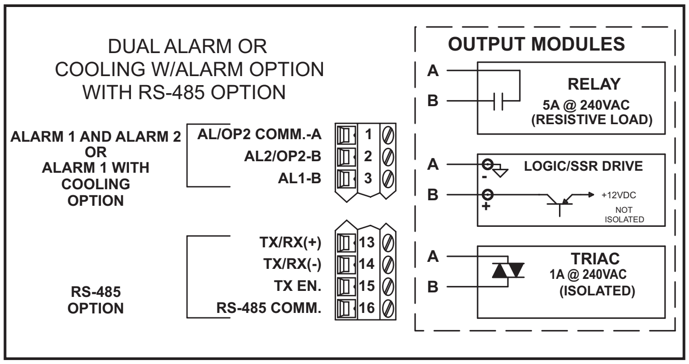
OUTPUT VARIATIONS WITHOUT RS485 OPTION

The Dual Alarm or the Cooling with Alarm output, without the RS485 option, has independent outputs. Therefore, the cooling output and/or alarm output*(s)* can be installed with any combination of output modules.



OUTPUT VARIATIONS WITH RS485 OPTION

The Dual Alarm or the Cooling with Alarm output, with RS485 option, does not have independent outputs. In this case, the cooling output and/or alarm output*(s)* must have the same type of output modules installed since they share the common terminal.

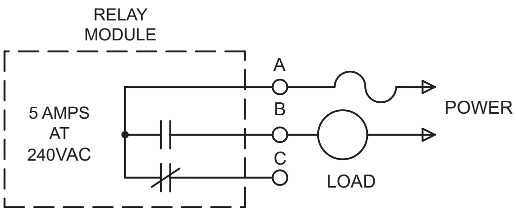


* *These parameters may not appear due to option configuration or other programming*

OUTPUT MODULES

Units equipped with RS485 option must have the Dual Alarm or Cooling w/ alarm options fitted with the same type of output modules. The controller's main output (OP1) can be fitted with any output module. Output modules are shipped separately and must be installed by the user.

TYPICAL CONNECTIONS



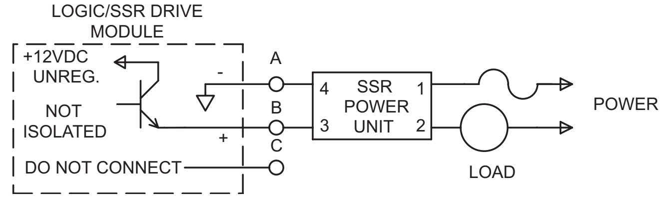
Relay:

Type: Form -C (Form-A with RS485 option only)

Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).

Life Expectancy:100,000 cycles at maximum load rating.

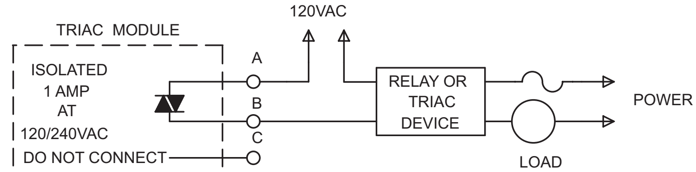
(Decreasing load and/or increasing cycle time, increases life expectancy).



Logic/SSR Drive: can drive multiple SSR Power Units.

Type: Non-isolated switched DC, 12 VDC typical.

Drive: 45 mA max.



Triac:

Type: Isolated, Zero Crossing Detection.

Rating:

Voltage: 120/240 VAC.

Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C

Min. Load Current: 10 mA

Off State Leakage Current: 7 mA max. @ 60 Hz

Operating Frequency: 20 to 500 Hz.

Protection: Internal Transient Snubber, Fused.

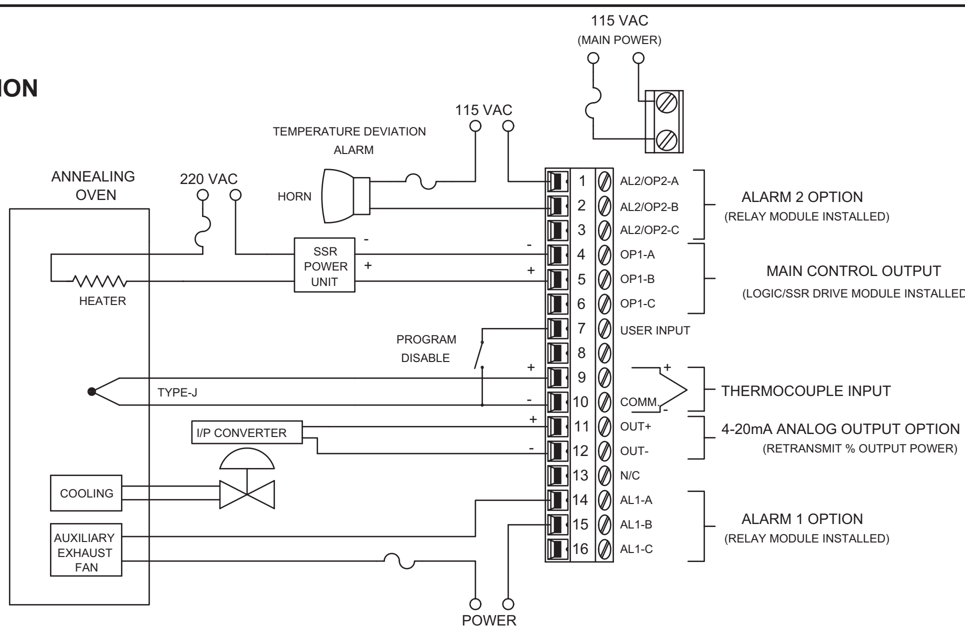
APPLICATION

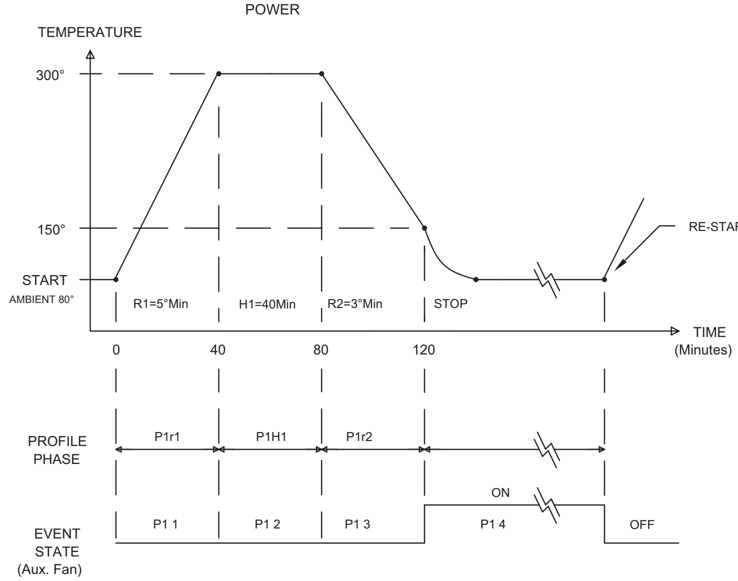
TSC GLASS TEMPERING APPLICATION

A manufacturer of glass items needs to anneal *(temper)* their products to reduce the brittleness of the glass structure. The tempering process requires the glass to be heated and subsequently cooled at a controlled rate to change the structure of the glass. Different tempering profiles are required for different types of glass products.

A TSC is employed to control the temperature profile of the annealing oven. Four different temperature profiles are stored in the controller. The 4 to 20 mA analog output option is utilized to cool the annealing oven during the cool down ramp phases. An event output is used to quickly cool the oven at the end of the batch run *(alarm 1)*. Alarm 2 is used to signal the operator whenever the temperature is outside the prescribed program profile.

Note: Units equipped with the RS485 option have different terminal designators. See "Output Variations with or without the RS485 Option".





The programming for this profile is as follows:

Parameter	Value	Description
"P1r1"	5.0	Ramp from ambient temp. during heat phase at 5.0°/min.
"P1L1"	300	Target setpoint level 300°
"P1H1"	40.0	Heat at 300° for 40.0 minutes
"P1r2"	3.0	Ramp down 3.0°/min. during cooling phase
"P1L2"	150	Target Setpoint is 150°
"P1H2"	0.0	Do not hold at 150° *(used as "phantom" hold time for triggering event output for auxiliary cooling)*
"P1r3"	-0.1	End Program
"P1 1"	1F2F	Turn off output 1 *(output 2 is alarm)*
"P1 2"	1F2F	Keep off output 1
"P1 3"	1F2F	Keep off output 1
"P1 4"	1N2F	Turn on output 1 for Auxiliary Exhaust Fan

F

ORDERING INFORMATION

MODEL NO	DESCRIPTION	Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
TSC	Temperature Setpoint Controller	NO	YES	NO	2	NO	NO	TSC01001
		YES	YES	NO	2	NO	NO	TSC11001
		YES	YES	NO	1	YES	NO	TSC11002
		YES	YES	NO	2	NO	YES	TSC11004
		YES	YES	NO	1	YES	YES	TSC11005
		YES	NO	YES	2	NO	YES	TSC12004
		YES	NO	YES	1	YES	YES	TSC12005
	Relay Module							OMD00000
	Triac Module							OMD00001
	Logic/SSR Drive Module							OMD00003
PMK5	Panel Mount Adapter Kit (1/4 DIN to 1/8 DIN)							PMK50000
RLY	45 A Single Phase Panel Mount SSR							RLY50000
	25 A Single Phase DIN Rail Mount SSR							RLY60000
	40 A Single Phase DIN Rail Mount SSR							RLY6A000
	25 A Three Phase DIN Rail Mount SSR							RLY70000
These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output								

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s) and cooling output. The controller can be fitted with any combination of output modules that do not have the RS485 option.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to a line voltage.

All modules are shipped separately and must be installed by the user.

F

MODEL P16 - 1/16 DIN PROCESS CONTROLLER

This is a brief overview of the P16. For complete specifications and programming information, see the **T16/P16 Temperature/Process Controller Bulletin** starting on **page 519**.

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ACCEPTS 0-10 V AND 0/4-20 mA SIGNALS*
- *ON DEMAND AUTO-TUNING OF PID SETTINGS*
- *DC ANALOG OUTPUT (OPTIONAL)*
- *USER PROGRAMMABLE FUNCTION BUTTON*
- *PC OR FRONT PANEL PROGRAMMING*
- *PC CONFIGURABLE WITH TP16KIT*

UL Recognized Component,
File #E156876

INPUT SPECIFICATIONS

1. **SENSOR INPUT**:
   Sample Period: 100 msec (10 Hz rate)
   Step Response Time: 300 msec typical, 400 msec max to within 99% of final value with step input.
   Failed Sensor Response:
   Main Control Output(s): Programmable preset output
   Display: "OPEN"
   Alarms: Upscale drive
   Analog Output: Upscale drive when assigned to retransmitted input.
   Normal Mode Rejection: >40 dB @ 50/60 Hz
   Common Mode Rejection: >120 dB, DC to 60 Hz
   Overvoltage Protection: 120 VAC @ 15 sec max
4. **SIGNAL INPUT**: (P16 only)
   * Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

INPUT RANGE	ACCURACY *	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.30 % of reading +0.03V	1 MΩ	50 V	10 mV
20 mA DC (-2 to 22)	0.30 % of reading +0.04mA	10 Ω	100 mA	10 µA

MODEL P48 - 1/16 DIN PROCESS CONTROLLER

- *PID CONTROL WITH REDUCED OVERSHOOT*
- *ACCEPTS 0 to 10 VDC or 0/4 to 20 mA DC INPUTS*
- *OPTIONAL TWO LINEAR DC OUTPUTS (0 to 10 V, 0/4 to 20 mA)*
- *OPTIONAL DUAL ALARM OUTPUTS*
- *OPTIONAL REMOTE SETPOINT INPUT (0/4 to 20 mA)*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS*
- *SECOND SETPOINT SETTING*
- *SETPOINT RAMPING FOR PROCESS STARTUP*
- *PROGRAMMABLE USER INPUT (Digital) FOR ADDED FLEXIBILITY*
- *PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS*
- *MANUAL/AUTOMATIC CONTROL MODES*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS AND SETPOINT*

- *STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES*
- *PC SOFTWARE AVAILABLE FOR CONTROLLER CONFIGURATION*
- *NEMA 4X/IP65 BEZEL*

UL Recognized Component,
File # E156876

DESCRIPTION

The P48 Controller accepts either a 0 to 10 VDC or a 0/4 to 20 mA DC signal, precisely displays the input process signal according to the programmable scaling points, and provides an accurate output control signal *(time proportional or linear DC)* to maintain the process at the desired control point. The controller's comprehensive yet simple programming allows it to meet a wide variety of application requirements.

In the PID control mode the controller operates with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also operate in the ON/OFF control mode with adjustable hysteresis. a second setpoint is available to allow quick selection of a different setpoint setting.

Dual 4-digit displays allow viewing of the process and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. On some models, the main control output and the alarm outputs are field replaceable.

Optional alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, and Band IN or OUT) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the process stabilizes outside the alarm region. The second alarm can be configured as a secondary PID output (heat/cool applications).

Optional Main Linear DC output (10 V or 20 mA) can be used for control or process re-transmission purposes. Programmable output update time reduces valve or actuator activity. The output range can be scaled independent of the input range.

Optional Second Linear DC output (10 V or 20 mA) provides an independent process re-transmission, while the main Linear DC output is being used for control. The output range can be scaled independent of the input range.

Optional Remote Setpoint input (0/4 to 20 mA) allows for cascade control loops; and allows for remotely driven setpoint signal from computers or other similar equipment. Straightforward end point scaling with independent filtering and local/remote transfer option expand the controller's flexibility.

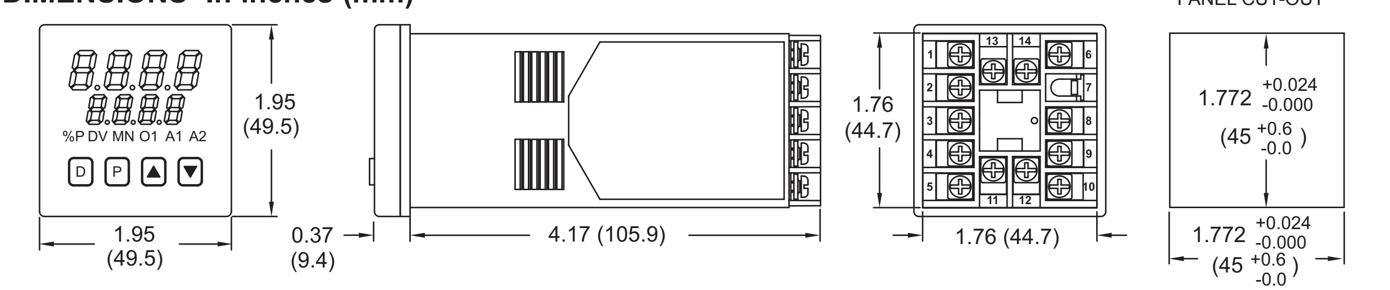
The optional RS485 serial communication interface provides two-way communication between a P48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each P48 on the line can be programmed separately from 0 to 99. Data from the P48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFCRM, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

F

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the P48 to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant process limit indicator with alarm outputs is strongly recommended.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + input range.
   "ULUL" - Appears when measurement exceeds - input range.
   "SENS" - Appears when measurement exceeds controller limits.
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.
   LED Status Annunciators:
   %P - Lower auxiliary display shows power output in (%).
   MN - Flashing: Controller is in manual mode.
   On: Local Setpoint (Remote Setpoint option)
   Off: Remote Setpoint
   DV - Lower auxiliary display shows deviation *(error)* from setpoint.
   O1 - Main control output is active.
   A1 - Alarm #1 is active *(for A1 option)*.
   A2 - Alarm #2 is active OR
   - Secondary output (02) is active.
2. **POWER:**
   AC Versions: 85 VAC min. to 250 VAC max., 50 to 60 Hz, 8 VA max.
   DC Versions:
   DC Power: 18 to 36 VDC; 7 W
   AC Power: 24 VAC ±10%; 50 to 60 Hz, 9 VA
3. **CONTROLS:** Four front panel push buttons for modification and setup of controller functions and one external user input for parameter lockout or other functions.
4. **MEMORY:** Nonvolatile E^2 PROM retains all programmable parameters and values.
5. **RANGE AND ACCURACY:**

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.10% of reading +0.02 V	0.30% of reading +0.03 V	1 M ohm	300 V	10 mV
20 mA DC (-2 to 22)	0.10% of reading +0.03 mA	0.30% of reading +0.04 mA	10 ohm	100 mA	10 µA

* Accuracies are expressed as ± percentages after 20 minutes warm-up. The controller's accuracy is specified in two ways: accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide sensor range reflects the coefficient of the internal circuitry.

6. **MAIN SIGNAL INPUT:**
   Sample Period: 100 msec
   Response Time: Less than 300 msec typ., 400 msec max. *(to within 99% of final value w/step input; typically, response is limited to response time of sensor)*
   Normal Mode Rejection: 40 dB @ 50/60 Hz (improves with increased digital filtering.)
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Protection: Input overload 120 VAC max. for 15 sec. max.
7. **USER INPUT:** Internally pulled up to +5 VDC (1 MΩ).
   $V_{IN\ MAX}$ = 5.25 VDC; V_{IL} = 0.85 V max.; V_{IH} = 3.65 V min.;
   I_{OFF} = 1µA max.
   Response Time: 120 msec max.
   Functions:
   Program Lock / Integral Action Lock
   Auto/Manual Mode Select / Setpoint Ramp Enable
   Reset Alarms / Setpoint 1/Setpoint 2 Select
   Local/Remote Setpoint Select / Serial block print
8. **CONTROL AND ALARM OUTPUTS:**
   Relay outputs with Form A contacts:
   Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load)
   1/10 HP @ 120 VAC (inductive load)
   Life Expectancy: 100,000 cycles at max. load rating.
   (Decreasing load and/or increasing cycle time, increases life expectancy.)
9. **MAIN CONTROL:**
   Control: PID or ON/OFF
   Output: Time proportioning or Linear DC
   Cycle time: Programmable
   Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
10. **ALARMS:** 1 or 2 alarms (optional)
    Modes:
    Absolute high acting / Absolute low acting
    Deviation high acting / Deviation low acting
    Inside band acting / Outside band acting
    Reset Action: Programmable; automatic or latched
    Standby Mode: Programmable; enable or disable
    Hysteresis: Programmable
    Annunciator: LED backlight for "A1", "A2"
11. **SECONDARY OUTPUT:** Software selectable (overrides alarm 2)
    Control: PID or ON/OFF
    Output: Time Proportioning
    Cycle time: Programmable
    Proportional Gain Adjust: Programmable
    Deadband /Overlap: Programmable
12. **MAIN AND SECOND LINEAR DC OUTPUT:** (optional)
    Main: Control or re-transmission, programmable update rate from 0.1 sec to 250 sec
    Second: Re-transmission only, fixed update rate of 0.1 sec

OUTPUT ** RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	RESOLUTION
0 to 10 V	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	10k ohm min.	1/3500
0 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/3500
4 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/2800

* Accuracies are expressed as ± percentages after 20 minutes warm-up. Output accuracy is specified in two ways: Accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide sensor range reflects the coeffecient of the internal circuitry.

** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 10% overrange and a small underrange (negative) signal.

13. **REMOTE SETPOINT INPUT:** (optional)
    Input type: 0/4 to 20 mA
    Input Resistance: 10Ω
    Overrange: -5% to 105%
    Overload: 100 mA (continuous)
    Scale Range: -999 to 9999
    Resolution: 1 part in 10,000.
    Accuracy:
    At 25° C: ±(0.1 % of full scale +½ LSD)
    Over 0 to 50°C range: ±(0.2% of full scale +½ LSD)
    Reading Rate: 10/sec.
    Setpoint Filtering: Programmable Digital
    Setpoint Ramping: Programmable, 1 to 9999 units/minute.
14. **SERIAL COMMUNICATIONS:** (optional)
    Type: RS485 multipoint, balanced interface
    Baud Rate: 300 to 9600
    Data Format: 7O1, 7E1, 7N2, 8N1
    Node Address: 0 to 99, max of 32 units per line
    Transmit Delay: 2 to 100 msec or 100 to 200 msec
    Data Encoding: ASCII
    Isolation w.r.t Main Input Common: 500 Vrms for 1 min. (50 V working)
    Not isolated w.r.t. Remote Setpoint or Analog Output common
    Note: RS485 and the Analog Output commons are not internally isolated within the controller. The terminating equipment of these outputs must not share the same common (ie. earth ground).
15. **ENVIRONMENTAL CONDITIONS:**
    Operating Range: 0 to 50°C
    Storage Range: -40 to 80°C
    Operating and Storage Humidity:
    85% max. relative humidity (non-condensing) from 0°C to 50°C.
    Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
    Shock According to IEC 68-2-27: Operational 20 g (10 g relay), 11 msec in 3 directions.
    Altitude: Up to 2000 meters

16. **ISOLATION BREAKDOWN RATINGS:**
AC line with respect to all Inputs and outputs: 250 V working (2300 V for 1 minute).
Main input with respect to Analog Outputs and Remote Setpoint Input: 50 V working (2300 V for 1 minute).
All other inputs and outputs with respect to relay contacts: 2000 VAC
Not isolated between Analog Output and Remote Setpoint commons.
17. **CERTIFICATIONS AND COMPLIANCES:**
SAFETY
UL Recognized Component, File #E156876, UL873, CSA 22.2 No. 24
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
Type 4X Enclosure rating (Face only), UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m [1]
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms [2]
		150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Simulation of cordless telephones	ENV 50204	Level 3; 10 V/m
		900 MHz ± 5 MHz
		200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A
		Power mains class A

Notes:
1. No loss of performance during EMI disturbance at 10 V/m.
Unit is panel mounted in a metal enclosure (Buckeye SM7013-0 or equivalent) that provides at least 20 dB shielding effectiveness. Metal panel is connected to earth ground.
Power Line and I/O cables routed in metal conduit connected to earth ground.
2. Self-recoverable loss of performance during EMI disturbance at 10 Vrms: Analog output may deviate during EMI disturbance.
For operation without loss of performance:
Install power line filter, RLC#LFIL0000 or equivalent.
OR
Install 2 ferrite cores, RLC#FCOR0000 or equivalent, to AC lines at unit for frequencies above 5 MHz.
I/O cables routed in metal conduit connected to earth ground.
Refer to the EMC Installation Guidelines section of the manual for additional information.
18. **CONNECTION:** Wire clamping screw terminals
19. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.
20. **WEIGHT:** 0.38 lbs (0.17 kgs)

BASIC OPERATION

The P48 controls a process by receiving a linear DC signal representing the process value, then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process at setpoint. The PID control algorithm incorporates features which provide for high control accuracy and low overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the process value in the upper display. One of the following parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Process Deviation
- Blank Display

The user scrolls through these parameters by pressing the D button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the P button and modified by use of the UP and DOWN buttons. Parameters are then entered by the P button, which advances the user to the next parameter. Pressing the D button immediately returns the controller to the normal operating mode without changing the currently selected parameter.

HARDWARE FEATURES

A fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent process control. Measurement accuracy of 0.1% or better, provides close process control conforming to the desired control setpoint value.

Low-drift, highly stable circuitry ensures years of reliable and accurate process control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

REMOTE SETPOINT INPUT

The remote setpoint input facilitates the use of a remote signal to drive the controller's setpoint. The remote signal can be scaled independent to that of the controller's range. The controller's response to local/remote setpoint transfers can be programmed. Also, the remote signal is filtered by use of an adaptive filter. With this filter, relatively large filtering time constants can be used without suffering from long settling times. The time constant and filter disable band are programmable. Additionally, the remote signal can also be velocity limited (or ramped) to slow the controller's response to changes in setpoint. This results in a steady control response with no overshoot.

LINEAR DC ANALOG OUTPUTS

The Main Linear DC output has independent scaling, programmable output update time and filter (damping) time. These parameters permit flexibility in process configuration. The output can be set for 0 to 10 V, 0 to 20 mA or 4 to 20 mA ranges and can be configured for control or for re-transmission of input or setpoint values.

A Second Linear DC output is dedicated for the re-transmission of the process input signal. The output can be scaled and converted independent of the input signal and Main Linear DC output. This output is isolated from the input.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

A second setpoint can be selected by the user input and/or through the front panel.

The setpoint ramp feature can be used to control the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces shock to the process and helps to minimize overshoot.

F

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating process characteristics, helping to provide better control.

The programmable user input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output*(s)*, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Programmable output cycle time, output hysteresis, and dampening can reduce output activity without degrading control accuracy. The main outputs can operate in PID, ON/OFF, or manual control modes.

CONTROL AND ALARM OUTPUTS

In addition to the Linear DC output, there are up to three relay outputs available. Relay outputs can switch user applied AC or DC voltages for control or alarm purposes.

AUTO-TUNE

The P48 has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into non-volatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

RS485 SERIAL COMMUNICATIONS

The RS485 communications option allows the connection of up to 32 devices on a single pair of wires with a distance of up to 4,000 feet and a maximum baud rate of 9600. Since the same pair of wires are used for both transmit and receive, only one way communication is possible at any given time. The controller has a programmable response time to allow the host device adequate time to release the communication line for a transmission.

Selected parameters from the P48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. It is also possible to invoke Auto-tune through the serial port. Serial communications used with SFCRM software allows for easy controller parameter configuration by computer.

DUAL TIME PROPORTIONAL SYSTEMS

The P48 is available with dual time proportional outputs. The dual outputs can be used for level or heat/cool applications. The A2 output can be configured for Secondary (cool) control. This allows for dual PID control or ON/OFF control with unbalanced hysteresis.

CONTROLLER PROGRAMMING

Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial set-up.

The following four programming modes allow the controller to adapt to any required user-interface level:

Unprotected Parameter Mode
Protected Parameter Mode
Hidden Function Mode
Configuration Parameter Mode

UNPROTECTED PARAMETER MODE ∗

The Unprotected Parameter Mode is accessible from the Normal Display mode when program disable is inactive or when the proper access code number from the Protected Parameter Mode is entered. The Configuration Parameter Modes can be accessed only from this mode.

"SP" - Enter setpoint
"OP" - Enter output power
"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CNFP" - Select configuration access point
"End" - Return to normal display mode

PROTECTED PARAMETERS MODE ∗

The Protected Parameters Mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are enabled in the Configuration 3 parameter (lock-out section) can be accessed.

"ProP" - Enter proportional band
"Intt" - Enter integral time
"dErt" - Enter derivative time
"AL-1" - Enter value for alarm #1
"AL-2" - Enter value for alarm #2
"CodE" - Enter value to access unprotected parameters and configuration parameters

HIDDEN FUNCTION MODE ∗

The Hidden Function Mode is accessible from the Normal Display Mode. The functions in this mode may be locked-out individually in Configuration 3 parameter (lock-out section).

"SPSL" - Select local (SP1 or SP2) or remote setpoint
"trnF" - Transfer between automatic (PID) control and manual control
"tUNE" - Invoke/cancel PID Auto-tune
"ALrS" - Reset latched alarms

F

CONFIGURATION PARAMETER MODE

The Configuration Parameter Mode allows the operator to set-up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the Configuration Access Point allowing the user to return to the Normal Display Mode.

Configuration 1, Inputs (1-IN)

"tYPE" - Select input signal type
"dCPt" - Select scaled display decimal point position
"rnd" - Enter rounding increment and trailing zeros for scaled display
"FLtr" - Select level of input filtering
"dSP1", "InP1", "dSP2", "InP2" - Scale main input
"SPLO" - Enter setpoint lower limit
"SPHI" - Enter setpoint higher limit
"SPrP" - Enter setpoint ramp rate
"InPt" - Select user input function

Configuration 2, Outputs (2-OP) ∗

"CYCt" - Enter time proportioning cycle time
"OPAC" - Select output control action
"OPLO" - Enter output power low limit
"OPHI" - Enter output power high limit
"OPdP" - Enter output control dampening
"CHYS" - Enter ON/OFF control hysteresis
"tcOd" - Select auto-tuning dampening
"ANtP" - Main Linear DC analog output range
"ANAS" - Main Linear DC analog output source
"ANut" - Main Linear DC analog output update time
"ANLO" - Main Linear DC analog output scaling low
"ANHI" - Main Linear DC analog output scaling high

Configuration 3, Parameter Lock-Outs (3-LC) ∗

"SP" - Select setpoint access level
"OP" - Select power access level
"dEv" - Enable deviation display
"bdSP" - Enable blank display
"CodE" - Enter parameter access code
"PId" - Select PID access level
"AL" - Select alarm access level
"ALrS" - Enable alarm reset access
"SPSL" - Enable local/remote selection
"trnF" - Enable auto/manual mode selection
"tUNE" - Enable auto-tune invocation

Configuration 4, Alarms (4-AL) ∗

"ACt1" - Select operation mode of alarm #1, or select main output
"rSt1" - Select reset mode of alarm #1
"Stb1" - Enable activation delay of alarm #1
"AL-1" - Enter value for alarm #1
"ACt2" - Select operation mode of alarm #2, or select second output
"rSt2" - Select reset mode of alarm #2
"Stb2" - Enable activation delay of alarm #2
"AL-2" - Enter value for alarm #2
"AHYS" - Enter hysteresis value for both alarms

Configuration 5, Second Output (5-O2) ∗

"CYC2" - Enter time proportioning cycle time
"GAN2" - Enter relative gain
"db-2" - Enter deadband or overlap

Configuration 6, Serial Communications (6-SC) ∗

"bAUd" - Select baud rate
"ConF" - Select character frame format
"Addr" - Enter address
"Abrv" - Select abbreviated or full transmission
"PoPt" - Select print options

Configuration 7, Remote Setpoint Input (7-N2) ∗

"dSP1" - Enter remote setpoint display scaling value #1
"INP1" - Enter remote setpoint process scaling value #1
"dSP2" - Enter remote setpoint display scaling value #2
"INP2" - Enter remote setpoint process scaling value #2
"FLtr" - Enter remote setpoint filter time constant
"bAnd" - Enter remote setpoint filter disable band
"trnF" - Select Local/Remote setpoint transfer response

Configuration 8, Second Linear DC Analog Output (8-A2) ∗

"A2tP" - Second linear DC analog range
"A2LO" - Second linear DC analog scaling low
"A2HI" - Second linear DC analog scaling high

Configuration 9, Factory Service Operations (9-FS)

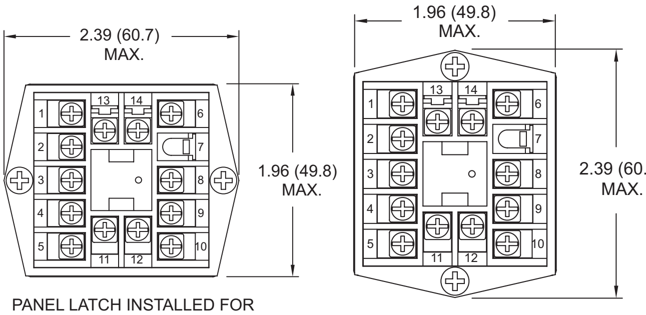
"Code 48" - Calibrate Instrument
"Code 66" - Reset parameters to factory setting

∗ *These parameters may not appear due to option configuration or other programming.*

MULTIPLE UNIT STACKING

The P48 is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

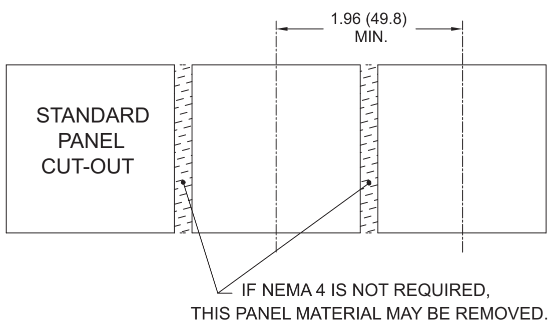
Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.



PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING

PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING

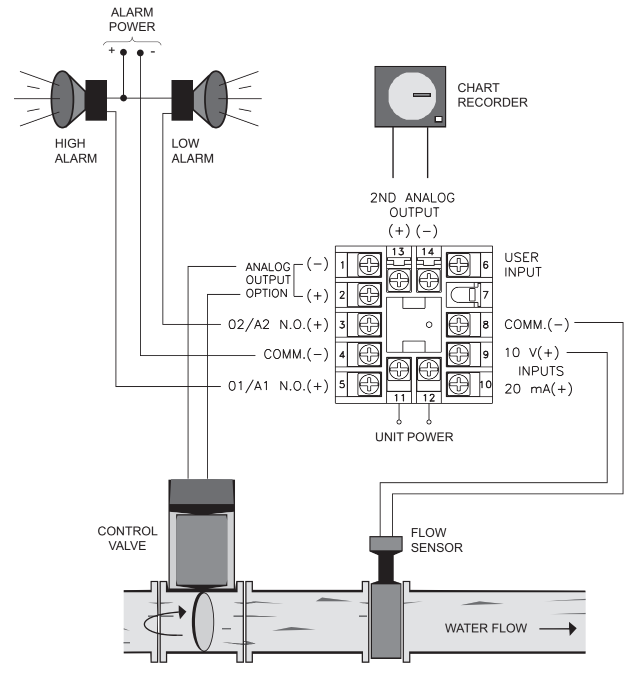
PANEL CUT-OUT SPACING FOR MULTIPLE UNIT STACKING.
HORIZONTAL ARRANGEMENT SHOWN.



APPLICATION

WATER PROCESSING APPLICATION

A city water company needs to maintain a steady flow of water for their customer needs. They have an existing 0 to 10 VDC flow transmitter to measure the water flow. They need to control the water flow, have a high and low alarm, and keep a recorded chart of the flow for later reference. The Main Linear DC output of the P48 can be used to control the position of water output values per the desired flow setpoint value. The P48 relay outputs can be programmed to give a high flow alarm and a low flow alarm. With the Second Linear DC output model, the flow measurement to the P48 can be converted from 0-10 V to 4-20 mA and retransmitted to a 4-20 mA chart recorder.



(Terminal assignments are model number dependent.)

ORDERING INFORMATION

Options and Output Boards are factory configured per the part number specified. Part numbers without replacement output boards listed must be returned to the factory for output board replacement.

DEDICATED MAIN CONTROL O1 OUTPUT	MAIN CONTROL O1 or A1(ALARM 1)*	DEDICATED ALARM 1 A1 OUTPUT	A2 (ALARM 2) OR O2 (SECONDARY)*	REMOTE SETPOINT INPUT @	RS485 @	MAIN ANALOG OUTPUT** @	SECOND ANALOG OUTPUT** @	REPLACEMENT OUTPUT BOARD	PART NUMBERS 18-36 VDC/24 VAC	PART NUMBERS 85 to 250 VAC
						YES		NA	P4800011	P4800001
Relay								RBD48100	P4810010	P4810000
	Relay		Relay			YES		NA	P4810111	P4810101
	Relay		Relay	YES		YES		NA	P4810115	P4810105
	Relay		Relay		YES	YES		NA	P4810117	P4810107
	Relay		Relay			YES	YES	NA	P481011A	P481010A
Relay		Relay	Relay					RBD48111	P4811110	P4811100
Relay		Relay	Relay		YES			RBD48111	P4811112	P4811102

* This output is programmable as either Control (PID) or as an Alarm.
** These part numbers are jumper and program selectable for either a current or a voltage Linear DC output.
@ These part numbers are equipped with a second setpoint.

Option Boards are installed at the factory for the appropriate models. These boards are only needed for field replacement.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
SFCRM	Crimson 2 PC Configuration Softwware for Windows 98, ME, 2000 and XP (for RS485 models)	SFCRM
ICM4	RS232/RS485 Serial Converter Module	ICM40030
ICM5	Three Way Isolated RS232/RS485 Serial Converter Module	ICM50000

*Crimson Software is available for download from http://www.redlion.net

F

MODEL PCU - PROCESS CONTROL UNIT

C UL US LISTED
IND. CONT. EQ.
51EB

- 100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY
- ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS
- DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS VALUE AND SETPOINT OR SECOND ANALOG INPUT
- ACCEPTS EITHER 0 to 10 VDC OR 0 to 20 mA DC INPUTS
- SELF-DIAGNOSTICS
- FULL PID CONTROL WITH REDUCED OVERSHOOT
- OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE
- OPTIONAL DUAL ALARM OUTPUTS (USES OUTPUT MODULES)
- OPTIONAL SECONDARY OUTPUT (USES OUTPUT MODULE)
- OPTIONAL LINEAR 4 to 20 mA OR 0 to 10 VDC OUTPUT FOR CONTROL OR PROCESS VALUE RE-TRANSMISSION
- OPTIONAL MOTORIZED VALVE POSITION CONTROL AND VALVE FAIL ALARM
- OPTIONAL SECOND ANALOG INPUT FOR REMOTE SETPOINT AND CASCADE CONTROL
- OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL
- STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES
- PROGRAMMABLE USER INPUT (DIGITAL) FOR ADDED FLEXIBILITY
- MANUAL/AUTOMATIC AND LOCAL/REMOTE SETPOINT CONTROL MODES
- SETPOINT RAMPING FOR PROCESS STARTUP
- PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS
- FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR Drive and Triac)

DESCRIPTION

The PCU Controller accepts either 0 to 10 VDC or a 0 to 20 mA DC input signal, precisely scales the process signal according to programmable scaling points, and provides an accurate output control signal *(time proportional, linear, or valve position)* to maintain a process at the desired control point. A comprehensive set of easy to use program instructions allows the controller to solve various applications.

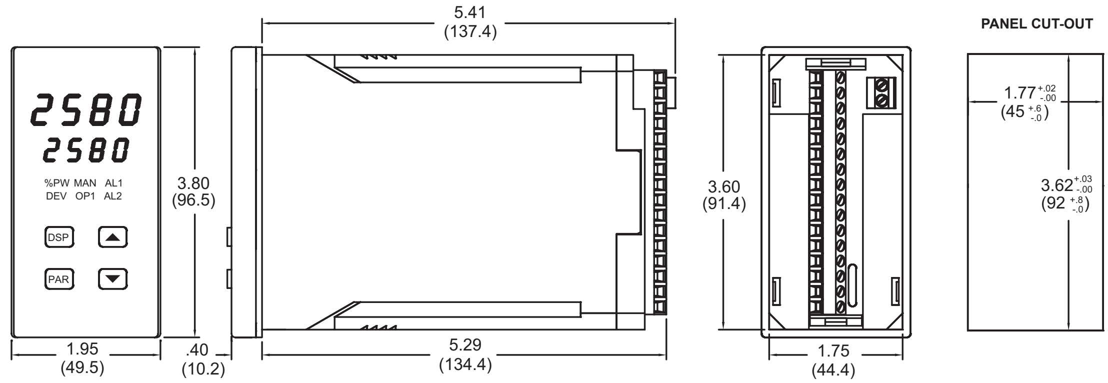
The controller can operate in the PID control mode for both the main output and optional secondary output, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked-out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis.

Dual 4-digit displays allow viewing of the process value and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. Replaceable and interchangeable output modules *(Relay, Logic/SSR Drive, or Triac)* can be installed for the main control output, alarm output(s) and secondary output.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



OPTIONS

Optional dual alarms can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT and Valve Fail Detect) with adjustable hysteresis. A standby feature suppresses the output during power-up until the process stabilizes outside the alarm region. An optional secondary output is available *(for processes that require cooling)* that provides increased control accuracy and response.

A linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following: % output power, measurement value, process measurement value deviation or setpoint value. Valve Positioner and Second Analog Input Models have the adjustable output demand dampening, output deadband and output update time parameters to expand the versatility of the PCU to control devices.

The optional Motorized Valve Positioner directly controls the position of a valve by the use of twin outputs (open and close) to control the direction of motor rotation. The motor position defines the opening position of the valve. Two control modes are possible: position control, that makes use of the slidewire feedback signal supplied with the positioner and velocity control, in which no slidewire feedback signal is used. Parameters are provided to adjust the operation of the valve. These include:

- Valve activity hysteresis
- Valve update time
- Variable control dampening
- Slidewire signal fail action
- Adjustable valve position limits

The Valve Positioner PCU achieves tight process control, yet minimizes unnecessary valve activity. An alarm event output or display alarm can be programmed under loss of slidewire feedback or under valve fail detection.

The optional Second Analog Input (0 to 20 mA DC) can be configured as a remote setpoint signal or as a secondary process signal. Configuration of the second analog input as a remote setpoint signal allows ratio control, master setpoint/multiple slave operation, and the ability to cascade the PCU with another controller (external cascade). Configuration of the second input as a secondary process signal allows operation as a two-process cascade controller within a single unit (internal cascade). In either control mode, parameters are provided to scale, configure, communicate and monitor the activity of both analog inputs. A square law linearizer function can be used to linearize signals derived from flow transmitters.

The optional RS485 multidrop serial communication interface provides two-way communication between a PCU unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from zero to ninety-nine. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output(s) may also be reset via the serial communications interface option.

An optional Type 4X/IP65 rated bezel is available for wash down and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the PCU to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY**: Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) high red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) high green LED
   Display Messages (Model dependent):
   "OLOL" - Appears when measurement exceeds +105% input range.
   "ULUL" - Appears when measurement exceeds -5% input range.
   "SENS" - Appears when measurement exceeds "OLOL" & "ULUL" range.
   "...." - Appears when display values exceed + display range.
   "-..." - Appears when display values exceed - display range.
   "SLid" - Appears when loss of slidewire signal is detected.
   "VALV" - Appears when valve actuator error is detected.
2. **POWER**: Switch selectable 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA.
3. **ANNUNCIATORS**:
   LED Backlight Status Indicators (Model dependent):
   %PW - Lower auxiliary display shows power output in (%).
   DEV - Lower auxiliary display shows deviation *(error)* from process setpoint.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Secondary output is active *(for Secondary Output Option)*.
   OPN - Valve positioner OPEN output is active *(for Valve Positioner Option)*.
   CLS - Valve positioner CLOSE output is active *(for Valve Positioner Option)*.
   SEC - Lower auxiliary display shows second analog input *(for Second Analog Input Option)*.
   MAN - Flashing: Controller is in Manual control mode.
   REM - ON: controller is in remote setpoint mode *(Second Analog Input Option)*.
   - OFF: controller is in local setpoint mode *(Second Analog Input Option)*.
   - Flashing: controller is in Manual control mode *(Second Analog Input Optional)*.
4. **CONTROLS**: Four front panel push buttons for modifying and setup of controller functions and one external input for parameter lockout or other functions.
5. **SIGNAL INPUT**:
   Sample Period: 100 msec typ.
   Response Time: 300 msec typ. *(to within 99% of final value w/step input)*
   Signal Overdrive Threshold:
   10 V Range: 13 V typ.
   20 mA Range: 26 mA typ.
   Signal Overdrive Response:
   Main Control Output: Programmable preset output
   Display: "SENS"
   Alarms: Upscale drive
   DC Linear: Programmable preset output
   Normal Mode Rejection: 40 dB typ. @ 50/60 Hz *(improves with increased digital filtering)*.
   Common Mode Rejection: 100 dB typ., DC to 60 Hz
   Protection: Input overload 120 VAC for 30 seconds.
   Range And Accuracy:

SIGNAL RANGE	ACCURACY (% OF UNSCALED READING)	MAXIMUM INPUT	INPUT IMPEDANCE	RESOLUTION
0 to 10 VDC	±(0.15% + 3 mV)	300 VDC	1M Ω	10 mV
0 to 20 mADC	±(0.15% + 6 μA)	200 mADC	10 Ω	10 μA

6. **OUTPUT MODULES [Optional] (For All Output Channels)**:
   Relay:
   Type: Form-C *(Form-A with some models. See Ordering Information.)*
   Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)* max.
   Life Expectancy: 100,000 cycles at max. load rating. *(Decreasing load and/or increasing cycle time, increases life expectancy)*.
   Logic/SSR Drive: Can drive multiple SSR Power Units.
   Type: Non-isolated switched DC, 12 VDC typ.
   Drive: 45 mA max.
   Triac:
   Type: Isolated, Zero Crossing Detection
   Rating:
   Voltage: 120/240 VAC
   Max. Load Current: 1 Amp @ 35°C
   0.75 Amp @ 50°C
   Min. Load Current: 10 mA
   Off State Leakage Current: 7 mA max. @ 60 Hz
   Operating Frequency: 20 to 400 Hz
   Protection: Internal Transient Snubber, Fused
7. **MAIN CONTROL OUTPUT**:
   Control: PID or ON/OFF
   Output: Time proportioning or linear DC
   Hardware: Plug-in, replaceable output modules
   Cycle time: Programmable
   Auto-tune: When selected, sets proportional band, integral time, and derivative time values.
   Signal Overdrive Action: Programmable

F

SPECIFICATIONS (Cont'd)

8. **SECONDARY OUTPUT (Optional)**:
   Control: PID or ON/OFF
   Output: Time proportioning or linear DC
   Hardware: Plug-in, replaceable output modules
   Cycle time: Programmable
   Proportional Gain Adjust: Programmable
   Deadband Overlap: Programmable
9. **LINEAR DC OUTPUT (Optional)**: With digital scale and offset, programmable deadband and update time.
   4 to 20 mA:
   Resolution: 1 part in 3500 typ.
   Accuracy: ±*(0.1% of reading + 25 µA)*
   Compliance: 10 V *(500 Ω max. loop impedance)*
   0 to 10 VDC:
   Resolution: 1 part in 3500 typ.
   Accuracy: ±*(0.1% of reading + 35 mV)*
   Min. Load Resistance: 10 KΩ *(1 mA max.)*
   Source: % output power, setpoint, deviation, or process value *(Available for OP1 or OP2, but not both.)*
10. **MOTORIZED VALVE POSITIONER (Optional)**:
    Two Outputs: Valve open and valve close or Linear DC *(optional)*
    Hardware: Plug-in, replaceable output modules
    Three Inputs: Slidewire feedback, signal fail detect *(Isolated from main input)*
    Slidewire Resistance: 100 Ω to 100 KΩ
    Slidewire Exciting Voltage: 0.9 VDC typ.
    Slidewire Fail Action: programmable
    Control Mode: Position mode *(with slidewire)* and velocity mode *(w/o slidewire)*.
    Control Deadband: 1% to 25.0% (position mode)
    0.1 to 25.0 seconds (velocity mode)
    Update Time: 1 to 250 seconds
    Motor Time (open, close): 1 to 9999 seconds
    Position Limits: Adjustable 0.0 to 100.0% of valve stroke
    Valve Fail Time: Off to 9999 seconds
    Alarm mode: Dual acting; loss of slidewire feedback signal and valve fail detection
11. **SECOND ANALOG INPUT**:
    Range: 0 to 20 mA (Isolated from main input)
    Overload: 100 mA $_{MIN}$ (steady state)
    Input Resistance: 10 Ω typ.
    Voltage Drop (@ 20 mA): 0.2 V typ.
    Accuracy: 0.15% of reading ±10 µA ±1 LSD
    Scale Range: -999 to 9999
12. **SERIAL COMMUNICATION**:
    Type: RS485 Multi-point, Balanced Interface
    Communication Format:
    Baud Rate: Programmable from 300 to 9600
    Parity: Programmable for odd, even, or no parity
    Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit
    Unit Address: Programmable from 0 to 99, max. of 32 units per line
    Transmit Delay: 100 msec min., 200 msec max.
    RS485 Common: Isolated from signal input common
    Auto Print Time: Off to 9999 seconds between print-outs
13. **USER INPUT (Optional)**: Internally pulled up to +5 VDC.
    V_{IN} = 5.25 VDC $_{MAX}$, V_{IL} = 0.85 V_{MAX}; V_{IH} = 3.0 V_{MIN},
    Available on all second input (MVP & ANA) models, and on models with RS485.
    Response Time: 100 msec max.
    Functions: Program Lock
    Integral Action Lock
    Auto/Manual Mode Select
    Setpoint Ramp Select
    Reset Alarms
    Print Request
    Local/Remote Setpoint Select
14. **ALARMS (Optional)**:
    Hardware: Plug-in, replaceable output module
    Modes: Absolute high acting
    Absolute low acting
    Deviation high acting
    Deviation low acting
    Inside band acting
    Outside band acting
    Valve fail
    Second Analog Input monitoring
    Reset Action: Programmable; automatic or latched
    Standby Mode: Programmable; enable or disable
    Hysteresis: Programmable
    Signal Overdrive Action: Upscale
    Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with secondary output or motorized valve position option.)*
15. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: 0 to 50°C
    Storage Temperature Range: -40 to 80°C
    Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
    Shock to IEC 68-2-27: Operational 5 g
    Span Drift *(maximum)*: 100 ppm/°C, main input; 150 ppm/°C, second input
    Zero Drift *(maximum)*:
    4 to 20 mA DC Range: 0.5 µA/°C
    0 to 10 VDC Range: 0.2 mV/°C
    Second Input: 2 µA/°C
    Relative Humidity: Less than 85% RH (non-condensing)
    Altitude: Up to 2000 meters
16. **ISOLATION BREAKDOWN RATINGS**:
    All inputs and outputs with respect to AC line: 2300 V_{MIN}
    Analog Outputs, Second Analog Input or Slidewire Input with respect to main input: 500 V_{MIN}
17. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E156876
    UL Listed: File #E137808
    Type 2 Enclosure rating (Face only) for PCU0
    Type 4X/IP65 Enclosure rating (Face only) for PCU1
    Refer to EMC Installation Guidelines section of the manual for additional information.
18. **CONNECTION**: Jaw-type terminal block
    Wire Range: 12-30 AWG copper wire
    Torque: 5-7 inch-lbs (56-79 N-cm)
19. **CONSTRUCTION**:
    Front Panel: Flame and scratch resistant tinted plastic
    Case: High impact black plastic. (Mounting collar included)
    Type 4X/IP65 model only: Sealed bezel utilizing two captive mounting screws (panel gasket included) This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2
20. **WEIGHT**: 1.3 lbs (0.6 kgs)

BASIC OPERATION

The PCU controls a process by measuring the input signal and then calculating a control output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value to keep the process at setpoint. The PID control algorithm incorporates features that provide for high control accuracy and low overshoot from process disturbances.

FRONT PANEL FEATURES

In the normal operating mode, the unit displays the scaled process value in the upper display. One of four other parameters can be viewed in the lower display:

- Setpoint
- % Power Output
- Deviation
- Second Input Process Value

The parameters can be scrolled through by pressing the DSP button. If enabled, the control setpoint or power output (manual mode only) can be directly modified in this mode.

In the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode when making a parameter change. The controller's configuration and parameter settings are stored in an internal E^2PROM device.

F

HARDWARE FEATURES

The fast 100 msec input sampling rate provides quick controller response to a process disturbance, thus providing excellent process control. Measurement accuracy of 0.15% or better, provides closer process control conforming to the desired control setpoint value. The unit accepts either a 0 to 10 VDC or a 0 to 20 mA DC input signal. The AC input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel. No re-programming is required when changing or replacing modules.

The optional Type 4X/IP65 rated model utilizes two bezel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed. The standard model simply requires pressing a latch to remove the unit.

Low-drift, highly stable circuitry ensures years of reliable and accurate process control. The recommended two-year re-calibration interval is easily accomplished via the programming menu.

SETPOINT FEATURES

The controller setpoint can be protected from out of range values by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate. This feature reduces shock to the process and helps to minimize overshoot. The setpoint may also be transmitted by the optional linear DC output for slave control loops.

The second analog input may be configured as a remote setpoint. As such, the controller is easily switched from local/remote setpoint operation via the front panel or user input. Ratio and bias parameters provide on-line scaling of the remote setpoint. Absolute limit values and maximum rate of change of the remote setpoint further enhance controller flexibility.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating characteristics, helping to provide better process control. Programmable scaling points allow the controller to display in any engineering unit; flow, level, pressure, etc. Scaling points are used in conjunction with the programmable rounding increment to stabilize a jittery or otherwise hard to read process signal for better indication.

The programmable User Input can be used to control a variety of functions, such as auto/manual transfer of the controller, reset alarm output(s), etc.

The second analog input has independent scaling parameters to match the units of other processes or transmitters, or to match the controller's range.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where excessive power can cause damage. Automatic signal overdrive detection, for fail-safe operation, causes the controller to default to a programmed output power (upscale or downscale burnout). With adjustable time proportioning cycle time, and programmable DC linear output, the controller can satisfy a wide variety of output requirements.

Programmable dampening output hysteresis and output update time parameters can dramatically reduce actuator activity without degrading control accuracy.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be set up to transmit various parameters at a programmable automatic print rate.

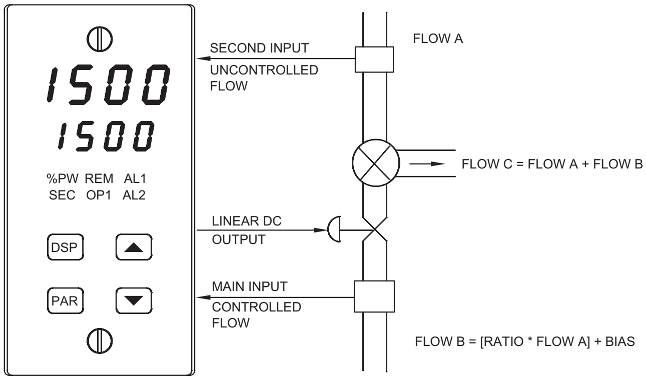
AUTO-TUNE

The PCU has an auto-tune feature that, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked either at start-up or at setpoint, depending on the process requirements. An auto-tune programmable dampening factor produces various levels of process control and response characteristics.

OPTIONS

RATIO CONTROL



The PCU configured for ratio operation controls a process as a ratio of another process or to another variable. Ratio control is commonly used for flow applications, however, any two process variables can be controlled in a ratio mode.

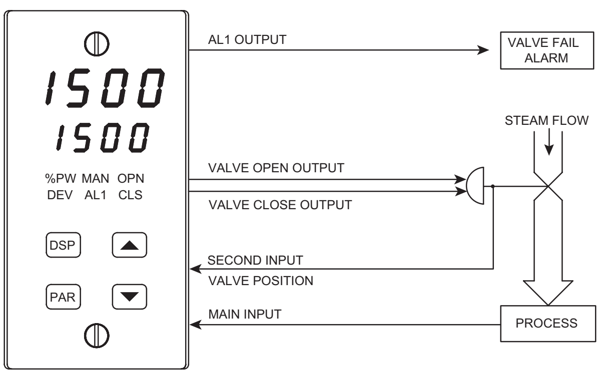
Ratio Control Configuration Parameters

"OPEr"	- Select ratio mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1" "INP1" "dSP2" "INP2"	- Enter scaling units of second input
"SPtr"	- Local/Remote Select options
"InPt"	- Program User Input for Local/Remote Setpoint selection

Ratio Control Operational Parameters

"rtio"	- Remote setpoint ratio
"bIAS"	- Remote setpoint bias

MOTORIZED VALVE POSITIONER



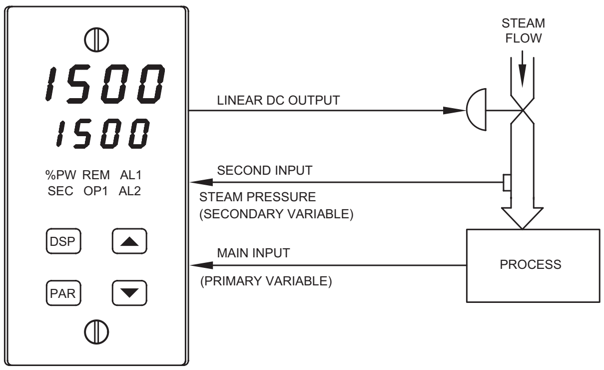
The motorized valve positioner controls the position of a valve directly, by use of *"open"* and *"close"* control outputs. The slidewire feedback signals of the valve may optionally be connected to the controller. Alternatively, the controller may be configured for linear input valve control using the 4 to 20 mA DC output.

Motorized Valve Positioner Configuration Parameters

Position mode:	"VPS1"	- Enter or measure valve closed position
	"VPS2"	- Enter or measure valve open position
	"VUdt"	- Enter Valve update time
	"VPdb"	- Enter valve control deadband
	"VFAL"	- Enter valve fail detect time
	"Act1"	- Program alarm as valve fail output
Velocity mode:	"VUdt"	- Enter Valve update time
	"VOPt"	- Enter valve open time
	"VCLt"	- Enter valve close time
	"VOnt"	- Enter valve control deadband *(minimum on time)*

F

INTERNAL CASCADE



Cascade control allows the process to be divided into two control loops: the primary control loop and the secondary control loop. The secondary loop receives its setpoint from the primary loop to control an intermediate variable (steam pressure). The control level of the intermediate variable is the input to the primary process. The primary loop (main input) controller maintains loop regulation by manipulating the setpoint of the secondary controller. The setpoint of the secondary controller, in turn, changes the intermediate variable. The secondary loop can react faster to disturbances of the intermediate variable, thereby minimizing the effects to the primary control loop. Control loops cascaded in such a manner provide greater control quality than would be possible with single loop control. A single PCU can accomplish two-process cascade control.

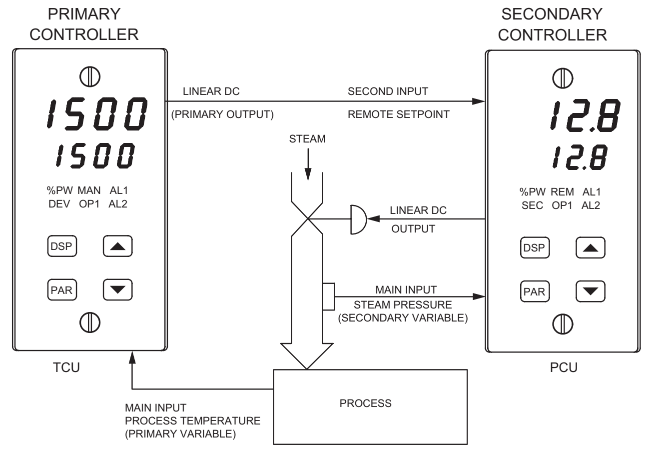
Internal Cascade Configuration Parameters

"OPEr"	- Select cascade mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1" "INP1" "dSP2" "INP2"	- Enter scaling units of second input
"OPd2"	- Output dampening of secondary

Internal Cascade Operational Parameters

"SP-2"	- View secondary setpoint value
"Pb-2"	- Enter secondary proportional band
"It-2"	- Enter secondary integral time
"dt-2"	- Enter secondary derivative time

EXTERNAL CASCADE



Similar to internal cascade control, external cascade control differs by the employment of two controllers, one of which is equipped with a second analog input configured as a remote setpoint. A PCU controls the secondary loop, while a TCU controls the primary loop.

External Cascade Configuration Parameters

"OPEr"	- Select ratio mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1" "INP1" "dSP2" "INP2"	- Enter scaling units of second input
"SPtr"	- Local/Remote select options

External Cascade Operational Parameters

"rtio"	- Remote setpoint ratio
"bIAS"	- Remote setpoint bias

SETPOINT MASTER CONTROL

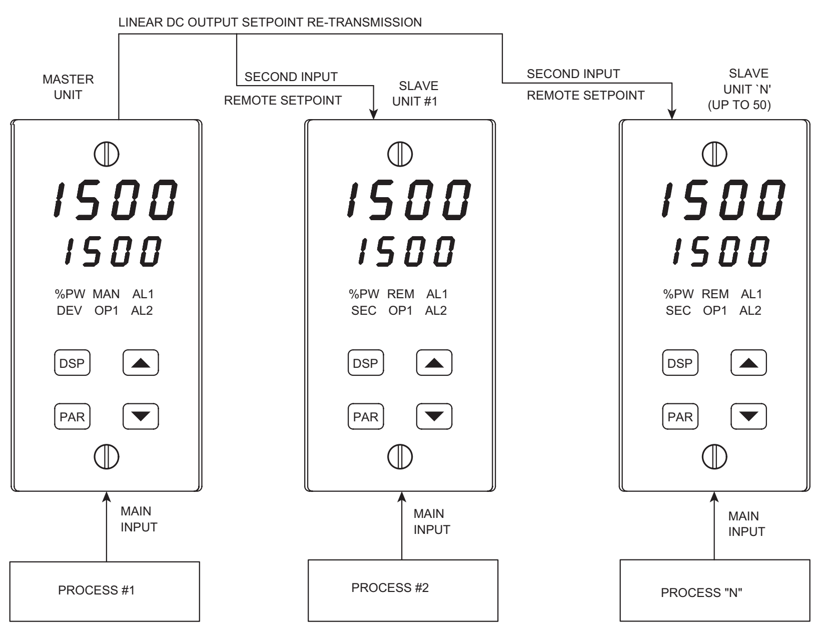
Setpoint Master Control allows automatic setpoint changes to slave controller units (up to 50 units total) from a master PCU controller. The linear DC output of the master is looped with the second analog input of the slave PCU controllers. Each slave unit can have unique remote setpoint ratio and bias values.

Setpoint Slave Configuration Parameters

"OPEr"	- Select remote setpoint mode
"root"	- Select second input square root linearization
"dPt2"	- Select second input decimal point
"dSP1" "INP1" "dSP2" "INP2"	- Enter scaling units of second input
"SPLO" "SPHI"	- Limit range of remote setpoint
"SPrP"	- Limit rate of change of remote setpoint

Setpoint Slave Operational Parameters

"rtio"	- Second input ratio
"bIAS"	- Second input bias



F

CONTROLLER PROGRAMMING

The PCU has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front Panel Program Disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

- Unprotected Parameter Mode
- Configuration Parameter Mode
- Protected Parameter Mode
- Hidden Function Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE *

The unprotected parameter mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. The configuration parameter modes can be accessed only from this mode.

“SP”	- Enter Setpoint
“OP”	- Enter output power
“Prop”	- Enter proportional band
“Intt”	- Enter integral time
“dErt”	- Enter derivative time
“rtio”	- Enter Remote Setpoint ratio value
“bIAS”	- Enter Remote Setpoint bias value
“SP-2”	- View internal cascade secondary setpoint demand
“Pb-2”	- Enter internal cascade, secondary proportional band
“It-2”	- Enter internal cascade, secondary integral time
“dt-2”	- Enter internal cascade, secondary derivative time
“AL-1”	- Enter value for alarm #1
“AL-2”	- Enter value for alarm #2
“CNFP”	- Select basic configuration mode
“End”	- Return to normal display mode

CONFIGURATION PARAMETER MODE

The configuration parameter mode allows the operator to set up the basic requirements of the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage allowing the user to return to the normal display mode.

Configuration 1, Inputs

“tYPE”	- Select input signal type
“root”	- Select square root linearization of main input *
“dCPt”	- Select scaled display decimal point position
“rnd”	- Enter rounding increment and trailing zeroes for scaled display
“FLtr”	- Select level of input filtering
“dSP1” “INP1” “dSP2” “INP2”	- Scale main input
“SPLO”	- Enter setpoint lower limit
“SPHI”	- Enter setpoint higher limit
“SPrP”	- Enter setpoint ramp rate
“InPt”	- Select user input function *

Configuration 2, Outputs

“CYCt”	- Enter time proportioning cycle time
“OPAC”	- Select control action
“OPLO”	- Enter output power low limit
“OPHI”	- Enter output power high limit
“OPFL”	- Enter signal overdrive power preset
“OPdP”	- Enter output control dampening
“CHYS”	- Enter ON/OFF control hysteresis
“tcod”	- Select auto-tuning dampening
“ANAS”	- Select linear DC output assignment *
“ANLO”	- Enter linear DC output low scaling value *
“ANHI”	- Enter linear DC output high scaling value *
“ANdb”	- Enter linear DC output control deadband *
“ANUt”	- Enter linear DC output update time *

Configuration 3, Parameter lock-outs

“SP”	- Select degree of setpoint access
“OP”	- Select degree of power access
“dEv”	- Enable deviation display *
“IN-2”	- Enable second input display *
“bdSP”	- Enable blank display
“CodE”	- Enter parameter access code
“PId”	- Select degree of PID access
“PId2”	- Select degree of secondary PID access *
“rtbS”	- Select degree of ratio/bias access *
“AL”	- Select degree of alarm access *
“ALrS”	- Enable alarm reset access *
“SPSL”	- Enable local/remote setpoint selection *
“trnF”	- Enable auto/manual mode selection
“tUNE”	- Enable auto-tune invocation

Configuration 4, Alarms *

“Act1”	- Select operation mode of alarm #1
“rSt1”	- Select reset mode of alarm #1
“Stb1”	- Enable activation delay of alarm #1
“AL-1”	- Enter value for alarm #1
“Act2”	- Select operation mode of alarm #2
“rSt2”	- Select reset mode of alarm #2
“Stb2”	- Enable activation delay of alarm #2
“AL-2”	- Enter value for alarm #2
“AHYS”	- Enter hysteresis value for both alarms

Configuration 5, Secondary Output *

“CYC2”	- Enter time proportioning cycle time
“GAN2”	- Enter relative gain
“db-2”	- Enter deadband or overlap

Configuration 6, Serial Communications *

“bAUd”	- Select baud rate
“PArb”	- Select parity bit
“Addr”	- Enter unit address number
“Abrv”	- Select abbreviated or full mnemonic transmissions
“PrAt”	- Enter automatic print rate
“PoPt”	- Select parameters to be included in print-out

Configuration 7, Second Input *

“OPEr”	- Select remote setpoint or internal cascade mode
“root”	- Select second input square root linearization
“dPt2”	- Select second input decimal point
“dSP1” “INP1” “dSP2” “INP2”	- Entering scaling parameters of second input
“SPtr”	- Enter local/remote select options
“OPd2”	- Enter Secondary output control dampening

Configuration 8, Motorized Valve Positioner *

Position mode:	“VPS1”	- Enter or measure valve closed position
	“VPS2”	- Enter or measure valve open position
	“VUdt”	- Enter valve update time
	“VPdb”	- Enter valve control deadband
	“VFAL”	- Enter valve fail detect time
Velocity mode:	“VUdt”	- Enter valve update time
	“VOPt”	- Enter valve open time
	“VCLt”	- Enter valve close time
	“VOnt”	- Enter valve control deadband *(minimum on time)*

HIDDEN FUNCTION MODE *

The hidden function mode is accessible from the normal operating mode. The four functions in this mode may be locked-out individually in configuration 3 parameter lock-out section.

“SPSL”	- Select Local/Remote Setpoint
“trnF”	- Transfer between automatic (PID) control and manual control
“tUNE”	- Invoke/cancel PID Auto-tune
“ALrS”	- Reset latched alarms

* *These parameters may not appear due to option configuration or other programming.*

PROTECTED PARAMETERS MODE *

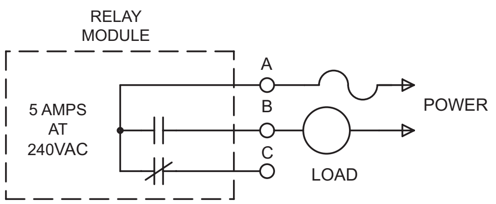
The protected parameters mode is enabled when program disable is active. This mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-out section can be accessed.

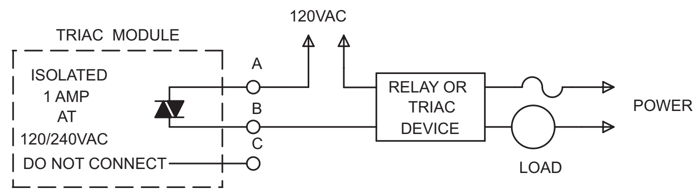
"ProP"	-	Enter Proportional band
"Intt"	-	Enter integral time
"dErt"	-	Enter derivative time
"rtio"	-	Enter remote setpoint ratio value
"bIAS"	-	Enter remote setpoint bias value
"SP-2"	-	Enter internal cascade, secondary setpoint
"Pb-2"	-	Enter internal cascade, secondary proportional band
"It-2"	-	Enter internal cascade, secondary integral time
"dt-2"	-	Enter internal cascade, secondary derivative time
"AL-1"	-	Enter value for alarm #1
"AL-2"	-	Enter value for alarm #2
"CodE"	-	Enter access value to unprotected parameters & configuration parameters

* *These parameters may not appear due to option configuration or other programming.*

OUTPUT MODULES

TYPICAL CONNECTIONS



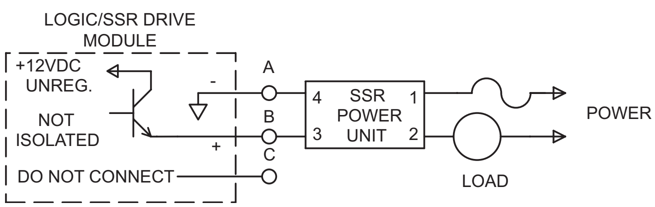


Relay:

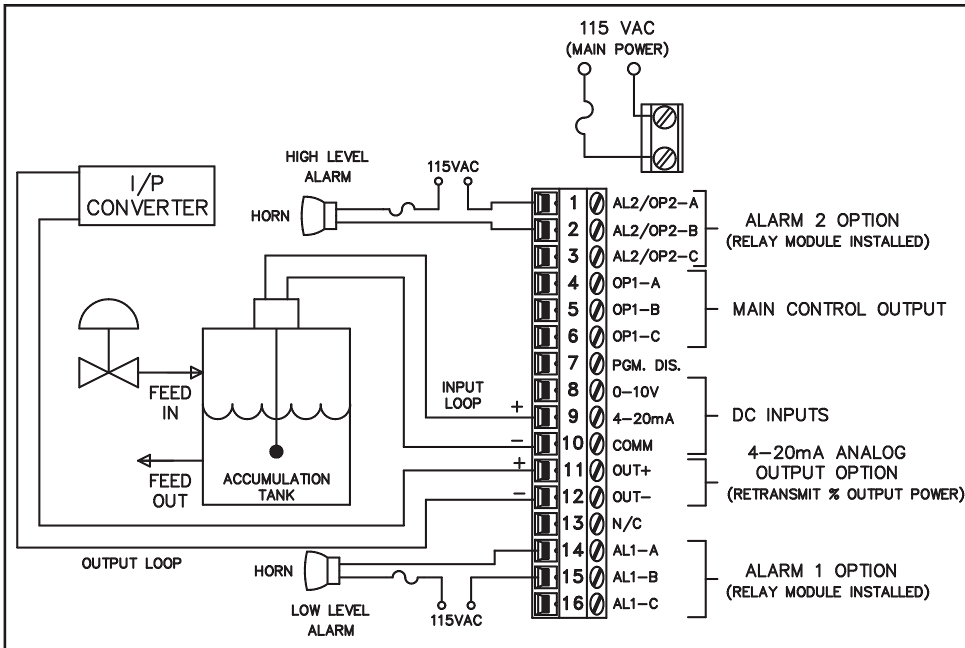
Type: Form-C (Form-A with some models. See ordering information.)
Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive) maximum.
Life Expectancy: 100,000 cycles at maximum load rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).

Triac:

Type: Isolated, Zero Crossing Detection
Rating:
Voltage: 120/240 VAC
Max. Load Current: 1 ampere @ 35°C
0.75 ampere @ 50°C
Min. Load Current: 10 mA
Off State Leakage Current: 7 mA max. @ 60 Hz
Operating Frequency: 20 to 400 Hz
Protection: Internal Transient Snubber, Fused



Logic/SSR Drive: Can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical
Drive: 45 mA maximum.



APPLICATION

A chemical company would like to maintain the level of an acid solution tank to insure constant availability for their process. They have chosen a PCU controller which has a continuous level probe with a 4 to 20 mA output proportional to tank level, connected to the input terminals. The tank is filled by controlling the position of a proportional control valve. The control valve is controlled by a 3 to 15 PSI air signal.

The PCU uses the level control input as its feedback. The 4 to 20 mA input signal is scaled so that 4 mA equals 0% and 20 mA equals 100%.

The 4 to 20 mA output of the PCU is taken to an I/P converter to convert the 4 to 20 mA output to a 3 to 15 PSI signal for the control valve. The relay outputs of the PCU are used for high and low level alarms.

F

ORDERING INFORMATION

MODELS WITHOUT SECOND INPUT OPTIONS

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
NO	YES	NO	NO	NO	NO	PCU01000
NO	YES	NO	2	NO	NO	PCU01001
YES	NO	NO	NO	NO	NO	PCU10000
YES	NO	NO	2	NO	NO	PCU10001
YES	NO	NO	1	YES	NO	PCU10002
YES	YES	NO	NO	NO	NO	PCU11000
YES	YES	NO	2	NO	NO	PCU11001
YES	YES	NO	1	YES	NO	PCU11002
YES	YES	NO	2	NO	YES	PCU11004
YES	YES	NO	1	YES	YES	PCU11005
YES	NO	YES	2	NO	NO	PCU12001
YES	NO	YES	2	NO	YES	PCU12004
YES	NO	YES	1	YES	YES	PCU12005
These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.						

SECOND ANALOG INPUT MODELS (RSP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	2	NO	YES	PCU10104
YES	YES	NO	2	NO	NO	PCU11108
YES	NO	YES	2	NO	NO	PCU12108
These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output module.						

MOTORIZED VALVE POSITIONER MODELS (MVP)

Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	COOLING OUTPUT	RS485 COM	PART NUMBER
YES	NO	NO	1	NO	YES	PCU10307
YES	YES	NO	1	NO	NO	PCU11306
YES	NO	YES	1	NO	NO	PCU12306

ACCESSORIES

DESCRIPTION	PART NUMBER
Relay Module	OMD00000
Triac Module	OMD00001
Logic/SSR Drive Module	OMD00003
45 A Single Phase Panel Mount SSR	RLY50000
25 A Single Phase DIN Rail Mount SSR	RLY60000
40 A Single Phase DIN Rail Mount SSR	RLY6A000
25 A Three Phase DIN Rail Mount SSR	RLY70000

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s), the secondary output, and valve positioner outputs.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to line voltage.

All modules are packaged separately and must be installed by the user.

MODEL PSC - PROCESS SETPOINT CONTROLLER

c UL US LISTED
IND. CONT. EQ.
51EB

- *SETPOINT PROGRAM CONTROLLER FOR TIME VS. PROCESS (RAMP/SOAK) AND SPECIAL BATCH/RECIPE APPLICATIONS*
- *ADVANCED PROGRAM PROFILING IN A 1/8 DIN PACKAGE*
- *ON-LINE MONITORING AND CONTROL OF PROGRAM STATUS, TIME, AND SETPOINT VALUE (Profile Run, Pause, Stop, Advance, Modify Time, & Setpoint Value)*
- *AUTOMATIC PROGRAM DELAY FOR PROFILE CONFORMITY, PLUS PROGRAM LINKING, REPEATING AND AUTO POWER-ON FUNCTIONS FOR ENHANCED CAPABILITY*
- *DUAL EVENT OUTPUTS FOR TIMED ACTIVATION OF PROCESS EQUIPMENT SUCH AS STIRRERS, FANS, HEATERS, ETC. (Uses Alarm Output Channels)*
- *FOUR SETPOINT & PID PARAMETER SETS FOR QUICK RECALL OF SETPOINTS AND/OR GAIN VALUES DURING BATCH OR PROCESS CHANGEOVER*
- *PROGRAMMABLE USER INPUT FOR CONTROLLER AND SETPOINT PROGRAM CONTROL*
- *100 MSEC SAMPLING PERIOD WITH 0.15% ACCURACY*
- *ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS*
- *DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF PROCESS AND SETPOINT OR PROCESS AND PROFILE STATUS*
- *ACCEPTS EITHER 0 to 10 VDC OR 4 to 20 mA DC INPUT SIGNAL*
- *FIELD REPLACEABLE AND INTERCHANGEABLE OUTPUT MODULES (Relay, Logic/SSR drive, and Triac)*
- *OPTIONAL DUAL ALARM OUTPUTS (Uses Output Modules)*
- *OPTIONAL SECONDARY OUTPUT (Uses Output Module)*
- *OPTIONAL LINEAR 4 to 20 mA OR 0 to 10 VDC OUTPUT FOR CONTROL OR PROCESS RE-TRANSMISSION*
- *OPTIONAL RS485 SERIAL COMMUNICATIONS INTERFACE*
- *OPTIONAL TYPE 4X/IP65 SEALED FRONT BEZEL*

DESCRIPTION

The PSC is a setpoint controller suitable for time vs. process control applications. The PSC Controller accepts either a 0 to 10 VDC or a 4 to 20 mA DC input signal, precisely scales the process signal, according to programmable scaling points, and provides an accurate output control signal (time proportional or linear) to maintain a process at the desired control point. A comprehensive set of easy to use steps allows the controller to satisfy various applications. The user input can be programmed to perform a variety of controller functions.

Dual 4-digit displays allow viewing of the measured process value and setpoint or the process and profile status simultaneously. Front panel indicators inform the operator of controller status and output states. Replaceable output modules (Relay, logic/SSR drive or Triac) can be fitted to the main control output, alarm output(s) or timed event output(s), and secondary output.

The PSC has been designed to simplify the set-up and operation of a controlled setpoint profile program. The setpoint program is easily entered and controlled through the front panel. Full display capabilities keep the operator informed of the process value, profile status, output states, and setpoint value.

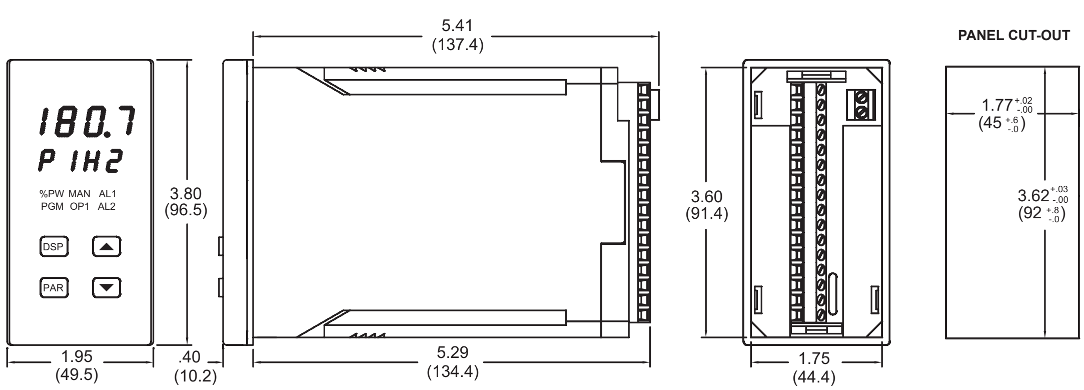
The controller can operate in the standard PID control mode for both Output 1 and Output 2 with on-demand auto-tune which establishes the PID gain set. The PID gain set can be fine tuned by the operator at any time or may be locked from further modification. The unit can be transferred to the manual control mode providing the operator with direct control of the output.

The PSC features four programs or profile recipes, each with up to eight ramp/soak segments, which can be easily stored and executed at any time. Longer profiles can be achieved by linking one or more profiles together, creating a single profile of up to 32 ramp/soak segments. Process profile conformity is assured during either soak (hold) phases or both ramp and hold phases by an adjustable error band parameter. The program repeat function cycles the profile either continuously or a set number of times. Power-on options automatically re-start, stop, or resume a running profile. The profile can be controlled via the front panel buttons, the user input, or the optional serial communications port.

F

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140) H x 2.1" (53.4) W.



DESCRIPTION (Cont'd)

Four control points, each having a setpoint and PID parameter set, are available for instant front panel implementation during batch changeover, or other process conditions. A control point may have its PID gain set values disabled when implementing the control point.

The optional RS485 multidrop serial communications interface provides the capability of two-way communication between a PSC unit and other compatible equipment such as a printer, a programmable controller, or a host computer. In multipoint applications the address number of each unit on the line can be programmed from 0 to 99. Up to thirty-two units can be installed on a single pair of wires. The Setpoint value, % Output Power, Setpoint Ramp Rate, etc. can be interrogated or changed by sending the proper command code via serial communications. Alarm output*(s)* may also be reset via the serial communications interface option.

Optional alarm output*(s)* may be configured to operate as a timed event output or as a standard alarm output. As an alarm output it may be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, or Band IN or OUT) with adjustable hysteresis. Also, a standby feature suppresses the output*(s)* on power-up until the process stabilizes outside the alarm region. Timed event output*(s)* allow the controller to activate other equipment while a programmed profile is running. Each profile can define up to 16 event states (phases), for each output*(s)*.

An optional secondary output is available for processes that require cooling which provides increased control accuracy and response.

The optional linear 4 to 20 mA or 0 to 10 VDC output signal is available to interface with final actuators, chart recorders, indicators, or other controllers. The output signal can be digitally scaled and selected to transmit one of the following:

% Output Power
Measurement Value
Measurement Value Deviation
Setpoint Value

An optional Type 4X/IP65 rated bezel is available for washdown and/or dirty environments, when properly installed. Modern surface-mount technology, extensive testing, plus high immunity to noise interference, makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the PSC to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit. An independent and redundant process limit indicator with alarm outputs is strongly recommended. The indicators should have input sensors and AC power feeds independent from other equipment.

SPECIFICATIONS

1. **DISPLAY:** Dual 4-digit
   Upper Process Display: 0.4" (10.2 mm) Red LED
   Lower Auxiliary Display: 0.3" (7.6 mm) Green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds +105% of input range.
   "ULUL" - Appears when measurement exceeds -5% of input range.
   "SENS" - Appears when measurement exceeds "OLOL" & "ULUL" range.
   "...." - Appears when display value exceeds + display range.
   "-..." - Appears when display value exceeds - display range.
2. **POWER**: Switch selectable 115/230 VAC (+10%, -15%) no observable line variation effect, 48 to 62 Hz, 10 VA.
3. **ANNUNCIATORS:**
   6 LED Backlight Status Indicators:
   %PW - Lower auxiliary display shows power output in (%).
   PGM - Lower auxiliary display shows profile status or profile time remaining.
   MAN - Controller is in manual mode.
   OP1 - Main control output is active.
   AL1 - Alarm #1 is active.
   AL2 - Alarm #2 is active *(for Dual Alarm Option)*.
   OP2 - Secondary output is active *(for Secondary Option)*.
4. **CONTROLS:** Four front panel push buttons for modifying and setup of controller functions and one external input.
5. **SETPOINT PROFILE:**
   Profiles: 4
   Segments Per Profile: 8 ramp/hold segments (linkable to 32 segments).
   Ramp Rate: 0.1 to 999.9 units/minute or no ramp.
   Hold Time: Off or from 0.1 to 999.9 minutes, can be extended to 500 hours by linking.
   Error Band Conformity: Off or from 1 to 9999 units deviation, + value for hold phases, - value for both ramp and hold phases.
   Power-On Modes: Stop, auto-start, or profile resume.
   Start Mode: Ramps from process value.
   Program Auto Cycle: 1 to 249, or continuous.
   Event Outputs: 2, time activated with profile [uses Alarm output(s)].
   Control: Front panel buttons, user input, or RS485 communications.
6. **CONTROL POINTS:**
   Setpoints: 4
   PID gain sets: 4
   Control: Front panel buttons or user input.
7. **SIGNAL INPUT:**
   Sample Period: 100 msec
   Response Time: 300 msec (to within 99% of final value w/step input).
   Signal Overdrive Threshold:
   10 V Range: 13 V
   20 mA Range: 26 mA
   Signal Overdrive Response:
   Main Control Output: Programmable preset output.
   Display: "SENS"
   DC Linear: Programmable preset output.
   Normal Mode Rejection: 40 db @ 50/60 Hz (improves with increased digital filtering).
   Common Mode Rejection: 100 db, DC to 50/60 Hz.
8. **RANGE AND ACCURACY:**

Signal Range	Accuracy (% of Unscaled Reading)	Max. Input	Input Impedance	Resolution
0 to 10 VDC	±(0.15% + 3 mV)	300 VDC	1M Ω	10 mV
0 to 20 mADC	±(0.15% + 6 μA)	200 mADC	10 Ω	10 μA

9. **OUTPUT MODULES (For All Output Channels):**
   (Optional - Must be ordered separately)
   Relay:
   Type: Form-C *(Form-A with RS485 option)*
   Rating: 5 Amps @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 HP @ 120 VAC *(inductive load)*.
   Life Expectancy: 100,000 cycles at max. rating. (Decreasing load and/or increasing cycle time, increases life expectancy).
   Logic/SSR Drive: Can drive multiple SSR Power Units.
   Type: Non-isolated switched DC, 12 VDC typical
   Drive: 45 mA max.
   Triac:
   Type: Isolated, Zero Crossing Detection.
   Ratings: Voltage: 120/240 VAC
   Max Load Current: 1 AMP @ 35°C
   0.75 AMP @ 50°C
   Min Load Current: 10 mA
   Off State Leakage Current: 7 mA max. @ 60 Hz
   Operating Frequency: 20 to 500 Hz
   Protection: Internal Transient Snubber, Fused.
10. **MAIN CONTROL OUTPUT:**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC.
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Auto-tune: When performed, sets proportional band, integral time, and derivative time values.
    Probe Break Action: Programmable.
11. **SECONDARY OUTPUT (Optional):**
    Control: PID or ON/OFF.
    Output: Time proportioning or linear DC
    Hardware: Plug-in, replaceable output modules.
    Cycle time: Programmable.
    Proportional Gain Adjust: Programmable.
    DeadBand Overlap: Programmable.
12. **LINEAR DC DRIVE (Optional):** With digital scale and offset, programmable deadband and update time.
    4 to 20 mA:
    Resolution: 1 part in 3500 typ.
    Accuracy: ±*(0.1% of reading + 25 μA)*.
    Compliance: 10 V *(500 Ω max. loop impedance)*.
    0 to 10 VDC:
    Resolution: 1 part in 3500 typ.
    Accuracy: ±*(0.1% of reading + 35 mV)*.
    Min. Load Resistance: 10 K Ω (1 mA max.)
    Source: % output power, setpoint, deviation, or process value.
    (Available for OP1 or OP2, but not both.)

F

SPECIFICATIONS (Cont'd)

13. **ALARMS (Optional):**
    Hardware: Plug-in, replaceable output module.
    Modes: Absolute high acting
    Absolute low acting
    Deviation high acting
    Deviation low acting
    Inside band acting
    Outside band acting
    Timed event output(s)
    Reset Action: Programmable; automatic or latched.
    Delay: Programmable; enable or disable.
    Hysteresis: Programmable.
    Annunciator: LED backlight for "AL1", "AL2", *(Alarm #2 not available with secondary output)*.
14. **SERIAL COMMUNICATIONS (Optional):**
    Type: RS485 Multi-point, Balanced Interface.
    Communication Format:
    Baud Rate: Programmable from 300 to 9600.
    Parity: Programmable for odd, even, or no parity.
    Frame: 1 start bit, 7 data bits, 1 or no parity bit, 1 stop bit.
    Unit Address: Programmable from 0-99, max. of 32 units per line.
    Transmit Delay: 100 msec min., 200 msec max.
    RS485 Common: Isolated from signal input common.
    Auto Print Time: Off to 9999 seconds between print-outs.
15. **USER INPUT:** $V_{IN\ MAX}$ = 5.25 VDC, V_{IL} = 0.85 V_{MAX}; V_{IH} = 2.0 V_{MIN}
    Response time: 100 msec max.
    Functions:

Program Lock	Print Request
Integral Action Lock	Load Control Point
Auto/Manual Transfer	Run/Hold Profile 1
Setpoint Ramp Select	Run/Stop Profile 1
Reset Alarms	

16. **ENVIRONMENTAL CONDITIONS:**
    Operating Temperature Range: 0° to 50°C
    Storage Temperature Range: -40° to 80°C
    Vibration to IEC 68-2-6: Operational 5-150 Hz, 1 g
    Shock to IEC 68-2-27: Operational 5 g
    Span Drift: 90 ppm/°C
    Zero Drift: 0 to 10 VDC Range - 0.2 mV/°C
    4 to 20 mA DC Range - 0.5 µA/°C
    Relative Humidity: Less than 85% RH (non-condensing)
    Altitude: Up to 2000 meters
17. **CERTIFICATIONS AND COMPLIANCES:**
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    EN 61010-1
    RoHS Compliant
    UL Recognized Component: File #E156876
    UL Listed: File #E137808
    Type 2 Enclosure rating (Face only) for PSC0
    Type 4X/IP65 Enclosure rating (Face only) for PSC1
    Refer to EMC Installation Guidelines section of the manual for additional information.
18. **CONNECTION:** Jaw-type terminal block.
19. **CONSTRUCTION:**
    Front Panel: Flame and scratch resistant tinted plastic.
    Case: High impact black plastic. (Mounting collar included).
    Type 4X/IP65 model only: Sealed bezel utilizing 2 captive mounting screws (panel gasket included). This unit is rated for Type 4X/IP65 indoor use. Installation Category II, Pollution Degree 2.
20. **WEIGHT:** 1.3 lbs. (0.6 kgs)

F

BASIC OPERATION

The PSC controls the process profile of a system by measuring the input signal, comparing it to the setpoint value of the profile in progress, and calculates the new output power value by use of a modified PID control algorithm. The unit controls the system with the new output power value so the process value conforms to the profile. The PID control algorithm incorporates features which provide high control accuracy and low disturbance overshoot.

FRONT PANEL FEATURES

In the normal display mode, the unit will display the scaled process value in the upper display. One of five other parameters may be selected for viewing in the lower display:

Target setpoint
% Output Power
Profile Status
Profile phase time remaining
Blank the lower display.

The profile status display indicates the active program number with the current ramp or hold phase of the program. The profile can be started, stopped, advanced, etc., from the front panel when the profile status display is viewed, if not locked from access.

The phase time remaining display, shows the time remaining in a ramp or hold phase and, if not locked from access, may be changed on-line to effect temporary changes to the profile. Additionally, the target setpoint and % output power (manual mode only) may also be changed on-line or locked from operator access.

From the normal operating mode, parameters are selected by use of the PAR button and modified by use of the UP and DOWN buttons. Parameters are then entered by the PAR button, which advances the user to the next parameter. Pressing the DSP button immediately returns the controller to the normal operating mode from any parameter module. The controller configuration and parameter settings are stored in an internal E^2PROM device.

HARDWARE FEATURES

Type 4X/IP65 BEZEL

The fast 100 msec input sampling rate provides quick controller response to a process disturbance for excellent process control. Measurement accuracy of 0.15% provides closer process control conforming to the desired control setpoint value.

The unit will accept either a 0 to 10 VDC or a 4 to 20 mADC input signal. The A.C. input power is switch selectable, allowing the unit to operate from either 115 VAC or 230 VAC. Since the controller is serviceable from the front of the panel, the output modules may be easily changed or replaced without disturbing the wiring behind the panel and NO re-programming is required. The standard model simply requires pressing a latch to remove the unit. The Type 4X/IP65 rated model utilizes two panel securing screws and a neoprene gasket to guarantee a water tight seal, when properly installed.

Low-drift, highly stable circuit design ensures years of reliable and accurate process control. The recommended two year re-calibration interval is easily accomplished via the programming menu.

CONFIGURATION MODE

The configuration modules serve to provide the basic set-ups required by the controller. It is divided into sections which group together related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each section, the program returns to the configuration selection stage, which allows the user to return to the normal display mode, or advance to a later configuration stage.

Configuration 1, Inputs

"tYPE"	-	Select current or voltage
"dCPt"	-	Select scaled display decimal point position
"rnd"	-	Enter rounding increment and trailing zeros for scaled display
"FLtr"	-	Select degree of input filtering
"dSP1"	-	Enter display reading for scaling point #1
"INP1"	-	Key-in or apply signal level for scaling point #1
"dSP2"	-	Enter display reading for scaling point #2
"INP2"	-	Key-in or apply signal level for scaling point #2
"SPLO"	-	Enter setpoint lower limit
"SPHI"	-	Enter setpoint higher limit
"SPrP"	-	Enter setpoint ramp rate
"InPt"	-	Select user input function

Configuration 2, Outputs

"CYCt"	-.	Enter time proportioning cycle time
"OPAC"	-.	Select control action
"OPLO"	-.	Enter output power low limit
"OPHI"	-.	Enter output power high limit
"OPFL"	-.	Enter signal overdrive power preset
"CHYS"	-.	Enter ON/OFF control hysteresis
"tcod"	-.	Select auto-tuning damping
"ANAS"	-.	Select linear DC output assignment ∗
"ANLO"	-.	Enter linear DC low scaling value ∗
"ANHI"	-.	Enter linear DC high scaling value ∗

Configuration 3, Parameter lock-outs

"SP"	-	Select degree of setpoint access
"OP"	-	Select degree of power access
"P-CS"	-	Select degree of profile status access
"P-tr"	-	Select degree of phase time remaining access
"bdSP"	-	Enable blank display
"CodE"	-	Enter parameter access code
"PId"	-	Select degree of PID access
"AL"	-	Select degree of alarm access ∗
"ALrS"	-	Enable manual reset of alarms ∗
"CPAC"	-	Enable control point access
"PrAC"	-	Enable ramp/hold program access
"trnF"	-	Enable automatic/manual transfer
"tUNE"	-	Enable auto-tune invocation

∗ *These parameters may not appear due to option configuration or other programming.*

Configuration 4, Alarms ∗

"Act 1"	-	Select operation mode of alarm #1
"rSt1"	-	Select reset mode of alarm #1
"Stb1"	-	Enable activation delay of alarm #1
"AL-1"	-	Enter value for alarm #1
"Act2"	-	Select operation mode of alarm #2
"rSt2"	-	Select reset mode of alarm #2
"Stb2"	-	Enable activation delay of alarm #2
"AL-2"	-	Enter value for alarm #2
"AHYS"	-	Enter hysteresis value for both alarms

Configuration 5, Secondary Output ∗

"CYC2"	-	Enter time proportioning cycle time
"GAN2"	-	Enter relative gain
"db-2"	-	Enter deadband or overlap

Configuration 6, Serial Communications ∗

"bAUd"	-	Select baud rate
"PArb"	-	Select parity bit
"Addr"	-	Enter unit address number
"Abrv"	-	Select abbreviated or full mnemonic transmissions
"PrAt"	-	Enter automatic print rate
"PoPt"	-	Select parameters to be included in print-out

Configuration 7, Control Points

"CSEt"	-	Select control point number for set-up 1, 2, 3, & 4
"SP-x"	-	Enter setpoint value for selected control point
"PID"	-	Select if PID gain set to be loaded with setpoint
"PB-x"	-	Enter proportional band for selected control point ∗
"It-x"	-	Enter integral time for selected control point ∗
"dt-x"	-	Enter derivative time for selected control point ∗

Configuration 8, Profiles

"PSEt"	-	Select profile or event output for set-up 1, 2, 3, or 4
"PnCC"	-	Enter program-repeat cycle count for selected profile
"PnLN"	-	Select link option for selected profile
"PnSt"	-	Enter power-down resume status for selected profile
"PnEb"	-	Enter error band for process conformity for selected profile
"Pnr1"	-	Enter ramp rate 1 for selected profile ∗
"PnL1"	-	Enter setpoint level 1 for selected profile ∗
"PnH1"	-	Enter hold time 1 for selected profile ∗
.	-	
.	-	
"Pnr8"	-	Enter ramp rate 8 for selected profile ∗
"PnL8"	-	Enter setpoint level 8 for selected profile ∗
"PnH8"	-	Enter hold time 8 for selected profile ∗
"Pn 1"	-	Select event outputs at phase 1 for selected profile ∗
.	-	
.	-	
"Pn16"	-	Select event outputs at phase 16 for selected profile ∗

Configuration 9, Factory Service Operations

(Detailed in the operator's manual)

SETPOINT FEATURES

The controller's setpoint can be protected from out of range values, by programming the setpoint range limit values. Additionally, safeguards from inadvertent data entry can also be programmed.

The setpoint ramp feature ramps the setpoint value at start-up or any time a setpoint change is made, at a user programmable rate, independent of a programmed profile. This feature reduces shock to the process and also helps to minimize overshoot.

The active setpoint, which can be a running profile, may also be transmitted by the linear DC output for slave control loops.

Four control points are available which can be implemented at any time. Each control point is programmed independently, with each having a setpoint and a PID gain set value. With gain value changes, the output power control signal will not "bump" resulting in a smooth control transition.

INPUT FEATURES

A programmable input filter can be used to stabilize readings from a process with varying or oscillating characteristics, helping to provide better process control.

Scaling points allow the controller to display in any engineering unit; flow, level, pressure temperature, etc. Scaling points are used in conjunction with the programmable rounding increment to stabilize a jittery or otherwise hard to read process signal for better indication.

A programmable User Input is available to control a variety of controller functions, such as profile control, auto/manual transfer, serial communication print requests, etc.

OUTPUT FEATURES

Programmable output power limits provide protection for processes where too much power can cause damage. Automatic signal overdrive detection can be used to define the state of the output channels, when this situation occurs. With adjustable time proportioning-cycle time and programmable D.C. Linear output, the controller can satisfy a wide variety of output requirements.

During execution of a profile, two independent timed event outputs are available to control or signal other equipment. The event outputs use the alarm channels.

The RS485 Communication option allows the user to access various controller parameters such as the setpoint, % output power, % proportional band, etc. The controller may be setup to transmit various parameters at a programmable automatic print rate.

AUTO-TUNE

The model PSC has an auto-tune feature which, on demand, automatically determines the PID control parameters for a particular process. After completion of auto-tune, the PID parameters are automatically optimized for that process and loaded into nonvolatile memory. The operator may view and modify the parameters as desired.

Auto-tune may be invoked at start-up, while ramping, or at setpoint, depending on the process requirements. A programmable auto-tune damping factor produces various levels of process control and response characteristics.

PROFILE PROGRAMMING

Profiles are programmed independently of each other and are separate from the configuration of other controller parameters. Each profile has parameters for error band (profile conformity), linking, auto-start and program repeat cycles. Profiles may be altered during execution, so changes take effect as the profile advances.

CONTROLLER PROGRAMMING

The model PSC has been designed to reduce the operator interaction with the controller while still maintaining a high degree of control accuracy and user flexibility. Front panel program disable allows all of the controller's set-ups to be locked-out from further operator intervention after the initial parameter set-up.

The programming of the controller is divided into four sections:

Hidden Mode
Protected Mode
Unprotected Mode
Configuration Mode

These four programming modes allow the controller to adapt to any required user-interface level.

UNPROTECTED PARAMETER MODE

The unprotected mode is accessible when program disable is inactive or when the proper access code number from the protected mode is entered. Only from this mode can the configuration modes be accessed.

- "SP" - Enter setpoint ∗
- "OPOF" - Enter %output power offset ∗
- "OP" - Enter output power ∗
- "ProP" - Enter proportional band
- "Intt" - Enter integral time ∗
- "dErt" - Enter derivative time ∗
- "AL-1" - Enter value for alarm #1 ∗
- "AL-2" - Enter value for alarm #2 ∗
- "CNFP" - Select basic configuration module
- "End" - Return to normal display mode

PROTECTED PARAMETER MODE ∗

The protected mode is accessible when program disable is active, also this mode prevents access to the configuration modes without the proper access code number. Only the parameters that are selected in the configuration 3 parameter lock-outs section can be accessed.

- "ProP" - Enter proportional band
- "Intt" - Enter integral time
- "dErt" - Enter derivative time
- "AL-1" - Enter value for alarm #1
- "AL-2" - Enter value for alarm #2
- "CodE" - Enter access value to unprotected mode

∗ *These parameters may not appear due to option configuration or other programming.*

HIDDEN FUNCTIONS MODE ∗

The hidden mode is accessible from the normal operating mode by holding the PAR button for 3 seconds. The five functions in this mode may be locked-out individually in configuration 3 parameter lock-outs section.

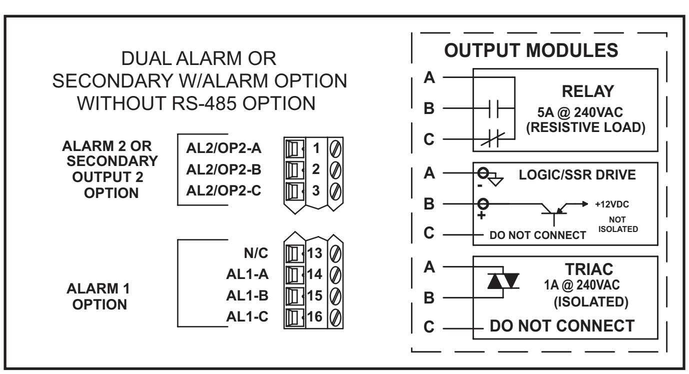
- " CP" - Invoke control point x
- "Prun" - Control ramp/hold profile state
- "trnF" - Transfer between automatic (PID) control and Manual control
- "tUNE" - Invoke/Cancel PID auto-tune
- "ALrS" - Reset latched alarms

∗ *These parameters may not appear due to option configuration or other programming.*

F

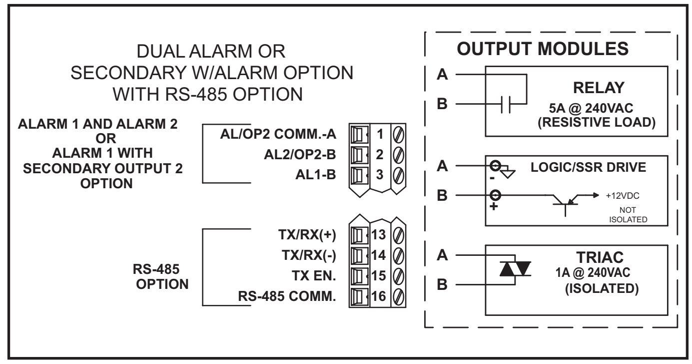
OUTPUT VARIATIONS WITHOUT RS485 OPTION

The Dual Alarm or the Secondary with Alarm output, without the RS485 option, has independent outputs. Therefore, the secondary output and/or alarm output*(s)* can be installed with any combination of output modules.



OUTPUT VARIATIONS WITH RS485 OPTION

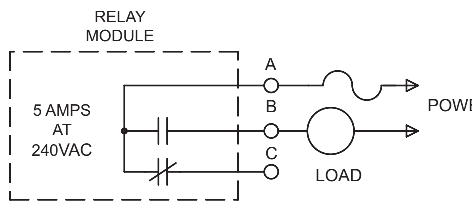
The Dual Alarm or the Secondary with Alarm output, with RS485 option, does not have independent outputs. In this case, the secondary output and/or alarm output*(s)* must have the same type of output modules installed since they share the common terminal.



OUTPUT MODULES

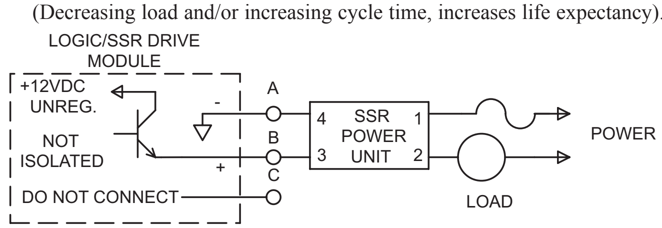
Units equipped with RS485 option must have the Dual Alarm or Secondary w/alarm options fitted with the same type of output modules. The controller's main output (OP1) can be fitted with any output module. Output modules are shipped separately and must be installed by the user.

TYPICAL CONNECTIONS

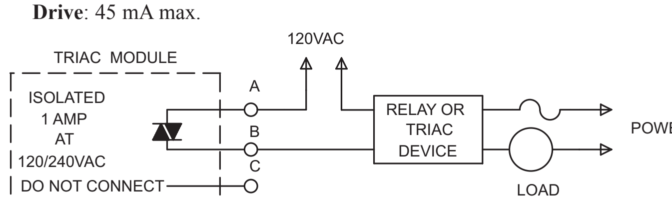


Relay:

Type: Form -C (Form-A with RS485 option only)
Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive).
Life Expectancy: 100,000 cycles at maximum load rating.
(Decreasing load and/or increasing cycle time, increases life expectancy).



Logic/SSR Drive: can drive multiple SSR Power Units.
Type: Non-isolated switched DC, 12 VDC typical.
Drive: 45 mA max.



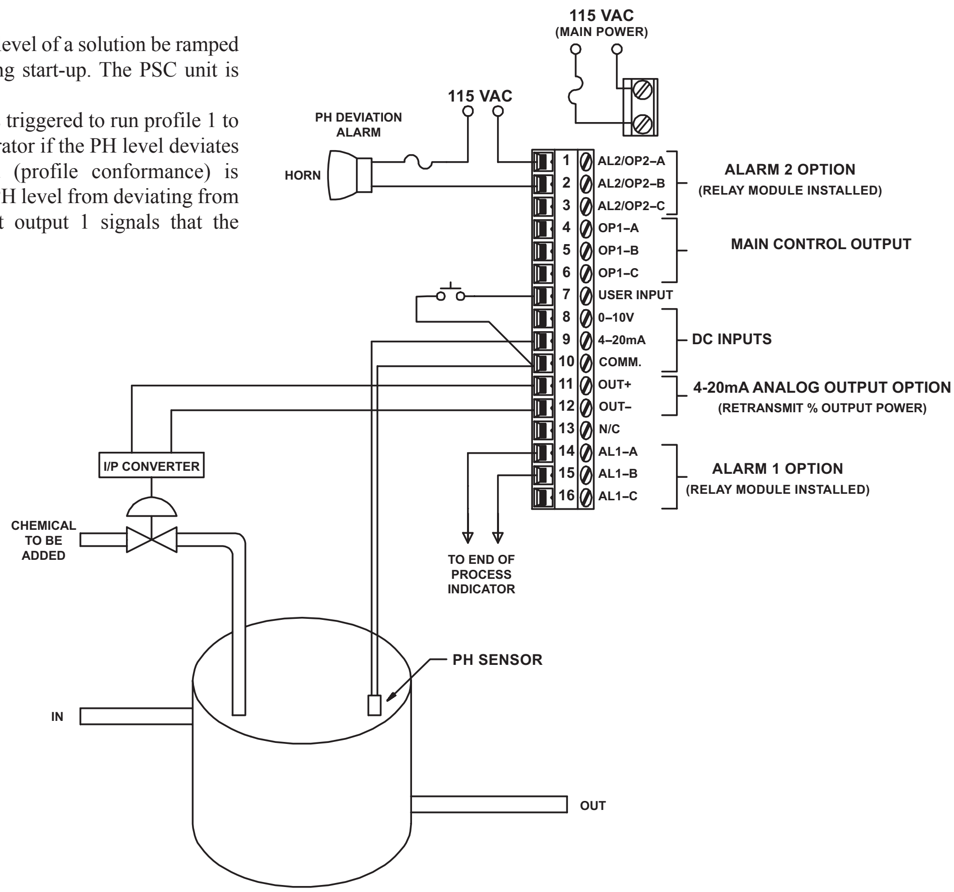
Triac:

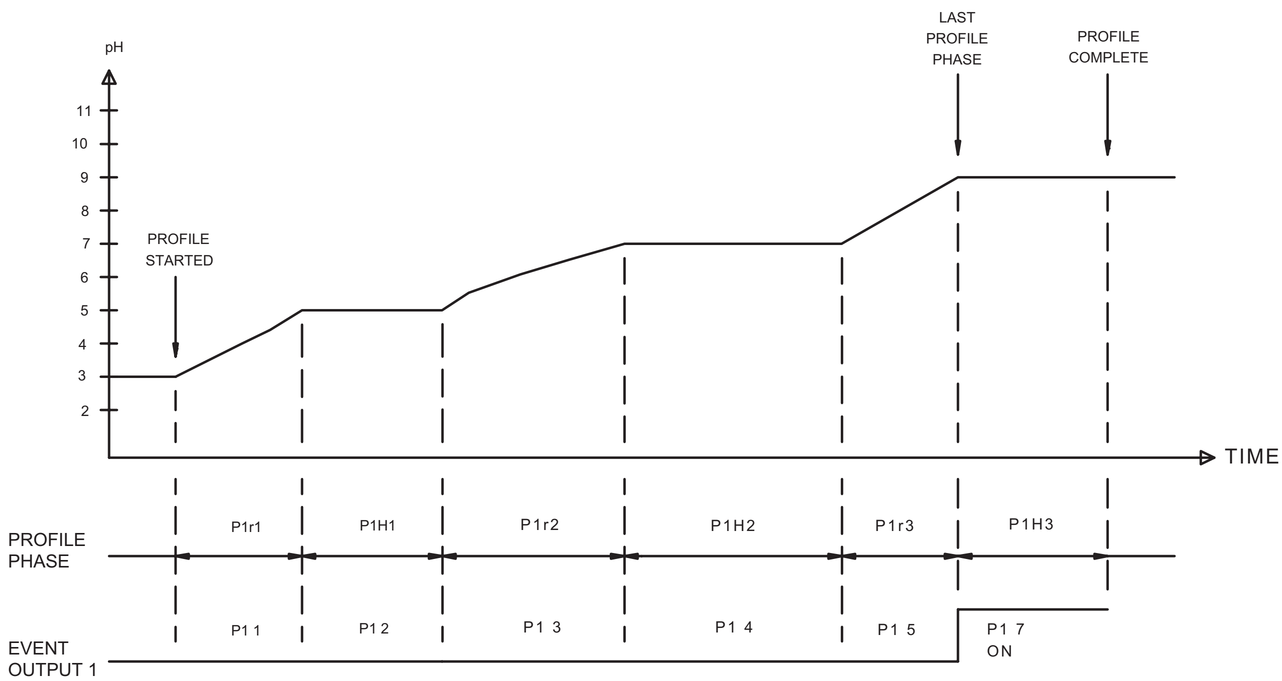
Type: Isolated, Zero Crossing Detection.
Rating:
Voltage: 120/240 VAC.
Max. Load Current: 1 Amp @ 35°C
0.75 Amp @ 50°C
Min. Load Current: 10 mA
Off State Leakage Current: 7 mA max @ 60 Hz.
Operating Frequency: 20 to 500 Hz.
Protection: Internal Transient Snubber, Fused.

APPLICATION

A chemical treatment process requires the PH level of a solution be ramped at staged levels over specific time periods during start-up. The PSC unit is installed to meet this requirement.

After the tank is filled, the PSC's user input is triggered to run profile 1 to start the process. Alarm output 2 signals the operator if the PH level deviates outside the running profile. The error band (profile conformance) is programmed to the desired value to prevent the PH level from deviating from the programmed setpoint profile. Timed event output 1 signals that the profile process is complete.





F

ORDERING INFORMATION

MODEL NO	DESCRIPTION	Type 4X/IP65 BEZEL	4 to 20 mA ANALOG OUTPUT	0 to 10 VDC ANALOG OUTPUT	ALARM OUTPUTS	SECONDARY OUTPUT	RS485 COM	PART NUMBER
PSC	Process Setpoint Controller	YES	YES	NO	2	NO	NO	PSC11001
		YES	YES	NO	2	NO	YES	PSC11004
		YES	YES	NO	1	YES	YES	PSC11005
		YES	NO	YES	2	NO	YES	PSC12004
		YES	NO	YES	1	YES	YES	PSC12005
	Relay Module							OMD00000
	Triac Module							OMD00001
	Logic/SSR Drive Module							OMD00003
PMK5	Panel Mount Adapter Kit (1/4 DIN to 1/8 DIN)							PMK50000
RLY	45 A Single Phase Panel Mount SSR							RLY50000
	25 A Single Phase DIN Rail Mount SSR							RLY60000
	40 A Single Phase DIN Rail Mount SSR							RLY6A000
	25 A Three Phase DIN Rail Mount SSR							RLY70000
These models have dual alarm outputs, or single alarm with secondary outputs, with shared common terminals (Form A Type). As a result, these outputs should be fitted with the same type of output module. The main output (OP1) may be fitted with any type of output								

Note: Output Modules are NOT supplied with the controller. When specifying the controller, be sure to purchase the appropriate output module for the Main Control Output and if necessary, the alarm output(s) and secondary output. The controller can be fitted with any combination of output modules that do not have the RS485 option.

The Logic/SSR Drive Module is a switched DC source, intended to drive the DC input of an SSR power unit. It should never be connected to a line voltage.

All modules are shipped separately and must be installed by the user.

MODEL TLA - TEMPERATURE LIMIT ALARM

- FM APPROVED, UL RECOGNIZED
- 2-LINE BY 4-DIGIT DISPLAY
- EXCEED, OUTPUT, AND ALARM ANNUNCIATORS
- FOUR BUTTON SILICONE RUBBER KEYPAD
- THERMOCOUPLE OR RTD SENSOR INPUT
- REMOTE RESET INPUT
- MAIN LIMIT OUTPUT: 5A RELAY. SELECTABLE FOR HIGH OR LOW TRIP ACTIVATION
- OPTIONAL ALARMS: 5A RELAY(S)
- OPTIONAL NEMA 4X/IP65 SEALED FRONT BEZEL
- PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS

FM APPROVED

UL Recognized Component, File # E156876

GENERAL DESCRIPTION

The TLA is a Factory Mutual approved temperature limit alarm, intended to provide an independent shutdown for thermal processes. The TLA accepts signals from a variety of temperature sensors (thermocouple or RTD elements), and its comprehensive programming allows it to meet a wide variety of application requirements.

Dual 4-digit displays allow viewing of the process temperature and limit setpoint simultaneously. Front panel indicators inform the operator of the process and output status. The main limit output and alarm outputs are field replaceable.

The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required (local or remote). Sensor failure will initiate a process shutdown.

Relay alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, and Band IN or OUT) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the process stabilizes outside the alarm region.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the TLA extremely reliable in industrial environments.

SAFETY SUMMARY

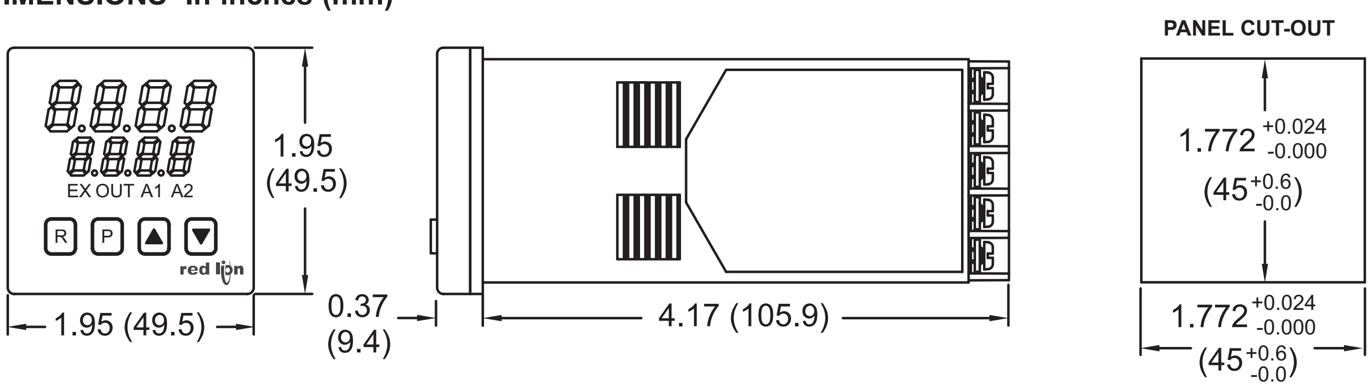
All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the TLA to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

F

DIMENSIONS In inches (mm)



GENERAL SPECIFICATIONS

1. **DISPLAY**: 2 line by 4-digit LED
   Upper (Main) Display: 0.4" (10.2 mm) high red LED
   Lower (Secondary) Display: 0.3" (7.6 mm) high green LED
   Display Messages:
   "OLOL" - Appears when measurement exceeds + sensor range.
   "ULUL" - Appears when measurement exceeds - sensor range.
   "OPEN" - Appears when open sensor is detected.
   "SHrt" - Appears when shorted sensor is detected (RTD only)
   "..." - Appears when display values exceed + display range.
   "-.." - Appears when display values exceed - display range.

LED Status Annunciators:
   EX - Temperature exceeds limit setpoint
   OUT - Limit output is de-energized
   A1 - Alarm #1 is active
   A2 - Alarm #2 is active

2. **POWER:**
   Line Voltage Models: 85 to 250 VAC, 50/60 Hz, 8 VA.
   Low Voltage Models:
   DC Power: 18 to 36 VDC, 7 W.
   AC Power: 24 VAC +/-10%, 50/60 Hz, 9 VA
3. **CONTROLS:** Four rubber push buttons: R, P, Up, Down
4. **MEMORY:** Nonvolatile E^2PROM retains all programmable parameters and values.
5. **ENVIRONMENTAL CONDITIONS:**
   Operating Range: FM rated @ 0 to 65°C, UL rated @ 0 to 55°C
   Storage Range: -40 to 80°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 65°C.
   Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
   Shock to IEC 68-2-27: Operational 20 g (10 g relay).
   Altitude: Up to 2000 meters
6. **ISOLATION BREAKDOWN RATINGS:**
   AC line with respect to all inputs and outputs: 2300 V for 1 minute (250 V working)
   Relay contacts to all other inputs and outputs: 2300 VAC
   DC Power with respect to sensor input: 50 V working (500 V for 1 minute)
7. **CERTIFICATIONS AND COMPLIANCES:**
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   RoHS Compliant
   Factory Mutual (FM) Listed: File #3014646
   UL Recognized Component: File #E156876
   Type 4X Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
8. **CONNECTION:** Wire clamping screw terminals
   Wire Gage Capacity: Two 14 AWG (2.55 mm), four 18 AWG (1.02 mm), or four 20 AWG (0.61 mm).
   Terminal Torque: 1.0Nm (8.9 in-lbs.).
   1.4Nm (12.4 in-lbs.) max.
9. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Flame resistant. Installation Category II, Pollution Degree 2.
10. **WEIGHT:** 0.38 lbs (0.17 kgs)

INPUT SPECIFICATIONS

1. **SENSOR INPUT:**
   Sample Period: 100 msec
   Step Response Time: Less than 300 msec typ., 400 msec max. (to within 99% of final value)
   Normal Mode Rejection: Greater than 40 dB @ 50/60 Hz
   Common Mode Rejection: Greater than 120 dB, DC to 60 Hz
   Overvoltage Protection: Input overload 120 VAC for 15 seconds max.
2. **Failed Sensor Response:**
   Main Output: Sensor failure will initiate a process shutdown
   Display: "OPEN"
   Alarms: Upscale
3. **INDICATION ACCURACY:** ±(0.3% of Span +1°C) at 23°C ambient after 20 minute warm-up. (Includes NIST conformity, cold junction effect, A/D conversion errors and linearization conformity.
   Span Drift (maximum): 130 PPM/°C
4. **RTD INPUT:** 2 or 3 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.0039162
   Excitation: 150 µA typical
   Resolution: 1 or 0.1 degree
   Lead Resistance: 15 Ω max. per input lead

RTD TYPE	RANGE
385	-200 to +600°C -328 to +1100°F
392	-200 to +600°C -328 to +1100°F
OHMS	2.0 to 320.0

5. **THERMOCOUPLE INPUT:**
   Types: T, E, J, K, R, S, B, N, Linear mV, software selectable
   Input Impedance: 20 MΩ all types
   Lead resistance effect: 0.25 µV/Ω
   Cold junction compensation: Less than ±1°C typ., (±1.5°C max), error over 0 to 65°C max. ambient temperature range. Defeated for Linear mV indication mode.
   Resolution: 1° for all types, or 0.1° for T, E, J, K, and N onlY.

TC TYPE	RANGE	WIRE COLOR	
		ANSI	BS 1843
T	-200 to +400°C -328 to +752°F	blue (+) red (-)	white (+) blue (-)
E	-200 to +750°C -328 to +1382°F	violet (+) red (-)	brown (+) blue (-)
J	-200 to +760°C -328 to 1400°F	white (+) red (-)	yellow (+) blue (-)
K	-200 to +1250°C -328 to +2282°F	yellow (+) red (-)	brown (+) blue (-)
R	0 to 1768°C +32 to +3214°F	black (+) red (-)	white (+) blue (-)
S	0 to 1768°C +32 to 3214°F	black (+) red (-)	white (+) blue (-)
B	+149 to +1820°C +300 to +3308°F	grey (+) red (-)	no standard
N	-200 to +1300°C -328 to +2372°F	orange (+) red (-)	orange (+) blue (-)
mV	-5.00 to +56.00	no standard	no standard

6. **REMOTE RESET INPUT:** Internally pulled up to +5 VDC (1MΩ).
   V_{IL}: 0.85 V max., V_{IH}: 3.65 V min., V_{IN} MAX: 5.25 VDC, I_{OFF}: 1µA max.

F

OUTPUT SPECIFICATIONS

1. **LIMIT AND ALARM OUTPUT RELAYS**:
   Contact Rating: 5 A @ 250 VAC or 30 VDC (resistive load).
   Life Expectancy: 100,000 cycles at max. load rating. (Decreasing load increases life expectancy.)
2. **LIMIT OUTPUT**: TLA21000: Form-C relay; TLA11100: Form-A relay. Selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required (local or remote).
   Annunciators:
   "EX" - Lit when the process temperature exceeds the limit setpoint.
   "OUT" - Lit when the limit output is de-energized.
3. **ALARM OUTPUTS (Optional)**: One or two Form-A relays.
   Modes:
   Absolute High Acting / Absolute Low Acting
   Deviation High Acting / Deviation Low Acting
   Inside Band Acting / Outside Band Acting
   Reset Action: Programmable; automatic or latched. Latched alarms can be reset regardless of limit exceed condition.
   Standby Mode: Programmable; enable or disable.
   Hysteresis: Programmable.
   Annunciator: "A1" and "A2" programmable for normal or reverse acting.

ORDERING INFORMATION

85 to 250 VAC

LIMIT OUTPUT	ALARM 1 OUTPUT	ALARM 2 OUTPUT	REPLACEMENT OUTPUT BOARD	PART NUMBERS
Form-C Relay	Form-A Relay		RBDLA210	TLA21000
Form-A Relay	Form-A Relay	Form-A Relay	RBD48111	TLA11100

18 to 36 VDC / 24 VAC

LIMIT OUTPUT	ALARM 1 OUTPUT	ALARM 2 OUTPUT	REPLACEMENT OUTPUT BOARD	PART NUMBERS
Form-C Relay	Form-A Relay		RBDLA210	TLA21010
Form-A Relay	Form-A Relay	Form-A Relay	RBD48111	TLA11110

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

F

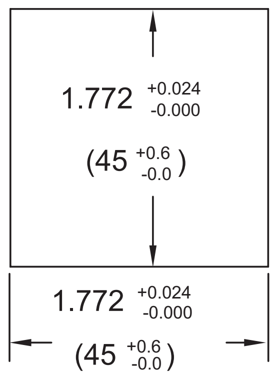
1.0 INSTALLING THE TLA

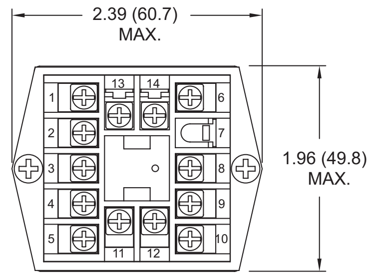
The TLA meets NEMA 4X/IP65 requirements for indoor use to provide a watertight seal in steel panels with a minimum thickness of 0.09 inch, or aluminum panels with a minimum thickness of 0.12 inch. The units are intended to be mounted into an enclosed panel. It is designed so that the units can be stacked horizontally or vertically. The bezel assembly **MUST** be in place during installation of the unit.

Instructions:

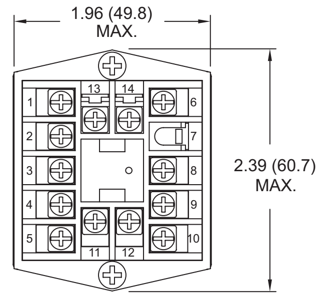
1. Prepare the panel cutout to the dimensions.
2. Remove the panel latch from the unit. Discard the cardboard sleeve.
3. Carefully remove the center section of the panel gasket and discard. Slide the panel gasket over the unit from the rear, seating it against the lip at the front of the case.
4. Insert the unit into the panel cutout. While holding the unit in place, push the panel latch over the rear of the unit, engaging the tabs of the panel latch in the farthest forward slot possible.
5. To achieve a proper seal, tighten the panel latch screws evenly until the unit is snug in the panel, torquing the screws to approximately 7 in-lbs (79 N-cm). Over tightening can result in distortion of the panel, and reduce the effectiveness of the seal.

Note: The installation location of the TLA is important. Be sure to keep it away from heat sources (ovens, furnaces, etc.), and away from direct contact with caustic vapors, oils, steam, or any other process byproducts in which exposure may affect proper operation.

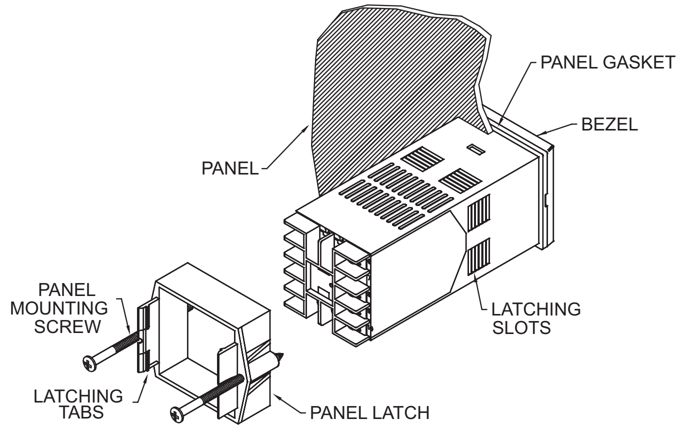




PANEL LATCH INSTALLED FOR VERTICAL UNIT STACKING

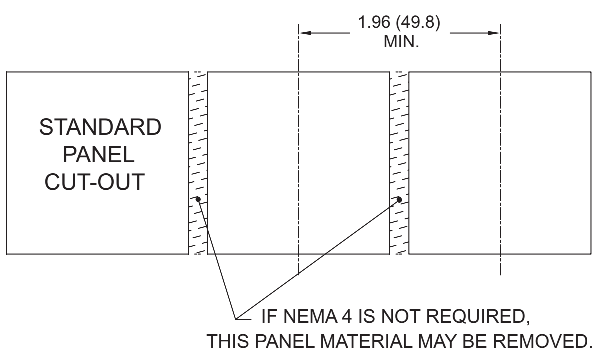


PANEL LATCH INSTALLED FOR HORIZONTAL UNIT STACKING



Multiple Unit Stacking

The TLA is designed for close spacing of multiple units. Units can be stacked either horizontally or vertically. For vertical stacking, install the panel latch with the screws to the sides of the unit. For horizontal stacking, the panel latch screws should be at the top and bottom of the unit. The minimum spacing from center line to center line of units is 1.96" (49.8 mm). This spacing is the same for vertical or horizontal stacking.

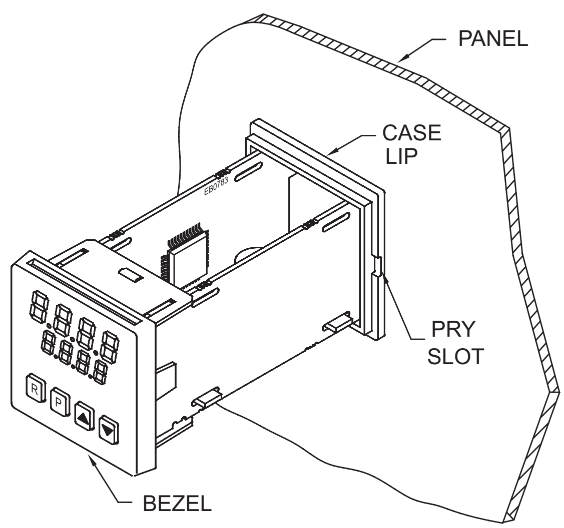


Note: When stacking units, provide adequate panel ventilation to ensure that the maximum operating temperature range is not exceeded.

Caution: Disconnect power to the unit and to the output control circuits to eliminate the potential shock hazard when removing the bezel assembly.

Unit Removal Procedure

To remove a unit from the panel, first loosen the panel latch screws. Insert flat blade screwdrivers between the latch and the case on either side of the unit, so that the latches disengage from the grooves in the case. Push the unit through the panel from the rear.



Removing Bezel Assembly

The bezel assembly must be removed from the case to replace the output board. To remove the bezel assembly, insert a flat blade screwdriver into the pry slot on either side of the unit. Twist the screwdriver handle until the unit is ejected enough to allow removal.

Caution: The bezel assembly contains electronic circuits that can be damaged by static electricity. Before removing the assembly, discharge static charge on your body by touching an earth ground point. It is also important that the bezel assembly be handled only by the bezel itself. Additionally, if it is necessary to handle a circuit board, be certain that hands are free from dirt, oil, etc., to avoid circuit contamination that may lead to malfunction. If it becomes necessary to ship the unit for repairs, place the unit in its case before shipping.

Installing Bezel Assembly

To install the bezel assembly, insert the assembly into the case until the bezel is fully seated against the lip of the case. Properly installing the bezel assembly is necessary for watertight sealing.

2.0 WIRING THE TLA

After the unit has been mechanically mounted, it is ready to be wired. All wiring connections are made to the rear screw terminals. When wiring the unit, use the numbers on the label and those embossed on the back of the case, to identify the position number with the proper function.

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker. Strip the wire, leaving approximately 1/4" (6 mm) bare wire exposed (stranded wires should be tinned with solder). Insert the wire under the clamping washer and tighten the screw until the wire is clamped tightly.

Caution: Unused terminals are NOT to be used as tie points. Damage to the TLA may result if these terminals are used.

POWER WIRING

AC Power

Primary AC power is connected to terminals #11 and #12, labeled AC. To reduce the chance of noise spikes entering the AC line and affecting the TLA, an AC feed separate from that of the load should be used to power the TLA. Be certain that the AC power to the TLA is relatively “clean” and within the variation limit. Connecting power from heavily loaded circuits or circuits that also power loads that cycle on and off (contacts, relays, motors, etc.), should be avoided.

DC Power

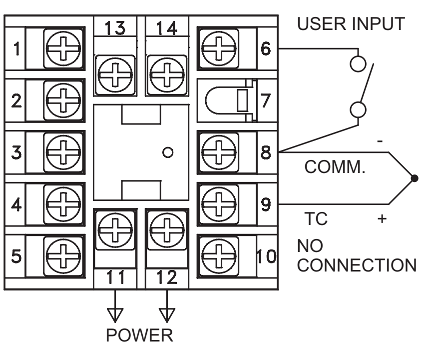
DC Power (18 to 36 VDC) is connected to terminals #11 and #12 labeled DC+ and DC- respectively.

CAUTION: Observe proper polarity when connecting DC voltages. Damage to the unit may occur if polarity is reversed.

SIGNAL WIRING

Thermocouple

When connecting the thermocouple, be certain that the connections are clean and tight. If the thermocouple probe cannot be connected directly to the TLA, thermocouple wire or thermocouple extension-grade wire must be used to extend the connection points (copper wire does not work). Always refer to the thermocouple manufacturer’s recommendations for mounting, temperature range, shielding, etc. For multi-probe temperature averaging applications, two or more thermocouple probes may be connected to the TLA (always use the same type). Paralleling a single thermocouple to more than one TLA is not recommended. Generally, the red wire from the thermocouple is negative and connected to the TLA’s common.



Thermocouple Connection

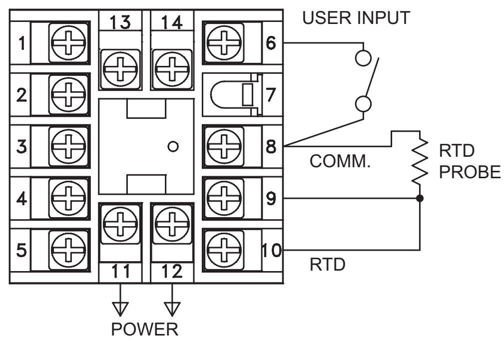
RTD

When connecting the RTD, be certain that the connections are clean and tight. RTD sensors have a higher degree of accuracy and stability than thermocouple sensors. Most RTD sensors available are the three wire type. The third wire is a sense lead for canceling the effects of lead resistance of the probe. Four wire RTD elements may be used by leaving one of the sense leads disconnected. Two wire RTD sensors may be used in either of two ways:

A) Attach the RTD to terminals #8 and #10. Install a copper sense wire of the same wire gauge as the RTD leads. Attach one end of the wire at the probe and the other end to terminal #9. Complete lead wire compensation is obtained. This is the preferred method.

B) Attach the RTD to terminals #8 and #10. Install a shorting wire between terminals #9 and #10. A temperature offset error of 2.5°C/ohm of lead resistance exists. The error may be compensated by programming a temperature offset.

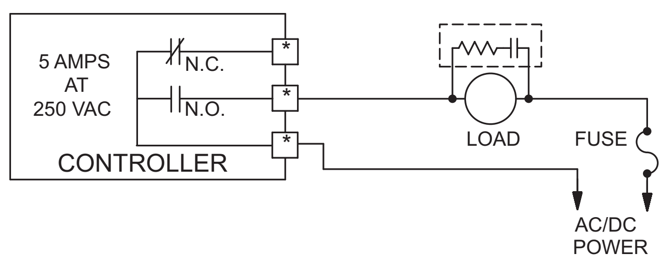
Note: With extended cable runs, be sure the lead resistance is less than 15 ohms/ lead.



RTD Connection

RELAY CONNECTIONS

To prolong contact life and suppress electrical noise interference due to the switching of inductive loads, it is good installation practice to install a snubber across the contactor. Follow the manufacturer's instructions for installation.



Note: Snubber leakage current can cause some electromechanical devices to be held ON.

*Terminal numbers are model dependent. See Terminal Configurations for description.

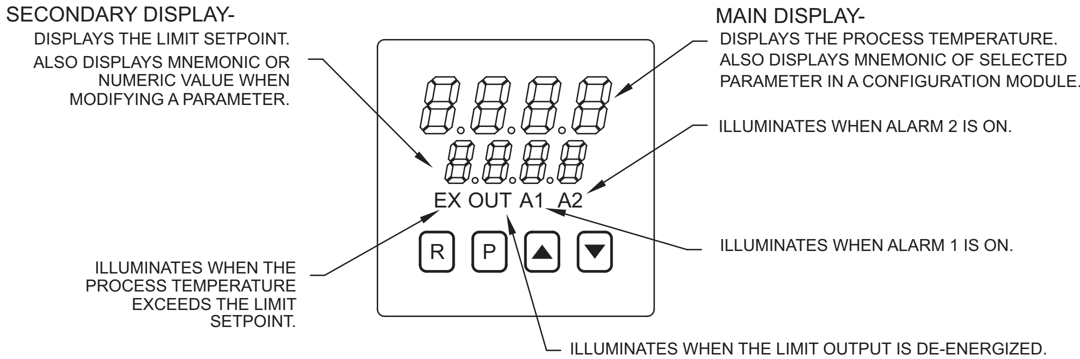
REMOTE RESET WIRING

The use of shielded cable is recommended. Follow the EMC installation guidelines for shield connection.

Terminal #6 is the Remote Reset. Any form of mechanical switch may be connected to terminal #6 (REMOTE RESET) and terminal #8 (COMM.). Sinking open collector logic with less than 0.7 V saturation and off-state leakage current of less than 1 µA may also be used.

F

3.0 FRONT PANEL DESCRIPTION



The front panel bezel material is flame and scratch resistant, tinted plastic that meets NEMA 4X/IP65 requirements, when properly installed. Continuous exposure to direct sunlight may accelerate the aging process of the bezel. The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. There are two 4-digit LED displays, a red upper Main Display and a lower green Secondary Display.

There are up to four panel annunciators, with red backlighting, that illuminate to inform the operator of the TLA and output status. See the front panel diagram for a description of the annunciators. Four front panel buttons are used to access different modes and parameters. The following is a description of each button.

Do NOT use tools of any kind (screwdrivers, pens, pencils, etc) to operate the keypad of this unit.

Button Functions

R - The Reset (R) button is used to reset the limit and alarm relays. The limit output cannot be reset until the process temperature returns to the proper operating range. Latched alarms can be reset regardless of limit exceed condition.

P - The Parameter (P) button is used to access programming, enter the change, and scroll through the available parameters in any mode.

UP, DN - The Up/Down buttons are used to modify parameters.

TLA POWER-UP

Upon applying power, the TLA delays input indication and control action for five seconds to perform several self-diagnostic tests and to display basic TLA information. Initially, the TLA illuminates both displays and all annunciators to verify that all display elements are functioning. The TLA then displays the programmed input sensor type in the main (top) display and the revision number of the TLA's operating system in the secondary (bottom) display. The TLA checks for correct internal operation and displays an error message (E-xx) if an internal fault is detected. (See the Troubleshooting section for further information.)

Upon completion of this sequence, the TLA begins displaying the input value and setpoint, and updates the outputs based upon this condition.

TLA CONFIGURATION OVERVIEW

The TLA is programmed with certain parameter settings from the factory. Factory settings are listed in parentheses in the various Configuration of Parameters tables. In many cases, these settings must be changed to the particulars of the application before proper operation can be started.

The TLA is typically in the Normal Display Mode. In this mode, the process temperature is displayed in the main (top) display, and the limit setpoint is displayed in the secondary (bottom) display. When changes to the parameter configurations are needed, the P button is pressed, and the TLA will enter into the Parameter Mode.

PARAMETER CONFIGURATION BASIC STARTUP

For basic start-up, it is important to verify or change Input Parameter Module (1-IN) parameters tYPE and SCAL, and Output Parameter Module (2-OP) parameter LiAC (Limit Trip Action). For alarm set-up, it is important to verify or change Alarms Parameter Module (4-AL) parameters ACt1, AL-1, ACt2, and AL-2.

If the above Input parameters or the input wiring connections are not correct, then the main (top) display may display an error message or incorrect value. Verify the input programming and wiring. (If incorrect display continues, refer to the Troubleshooting section.) All other parameter configurations are important but will not prevent the TLA from showing a correct display.

4.0 PARAMETER MODE

The Parameter Mode is accessed by pressing the P Button from the Normal Display Mode. While in the Parameter Mode, the temperature is displayed in the main (top) display, and the parameter is displayed in the secondary (bottom) display. The correct password must be entered before any parameters can be accessed. To modify values, use the UP or DOWN button while the parameter is displayed. Use the P button to accept the new value, and to scroll through the parameters. The TLA will automatically return to the normal display mode if no action is taken. The TLA responds to the new values immediately, but the change is not committed to non-volatile memory until the TLA is returned to the Normal Display Mode. If power loss occurs before returning to the normal display mode, the new values must be re-entered.

To gain access to the Configuration Parameter Modules continue to CNFP and press the UP button. These modules allow access to the fundamental set-up parameters of the TLA. If the setpoint or alarm values are modified, the CNFP step will be skipped.

Parameter Mode Reference Table

Display	Parameter	Range	Description
PASS	Password to access parameters	0 to 250	If an incorrect value is entered, the TLA will display "End" momentarily, and then return to the normal display mode. The default password is 10. The wildcard password is 222 (in case the password is forgotten).
SP	Limit setpoint	-999 to 9999	Range limited by SPLO & SPHI.
AL-1 *	Alarm #1	-999 to 9999	The Alarm parameters can be independently locked out from appearing. See Configuration Module 3, Parameter Lock-outs.
AL-2 *	Alarm #2	-999 to 9999	
CNFP	Configuration parameter modules	"Up" button: enter configuration modules.	These modules allow access to the fundamental set-up parameters of the TLA. The modules are grouped into related programming steps, such as inputs, outputs, alarms, etc. Upon completion of each module, the program returns to "CNFP".
End	End of Parameter Mode		When the parameter list has been scrolled through, the TLA will display "End" momentarily, and then return to the normal display mode.

* Model Number Dependent.

CONFIGURATION PARAMETER MODULES

The Configuration Parameter modules are accessed by pressing the UP button from CNFP in the Parameter Mode. The UP or DOWN buttons can be pressed to move to the desired Parameter Module. The P button is then pressed to enter into that module. The main (top) display will be the parameter, and the secondary (bottom) display will be the parameter value. The UP or DOWN buttons are used to modify the desired parameter value, and the P button enters the new value, and moves to the next parameter. The TLA responds to the new values after the P button is pressed, however, the change is not committed to permanent memory until the TLA is returned to the Normal Display Mode. If power loss occurs before returning to the Normal Display Mode, the new values must be entered again. At the end of each module, the TLA will go back to CNFP. Other Parameter Modules can be accessed by pressing the UP or DOWN buttons, or pressing P will return to the Normal Display Mode.

Parameters that are model number, or program dependent will only be displayed when the appropriate options are installed or programmed.

CONFIGURE MODULE 1 - INPUT PARAMETERS (1-IN)

Display	Parameter	Range (Factory Setting)	Description/ Comments
tYPE	Input Type	tc-t - Type T TC tc-E - Type E TC tc-J - Type J TC tc-K - Type K TC tc-r - Type R TC tc-S - Type S TC tc-b - Type B TC tc-N - Type N TC LIN - Linear mV r385 - 385 curve RTD r392 - 392 curve RTD rLIN - Linear ohms (tc-J)	Select from the list of various thermocouple and RTD sensors.
SCAL	Temperature Scale	°F or °C (°F)	Select either degrees Fahrenheit (F) or degrees Celsius (C). **If changed, be sure to check all parameters.**
dCPt	Temperature Resolution	0 or 0.0 (0)	Select either 1 or 0.1 degree resolution. **If changed, be sure to check all parameters.**
FLtr	Digital Input Filtering and Display Update	0 to 4 0 - least input filtering 3 - most input filtering 4 - most input filtering and slower 500 msec display update rate (outputs still update at 100 msec rate) (1)	Select the relative degree of input signal filtering and display update rate. The filter is an adaptive digital filter that discriminates between measurement noise and actual process changes. Therefore, the influence on step response time is minimal. If the signal is varying too greatly due to measurement noise, increase the filter value. Conversely, if the fastest TLA response is desired, decrease the filter value.
SHFt	Input Signal Shift (correction offset)	-999 to 9999 1 or 0.1 degree (0)	If the TLA temperature disagrees with a reference temperature instrument or if the temperature sensor has a known calibration, the TLA temperature can be compensated by a correction offset. The following equation expresses the relationship: Desired Display Temp = (TLA Temp) + SHFt. Normally set to 0.
SPLO	Limit Setpoint Lower Limit	-999 to 9999 1 or 0.1 degree (0)	The TLA has programmable high and low setpoint limit values to restrict the setting range of the limit setpoint. Set the limit values so that the temperature setpoint value cannot be set outside the safe operating area of the process. SPHI must be above SPLO.
SPHI	Limit Setpoint Upper Limit	-999 to 9999 1 or 0.1 degree (9999)	

CONFIGURE MODULE 2 - OUTPUT PARAMETERS (2-OP)

Display	Parameter	Range (Factory Setting)	Description/ Comments
LiAc	Limit Output Trip Action	LO - Low Acting HI - High Acting (HI)	The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. See the Limit Output Action section for details.

F

CONFIGURE MODULE 3 - LOCKOUT PARAMETERS (3-LC)

Display	Parameter	Range (Factory Setting)	Description/ Comments
PASS	Password	0 to 250 (10)	The password is required to access all parameters. The password can be set to any value between 0 and 250. A wildcard password, 222, can be used as an alternative to the programmed password.
AL *	Alarms #1 and #2 access level	LOC - lockout, prevents the alarms from appearing rEd - read only, alarms appear, but cannot be modified Ent - enter, alarms appear, and can be modified (Ent)	The alarm(s) parameter in the Parameter Mode can be configured to be completely locked out, read only, or fully accessible.
FPrS	Front panel reset	NO - disabled YES - active (YES)	The front panel R button can be enabled or disabled. The Remote Reset input is not affected by this setting.

* Model Number Dependent.

CONFIGURE MODULE 4 - ALARMS PARAMETERS (4-AL)

Display	Parameter	Range (Factory Setting)	Description/ Comments
Act1	Alarm 1 action mode	A-HI - absolute high A-LO - absolute low d-HI - deviation high d-LO - deviation low b-IN - band inside b-Ot - band outside (A-HI)	When deviation low-acting with positive alarm value (d-LO), deviation high-acting with negative value (d-HI), or band inside-acting (b-IN) is selected for the alarm action, the indicator is OFF when the alarm output is ON. See the Alarms section for complete details of each action. **If changed, check alarm values.**
rSt1	Alarm 1 reset mode	Auto - automatic LATC - manual reset (Auto)	Automatic reset alarms are reset by the TLA when the alarm condition clears. Latched alarms require operator action to reset the alarm condition. The front panel R button, if enabled, can be used to reset a latched alarm (see FPrS in Configure Module 3). A latched alarm condition may also be reset via the Remote Reset input. See the Reset Action diagram in the Alarms section.
Stb1	Alarm 1 standby function (delay)	NO or YES (NO)	The alarm(s) may be independently configured to exhibit a power-on, standby delay which suppresses the alarm output from turning ON until the temperature first stabilizes outside the alarm region. After this condition is satisfied, the alarm standby delay is canceled and the alarm triggers normally, until the next TLA power-on. This feature also works for deviation and band alarms when the setpoint is changed via keypad. This action suppresses “nuisance” alarms. See the Alarm Standby diagram in the Alarms section.
AL-1	Alarm 1 value	-999 to 9999 (0)	The alarm values are either absolute values, or relative to the limit setpoint value (deviation and band alarms). An absolute alarm value is the value that is entered for the alarm. A relative alarm value is the mathematical sum of the temperature limit setpoint value and the alarm value (positive or negative), thus a relative alarm tracks the limit setpoint value as it is changed. If the alarm action is set as a Band Alarm, then only a positive alarm value can be entered.
Act2 *	Alarm 2 action mode	A-HI - absolute high A-LO - absolute low d-HI - deviation high d-LO - deviation low b-IN - band inside b-Ot - band outside (A-HI)	The Alarm 2 parameters are programmed independently of alarm 1. See the corresponding Alarm 1 parameter for description.
rSt2 *	Alarm 2 reset mode	Auto - automatic LATC - manual reset (Auto)	
Stb2 *	Alarm 2 standby function (delay)	NO or YES (NO)	
AL-2 *	Alarm 2 value	-999 to 9999 (0)	
AHYS	Alarm hysteresis value	1 to 250 (1)	The alarm value(s) have a programmable hysteresis band to prevent alarm output chatter near the alarm trigger point. The hysteresis value should be set to eliminate this effect. A value of 2 to 5 is usually sufficient for most applications. A single alarm hysteresis value applies to both alarms. See the Alarm Action Figures, in the Alarms section, for the effect of hysteresis on the various alarm types.

* Model Number Dependent.

F

CONFIGURE MODULE 9 - FACTORY SERVICE OPERATIONS (9-FS)

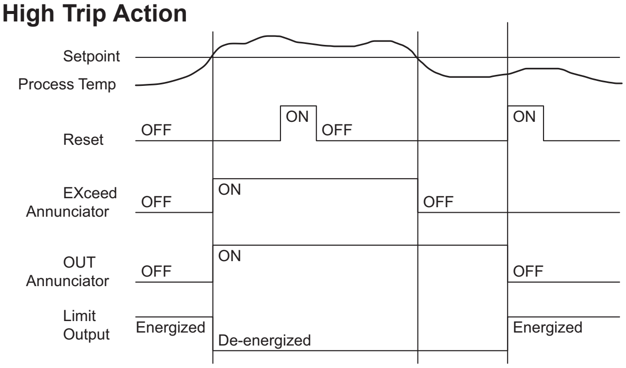
Display	Parameter	Range	Description/ Comments
CodE	Factory service function code	48 - Calibrate instrument	TLA calibration. Refer to the Calibration section for details.
		66 - Reset parameters to factory settings	Entering code 66 restores all parameters to factory settings. The unit indicates the operation after the P button is pressed, by displaying “rSEt” in the lower display momentarily.
		77 (twice in succession) - Reset TLA calibration to nominal values	Caution: this operation erases the TLA calibration values and defaults the values to nominal settings. Reading errors of ±10% may result. Do not perform this operation unless the TLA has lost calibration. Loss of calibration is signaled by an “E-CL” error flag at power-up. To clear this flag, perform calibration procedure as noted in the Calibration section. Alternatively, “stepping” through one of the calibration procedures clears the error flag, but does NOT validate the calibration accuracy in any manner.

F

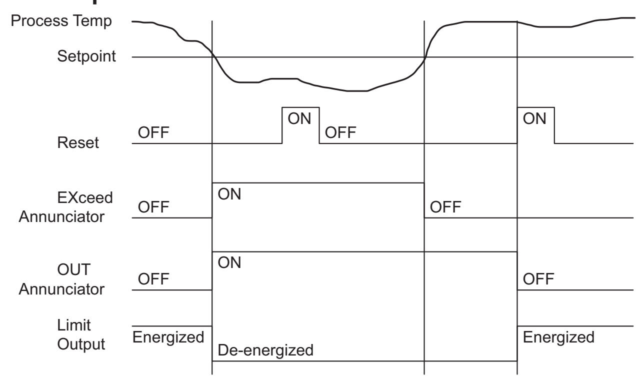
LIMIT OUTPUT ACTION

The limit output is selectable for high or low trip activation. If the process temperature goes above the limit setpoint for a high trip, or below the limit setpoint for a low trip, the limit relay will de-energize to initiate a process shutdown. The limit output cannot be reset until the process temperature returns to the proper operating range; manual reset is required. The following action figures describe the status of the limit output and the front panel indicators for various over/under setpoint, and reset conditions. Reset is either by the front panel R button, if enabled, or by the Remote Reset input, terminal #6. Refer to Configure Module 2 - Output Parameters for details of configuring the limit output. Refer to Configure Module 3 - Lockout Parameters for details of configuring the front panel Reset button.

High Trip Action

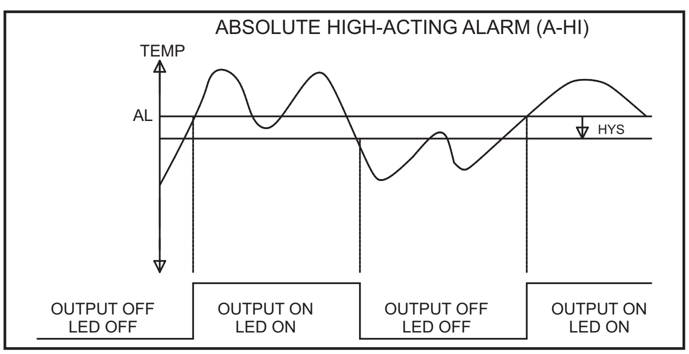


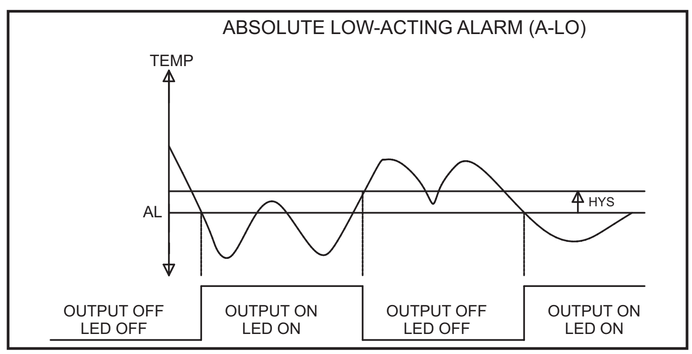
Low Trip Action

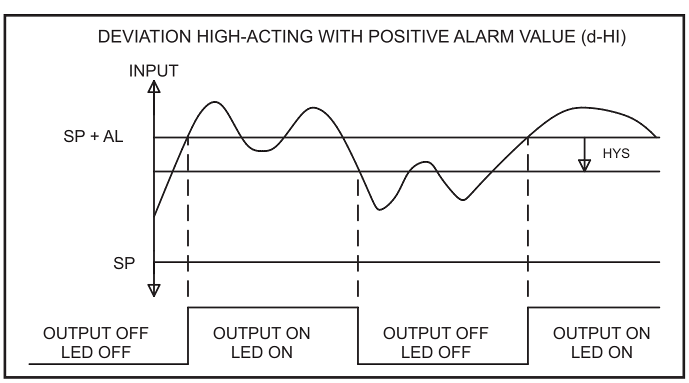


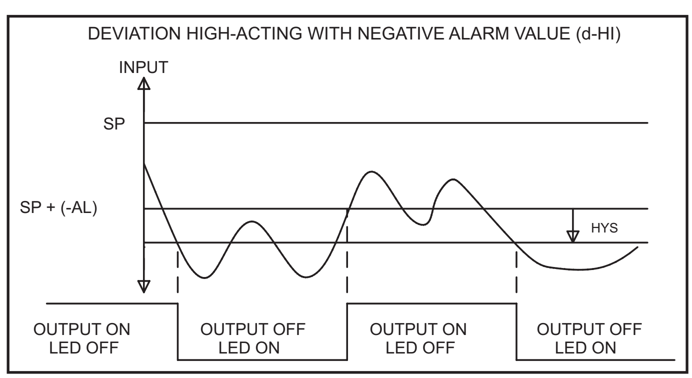
5.0 ALARMS (OPTIONAL)

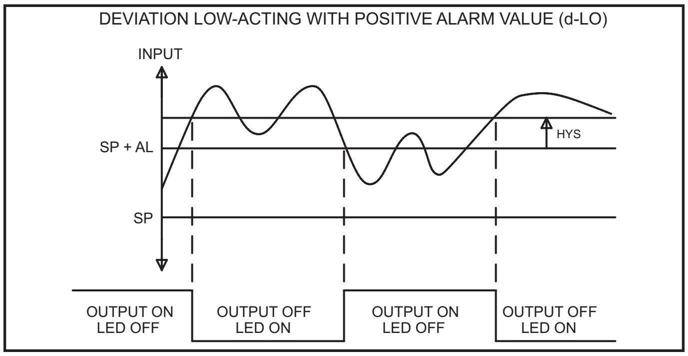
The alarm action figures describe the status of the alarm output and the front panel indicator for various over/under temperature conditions. The alarm output wave form is shown with the output in the automatic reset mode. Select the alarm action with care -- in some configurations, the front panel indicator (LED) might be OFF while the output is ON. Refer to Configure Module 4 - Alarm Parameters for details of configuring the alarms.

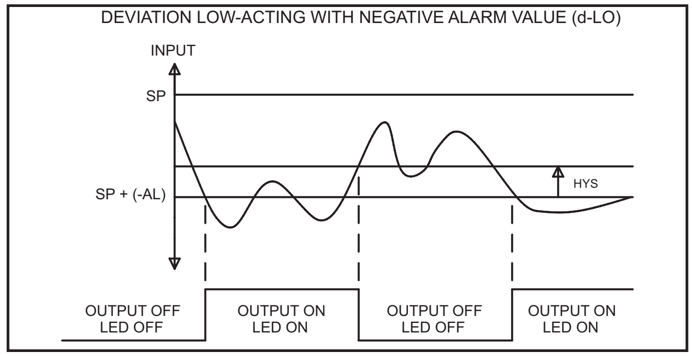


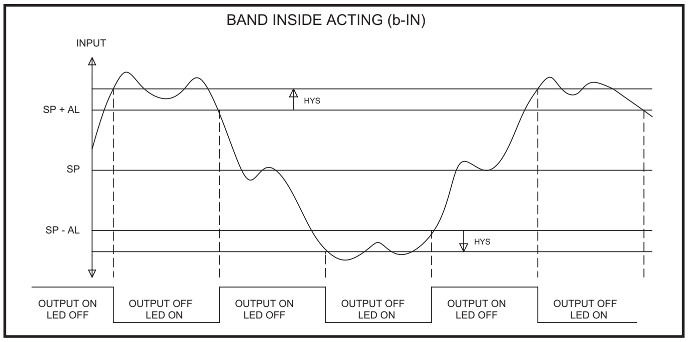


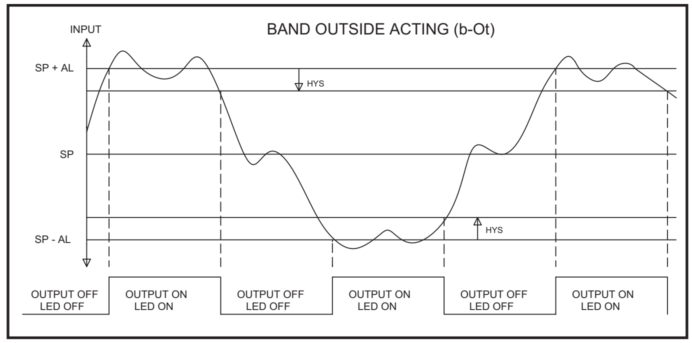




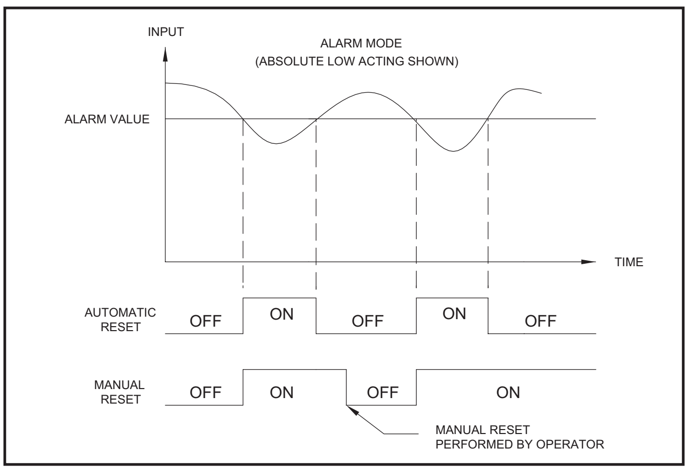




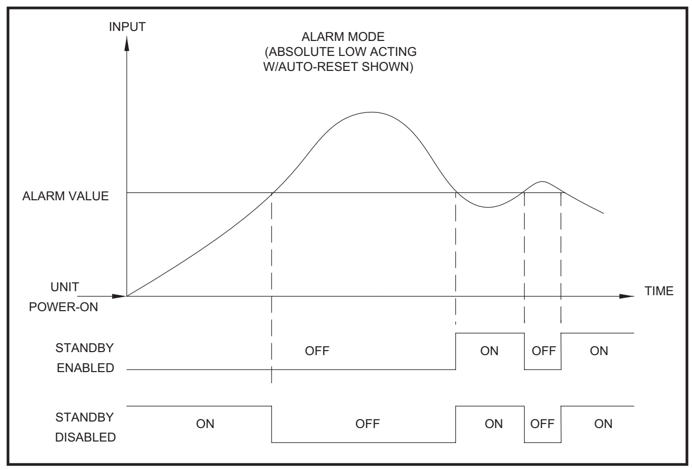




Alarm Reset Sequence



Alarm Standby Delay Sequence



CALIBRATION CHECKS

The instrument has been fully calibrated at the factory for all input types. If the unit appears to be indicating or controlling incorrectly, see the Troubleshooting section before attempting this procedure.

If the TLA is suspected of reading incorrectly, the instrument may be checked for indication accuracy without disturbing the factory calibration. The following procedures may be used for this purpose.

Note: Allow ½ hour warm-up before checking these parameters.

mV Reading Check

1. Connect a DC mV source with an accuracy of 0.03% or better to terminal #8 (-) & #9 (+).
2. Configure Input Parameters Module 1 for linear mV (Lin) input, under tYPE.
3. Compare the TLA read-out to the standard at various points over the range (-5.00 mV to 56.00 mV). The tolerance is ±(0.15% of reading + 1 LSD).
4. Calibrate the TLA if the readings are out of tolerance.

Thermocouple Cold Junction Temperature Check

1. Connect a thermocouple probe of known accuracy (Types T, E, J, K, N only) to TLA. Select the probe used in Configure Module 1.
2. Connect a reference temperature probe to measuring end of thermocouple to monitor temperature. Allow sufficient time for temperatures to equalize.
3. Compare TLA display with reference temperature probe. The TLA display should equal the calibrated probe temperature. (Tolerance is ±1ºC.)
4. Calibrate the cold junction temperature if out of tolerance.

RTD Ohms Reading Check

1. Connect RTD simulator (with an accuracy of 0.1 ohm or better) capable of operating with less than 150 µA to terminals #8, #9, & #10.
2. Configure Input Parameters Module 1 for linear ohms (rLin) input, under tYPE.
3. Compare the TLA read-out with the RTD simulator at various points over the range 2.0 to 300.0 ohms. The tolerance is ±(0.3% of span + 1 LSD).
4. Calibrate the TLA RTD ohms if out of tolerance.

Error Flag E-CL

If error flag "E-CL" appears at power-up, a loss of calibration parameters due to noise spikes has occurred. Entering code 77 twice in Factory Service Operations Module (9-FS) erases the TLA calibration values and defaults the values to nominal settings. Reading errors of ±10% may result. It is recommended that the TLA be fully recalibrated. If using thermocouple only, the RTD calibration need not be performed.

Note: the "E-CL" flag may be cleared by "stepping" through cold junction calibration procedure without the need to change any calibration values. A ±10% reading error will still exist.

6.0 Calibration

When re-calibration is required (generally every two years), this procedure should be performed by qualified technicians using appropriate equipment. Equipment source accuracy of 0.03% or better is required.

The procedure consists of: applying accurate mV signals, setting the thermocouple cold junction temperature, and applying precision resistance, among others. Allow a 30 minute warm-up period before starting this procedure. Do not use thermocouple wire for the millivolt or RTD ohms calibration.

This procedure may be aborted by disconnecting power to the TLA before exiting the configuration mode. The existing calibration settings remain in affect.

Note: After completing any of the calibration sequences, the TLA defaults the input sensor type to thermocouple type "J" (tc-J). Be sure to set input sensor for proper type.

Note: The TLA must be restored to normal display mode before any data is stored.

Factory Service Operations - Calibration (9-FS)

Display	Parameter	Range	Description/ CoMMENTS
CodE	Enter function code	48	Calibrate instrument.
CAL	Millivolt calibration	yes/no	Calibration required for both RTD and TC input. If this procedure is performed, the cold junction temp or RTD ohms calibration procedures in turn must be completed.
CJC	Thermocouple cold junction temperature calibration	yes/no	Not required if only using RTD input. This procedure can only be performed AFTER an accurate mV calibration.
rtd	RTD resistance calibration	yes/no	Not required if only using TC input. This procedure can only be performed AFTER an accurate mV calibration.

Millivolt Calibration (CAL)

Connect precision millivolt source with an accuracy of 0.03% to terminals #8 (-) & #9 (+). Cold Junction or RTD ohms calibration MUST be performed after millivolt calibration.

Display	action	Description/ CoMMENTS
StP1	Apply 0.0 mV	Wait 10 seconds, press P.
StP2	Apply 14.0 mV	Wait 10 seconds, press P.
StP3	Apply 28.0 mV	Wait 10 seconds, press P.
StP4	Apply 42.0 mV	Wait 10 seconds, press P.
StP5	Apply 56.0 mV	Wait 10 seconds, press P.

Thermocouple Cold Junction Calibration (CJC)

This procedure must be performed AFTER an accurate mV calibration.

1. Exit Factory Service Operations (continually press P until "End"), and return to Normal Display Mode.
2. Connect a thermocouple probe of known accuracy to the TLA (Types T, E, J, K, and N only). Select the probe type used in Configure Module 1.
3. Connect a reference temperature probe to the measuring end of the TLA thermocouple probe. The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (As an alternative, the TLA thermocouple probe may be placed in a calibration bath of known temperature.)
4. Compare TLA display with reference temperature probe (or calibration bath). If the displayed TLA temperature does not equal the reference probe temperature, calculate the CJ error as follows:
   CJ Error = reference probe temperature - displayed TLA temperature
5. Enter Factory Service Operations Module (9-FS).

Display	Parameter	Description/ CoMMENTS
CJC	Cold Junction Temperature	Observe the indicated cold junction temperature. Add the calculated CJ Error to the displayed value. Enter the sum as the new value for CJC. Exit 9-FS and repeat step 4.
		Note: If the initial value for CJC is not within the range of 15°C to 40°C, enter 25.0° for CJC and repeat the Cold Junction Calibration procedure.

RTD Ohms Calibration (RTD)

This procedure must be performed AFTER an accurate mV calibration. Connect one leg of precision resistance (accuracy of 0.1 ohm) to terminals #9 and #10 together, and the other leg to #8.

Display	action	Description/ CoMMENTS
rtd1	Connect 0.0 ohm (jumper wire)	Wait 10 seconds, press P.
rtd2	Connect 277.0 ohm	Wait 10 seconds, press P.

7.0 TROUBLESHOOTING

The majority of problems can be traced to improper connections or incorrect set-up parameters. Be sure all connections are clean and tight, that the correct output board is fitted, and that the set-up parameters are correct.

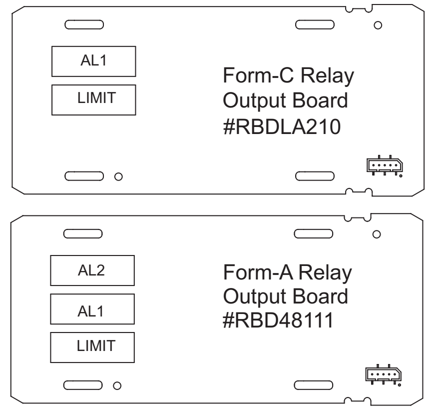
For further technical assistance, contact technical support at the appropriate company numbers listed.

Problems	Possible Cause	Remedies
NO DISPLAY	1. Power off. 2. Brown-out condition. 3. Loose connection or improperly wired. 4. Bezel assembly not fully seated into rear of TLA.	1. Check power. 2. Verify power reading. 3. Check connections. 4. Check installation.
TLA NOT WORKING	1. Incorrect parameter set-up.	1. Check set-up parameters.
“E-FP” IN DISPLAY	1. Defective front panel button.	1. Press R to escape, then check all buttons for proper operation. 2. Replace unit.
“E-UP” IN DISPLAY	1. Internal problem with TLA.	1. Replace unit.
“E-E2” IN DISPLAY	1. Loss of setup parameters due to noise spike or other EMI event.	1. Press R to escape, then check all set-up parameters. a. Check sensor input and AC line for excessive noise. b. If fault persists, replace TLA.
“E-CL” IN DISPLAY	1. Loss of calibration parameters due to noise spike or other EMI event.	1. Press R to escape, then check TLA accuracy. a. Recalibrate TLA. (See Factory Service Module code 77.) b. Reset parameters to factory default settings.
“...” or “-..” IN DISPLAY	1. Display value exceeds display range. 2. Defective or mis-calibrated cold junction circuit. 3. Loss of set-up parameters. 4. Internal malfunction.	1. Change resolution to display whole number and verify reading. 2. Perform cold junction calibration. 3. Check set-up parameters. 4. Perform Input calibration.
“OPEN” IN DISPLAY	1. Probe disconnected. 2. Broken or burned-out probe. 3. Corroded or broken terminations. 4. Excessive process temperature.	1. Connect probe. 2. Replace probe. 3. Check connections. 4. Check process parameters.
“OLOL” IN UPPER DISPLAY	1. Check input parameters. 2. Change to input sensor with a higher temperature range. 3. Replace transmitter or probe. 4. Reduce temperature. 5. Perform input calibration.	1. Input exceeds range of TLA. 2. Temperature exceeds range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive high temperature for probe. 5. Loss of setup parameters.
“ULUL” IN UPPER DISPLAY	1. Input is below range of TLA. 2. Temperature below range of input probe. 3. Defective or incorrect transmitter or probe. 4. Excessive low temperature for probe. 5. Loss of setup parameters.	1. Check input parameters. 2. Change to input sensor with a lower temperature range. 3. Replace transmitter or probe. 4. Raise temperature. 5. Perform input calibration.
“OLOL” OR “ULUL” IN LOWER DISPLAY	1. Signal input exceeds allowable range by 5%.	1. Check remote signal source.

F

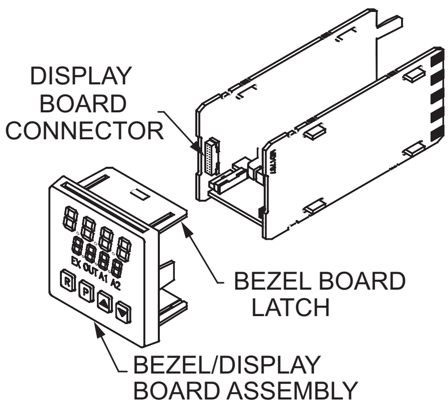
8.0 Installing an Output Board

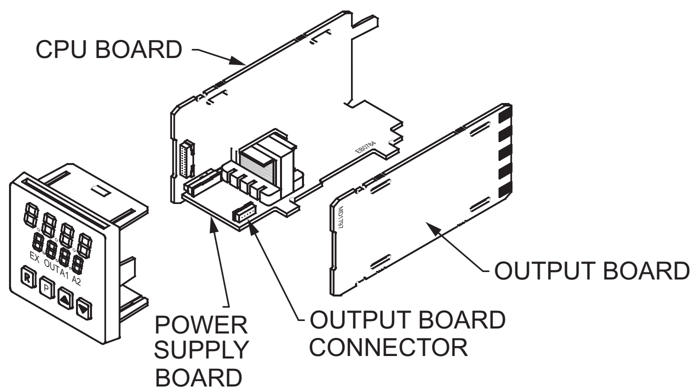
The TLA is supplied with an output board installed.



Replacing Output Board

1. Remove the bezel assembly.
2. Lift up on the top bezel board latch while gently pulling out on the bezel/ display board assembly. Do NOT remove the display board from the bezel.
3. Remove the output board by pulling it away from the other boards. Replace the output board by aligning the board to board connector. Be certain the connector is fully mated.
4. Connect the bezel/ display board assembly by guiding the board ends into the bezel latches. Slide the assembly on evenly until the display board connector is completely engaged and bezel latches are fully seated onto the boards.

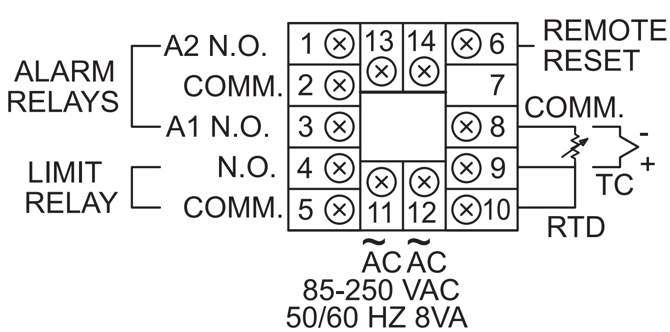




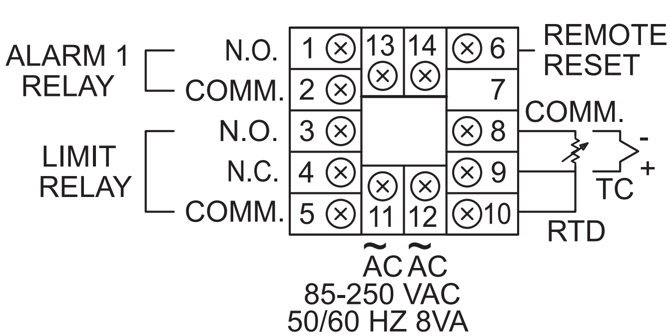
9.0 Terminal Configurations

AC Models

Form-A Limit Relay with 2 Alarms

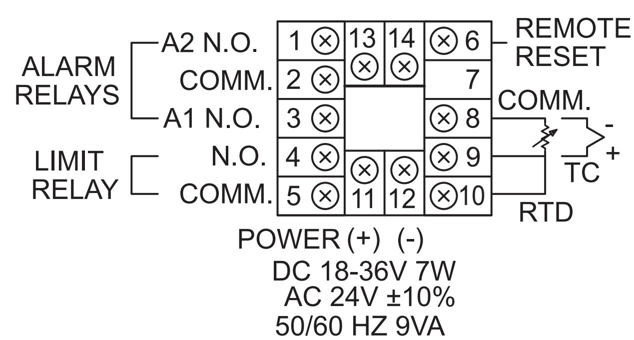


Form-C Limit Relay with 1 Alarm

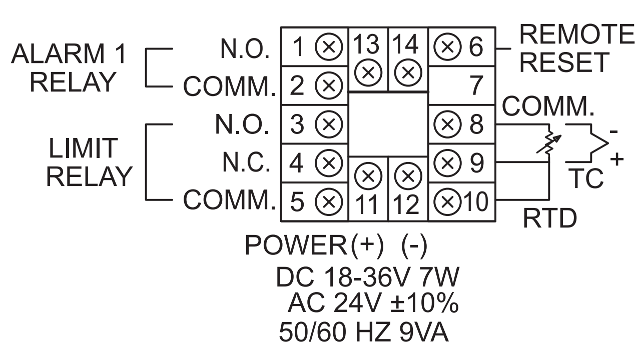


DC Models

Form-A Limit Relay with 2 Alarms



Form-C Limit Relay with 1 Alarm



F

LARGE DISPLAYS

The Trusted Source for Innovative Control Solutions

G

QUICK Specs

Large Displays

LED DISPLAY

	LD2	LD4	LPAX	EPAX
				
Description	4, 5 and 6 Digit, 2.25" (57 mm) Red LED	4, 5 and 6 Digit, 4" (101 mm) Red LED	ANALOG INPUTS 5 Digit, 1.5" (38 mm) Red LED DIGITAL INPUTS 6 Digit, 1.5" (38 mm) Red LED	ANALOG INPUTS 5 Digit, 4" (101 mm) Red LED DIGITAL INPUTS 6 Digit, 4" (101 mm) Red LED
Dimensions (Height) x (Width)	4 DIGIT 102 mm (H) x 305 mm (W) 5 and 6 DIGIT 102 mm (H) x 406 mm (W)	4 DIGIT 200 mm (H) x 508 mm (W) 5 and 6 DIGIT 200 mm (H) x 660 mm (W)	121 mm (H) x 254 mm (W)	183 mm (H) x 630 mm (W)
Input	Basic Count Input	Basic Count Input	Via a Plug-in Personality Module	Via a Plug-in Personality Module
Available Inputs	ANALOG INPUTS Process, DC Voltage, DC Current, and Strain Gage DIGITAL INPUTS Count, Count/Rate, Timer, and Serial Slave	ANALOG INPUTS Process, DC Voltage, DC Current, and Strain Gage DIGITAL INPUTS Count, Count/Rate, Timer, and Serial Slave	ANALOG INPUTS Process, Voltage, Current, Temperature, and Strain Gage DIGITAL INPUTS Count, Rate, Count/Rate, Timer, and Real Time Clock	ANALOG INPUTS Process, Voltage, Current, Temperature, and Strain Gage DIGITAL INPUTS Count, Rate, Count/Rate, Timer, and Real Time Clock
Setpoint Capability	Dual Form C (Not Available w/4 Digit Model)	Dual Form C (Not Available w/4 Digit Model)	Dual Form C Quad Form A Quad Sinking Quad Sourcing	Dual Form C Quad Form A Quad Sinking Quad Sourcing
Communications	RS232 RS485 (Not Available w/4 Digit Model)	RS232 RS485 (Not Available w/4 Digit Model)	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8	RS232 RS485 Modbus DeviceNet Profibus Ethernet w/ICM8
Other Features/ Options	NEMA 4X	NEMA 4X	NEMA 4 Enclosure, Mounting Brackets, Custom Units Label (5 Digit Only)	NEMA 4 Enclosure, Mounting Brackets
Power Source	50 to 250 VAC 21.6 to 250 VDC	50 to 250 VAC 21.6 to 250 VDC	85 to 250 VAC 18 to 36 VDC 24 VAC	85 to 250 VAC
Page Number	Page 657	Page 657	Page 725	Page 737

REPLACEMENT Guide

WHAT YOU'RE USING NOW		CURRENT PRODUCT	
MODEL NUMBER	**FEATURES**	**MODEL NUMBER**	**FEATURES**
 **LDD**	■ Display: 4 or 6 Digit, 3.3" (84 mm) Red LED ■ Power Source: 115/230 VAC ■ Input Models: Various Models	 **EPAX**	■ Display: 5 or 6 Digit, 4" (101 mm) Red LED ■ Power Source: 115/230 VAC ■ Input Models: Various Models **Panel Cut-Out Dimension Differences**

Note: Refer to the current product literature, as some differences may exist.

G

G

This page intentionally left blank.

MODEL LD - LARGE DISPLAY

- *2.25" & 4" HIGH RED LED DIGITS*
- *AVAILABLE IN 4 OR 6 DIGIT VERSIONS*
- *SINGLE OR DUAL COUNTER with RATE INDICATOR **
- *PROGRAMMABLE SCALING AND DECIMAL POINTS **
- *BUILT-IN BATCH COUNTING CAPABILITY **
- *PROGRAMMABLE USER INPUT **
- *UNIVERSALLY POWERED*
- *DUAL 5 AMP FORM C RELAY **
- *ALUMINUM NEMA 4X CASE CONSTRUCTION*

** Programmable models only*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The Large Display is a versatile display that can be configured as a single or dual counter with rate indication, scaling, serial communications and a dual relay output. There are also basic models that have a single counter with direction control only (no scaling or relay output).

The 4 & 6 digit displays are available in either 2.25" or 4" high red LED digits with adjustable display intensities. The 2.25" high models are readable up to 130 feet. The 4" high models are readable up to 180 feet. All versions are constructed of a NEMA 4X/IP65 enclosure in light weight aluminum.

The 6-digit programmable models have two signal inputs and a choice of eight different count modes. These include bi-directional, quadrature and anti-coincidence counting, as well as a dual counter mode. When programmed as a dual counter, each counter has separate scaling and decimal point selection.

Rate indication is available on the programmable models only. The rate indicator has separate scaling and decimal point selection, along with programmable display update times. The meter display can be toggled either manually or automatically between the count and rate values.

The programmable models also come with a dual Form C relay output and RS232 or RS485 serial communications. The outputs can activate based on either counter or rate setpoint values. An internal batch counter can be used to count setpoint output activations.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

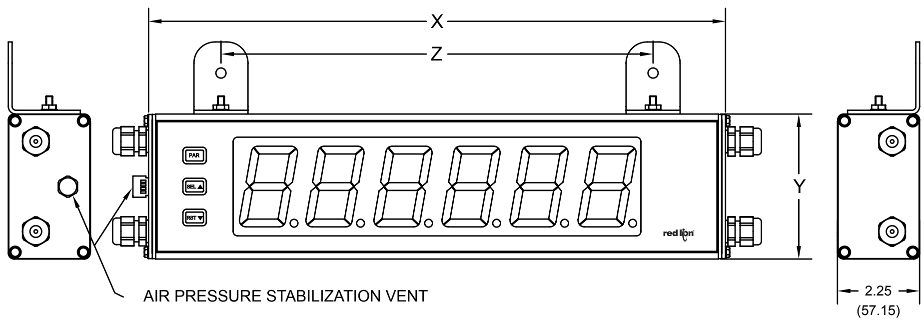
CAUTION: Risk of electric shock.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

SPECIFICATIONS

1. **DISPLAY**: 2.25" (57 mm) or 4" (101 mm) intensity adjustable Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 26 VA
   DC POWER: 21.6 to 250 VDC, 11 W
   DC OUT: +24 VDC @ 100 mA if input voltage is greater than 50 VAC/VDC
   +24 VDC @ 50 mA if input voltage is less than 50 VDC
   Isolation: 2300 V_{RMS} for 1 min. to all inputs and outputs
3. **COUNT INPUT(S)**:
   Counter(s) have DIP switch selectable pull-up (7.8 KΩ) or pull-down resistors (3.9 KΩ) that determine active high or active low input logic.
   Counters are DIP switch selectable for high or low frequency (Damping capacitor provided for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec min.)
   Input A Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
   Input B Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Overflow Indication: Display "OLOL" alternates with overflowed count value.
   LD200400, LD200600, LD400400, & LD400600:
   Count Rate: 25 KHz max. @ 50% duty cycle (no scaling)
   LD2006P0 & LD4006P0:
   Maximum Count Rates: 50% duty cycle, count mode dependent.
   With setpoints disabled: 25 KHz, all modes except Quadrature x4 (23 KHz).
   With setpoint(s) enabled: 20 KHz, all modes except Dual Counter (14 KHz), Quadrature x2 (13 KHz) and Quadrature x4 (12 KHz).
4. **RATE INPUT**: **Models LD2006P0 & LD4006P0 only**
   Display Range: 0 to 99999
   Min Freq.: 0.01 Hz
   Max Freq.: See Count Input specification
   Accuracy: ±0.01%
   Rate Overflow Indication: Display "r OLOL"

DIMENSIONS In inches (mm)



PART NUMBER	X (Length)	Y (Height)	Z (Center)
LD2004xx	12 (304.8)	4 (101.6)	8 (203.2)
LD2006xx	16 (406.4)	4 (101.6)	12 (304.3)
LD4004xx	20 (508)	7.875 (200)	16 (406.4)
LD4006xx	26 (660.4)	7.875 (200)	22 (558.8)

G

5. **RESET/USER INPUT**: Function programmable for LD2006P0 &LD4006P0
Reset/User Input: DIP switch selectable pull-up (7.8 KΩ) or pull-down resistor (3.9 KΩ) that determines active high or active low input logic.
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 10 msec typ.; 50 msec debounce (activation and release)
6. **COMMUNICATIONS (LD2006P0 & LD4006P0 only)**:
RS485 SERIAL COMMUNICATIONS
Type: RS485 multi-point balanced interface (isolated)
Baud Rate: 300 to 38.4 k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
RS232 SERIAL COMMUNICATIONS
Type: RS232 half duplex (isolated)
Baud Rate: 300 to 38.4 k
Data Format: 7/8 bits; odd, even, or no parity
7. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and count values when power is removed.
8. **OUTPUT (LD2006P0 & LD4006P0 only)**:
Type: Dual Form C contacts
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads.
Response Time: Turn On or Off: 5 msec max.
Isolation to Input & User/Exc Commons: 2000 Vrms for 1 min. Working Voltage: 240 Vrms
9. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 65 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's (1g relay).
Shock According to IEC 68-2-27: Operational 30 g's (10g relay), 11 msec in 3 directions.
Altitude: Up to 2,000 meters
10. **CONNECTIONS**:
Internal removable terminal blocks are used for power and signal wiring. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and signal wiring connections are on the right side and the relays and serial options are on the left side.
Wire Strip Length: 0.4" (10 mm)
Wire Gage: 24-12 AWG copper wire, 90°C rated insulation only
Torque: 5.3 inch-lbs (0.6 N-m) max.
Cable Diameter: Outside diameter must be 0.181" (4.6 mm) to 0.312" (7.9 mm) to maintain NEMA 4 rating of cord grips.
11. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Enclosure rating, UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating, IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A LD200400 Criterion B LD2006P0 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions LD200400	EN 55011	Class B
Emissions LD2006P0	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

12. **CONSTRUCTION**: Aluminum enclosure, and steel side panels with textured black polyurethane paint for scratch and corrosion resistance protection. Meets NEMA 4X/IP65 specifications. Installation Category II, Pollution Degree 2.
13. **WEIGHT**:
LD2004XX: 3.5 lbs (1.59 kg)
LD2006XX: 4.5 lbs (2.04 kg)
LD4004XX: 8 lbs (3.63 kg)
LD4006XX: 10.5 lbs (4.76 kg)

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Basic (No front panel keys)	LD	2.25" High 4-Digit Red LED Counter	LD200400
		2.25" High 6-Digit Red LED Counter	LD200600
		4" High 4-Digit Red LED Counter	LD400400
		4" High 6-Digit Red LED Counter	LD400600
Programmable (With front panel keys)	LD	2.25" High 6-Digit Red LED Count/Rate Indicator w/ dual Relay Output & RS232/RS485 Serial Communications	LD2006P0
		4" High 6-Digit Red LED Count/Rate Indicator w/ dual Relay Output & RS232/ RS485 Serial Communications	LD4006P0
	LD Plug	Panel Meter Plug for LD models	LDPLUG00

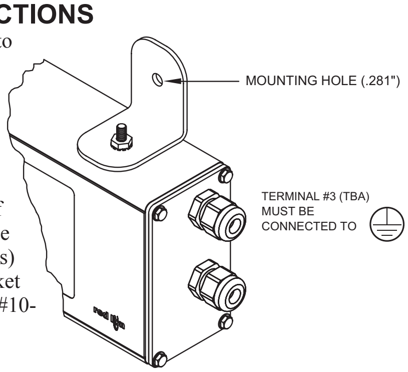
1.0 INSTALLING THE METER

INSTALLATION
The meter meets NEMA 4X/IP65 requirements when properly installed.

INSTALLATION ENVIRONMENT
The unit should be installed in a location that does not exceed the operating temperature. Placing the unit near devices that generate excessive heat should be avoided. The unit should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the front overlay. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

MOUNTING INSTRUCTIONS
This display is designed to be wall mounted or suspended from a ceiling truss or other suitable structure capable of supporting the LD. Caution should be exercised when hanging the display to provide for the safety of personnel. If hanging the LD, run the suspension cables (or chains) through the mounting bracket holes. For wall mounting use #10-32 size bolts.



2.0 Setting the DIP Switches

SETTING THE 8 DIP SWITCHES

To access the switches, remove the right side plate of the meter. A bank of eight switches is located inside the unit.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

SWITCH 1 (Input A)

LOGIC: Input A trigger levels V_{IL} = 1.25 V max.; V_{IH} = 2.75 V min.; V_{MAX} = 28 VDC

MAG: 200 mV peak input sensitivity; 100 mV hysteresis; maximum voltage: 40 V peak (28 Vrms); Must also have SRC switch ON. (Not recommended with counting applications.)

SWITCH 2 (Input A) {See Note 1}

SNK.: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 2.1 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 3 (Input A)

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.

SWITCH 4 (Input B) {See Note 1}

SNK.: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 2.1 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 5 (Input B)

HI Frequency: Removes damping capacitor and allows max. frequency.

LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.

SWITCH 6 (RESET/USER INPUT) {See Note 1}

SNK.: Adds internal 7.8 KΩ pull-up resistor to +12VDC, I_{MAX} = 2.1 mA.

SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 7 (POWER UP RESET)

ENABLE: In this position, the counter resets to zero at power up.

DISABLE: In this position, the counter does not reset at power up.

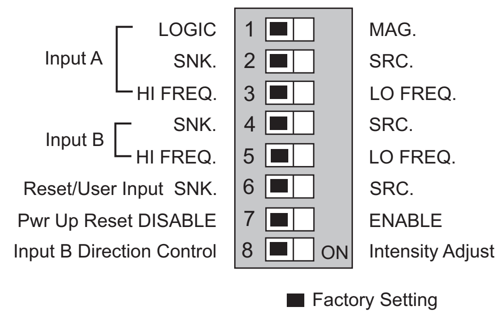
Note: This switch has no function for programmable models. Power-up reset is selected through a programming parameter.

SWITCH 8 (Input B)

DIRECTION CONTROL: In this position Input B is used to control the count direction of Input A when Input A is set to Count with Direction mode (default mode).

INTENSITY ADJUST: In this position Input B is used to adjust the LED intensity. There are five distinct LED levels that can be changed by pulsing Input B. After setting the desired intensity, move switch to OFF position for Direction Control. Units with keypads can program the LED intensity level using Programming Menu 3.

Note 1: When the DIP switch is in the SNK position (OFF), the input is configured as active low. When the switch is in the SRC position (ON), the input is configured as active high.



3.0 Wiring the Meter

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC# FCOR0000)
   TDK # ZCAT3035-1330A
   Steward # 28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC# LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

G

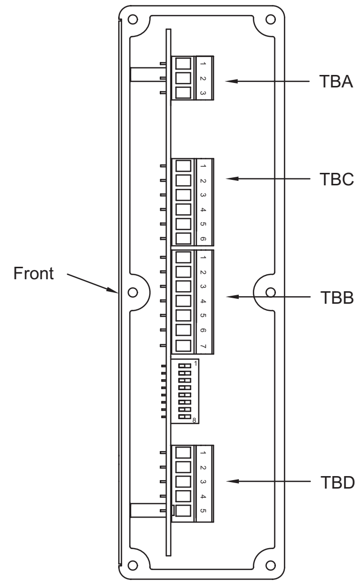
WIRING OVERVIEW

Electrical connections are made via pluggable terminal blocks located inside the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker. When wiring the meter, compare the numbers on the label on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.4" (10 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm). Use copper conductors only, with insulation rated at 90°C.

WIRING CONNECTIONS

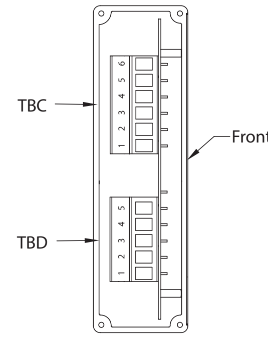
Internal removable terminal blocks are used for power and signal wiring. Access to terminal blocks is through conduit fittings. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and input wiring connections are on the right side and the relay and serial options are on the left side.

Connect the drain wire from the shielded cable(s) to the screw on the side plate for proper grounding.

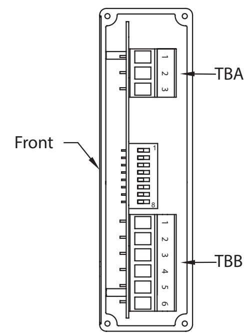


LD4

Only programmable models have terminals TBC and TBD.



LD2 Left Side

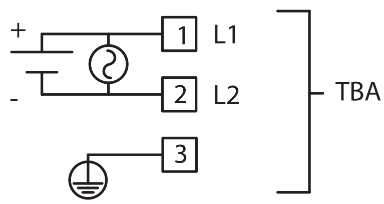


LD2 Right Side

3.1 POWER WIRING

The power wiring is made via the 3 position terminal block (TBA) located inside the unit (right side). The DC out power is located on TBB (right side).

Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -
Terminal 3: Protective Conductor Terminal



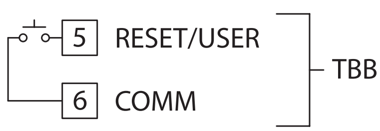
DC Out Power
Terminal 4: + 24 VDC OUT
Terminal 6: User Common

3.2 RESET/USER INPUT WIRING

The Reset/User Input is located on the right side.

Terminal 5: Reset/User
Terminal 6: Comm

Sinking Logic



DIP switch 6 OFF

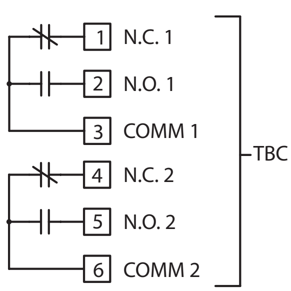
Sourcing Logic

DIP switch 6 ON

3.3 SETPOINT (OUTPUT) WIRING

The setpoint relays use a six position terminal block (TBC) located inside the unit: LD4 (right side) and LD2 (left side).

Terminal 1: NC 1
Terminal 2: NO 1
Terminal 3: Relay 1 Common
Terminal 4: NC 2
Terminal 5: NO 2
Terminal 6: Relay 2 Common



G

3.4 INPUT WIRING

The Large Display has two signal inputs, A and B. These inputs are wired to terminal block TBB located inside the unit on the right side.

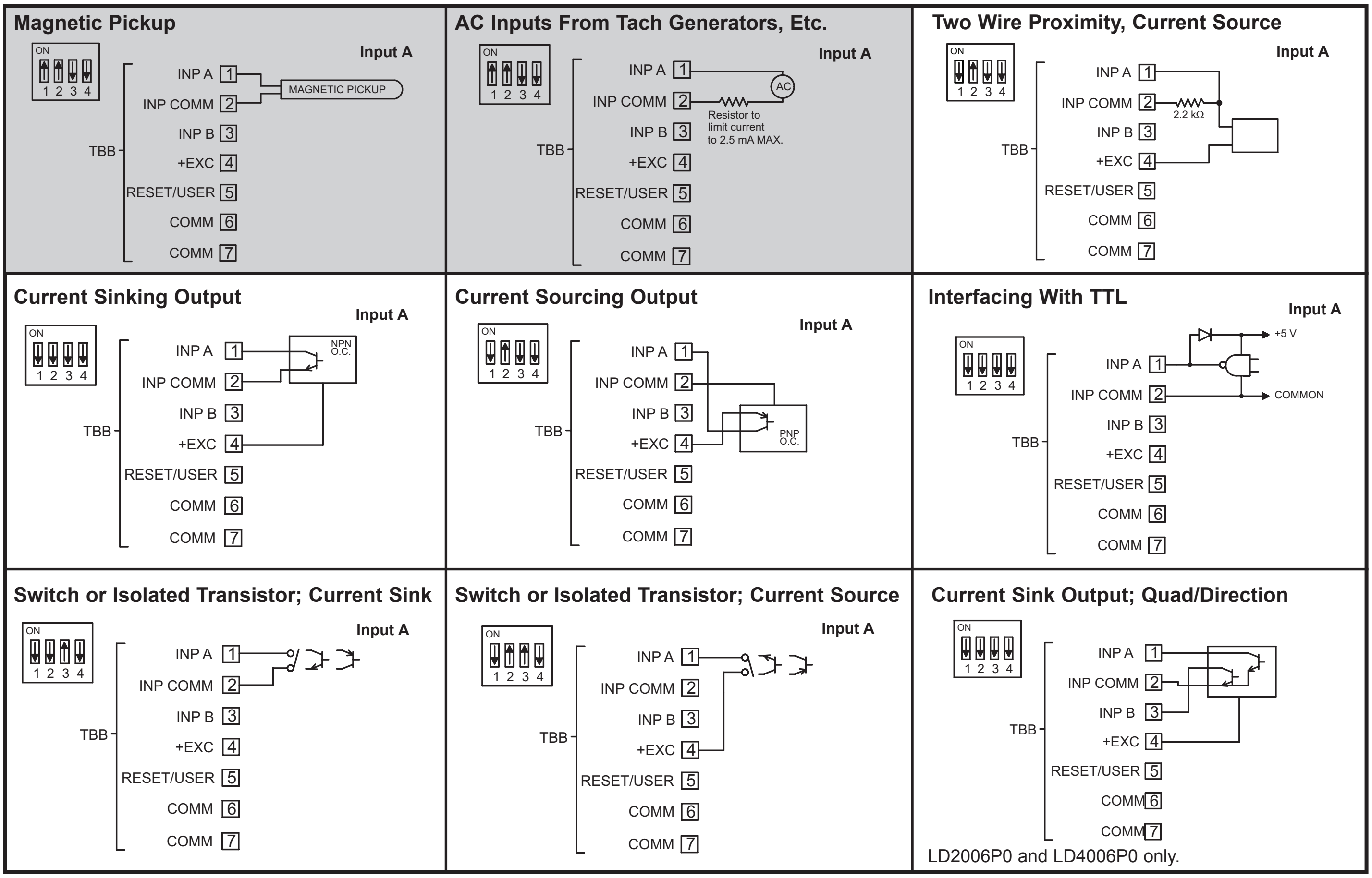
Terminal 1: Input A
Terminal 3: Input B
Terminal 2: Input Common

Programmable models LD2006P0 and LD4006P0 provide a choice of eight different Count Modes. The Count Mode selected determines the action of Inputs A and B. Section 5.1, Input Setup Parameters, provides details on count mode selection and input action.

All other models are non-programmable and provide Count with Direction Mode only. Input A accepts the count signal, while Input B controls the count direction (up/down).

Input B can also be used to adjust the LED display intensity by setting DIP Switch 8 to the ON position (See Section 2.0, Setting the DIP Switches). For programmable models, this only applies in Count with Direction mode.

CAUTION: User common is NOT isolated from input common. In order to preserve the safety of the meter application, the DC common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Input and Input Common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground.

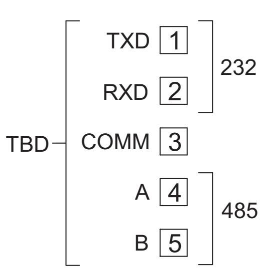


∗ *Switch position is application dependent.*

Shaded areas not recommended for counting applications.

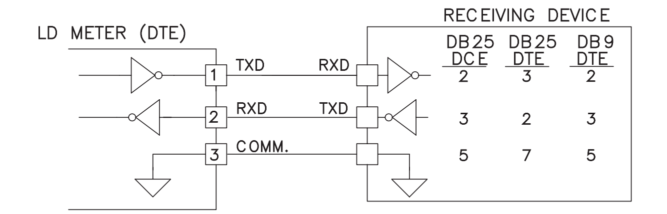
3.5 SERIAL WIRING

The serial connections are made via terminal block TBD located inside the unit on the left side for the LD2 and on the right side for the LD4.



G

RS232 Communications



Terminal Block Connection Figure

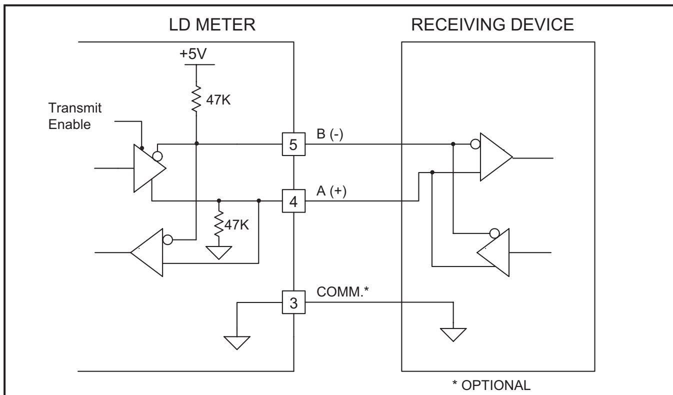
RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The LD emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function.

As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is "busy". The receiving device asserts that it is busy by setting the RXD line to a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.

RS485 Communications

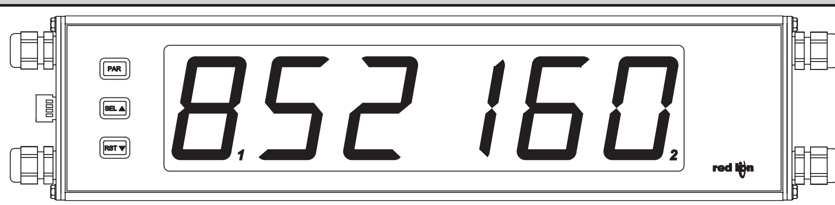
The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the LD is limited to 38.4k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



Terminal Block Connection Figure

Sections 4 and 5 apply to Programmable Models Only

4.0 Reviewing the Front Panel Keys and Display



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL▲	Index display through selected displays	Advance through selection list/select digit position in parameter value
RST▼	Resets count display(s) and/or outputs	Increment selected digit position of parameter value

OPERATING MODE DISPLAY DESIGNATORS

"r" - To the left of the display is the rate value.
- Counter A has no designator.
"b" - To the left of the display is the Counter B value (dual count or batch).

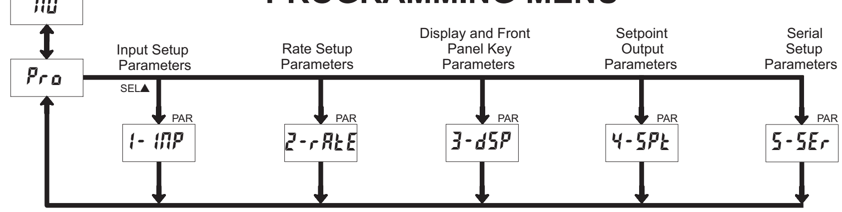
" 1 " - To the right of digit 6 indicates setpoint 1 output status.
" 2 " - To the right of digit 1 indicates setpoint 2 output status.

Pressing the **SEL▲** key toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the rate and count values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR KEY)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** key. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL▲ & PAR KEYS)

The Programming Menu is organized into five modules. These modules group together parameters that are related in function. The display will alternate between **Pro** and the present module. The **SEL▲** key is used to select the desired module. The displayed module is entered by pressing the **PAR** key.

G

MODULE MENU (PAR KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL▲** and **RST▼** keys are used to move through the selections/values for that parameter. Pressing the **PAR** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST▼** key increments the digit by one or the user can hold the **RST▼** key and the digit will automatically scroll. The **SEL▲** key will select the next digit to the left. Pressing the **PAR** key will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR KEY)

The Programming Mode is exited by pressing the **PAR** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

It is recommended to start with Module 1 for counting or Module 2 for rate. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 3. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.

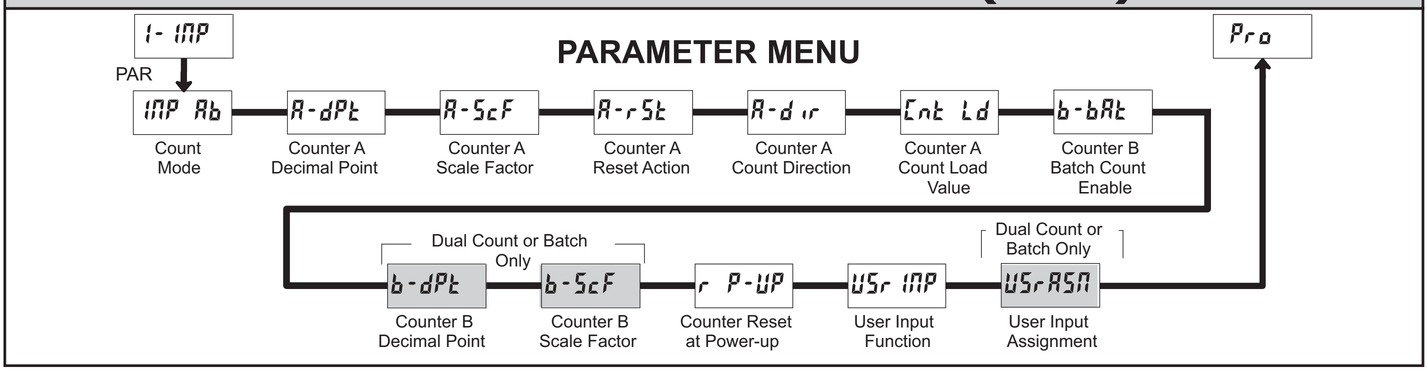
Indicates Program Mode Alternating Display

Parameter INP Ab

Cnt ud Selection/Value

Factory Settings are shown.

5.1 MODULE 1 - INPUT SETUP PARAMETERS (1- INP)



Shaded area selections only apply when Counter B is enabled (Dual Count mode or batch counter).

COUNT MODE

INP Ab

Cnt ud

Cnt ud   qUAd 1   AddAdd
rt-Cnt   qUAd 2   AddSub
dUAL   qUAd 4

Select the count mode that corresponds with your application. The input actions are shown in the boxes below. For simple counting applications, it is recommended to use Count with Direction for the count mode. Simply leave the direction input unconnected.

DISPLAY	MODE	INPUT A ACTION	INPUT B ACTION
Cnt ud	Count with Direction	Counter A	Counter A Direction
rt-Cnt	Rate/Counter	Rate only	Counter A Add
dUAL	Dual Counter	Counter A Add	Counter B Add
qUAd 1	Quadrature x1	Count A	Quad A
qUAd 2	Quadrature x2	Count A	Quad A
qUAd 4	Quadrature x4	Count A	Quad A
AddAdd	2 Input Add/Add	Counter A Add	Counter A Add
AddSub	2 Input Add/Subtract	Counter A Add	Counter A Subtract

Note: The Rate indicator signal is derived from Input A in all count modes.

COUNTER A DECIMAL POINT POSITION

A-dPt

0

0   0.00   0.0000
0.0   0.000

This selects the decimal point position for Counter A and the setpoint value, if assigned to Counter A. The selection will also affect Counter A scale factor calculations.

COUNTER A SCALE FACTOR

A-ScF

01.0000

00.0001 to 99.9999

The number of input counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER A RESET ACTION

A-rSt

ZEro

ZEro   Cnt Ld

When Counter A is reset, it returns to Zero or Counter A Count Load value. This reset action applies to all Counter A resets, except a Setpoint generated Counter Auto Reset programmed in Module 4.

COUNTER A COUNT DIRECTION

A-dir

NOr

NOr   rEU

Reverse (rEU) switches the normal Counter A count direction shown in the Count Mode parameter chart.

G

COUNTER A COUNT LOAD VALUE

Cnt Ld
000500

-99999 to 999999

Counter A resets to this value if Reset to Count Load action is selected. To enter a negative Count Load value, increment digit 6 to display a “-” sign.*

COUNTER B BATCH COUNT ENABLE

b-bAt
nO

nO SP-2
SP-1 SP1-2

The Counter B Batch Count function internally counts the number of output activations of the selected setpoint(s). The count source for the batch counter can be SP1, SP2 or both. Batch counting is available in all count modes except Dual Counter, which uses an external input signal for Counter B.

COUNTER B DECIMAL POINT POSITION

b-dPt
0

0 0.00 0.0000
0.0 0.000

This selects the decimal point position for Counter B. The selection will also affect Counter B scale factor calculations.

COUNTER B SCALE FACTOR

b-ScF
01.0000

00.0001 to 99.9999

The number of input or batch counts is multiplied by the scale factor to obtain the desired process value. A scale factor of 1.0000 will result in the display of the actual number of input or batch counts. (Details on scaling calculations are explained at the end of this section.)*

COUNTER RESET AT POWER-UP

r P-UP
nO

nO nO Cnt b
YES Cnt A both

The selected counter(s) will reset at each meter power-up.

SCALING FOR COUNT INDICATION

The counter’s scale factor is factory set to 1, to provide one count on the display for each pulse that is input to the unit. In many applications, there will not be a one-to-one correspondence between input pulses and display units. Therefore, it is necessary for the meter to scale or multiply the input pulses by a scale factor to achieve the desired display units (feet, meters, gallons, etc.)

The Count Scale Factor Value can range from 00.0001 to 99.9999. It is important to note that the precision of a counter application cannot be improved by using a scale factor greater than one. To accomplish greater precision, more pulse information must be generated per measuring unit. The following formula is used to calculate the scale factor.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

WHERE:

Desired Display Units: Count display units acquired after pulses that occurred.

Number of Pulses: Number of pulses required to achieve the desired display units.

Decimal Point Position:

0	=	1
0.0	=	10
0.00	=	100
0.000	=	1000
0.0000	=	10000

EXAMPLE: The counter display is used to indicate the total number of feet used in a process. It is necessary to know the number of pulses for the desired units to be displayed. The decimal point is selected to show the resolution in hundredths.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}} \times \text{Decimal Point Position}$$

Given that 128 pulses are equal to 1 foot, display total feet with a one-hundredth resolution.

$$\text{Scale Factor} = \frac{1.00}{128} \times 100$$

Scale Factor = 0.007812 x 100
Scale Factor = 0.7812

USER INPUT FUNCTION

USr INP
rESEt

DISPLAY	MODE	DESCRIPTION
nO	No Function	User Input disabled.
ProLoc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
Inhibit	Inhibit	Inhibit counting for the selected counter(s).
rESEt	Maintained Reset	Level active reset of the selected counter(s).
StorE	Store	Freeze display for the selected counter(s) while allowing counts to accumulate internally.
St-rSt	Store and Reset	Edge triggered reset of the selected counter(s) after storing the count.
d-SEL	Display Select *	Advance once for each activation.
d-LEU	Display Intensity Level *	Increase intensity one level for each activation.
rSt-1	Setpoint 1 Reset *	Reset setpoint 1 output.
rSt-2	Setpoint 2 Reset *	Reset setpoint 2 output.
rSt-12	Setpoint 1 and 2 Reset *	Reset both setpoint 1 and 2 outputs.
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
Pr-rSt	Print and Reset *	Same as Print Request followed by a momentary reset of the selected counter(s).

** Indicates Edge Triggered function. All others are Level Active functions.*

USER INPUT ASSIGNMENT

USrASN
Cnt A

Cnt A
Cnt b
both

The User Input Assignment is only active when Counter B is enabled and the user input selection perfroms a Reset, Inhibit or Store function on one or both of the counters.

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

Shaded area selections only apply when Counter B is enabled (Dual Count mode or batch counter).

G

5.2 MODULE 2 - RATE SETUP PARAMETERS (2-rAtE)

PARAMETER MENU

2-rAtE → PAR → rt-Enb — rt-dPt — StYLE — rt-dSP — rt-INP — LO-Udt — HI-Udt → Pro

rt-Enb	rt-dPt	StYLE	rt-dSP	rt-INP	LO-Udt	HI-Udt
Rate Enable	Rate Decimal Point	Rate Input Scaling Style	Rate Scaling Display Value	Rate Scaling Input Value	Rate Low Update Time	Rate High Update Time

RATE ENABLE

rt-Enb
no

no   YES

This parameter enables the rate display. For maximum input frequency, Rate Enable should be set to no when not in use. When set to no, the remaining rate parameters are not accessible.

RATE DECIMAL POINT

rt-dPt
0

0   0.00   0.0000
0.0   0.000

This selects the decimal point position for rate displays and any setpoint value assigned to these displays. This parameter does not affect rate scaling calculations.

RATE INPUT SCALING STYLE

StYLE
KEY

KEY   APLY

If a Rate Input value (in Hz) and the corresponding Rate Display value are known, the Key-in (KEY) Scaling Style can be used. This allows rate scaling without the presence of a rate input signal.

If the Rate Input value has to be derived from the actual rate input signal, the Apply (APLY) Scaling Style should be used.

RATE SCALING DISPLAY VALUE

rt-dSP
001000

0 to 999999

Enter the desired Rate Display value for the Scaling Point. This value is entered using the front panel buttons for either Scaling Style.*

RATE SCALING INPUT VALUE

rt-INP
01000.0

0.1 to 99999.9

Enter the corresponding Rate Input value using the Scaling Style selected. *

Key-in Style:

Enter the Rate Input value using the front panel buttons. This value is always in pulses per second (Hz).*

Apply Style:

The meter initially shows the stored Rate Input value. To retain this value, press **PAR** to advance to the next parameter. To enter a new value, apply the rate input signal to Input A. Press **RST▼** and the applied input frequency (in Hz) will appear on the display. To insure the correct reading, wait several rate sample periods (see Rate Low Update Time) or until a consistent reading is displayed. Press **PAR** to store the displayed value as the new Rate Input value.

*For value entry instructions, refer to selection/value entry in the Programming The Meter section.

RATE LOW UPDATE TIME (DISPLAY UPDATE)

LO-Udt
01.0

0.1 to 99.9 seconds

The Low Update Time is the minimum amount of time between display updates for the Rate display. Values of 0.1 and 0.2 seconds will update the display correctly but may cause the display to appear unsteady.

RATE HIGH UPDATE TIME (DISPLAY ZERO)

HI-Udt
02.0

0.2 to 99.9 seconds

The High Update Time is the maximum amount of time before the Rate display is forced to zero. (For more explanation, refer to Rate Value Calculation.) The High Update Time **must** be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.

SCALING FOR RATE INDICATION

To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. These values are internally plotted to a Display value of 0 and Input value of 0.0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The meter is capable of showing a rate display value for any positive slope linear process.

SCALING CALCULATION FOR KEY-IN STYLE

If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (rt-dSP) and Scaling Input (rt-INP). No further calculations are needed.

If only the number of pulses per 'single' unit (i.e. # of pulses per foot) is known, then it can be entered as the Scaling Input value and the Scaling Display value will be entered as the following:

RATE PER	DISPLAY (rt-dSP)	INPUT (rt-INP)
Second	1	# of pulses per unit
Minute	60	# of pulses per unit
Hour	3600	# of pulses per unit

NOTES:

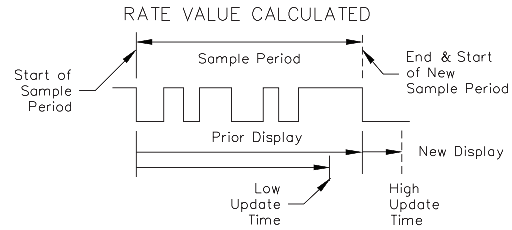
1. If # of pulses per unit is less than 1, then multiply both Input and Display values by 10 or 100 as needed for greater accuracy.
2. If the Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
3. Both values must be greater than 0.

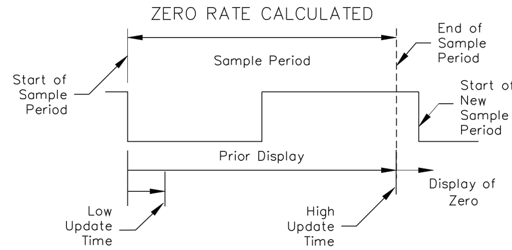
EXAMPLE:

1. With 15.1 pulses per foot, show feet per minute in tenths. Scaling Display = 60.0 Scaling Input = 15.1.
2. With 0.25 pulses per gallon, show whole gallons per hour. (To have greater accuracy, multiply both Input and Display values by 10.) Scaling Display = 36000 Scaling Input = 2.5.

INPUT FREQUENCY CALCULATION

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by the scaling calculation.





5.3 MODULE 3 - Display and Front Panel Key Parameters (3-dSP)

PARAMETER MENU

3-dSP → PAR

SEL-En	rSt-En	ScroLL	d-LEU	CodE	FCS
Front Panel Display Select Enable	Front Panel Counter Reset Enable	Display Scroll Enable	Display Intensity Level	Programming Security Code	Factory Service Operations

→ Pro

FRONT PANEL DISPLAY SELECT ENABLE (SEL▲)

SEL-En
YES

nO YES

The YES selection allows the SEL▲ key to toggle through the enabled displays.

FRONT PANEL COUNTER RESET ENABLE (RST▼)

rSt-En
YES

nO	nO	both
YES	Cnt A	dSPLAY
	Cnt b	

The YES selection allows the RST▼ key to reset the selected counter(s). The shaded selections are only active when Counter B is enabled (Dual Count Mode or batch counter).

DISPLAY SCROLL ENABLE

ScroLL
nO

nO YES

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is about every 4 seconds.

DISPLAY INTENSITY LEVEL

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE
000

0 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (ProLoc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all unit parameters to be viewed and modified. Quick Programming mode permits only user selected values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Entering a Security Code from 1-99 enables Quick Programming mode, and displays a sublist to select which values appear in the Quick Programming menu. All of the values set to YES in the sublist are accessible in Quick Programming. The values include Setpoints (SP-1, SP-2), Output Time-outs (tOUt-1, tOUt-2), Count Load value (Cnt Ld) and Display Intensity (d-LEU).

Programming any Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Quick Programming mode, if enabled, is accessed before the CodE prompt appears.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
not ProLoc	———	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
ProLoc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

G

FACTORY SERVICE OPERATIONS

FCS — NO

NO YES

Select YES to perform either of the Factory Service Operations shown below.

VIEW MODEL AND VERSION DISPLAY

CodE — 50

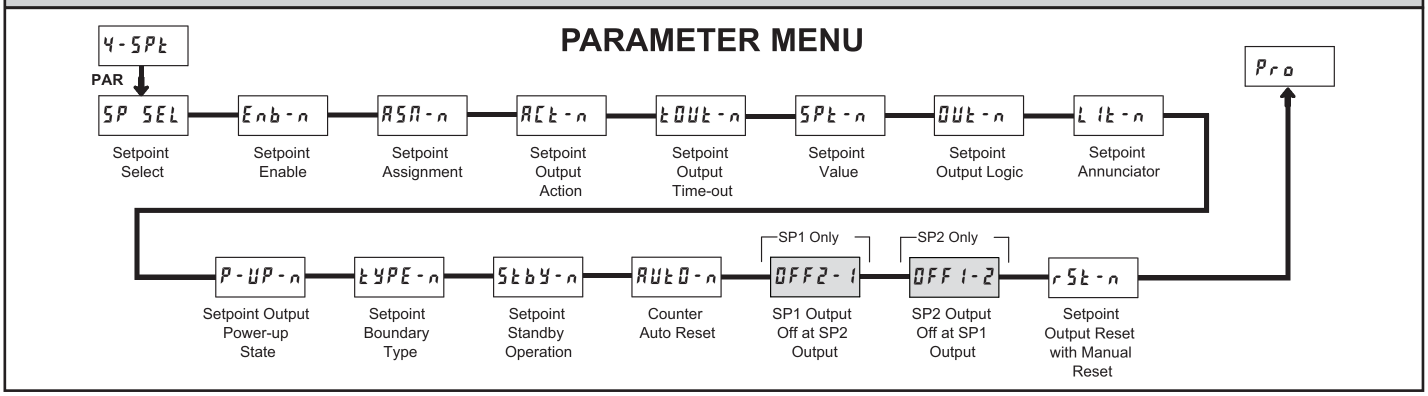
Entering Code 50 will display the model and version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** key to exit the module.

RESTORE FACTORY DEFAULT SETTINGS

CodE — 66

Entering Code 66 will overwrite all user settings with the factory default settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** key to exit the module.

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



Some Setpoint parameters will not appear depending on the Setpoint Assignment and Setpoint Output Action selected. The Setpoint Parameter Availability chart below illustrates this.

PARAMETER	DESCRIPTION	COUNTER ASSIGNMENT (A or B)*			RATE ASSIGNMENT		
		TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH	TIMED OUT t-OUt	BOUNDARY bOUNd	LATCH LAtCH
tOUt-n	Setpoint Output Time-out Value	Yes	No	No	Yes	No	No
SPt-n	Setpoint Value	Yes	Yes	Yes	Yes	Yes	Yes
OUt-n	Setpoint Output Logic	Yes	Yes	Yes	Yes	Yes	Yes
LIt-n	Setpoint Annunciator	Yes	Yes	Yes	Yes	Yes	Yes
P-UP-n	Setpoint Output Power-up State	No	No	Yes	No	No	Yes
tYPE-n	Setpoint Boundary Type	No	Yes	No	Yes	Yes	Yes
Stby-n	Standby Operation (Low ActingOnly)	No	Yes	No	Yes	Yes	Yes
AUtO-n	Counter Auto Reset	Yes	No	Yes	No	No	No
OFF2-1	SP1 Output Off at SP2 (SP1 only)	Yes	No	Yes	No	No	No
OFF1-2	SP2 Output Off at SP1 (SP2 only)	Yes	No	Yes	No	No	No
rSt-n	Output Reset with Manual Reset	Yes	No	Yes	Yes	No	Yes

* BOUNDARY Setpoint Action not applicable for Counter B assignment.

SETPOINT SELECT

SP SEL — NO

NO
SP-1
SP-2

Select the Setpoint Output to be programmed, starting with Setpoint 1. The "n" in the following parameters reflects the chosen Setpoint number. After the selected setpoint is completely programmed, the display returns to SP SEL. Repeat steps for Setpoint 2 if both Setpoints are being used. Select NO to exit the Setpoint programming module.

SETPOINT ENABLE

Enb-n — NO

NO YES

Select YES to enable the chosen setpoint and access the setup parameters. If NO is selected, the unit returns to SP SEL and the setpoint is disabled.

G

SETPOINT ASSIGNMENT

ASN-n → Cnt A

Cnt A
Cnt b
rAtE

Select the display the Setpoint is to be assigned.

SETPOINT OUTPUT ACTION

ACt-n → LAtCH

LAtCH
t-Out
bOUNd

This parameter selects the action of the Setpoint output as described in the chart below. Boundary mode is not applicable for Counter B assignment.

SPT ACTION	DESCRIPTION	OUTPUT ACTIVATES	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	When Count = Setpoint	At Manual Reset (if rSt-n=YES)
t-Out	Timed Output Mode	When Count = Setpoint	After Setpoint Output Time-Out
bOUNd	Boundary Mode (High Acting)	When Count ≥ Setpoint	When Count < Setpoint
	Boundary Mode (Low Acting)	When Count ≤ Setpoint	When Count > Setpoint

SETPOINT OUTPUT TIME-OUT

tOUt-n → 001.00

0.01 to 599.99 seconds

This parameter is only active if the Setpoint Action is set to timed output mode (t-Out). Enter the value in seconds that the output will be active, once the Setpoint Value is reached.

SETPOINT VALUE

SPt-n → 000100

Count A: -99999 to 999999
Count B: 0 to 99999
Rate: 0 to 99999

Enter the desired Setpoint value. To enter a negative setpoint value, increment digit 6 to display a "-" sign (Counter A only).

SETPOINT OUTPUT LOGIC

Out-n → NOr

NOr rEU

Normal (NOr) turns the output "on" when activated and "off" when deactivated. Reverse (rEU) turns the output "off" when activated and "on" when deactivated.

SETPOINT ANNUNCIATOR

LIt-n → NOr

NOr rEU

Normal (NOr) displays the setpoint annunciator when the corresponding output is "on". Reverse (rEU) displays the setpoint annunciator when the output is "off".

SETPOINT OUTPUT POWER-UP STATE

P-UP-n → OFF

OFF
ON
SAUE

SAUE will restore the output to the same state it was at before the meter was powered down. ON will activate the output at power up. OFF will deactivate the output at power up.

SETPOINT BOUNDARY TYPE

tYPE-n → HI-ACt

HI-ACt LO-ACt

High Acting Boundary Type activates the output when the assigned display value (ASN-n) equals or exceeds the Setpoint value. Low Acting activates the output when the assigned display value is less than or equal to the Setpoint.

SETPOINT STANDBY OPERATION

StbY-n → NO

NO YES

This parameter only applies to Low Acting Boundary Type setpoints. Select YES to disable a Low Acting Setpoint at power-up, until the assigned display value crosses into the output "off" area. Once in the output "off" area, the Setpoint will then function per the description for Low Acting Boundary Type.

COUNTER AUTO RESET

AUtO-n → NO

NO ZEr-St CLd-St
ZEr-En CLd-En

This parameter automatically resets the Setpoint Assigned Counter (A or B) each time the Setpoint value is reached. The automatic reset can occur at output start, or output end if the Setpoint Output Action is programmed for timed output mode. The Reset-to-Count Load selections ("CLd-") only apply to Counter A assignment. This reset may be different from the Counter A Reset Action selected in Module 1.

SELECTION	ACTION
NO	No Auto Reset
ZEr-St	Reset to Zero at the Start of output activation
CLd-St	Reset to Count Load value at the Start of output activation
ZEr-En	Reset to Zero at the End of output activation (timed out only)
CLd-En	Reset to Count Load at the End of output activation (timed out only)

SETPOINT 1 OUTPUT OFF AT SETPOINT 2 (SP1 Only)

OFF2-1 → NO

NO
O2-Str
O2-End

This parameter will deactivate Setpoint 1 output at the Start or End of Setpoint 2 output (O1 off at O2). The "-End" setting only applies if Setpoint 2 Output Action is programmed for timed output.

SETPOINT 2 OUTPUT OFF AT SETPOINT 1 (SP2 Only)

OFF1-2 → NO

NO
O1-Str
O1-End

This parameter will deactivate Setpoint 2 output at the Start or End of Setpoint 1 output (O2 off at O1). The "-End" setting only applies if Setpoint 1 Output Action is programmed for timed output.

SETPOINT OUTPUT RESET WITH MANUAL RESET

rSt-n → YES

NO YES

Selecting YES causes the Setpoint output to deactivate (reset) when the Setpoint Assigned Counter is reset. The counter reset can occur by the **RST▼** key, User Input or Counter Reset at Power-up.

This output reset will not occur when the Assigned Counter is reset by a Setpoint generated Counter Auto Reset.

5.5 MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SEr)

PARAMETER MENU

5-SEr → PAR

bAUd	dAtA	PAr itY	Addr	Abbr	Pr-OPt	AUtO	COPY	Pro
Baud Rate	Data Bit	Parity Bit	Meter Address	Abbreviated Printing	Print Options	Automatic Data Transmit	Copy Program Settings	

Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the meter with those of the host computer or other serial device.

BAUD RATE

bAUd
9600

300 1200 4800 19200
600 2400 9600 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA
7-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr itY
Odd

nO
Odd
EUEn

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to nO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr
00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr
nO

nO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select nO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS

Pr-OPt
nO

nO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as nO will not be sent.

The "Print All" (Pr-ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, Counter B or Scale Factor B will only be sent if Counter B is enabled (Dual Counter mode or batch count). Likewise, the Rate value will not be sent unless the Rate Display is enabled.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
Cnt A	Counter A	YES	CTA
Cnt b	Counter B	nO	CTB
rAtE	Rate Value	nO	RTE
ScF A	Scale Factor A	nO	SFA
ScF b	Scale Factor B	nO	SFB
SP-1	Setpoint 1	nO	SP1
SP-2	Setpoint 2	nO	SP2
Cnt Ld	Counter A Count Load	nO	CLD

AUTOMATIC DATA TRANSMIT

AUtO
nO

nO YES

Selecting YES causes the meter to automatically transmit serial data per the Print Options selection list. This occurs without using the User Input terminal Print Request function (Module 1), and without requiring any serial data request commands. This makes the User Input available to perform other functions, while still allowing the meter to output serial data.

The selected data is transmitted repeatedly every 1.5 seconds during normal operating mode, and pauses during programming mode.

COPY PROGRAM SETTINGS

COPY
nO

nO YES

This parameter is used to copy all the program settings from one LD meter directly to another LD meter(s), through the serial terminal block connections (RS232 or RS485). No PC connection or additional software is required. Copying program setttings eliminates or greatly reduces programming time when multiple meters use identical, or very similar, settings for an application.

Copy Requirements:
To copy program settings from one meter to another requires the following:
1. Each meter must have the same software version. The version is displayed during the meter power-up sequence, or by entering Code 50 in the Factory Service Operations. (See Module 3 for details)
2. Each meter receiving the program settings (receiver) must have the baud rate

set to 9600 baud. This is the factory default setting, so a new meter should arrive ready for copying. The meter sending the program settings (master) should be set to the desired baud rate for the application (if different than 9600). This baud rate setting will then be copied to the receiver(s).

Copy Connections:

To connect the LD meters for copying, refer to section 3.5 Serial Wiring for details. The meter shown in the figures as LD METER will be the master.

1. RS232 - Allows copying from the master meter to a single receiver only.
2. RS485 - Allows copying from the master meter to one or more receivers simultaneously. Up to 31 receiving meters can be connected during copying.

Copy Procedure:

1. Connect the master and receiver(s) using RS232 or RS485 terminals.
2. Apply power to the meters. The receiving meter(s) must be operating in the normal display mode (not programming mode).
3. On the master meter, proceed to the Copy Program Settings parameter and select YES to begin copying.
4. During the copy process (~ 2 sec.), the master meter displays an upload message (UP-Ld) while the receiver(s) displays a download message (dn-Ld). This indicates successful communication between the master and receiver(s).
5. When copying is completed, all receivers display the power-up sequence and return to normal operating mode, programmed with all the same settings as the master meter. The master remains at the COPY prompt, ready for another receiver(s) to be connected for copying.

Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a count value or setpoint output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences in meter response time when using the * and $ terminating characters.

Register Identification Chart

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Counter A	CTA	T, V, R	6 digit positive/5 digit negative (with minus sign)
B	Counter B	CTB	T, V, R	5 digit, positive only
C	Rate	RTE	T	5 digit, positive only
D	Scale Factor A	SFA	T, V	6 digit, positive only
E	Scale Factor B	SFB	T, V	6 digit, positive only
F	Setpoint 1 (Reset Output 1)	SP1	T, V, R	per setpoint Assignment, same as Counter or Rate
G	Setpoint 2 (Reset Output 2)	SP2	T, V, R	per setpoint Assignment, same as Counter or Rate
H	Counter A Count Load Value	CLD	T, V, R	6 digit positive/5 digit negative (with minus sign)

Command String Examples:

1. Node address = 17, Write 350 to the Setpoint 1 value
   String: N17VF350*
2. Node address = 5, Read Counter A, response time of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 1 output
   String: RF*
4. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to transmit details listed in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 10 for number, one for sign, one for decimal point
19	<CR> (carriage return)
20	<LF> (line feed)
21	<SP>* (Space)
22	<CR>* (carriage return)
23	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 18) is 12 characters long. When a requested counter or rate value exceeds the meter's display limits, an * (used as an overflow character) replaces a space in byte 7. Byte 8 is always a space.

The remaining ten positions of this field consist of a minus sign (for negative values), a floating decimal point (if applicable), and eight positions for the requested value. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> (carriage return)
14	<LF> (line feed)
15	<SP>* (Space)
16	<CR>* (carriage return)
17	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Counter A = 875
   17 CTA 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 1 = -250.5
   SP1 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 1 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 times the # of characters) / baud rate

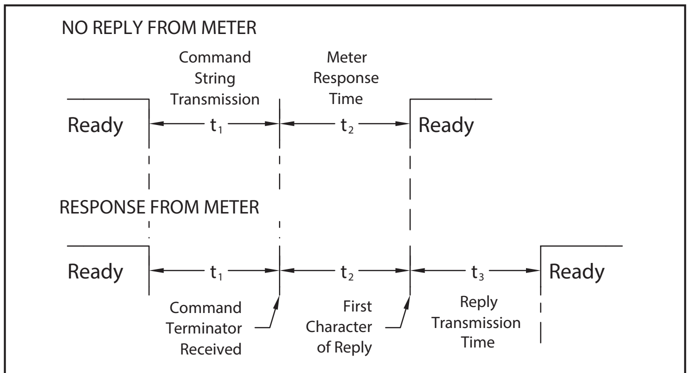
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

t_3 = (10 times the # of characters) / baud rate

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



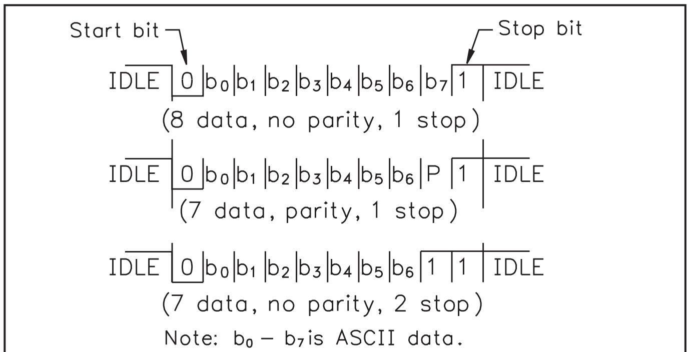
Timing Diagram Figure

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

MODEL LD - LARGE DISPLAY TIMER AND CYCLE COUNTER

- *2.25" or 4" HIGH RED LED DIGITS*
- *6-DIGIT BI-DIRECTIONAL TIMING CAPABILITY*
- *5-DIGIT CYCLE COUNTING CAPABILITY*
- *SELECTABLE TIMER RANGES AND OPERATING MODES*
- *ELAPSED TIMER AND PRESET TIMER FUNCTIONALITY*
- *SERIAL COMMUNICATIONS (RS232 or RS485)*
- *PROGRAMMABLE USER INPUT*
- *UNIVERSALLY POWERED*
- *5 AMP FORM C RELAY OUTPUT*
- *ALUMINUM NEMA 4X CASE CONSTRUCTION*

C UL US LISTED
IND. CONT. EQ.
51EB

CE

GENERAL DESCRIPTION

The Large Display Timer and Cycle Counter is a versatile display that functions as an Elapsed Timer or Preset Timer, with full-featured user programmability. The meter includes a built-in Cycle Counter, relay output and serial communications capability. The 6 digit displays are available in either 2.25" or 4" high red LED digits with adjustable display intensity. The 2.25" high models are readable up to 130 feet. The 4" high models are readable up to 180 feet. Both versions are constructed of a NEMA 4X/IP65 enclosure in light weight aluminum.

The Timer has two signal inputs and eight input operating modes. These modes provide level active or edge triggered start/stop operation. The Timer features 18 selectable timer ranges to cover a wide variety of timing applications. The built-in Cycle Counter can be linked to timer operation to count timing cycles, or function as a totally independent counter, accepting count speeds up to 500 Hz. The display can be toggled either manually or automatically between the Timer and Counter values.

In addition to the Timer/Counter inputs, a programmable User Input is provided to perform a variety of meter functions. DIP switches are used to configure the inputs for current sinking (active low) or current sourcing (active high) operation.

The Setpoint Output can be assigned to the Timer or Counter value, and configured to suit a variety of control and alarm requirements. The meter also includes RS232 or RS485 serial communications.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

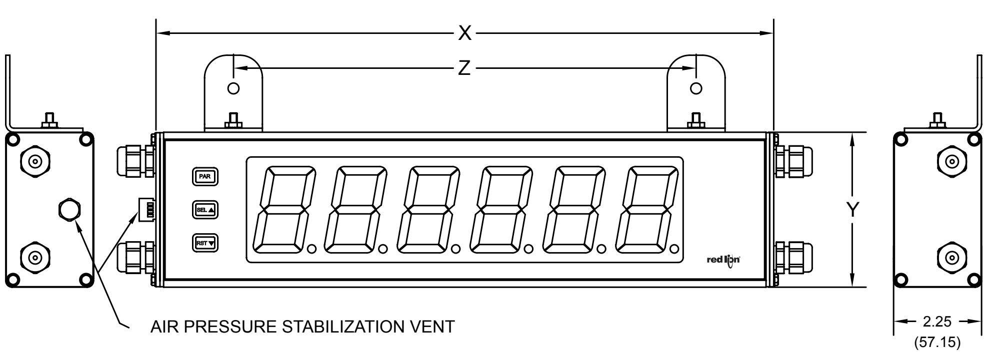
The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

SPECIFICATIONS

1. **DISPLAY**: 2.25" (57 mm) or 4" (101 mm) intensity adjustable Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 26 VA
   DC POWER: 21.6 to 250 VDC, 11 W
   DC Out: +24 VDC @ 100 mA if input voltage is greater than 50 VAC/VDC
   +24 VDC @ 50 mA if input voltage is less than 50 VDC
   Isolation: 2300 V_{RMS} for 1 min. to all inputs and outputs
3. **TIMER DISPLAY**: 6-digits
   Display Range: 0 to 999999
   Overflow/Underflow Indication: Display flashes "t OUEr"
   Minimum Digit Resolution: 0.001 Sec.
   Maximum Single Digit Resolution: 1 Hr.
   Timing Accuracy: ±0.01%
4. **CYCLE COUNTER DISPLAY**: 5-digits, may be disabled if not used
   Display Designator: "C" to the left side of the display
   Display Range: 0 to 99999
   Overflow/Underflow Indication: Display flashes "C OUEr"

G

DIMENSIONS In inches (mm)



PART NUMBER	X (Length)	Y (Height)	Z (Center)
LD2T06P0	16 (406.4)	4 (101.6)	12 (304.8)
LD4T06P0	26 (660.4)	7.875 (200)	22 (558.8)

Maximum Count Rate:
All Count Sources except Input B: 10 Hz
Input B Count Source:
With Timer Input Filter ON: 10 Hz
With Timer Input Filter OFF: 500 Hz

5. **TIMER SIGNAL INPUTS** (INP A and INP B)
DIP switch selectable pull-up (7.8 KΩ) or pull-down (3.9 KΩ) resistors determine active high or active low input logic.
Input A Trigger levels: V_{IL} = 1.25 V max; V_{IH} = 2.75 V min; V_{MAX} = 28 VDC
Input B: Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Inputs A and B:
Timer Input Pulse Width: 1 msec min.
Timer Start/Stop Response Time: 1 msec max.
Filter: Software filtering provided for relay or switch contact debounce. Filter enabled or disabled through programming. If enabled, results in 50 msec start/stop response time for successive pulses applied to the same input terminal.

6. **RESET/USER INPUT** Programmable Function Input:
DIP switch selectable pull-up (7.8 KΩ) or pull-down (3.9 KΩ) resistor that determines active high or active low input logic.
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 10 msec typ.; 50 msec debounce (activation and release)

7. **COMMUNICATIONS**:
RS485 SERIAL COMMUNICATIONS
Type: RS485 multi-point balanced interface (isolated)
Baud Rate: 300 to 38400
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
RS232 SERIAL COMMUNICATIONS
Type: RS232 half duplex (isolated)
Baud Rate: 300 to 38400
Data Format: 7/8 bits; odd, even, or no parity

8. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and timer/count values when power is removed.

9. **OUTPUT**:
Relay: Form C contacts rated at 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)

10. **CONNECTIONS**:
Internal removable terminal blocks are used for power and signal wiring. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and signal wiring connections are on the right side and the relay and serial output options are on left side.
Wire Strip Length: 0.4" (10 mm)
Wire Gage: 24-12 AWG copper wire
Torque: 5.3 inch-lbs (0.6 N-m) max
Cable Diameter: Outside diameter must be 0.181" (4.6 mm) to 0.312" (7.9 mm) to maintain NEMA 4 rating of cord grips.

11. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 50 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's (1g relay).
Shock According to IEC 68-2-27: Operational 30 g's (10g relay), 11 msec in 3 directions.
Altitude: Up to 2,000 meters

12. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Enclosure rating, UL50
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating, IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.

13. **CONSTRUCTION**: Aluminum enclosure, and steel side panels with textured black polyurethane paint for scratch and corrosion resistance protection. Meets NEMA 4X/IP65 specifications. Installation Category II, Pollution Degree 2.

14. **WEIGHT**:
LD2T06P0 - 4.5 lbs (2.04 kg)
LD4T06P0 - 10.5 lbs (4.76 kg)

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LD	2.25" High 6-Digit Red LED Timer/Cycle Counter w/ Relay Output & RS232/RS485 Serial Communications	LD2T06P0
	4" High 6-Digit Red LED Timer/Cycle Counter w/ Relay Output & RS232/RS485 Serial Communications	LD4T06P0
LD Plug	Panel Meter Plug for LD models (NOT included in LD Product UL File)	LDPLUG00

1.0 Installing the Meter

G

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed.

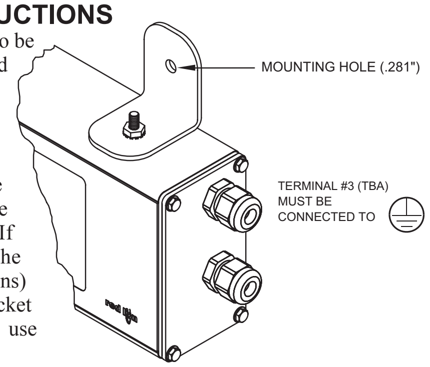
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature. Placing the unit near devices that generate excessive heat should be avoided. The unit should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the front overlay. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

MOUNTING INSTRUCTIONS

This display is designed to be wall mounted or suspended from a ceiling truss or other suitable structure capable of supporting the LDT. Caution should be exercised when hanging the display to provide for the safety of personnel. If hanging the LDT, run the suspension cables (or chains) through the mounting bracket holes. For wall mounting use #10-32 size bolts.



2.0 SETTING THE DIP SWITCHES

To access the switches, remove the right side plate of the meter. A bank of eight switches is located inside the unit. *Note: Some switches are not used and should remain in the factory set position.*

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

SWITCH 1 (Unused)

This switch is not used and should remain in the factory set position.

SWITCH 2 (Input A) {See Note 1}

SNK: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 2.1 mA.
SRC: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 3 (Input A)

FILTER ON: Provides hardware debounce for Input A to allow relay or switch contacts to be used as a signal source. Software debounce for Inputs A and B is provided in the programming menu (Module 1).

SWITCH 4 (Input B) {See Note 1}

SNK: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, I_{MAX} = 2.1 mA.
SRC: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCH 5 (Input B)

FILTER ON: Provides hardware debounce for Input B to allow relay or switch contacts to be used as a signal source. Software debounce for Inputs A and B is provided in the programming menu (Module 1).

SWITCH 6 (RESET/USER INPUT) {See Note 1}

SNK: Adds internal 7.8 KΩ pull-up resistor to +12VDC, I_{MAX} = 2.1 mA.
SRC: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

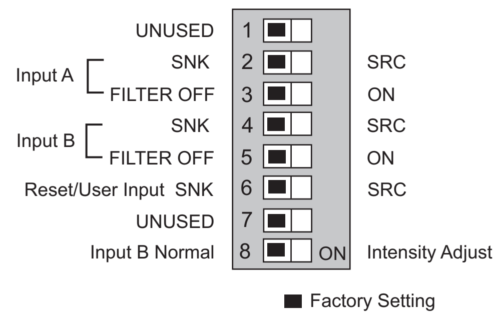
SWITCH 7 (Unused)

This switch is not used and should remain in the factory set position.

SWITCH 8 (Input B)

NORMAL: Input B performs the normal functions described in the Timer Input Operation parameter of the programming menu (Module 1).
INTENSITY ADJUST: In this position, Input B is used to adjust the LED display intensity. Five distinct LED levels can be set by pulsing Input B. The display intensity level can also be set in the programming menu (Module 3).

Note 1: When the DIP switch is in the SNK position (OFF), the input is configured as active low. When the switch is in the SRC position (ON), the input is configured as active high.



3.0 WIRING THE METER

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

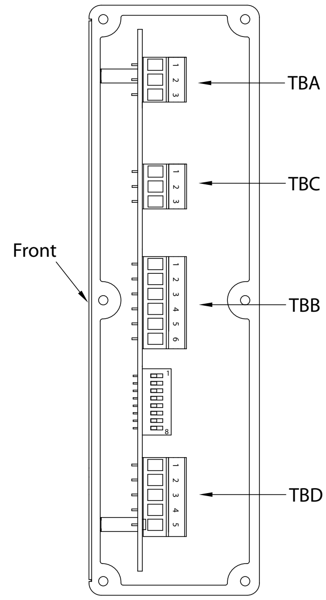
1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

WIRING OVERVIEW

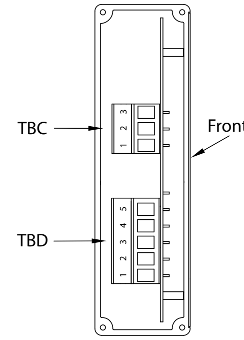
Electrical connections are made via pluggable terminal blocks located inside the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker. When wiring the meter, compare the numbers on the label on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.4" (10 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

WIRING CONNECTIONS

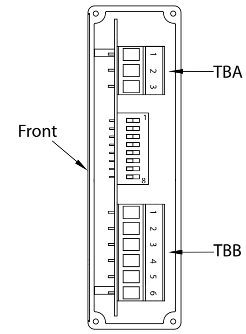
Internal removable terminal blocks are used for power and signal wiring. Access to terminal blocks is through conduit fittings. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and input wiring connections are on the right side and the relay and serial connections are on the left side.



LD4



LD2 Left Side

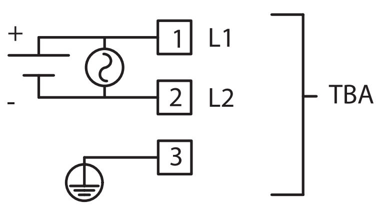


LD2 Right Side

3.1 POWER WIRING

The power wiring is made via the 3 position terminal block (TBA) located inside the unit (right side). The DC out power is located on TBB (right side).

Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -
Terminal 3: Protective Conductor Terminal



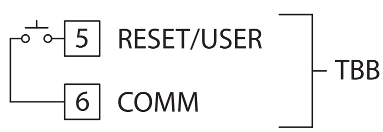
DC Out Power
Terminal 4: + 24 VDC OUT
Terminal 6: User Common

3.2 RESET/USER INPUT WIRING

The Reset/User Input is located on the right side

Terminal 5: Reset/User Input
Terminal 6: User Common

Sinking Logic



DIP switch 6 OFF

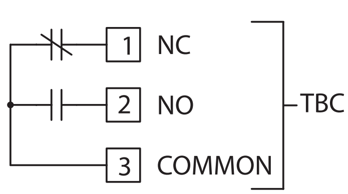
Sourcing Logic

DIP switch 6 ON

3.3 SETPOINT (OUTPUT) WIRING

The setpoint relay uses a three position terminal block (TBC) located on the left side of the LD2 model, and on the right side for the LD4 model.

Terminal 1: Normally Closed
Terminal 2: Normally Open
Terminal 3: Relay Common

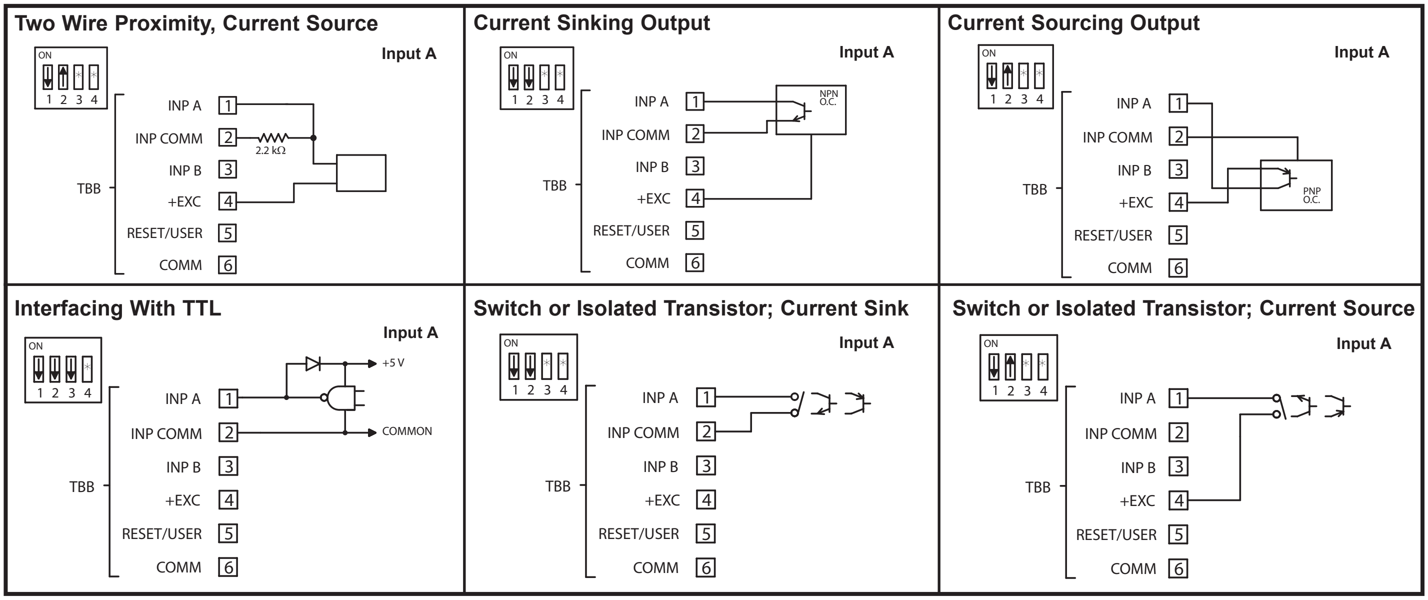


3.4 INPUT WIRING

The Large Display Timer is equipped with two signal inputs, A and B. These inputs are wired using the six position terminal block (TBB) located inside the unit on the right side.

Terminal 1: Input A
Terminal 3: Input B
Terminal 2: Input Common

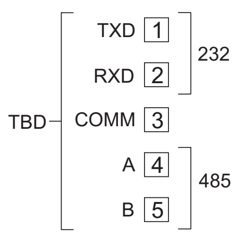
CAUTION: DC common is NOT isolated from input common. In order to preserve the safety of the meter application, the DC common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Input and Input Common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground.



∗ Switch position is application dependent.

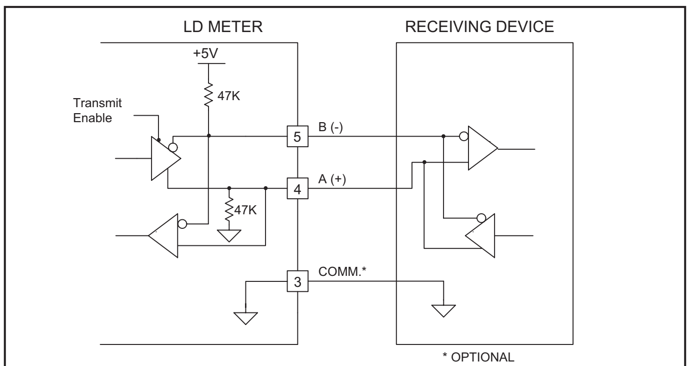
3.5 SERIAL WIRING

The serial connections are made via terminal block TBD located inside the unit on the left side for the LD2 and on the right side for the LD4.



RS485 Communications

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the LD is limited to 38.4k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



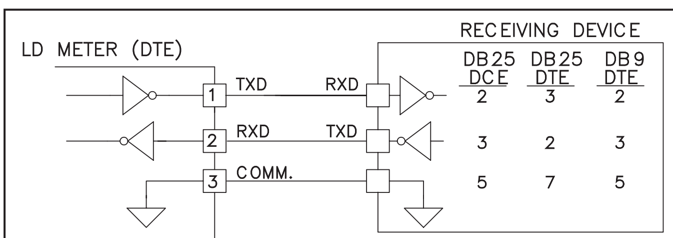
RS485 Terminal Block Connection Figure

RS232 Communications

RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The LD emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function.

As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is “busy”. The receiving device asserts that it is busy by setting the RXD line to a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.



RS232 Terminal Block Connection Figure

4.0 Reviewing the Front Panel Keys and Display

KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL▲	Select display (Timer or Cycle Counter)	Advance through selection list/select digit position in parameter value
RST▼	Reset value(s) per front panel reset setting	Increment selected digit position of parameter value

OPERATING MODE DISPLAY DESIGNATORS

"C" - To the left of the display is the Cycle Counter value.

" 1 " - Between digits 5 and 6 indicates the setpoint status.

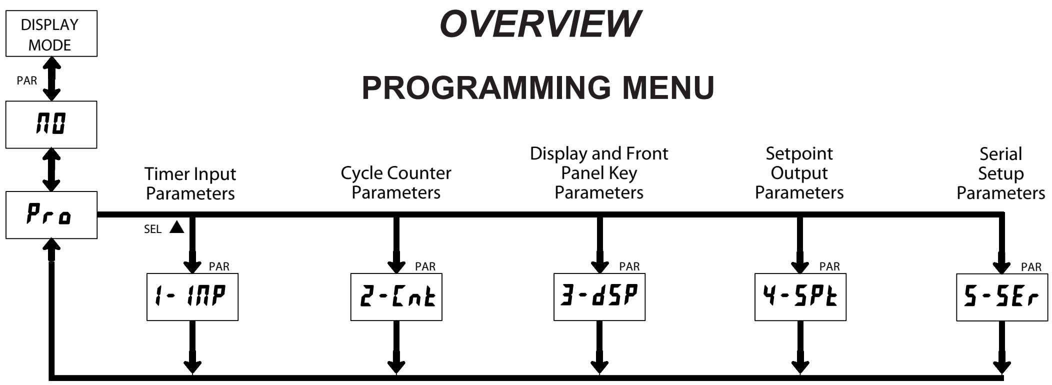
" . " - Decimal point to the far right of the display can be programmed to flash when the timer is running, to provide a "Timer Run" indicator.

If display scroll is enabled, the display will toggle automatically every four seconds between the Timer and Cycle Counter values.

5.0 Programming the Meter

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR KEY)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** key. If it is not accessible, then it is locked by either a security code or a hardware lock (See Module 3).

MODULE ENTRY (SEL▲ & PAR KEYS)

The Programming Menu is organized into five modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL▲** key is used to select the desired module. The displayed module is entered by pressing the **PAR** key.

MODULE MENU (PAR KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL▲** and **RST▼** keys are used to move through the selections/values for that parameter. Pressing the **PAR** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST▼** key increments the digit by one or the user can hold the **RST▼** key and the digit will automatically scroll. The **SEL▲** key will select the next digit to the left. Pressing the **PAR** key will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR KEY)

The Programming Mode is exited by pressing the **PAR** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

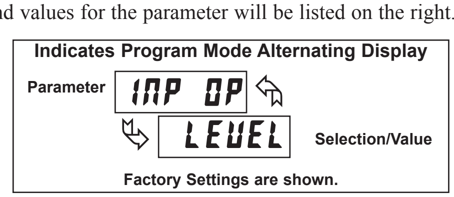
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 3. This is useful when encountering programming problems.

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



G

5.1 MODULE 1 - Timer Input Parameters (1- INP)

PARAMETER MENU

1- INP → PAR →

rANGE	INP OP	FILtEr	t-dir	t-Strt	t-StOP	FLASH	t P-UP	r P-UP	USr INP	USrASN
Timer Range	Timer Input Operation	Timer Input Filter	Timing Direction	Timer Start Value	Timer Stop Value	Flash Timer Run Indicator	Timer Run State At Power-up	Timer Reset At Power-up	User Input Function	User Input Assignment

→ Pro

TIMER RANGE

rANGE
SSSSSS

18 TIMER RANGE SELECTIONS

(S = SEC; N = MIN; H = HR; d = DAY)

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
SECONDS		
SSSSSS	999999	1 SEC
SSSSS.S	99999.9	0.1 SEC
SSSS.SS	9999.99	0.01 SEC
SSS.SSS	999.999	0.001 SEC
MINUTES		
NNNNNN	999999	1 MIN
NNNNN.N	99999.9	0.1 MIN
NNNN.NN	9999.99	0.01 MIN
HOURS		
HHHHHH	999999	1 HR
HHHHH.H	99999.9	0.1 HR
HHHH.HH	9999.99	0.01 HR

RANGE SELECTION	MAXIMUM DISPLAY	DISPLAY RESOLUTION
MINUTES/SECONDS		
NNNN.SS	9999.59	1 SEC
NNN.SS.S	999.59.9	0.1 SEC
NN.SS.SS	99.59.99	0.01 SEC
HOURS/MINUTES		
HHHH.NN	9999.59	1 MIN
HHH.NN.N	999.59.9	0.1 MIN
HH.NN.NN	99.59.99	0.01 MIN
HOURS/MINUTES/SECONDS		
HH.NN.SS	99.59.59	1 SEC
DAYS/HOURS/MINUTES		
dd.HH.NN	99.23.59	1 MIN

TIMER INPUT OPERATION

INP OP
LEUEL

LEUEL EdGE-1 EdGE-2 HOLd-2
LEUrSt ErSt-1 ErSt-2 HrSt-2

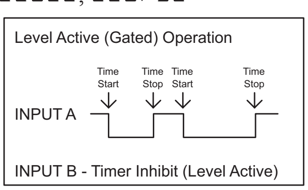
This parameter determines how the Timer Input Signals affect the Run/Stop status of the Timer. Timing diagrams are shown below for level active and edge triggered (1-input or 2-input) operation. For single input modes (Input A only), Input B provides a level active Timer Inhibit function. In the Display Hold mode, the timer display value remains held and only updates when a Timer Start (Input A) or Timer Stop (Input B) edge occurs.

The timer reset (rSt) operating modes are identical to the other modes in the diagrams, except the timer display value is reset at the Time Start edges.

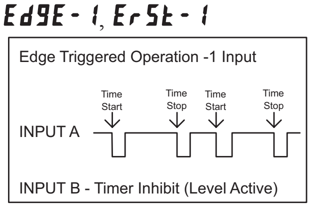
The Timer can also be stopped at a Timer Stop Value or at Setpoint output activation or deactivation. This type of Stop condition is cleared when a Timer Reset occurs, or another start edge is applied on the timer input.

For Reset Modes (rSt), the timer is reset at Time Start edge.

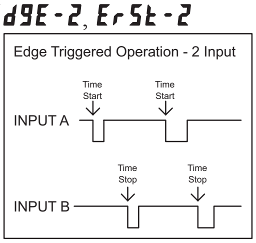
LEUEL, LEUrSt



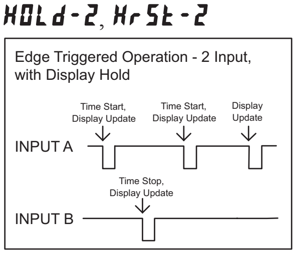
EdGE-1, ErSt-1



EdGE-2, ErSt-2



HOLd-2, HrSt-2



TIMER INPUT FILTER

FILtEr
ON

ON OFF

Provides a 50 msec software debounce for the Timer Inputs (A and B). Select ON when using relays or switch contacts as a signal source.

TIMING DIRECTION

t-dir
UP

UP dn

Bi-directional timing capability. Select the timing direction desired for the application.

TIMER START VALUE

t-Strt
000000

000000 to 999999

The Timer returns to this value whenever a Timer Reset occurs. The value is entered in the same display format as the Timer Range selected. Non-zero values are normally used for "timing down" applications, but they can also provide an offset value when timing up.

TIMER STOP VALUE

t-StOP
NO

NO YES

The Timer stops when this value is reached regardless of the signal levels on the timer inputs. Selecting YES displays a sub-menu where the Stop Value is entered in the same display format as the Timer Range selected. This stop condition is cleared when a Timer Reset occurs or another start edge is applied on the timer input. Select NO if a Stop Value is not desired.

UALUE
000000

000000 to 999999

FLASH TIMER RUN INDICATOR

FLASH
YES

NO YES

Select YES to have the Timer Run indicator flash when the timer is running.

TIMER RUN STATE AT POWER-UP

t P-UP
StOP

StOP SAUE

Determines the Run/Stop state of the Timer at Power-up. This parameter does not apply to LEUEL Input Operation.

StOP - Timer Stopped at power-up, regardless of prior Run/Stop state
SAUE - Timer assumes the Run/Stop state it was in prior to power-down

G

TIMER RESET AT POWER-UP

r P-UP → NO

NO YES

The Timer can be programmed to Reset at each meter power-up.

USER INPUT FUNCTION

USr INP → NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
ProLoc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
d-SEL	Display Select (Edge triggered)	Toggle display with each activation.
rESEt	Maintained Reset	Level active reset of the selected value(s).
d-HOLd	Display Hold	Freeze display for the selected value(s) while allowing time or counts to accumulate internally.
Hd-rSt	Hold and Reset	Edge triggered reset of the selected value(s) after storing the time or count.

USER INPUT FUNCTION (Cont'd)

DISPLAY	MODE	DESCRIPTION
Inhibt	Inhibit	Inhibit timing or counting for the selected value(s).
d-LEV	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation.
Print	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
Pr-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the selected value(s).
O-rSt	Reset Output	Edge triggered deactivation of the Setpoint Output.

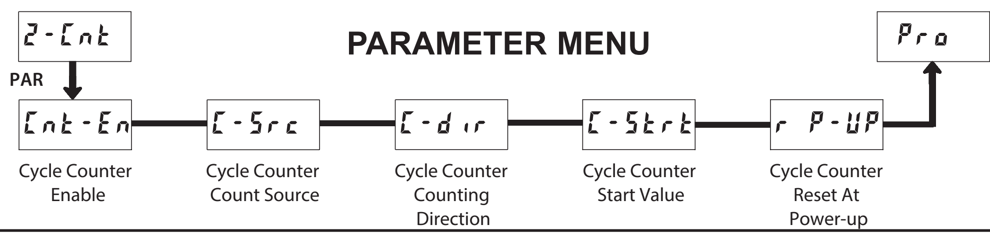
USER INPUT ASSIGNMENT

USrASN → t-VAL

t-VAL
C-VAL
both

The User Input Assignment only applies if the cycle counter is enabled and a selection of reset, display hold, hold and reset, inhibit, or print and reset is selected in the User Input Function menu.

5.2 MODULE 2 - CYCLE COUNTER PARAMETERS (2-Cnt)



CYCLE COUNTER ENABLE

Cnt-En → YES

NO YES

When set to NO, the remaining Cycle Counter parameters are not accessible.

CYCLE COUNTER COUNT SOURCE

C-Src → O-ON

INP b, O-ON, USr INP, O-OFF, t-rSt

This parameter selects the source from which the Cycle Counter derives counts. The Timer Reset (t-rSt) selection generates a count when either a manual or automatic timer reset occurs (See Module 4 for programming Automatic Reset). The Input B (INP b) selection generates a count each time Input B is activated. This selection overrides the timer inhibit function of Input B, when the timer is programmed for Level or Edge-1 operating mode (See Module 1 for Timer Input Operating Modes).

The User Input (USr INP) selection generates a count each time the User Input is activated. When selected as the count source, the User Input can still be set to perform a User Function described in Module 1. In this case, the Cycle Counter will count the number of times the selected User Function occurred.

The Output ON/OFF selections generate a count when the Setpoint output either activates or deactivates.

CYCLE COUNTER COUNTING DIRECTION

C-dir → UP

UP dn

Bi-directional counting capability. Select the counting direction desired for the application.

CYCLE COUNTER START VALUE

C-Strt → 00000

00000 to 99999

The Cycle Counter returns to this value whenever a Counter Reset occurs. Non-zero values are normally used for "down counting" applications, but can also provide an offset value when counting up.

CYCLE COUNTER RESET AT POWER-UP

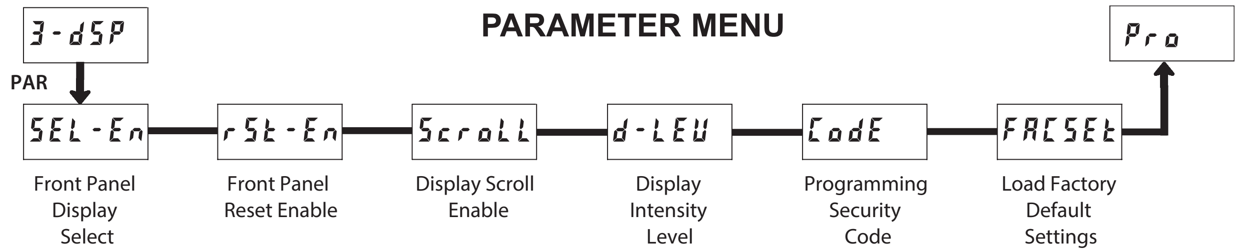
r P-UP → NO

NO YES

The Cycle Counter can be programmed to Reset at each meter power-up.

G

5.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSP)



FRONT PANEL DISPLAY SELECT ENABLE (SEL▲)

SEL-En
YES

YES NO

The YES selection allows the SEL▲ key to toggle between the timer and cycle counter displays.

FRONT PANEL RESET ENABLE (RST▼)

rSt-En
YES

YES NO both
NO t-VAL dSPLAY
C-VAL

The YES selection allows the RST▼ key to reset the selected value(s). The shaded selections only appear if the cycle counter is enabled.

DISPLAY SCROLL ENABLE

ScroLL
NO

YES NO

The YES selection allows the display to automatically scroll between the timer and cycle counter values. The scroll rate is about every 4 seconds.

DISPLAY INTENSITY LEVEL

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (ProLoc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values and Timer Stop value to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "PAR" KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
not ProLoc	———	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
ProLoc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

** Entering Code 222 allows access regardless of security code.*

LOAD FACTORY DEFAULT SETTINGS

FRCSEt
NO

NO YES

The YES selection will return the meter to the factory default settings. The meter will display rESEt and then return to Pro, at which time all settings have been changed.

G

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)

PARAMETER MENU

4-SPt → PAR									→ Pro
	SP-ASn	SP-ACt	SP-On	SP-OFF	O-tOUt	StOP-t	AUtO-r	OrSt-r	O P-UP
	Setpoint Assignment	Setpoint Output Action	Setpoint On	Setpoint Off	Setpoint Output Time-out	Stop Timer	Timer/Counter Auto Reset	Setpoint Output Reset with Display Reset	Setpoint Output Power-up State

Module 4 is the programming module for the Setpoint Output parameters. Some parameters will not appear depending on the Setpoint Assignment and Setpoint Output Action selected.

SETPOINT ASSIGNMENT

SP-ASn
t-VAL

t-VAL C-VAL

Select the display for Setpoint assignment.

SETPOINT OUTPUT ACTION

SP-ACt
LAtCH

LAtCH
t-OUt
On-OFF

This parameter selects the action of the Setpoint output as shown below.

SPT ACTION	DESCRIPTION	OUTPUT ACTIVATES	OUTPUT DEACTIVATES
LAtCH	Latched Output Mode	When Time or Count = Setpoint On value	At Manual Reset (if OrSt-r = YES)
t-OUt	Timed Output Mode	When Time or Count = Setpoint On value	After Setpoint Output Time-Out
On-OFF	On-Off Output Mode	When Time or Count = Setpoint On value	When Time or Count = Setpoint Off value

SETPOINT ON

SP-On
VALUE

VALUE
t-Strt
t-StOP

This parameter determines when the Setpoint output will activate. The output can activate at a programmed Setpoint Value or can be set to activate when the Timer starts (t-Strt) or stops (t-StOP).

Selecting VALUE displays a sub-menu where the Setpoint Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

On-VAL
000100

000000 to 999999

SETPOINT OFF

SP-OFF
VALUE

VALUE
t-Strt
t-StOP

The Setpoint Off parameter only appears if the Setpoint Action is set to On-Off Output mode (On-OFF). In this mode, the Setpoint OFF parameter determines when the Setpoint Output will deactivate. The output can be programmed to deactivate at a Setpoint Off Value or can be set to deactivate when the Timer starts (t-Strt) or stops (t-StOP).

Selecting VALUE displays a sub-menu where the Setpoint Off Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

OF-VAL
000200

000000 to 999999

SETPOINT OUTPUT TIME-OUT

O-tOUt
00.01.00

00.00.01 to 99.59.99

This parameter is only active if the Setpoint Action is set to Timed Output mode (t-OUt). Enter the time duration the Setpoint Output will remain ON once it is activated. This value is always entered in minutes, seconds, and hundredths of seconds format. The maximum value is 99 minutes 59.99 seconds.

STOP TIMER

StOP-t
nO

nO
O-On
O-OFF

Stops the Timer when the Setpoint output activates (O-On) or deactivates (O-OFF). Select nO if the output should not affect the Timer Run/Stop status.

The Timer Stop condition is cleared when a Timer Reset occurs, or a Time Start edge is applied on the Timer input.

TIMER/COUNTER AUTO RESET

AUtO-r
nO

nO
O-On
O-OFF

Automatically resets the Setpoint Assigned display value when the Setpoint Output activates (O-On) or deactivates (O-OFF). Select nO if the output should not cause a display reset.

SETPOINT OUTPUT RESET WITH DISPLAY RESET

OrSt-r
YES

YES nO

Select YES to have the Setpoint Output deactivate (reset) when the Setpoint Assigned display resets. Reset can occur by the **RST▼** key or the User Input, if programmed for that function. Select nO if the Setpoint output should not reset when the display resets.

SETPOINT OUTPUT POWER-UP STATE

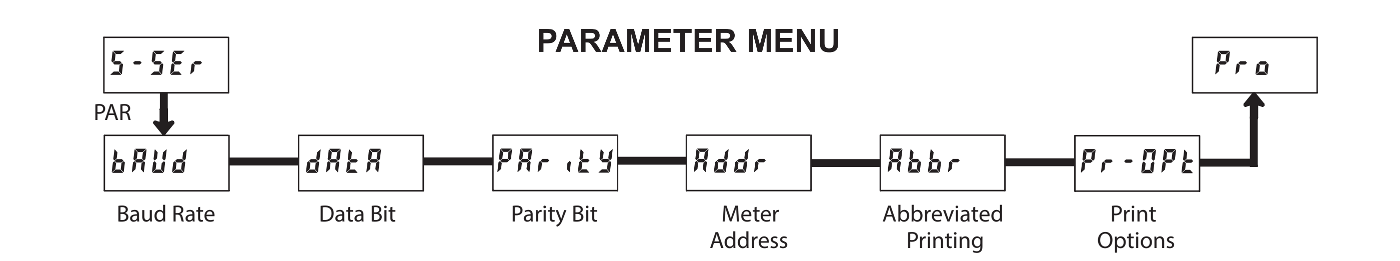
O P-UP
OFF

OFF
On
SAVE

SAVE will restore the output to the same state it was at before the meter was powered down. On will activate the output at power up. OFF will deactivate the output at power up. This parameter is not active when the Setpoint Action is selected for timed output mode.

G

5.5 MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SEr)



Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the meter with those of the host computer or other serial device.

BAUD RATE

bAUd — 9600

300 1200 4800 19200
600 2400 9600 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA — 8-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PArity — NO

NO Odd EUEN

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to NO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr — 00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr — NO

NO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select NO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS

Pr-OPt — NO

NO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as NO will not be sent.

The “Print All” (Pr-ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, the Cycle Counter and Cycle Counter Start values will only be sent when the Cycle Counter is enabled. If disabled, these parameters are inactive and will not be transmitted. Likewise, only the Setpoint parameters that apply to the programmed Setpoint Output Action will be transmitted.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
t-UAL	Timer	YES	TMR
C-UAL	Cycle Counter	NO	CNT
t-Strt	Timer Start	NO	TST
t-StOP	Timer Stop	NO	TSP
C-Strt	Counter Start	NO	CST
SP-ON	Setpoint ON	NO	SPT
SP-OFF	Setpoint OFF	NO	SOF
O-tOUt	Setpoint Time-out	NO	STO

G

Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a value or the output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences in meter response time when using the * and $ terminating characters.

Register Identification Chart

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Timer	TMR	T, V, R	6 digit, per Timer Range
B	Cycle Counter	CNT	T, V, R	5 digit
C	Timer Start	TST	T, V	6 digit, per Timer Range
D	Timer Stop	TSP	T, V	6 digit, per Timer Range
E	Counter Start	CST	T, V	5 digit
F	Setpoint ON (Reset Output)	SPT	T, V, R	per Setpoint Assignment, same as Timer or Counter
G	Setpoint OFF	SOF	T, V	per Setpoint Assignment, same as Timer or Counter
H	Setpoint Time-out	STO	T, V	6 digit, mm.ss.ss format

Command String Examples:

1. Node address = 17, Write 350 to the Setpoint On value
   String: N17VF350$
2. Node address = 5, Read Timer value, response time of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint output
   String: RF*
4. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to Transmit Details listed in the Register Identification Chart. Leading zeros are ignored. The meter ignores any decimal point and conforms the number to the appropriate display format. (For example: The Timer range is set for tenths of a second and 25 is written to the Timer Start register. The value of the register is now 2.5 seconds. In this case, write a value of 250 to equal 25.0 seconds).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 9 bytes for number and three bytes for decimal points
19	<CR> (carriage return)
20	<LF> (line feed)
21	<SP>* (Space)
22	<CR>* (carriage return)
23	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 18) is 12 characters long. When a display overflow exists for a requested timer or cycle counter value, an * (used as an overflow character) replaces a space in byte 7. Byte 8 is always a space.

The remaining ten positions of this field consist of seven positions for the requested value with decimal points positioned for the selected timer range. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 9 bytes for number and three bytes for decimal points
13	<CR> (carriage return)
14	<LF> (line feed)
15	<SP>* (Space)
16	<CR>* (carriage return)
17	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register mnemonic, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Cycle Counter = 875
   17 CNT 875 <CR><LF>
2. Node address = 0, full field response, Setpoint On value = 250.5
   SPT 250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint On value= 250, last line of block print
   250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

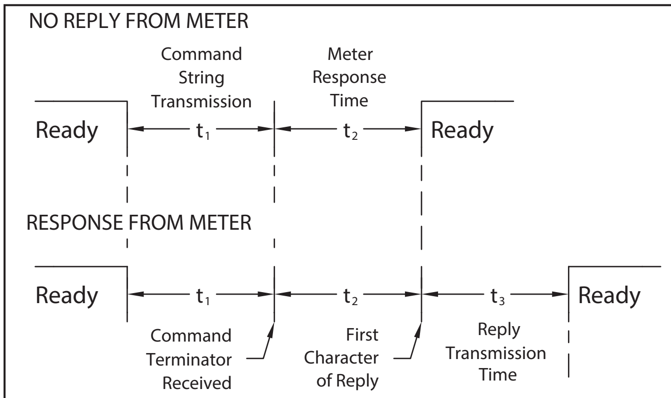
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

$$t_3 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



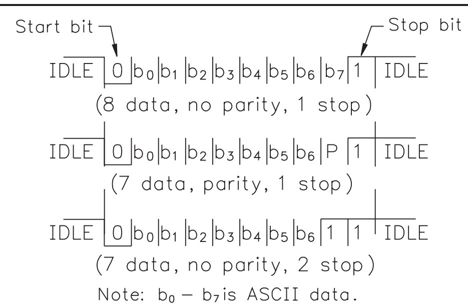
Timing Diagram Figure

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The LD Timer ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

G

MODEL LD - LARGE DC VOLT/CURRENT/PROCESS DISPLAY

- 2.25" & 4" HIGH RED LED DIGITS
- PROGRAMMABLE SCALING AND DECIMAL POINTS
- PROGRAMMABLE USER INPUT
- DUAL 5 AMP FORM C RELAY
- ALUMINUM NEMA 4X/IP65 CASE CONSTRUCTION
- RS232/RS485 SERIAL COMMUNICATIONS
- UNIVERSALLY POWERED

C UL US LISTED
IND. CONT. EQ.
51EB

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

GENERAL DESCRIPTION

The Large Display is a versatile display available as a DC volt, current, or process meter with scaling, serial communications and dual relay outputs. The 5 digit displays are available in either 2.25" or 4" high red LED digits with adjustable display intensities. The 2.25" high models are readable up to 130 feet. The 4" high models are readable up to 180 feet. Both versions are constructed of a NEMA 4X/IP65 enclosure in light weight aluminum.

All models also come with dual Form C relay outputs and RS232 / RS485 serial communications.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LD2A	2.25" High 5 Digit Red LED Volt/Current Meter w/ Relay Output and RS232/RS485 Serial Comms	LD2A05P0
LD4A	4" High 5 Digit Red LED Volt/Current Meter w/ Relay Output and RS232/RS485 Serial Comms	LD4A05P0
LD Plug	Panel Meter Plug for LD models	LDPLUG00

SPECIFICATIONS

1. **DISPLAY**: 5 digit, 2.25" (57 mm) or 4" (101 mm) intensity adjustable Red LED (-99999 to 99999)
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 26 VA
   DC POWER: 21.6 to 250 VDC, 11 W
   DC Out: +24 VDC @ 100 mA if input voltage is greater than 50 VAC/VDC
   +24 VDC @ 50 mA if input voltage is less than 50 VDC
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs
3. **INPUT RANGES**: Jumper Selectable
   D.C. Voltages: 200 mV, 2 V, 20 V, 200 V, 10 V

INPUT RANGE	ACCURACY @ 23 °C LESS THAN 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 mV	0.1% of span	1.027 MΩ	75 VDC	10 µV	70 ppm /°C
2 V	0.1% of span	1.027 MΩ	75 VDC	0.1 mV	70 ppm /°C
20 V	0.1% of span	1.027 MΩ	250 VDC	1 mV	70 ppm /°C
200 V	0.1% of span	1.027 MΩ	250 VDC	10 mV	70 ppm /°C
10 V	0.1% of span	538 KΩ	30 V	1 mV	70 ppm /°C

D.C. Currents: 200 µA, 2 mA, 20 mA, 200 mA

INPUT RANGE	ACCURACY @ 23 °C LESS THAN 85% RH	INPUT IMPEDANCE	MAX INPUT SIGNAL	RESOLUTION	TEMP. COEFFICIENT
200 µA	0.1% of span	1.111 KΩ	15 mA	10 nA	70 ppm /°C
2 mA	0.1% of span	111 Ω	50 mA	0.1 µA	70 ppm /°C
20 mA	0.1% of span	11 Ω	150 mA	1 µA	70 ppm /°C
200 mA	0.1% of span	1 Ω	500 mA	10 µA	70 ppm /°C

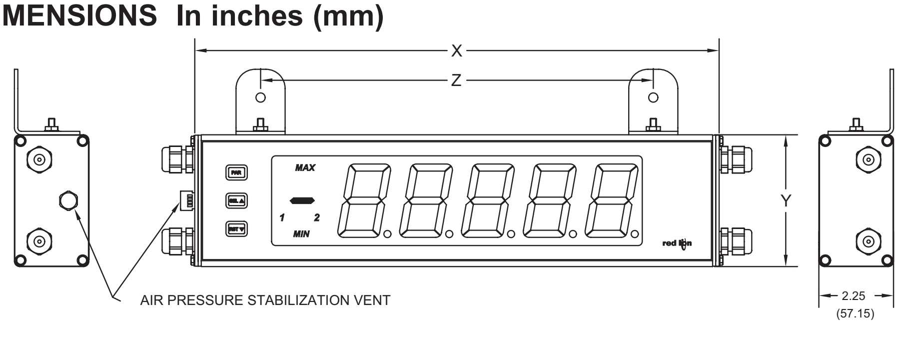
INPUT RANGE	SELECT RANGE
4 - 20 mA	Use the 20 mA range
1 - 5 VDC	Use the 10V range
1 - 10 VDC	Use the 10V range

D.C. Process: 4 to 20 mA, 1 to 5 VDC, 0/1 to 10 VDC

4. **OVERRANGE/UNDERRANGE INDICATION:**
   Input Overrange Indication: “OLOL”.
   Input Underrange Indication: “ULUL”.
   Display Overrange/Underrange Indication: “.....”/“-.....”

G

DIMENSIONS In inches (mm)



PART NUMBER	X (Length)	Y (Height)	Z (Center)
LD2A05P0	16 (406.4)	4 (101.6)	12 (304.3)
LD4A05P0	26 (660.4)	7.875 (200)	22 (558.8)

5. **A/D CONVERTER:** 16 bit resolution
A/D Conversion Rate: 6 readings/sec.
6. **DISPLAY RESPONSE TIME**: 500 msec min.
7. **USER INPUT**:
Software selectable pull-up (8.6 KΩ) or pull-down resistor (3.9 KΩ) that determines active high or active low input logic.
Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
Response Time: 5 msec typ.; 50 msec debounce (activation and release)
8. **COMMUNICATIONS**:
Type: RS485 or RS232
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min. Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Parity: no, odd or even
Baud Rate: 300 to 38.4 K
Bus Address: Selectable 0 to 99, Max. 32 meters per line (RS485)
9. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and max/min values when power is removed.
10. **OUTPUT**:
Type: Single FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min. Working Voltage: 150 Vrms
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100,000 minimum operations
Response Time:
Turn On Time: 4 msec max.
Turn Off Time: 4 msec max.
11. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 65 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's (1 g relay).
Shock According to IEC 68-2-27: Operational 30 g's (10 g relay), 11 msec in 3 directions.
Altitude: Up to 2,000 meters
12. **CONNECTIONS**:Internal removable terminal blocks
Wire Strip Length: 0.4" (10 mm)
Wire Gage: 24-12 AWG copper wire, 90°C rated insulation only
Torque: 5.3 inch-lbs (0.6 N-m) max.
Cable Diameter: Outside diameter must be 0.181" (4.6 mm) to 0.312" (7.9 mm) to maintain NEMA 4 rating of cord grips.
13. **CONSTRUCTION**: Aluminum enclosure, and steel side panels with textured black polyurethane paint for scratch and corrosion resistance protection. Meets NEMA 4X/IP65 specifications. Installation Category II, Pollution Degree 2.
14. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
File # E179259, UL61010-1, CAN/CSA C22.2 No. 61010-1
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Enclosure rating, UL50
IECEE CB Scheme Test Report #E179259-A3-CB-1
Issued by Underwriters Laboratories, Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating, IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion B 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion B 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion B 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

15. **WEIGHT**:
LD2A05XX - 4.5 lbs (2.04 kg)
LD4A05XX - 10.5 lbs (4.76 kg)

1.0 Installing the Meter

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed.

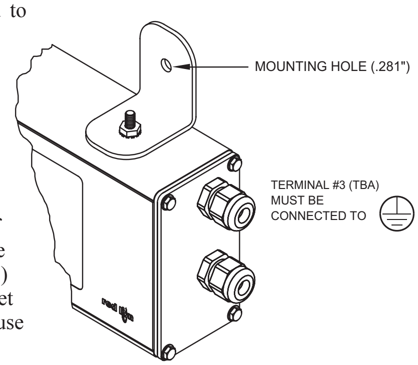
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature. Placing the unit near devices that generate excessive heat should be avoided. The unit should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the front overlay. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

MOUNTING INSTRUCTIONS

This display is designed to be wall mounted or suspended from a ceiling truss or other suitable structure capable of supporting the LDA. Caution should be exercised when hanging the display to provide for the safety of personnel. If hanging the LDA, run the suspension cables (or chains) through the mounting bracket holes. For wall mounting use #10-32 size bolts.

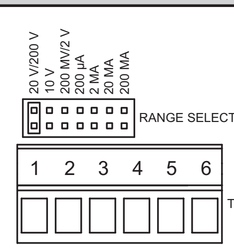


G

2.0 Setting the Jumpers

INPUT RANGE JUMPER

This jumper is used to select the proper input range. The input range selected in programming must match the jumper setting. Select a range that is high enough to accommodate the maximum signal input to avoid overloads. To access the jumper, remove the side cover of the meter.



Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.

3.0 Wiring the Meter

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC# FCOR0000)
   TDK # ZCAT3035-1330A
   Steward # 28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC# LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

WIRING OVERVIEW

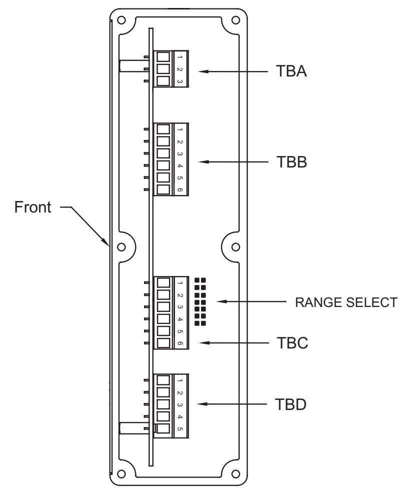
Electrical connections are made via pluggable terminal blocks located inside the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker. When wiring the meter, compare the numbers on the label on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.4" (10 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm). Use copper conductors only, with insulation rated at 90°C.

WIRING CONNECTIONS

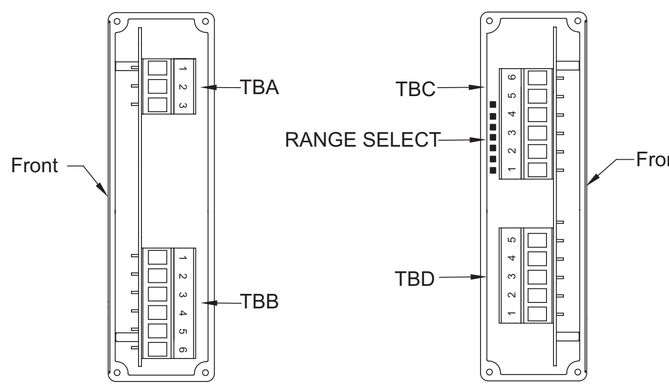
Internal removable terminal blocks are used for power and signal wiring. Access to terminal blocks is through conduit fittings. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and relay wiring is on the right side and the input, serial, DC out and user input is on the left side.

Connect drain wire from shielded cable(s) to screw on side plate for proper grounding.

LD4



LD2

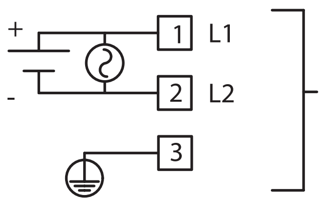


RIGHT SIDE VIEW **LEFT SIDE VIEW**

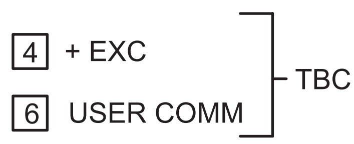
3.1 POWER WIRING

The power wiring is made via the 3 position terminal block (TBA) located inside the unit (right side). The DC out power is located: LD2 - left side, LD4 - right side

Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -
Terminal 3: Protective Conductor Terminal



DC Out Power
Terminal 4: + 24 VDC OUT
Terminal 6: User Common



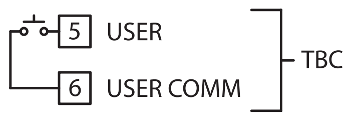
G

3.2 USER INPUT WIRING

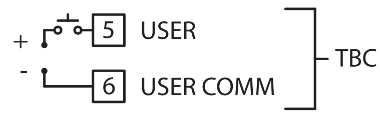
The User Input is located: LD2 - left side, LD4 - right side

Terminal 5: User Input
Terminal 6: User Comm

Sinking Logic



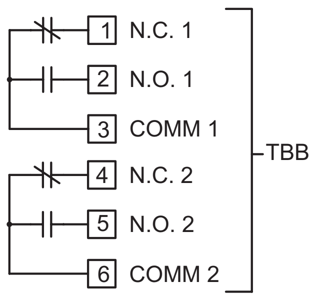
Sourcing Logic



3.3 SETPOINT (OUTPUT) WIRING

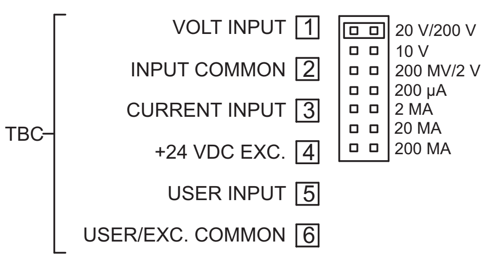
The setpoint relays use a six position terminal block (TBB) located inside the (right side).

Terminal 1: NC 1
Terminal 2: NO 2
Terminal 3: Relay 1 Common
Terminal 4: NC 1
Terminal 5: NO 2
Terminal 6: Relay 2 Common



3.4 INPUT WIRING

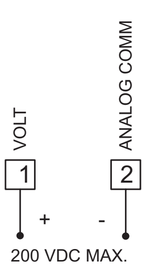
Before connecting signal wires, the Input Range Jumper should be verified for proper position.



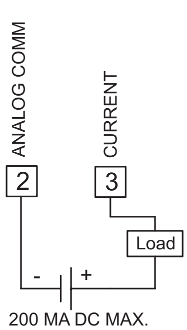
CAUTION: Analog common is NOT isolated from user input common. In order to preserve the safety of the meter application, the DC common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Input and Input Common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground. Always connect the analog signal common to terminal 2.

3.5 INPUT SIGNAL WIRING

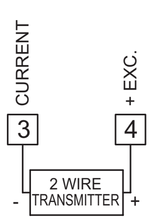
Voltage Signal (self powered)
Terminal 1: +VDC
Terminal 2: -VDC



Current Signal (self powered)
Terminal 3: +ADC
Terminal 2: -ADC

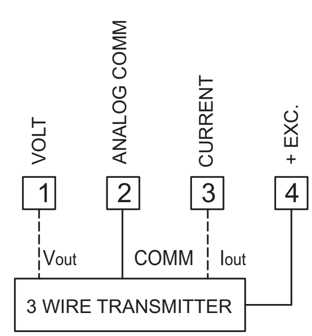


Current Signal (2 wire requiring excitation)
Terminal 4: +EXC
Terminal 3: +ADC



Current Signal (3 wire requiring excitation)
Terminal 3: +ADC (signal)
Terminal 2: -ADC (common)
Terminal 4: +EXC

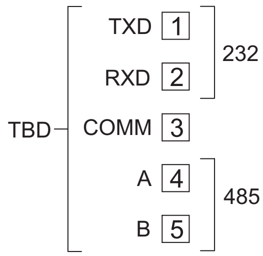
Voltage Signal (3 wire requiring excitation)
Terminal 1: +VDC (signal)
Terminal 2: -VDC (common)
Terminal 4: +EXC

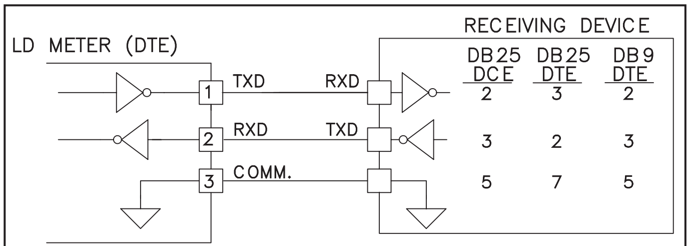


G

3.6 SERIAL WIRING

The serial connections are made via terminal block TBD located inside the unit on the left side for the LD2 and on the right side for the LD4.





Terminal Block Connection Figure

RS485 Communications

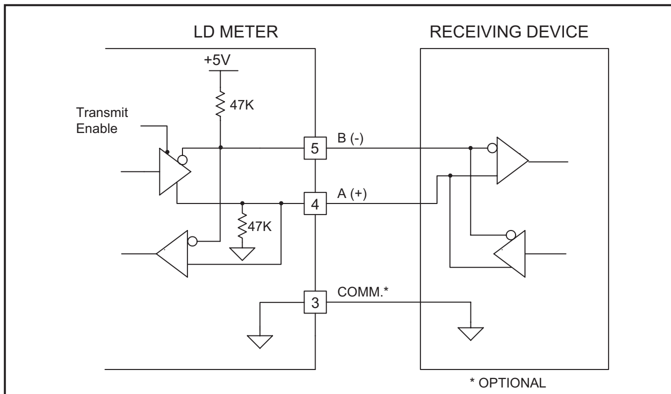
The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the LDA is limited to 38.4k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.

RS232 Communications

RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The LD emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function.

As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is "busy". The receiving device asserts that it is busy by setting the RXD line to a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.



Terminal Block Connection Figure

4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

BUTTON	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL▲	Index display through selected displays	Advance through selection list/select digit position in parameter value
RST▼	Resets display	Increment selected digit of parameter value

OPERATING MODE DISPLAY DESIGNATORS

MAX - Maximum display capture value
MIN - Minimum display capture value

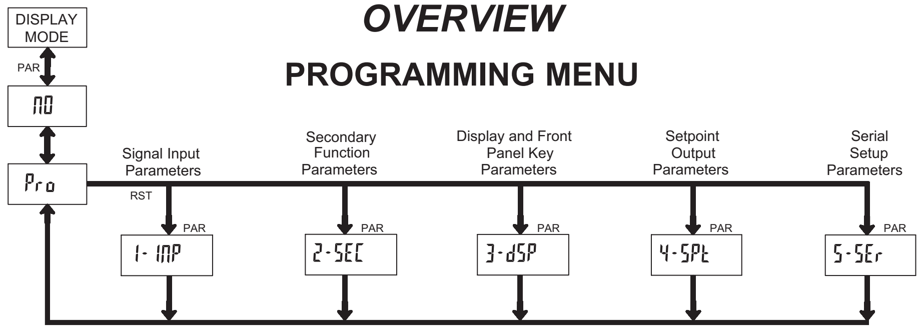
"1" - To the left of the display indicates setpoint 1 output activated.
"2" - To the left of the display indicates setpoint 2 output activated.

Pressing the **SEL▲** button toggles the meter through the selected displays. If display scroll is enabled, the display will toggle automatically every four seconds between the enabled display values.

5.0 PROGRAMMING THE METER

OVERVIEW

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR BUTTON)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** button. If it is not accessible, then it is locked by either a security code or a hardware lock.

MODULE ENTRY (SEL▲ & PAR BUTTONS)

The Programming Menu is organized into five modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL▲** button is used to select the desired module. The displayed module is entered by pressing the **PAR** button.

MODULE MENU (PAR BUTTON)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** button is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL▲** and **RST▼** buttons are used to move through the selections/values for that parameter. Pressing the **PAR** button, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST▼** button increments the digit by one or the user can hold the **RST▼** button and the digit will automatically scroll. The **SEL▲** button will select the next digit to the left. Pressing the **PAR** button will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR BUTTON)

The Programming Mode is exited by pressing the **PAR** button with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

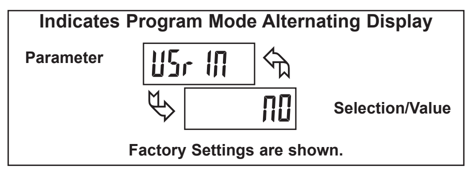
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems.

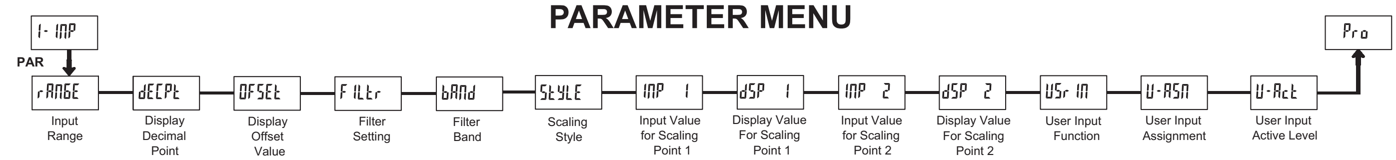
ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU



G

INPUT RANGE

rANGE
200u

SELECTION	RANGE RESOLUTION	SELECTION	RANGE RESOLUTION
200uA	200.00 µA	0.02A	20.000 mA
0.002A	2.0000 mA	0.2A	200.00 mA
0.2u	200.00 mV	20u	20.000 V
2u	2.0000 V	200u	200.00 V
10u	10.000 V		

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt
0.00

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dSP1 and dSP2 parameters and setpoint values and offset value.

DISPLAY OFFSET VALUE

OFSEt
0.00

-19999 to 19999

The display can be corrected with an offset value. This can be used to compensate for signal variations or sensor errors. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero removes the effects of offset. The decimal point follows the dECPt selection.

FILTER SETTING

FILtr → 1   0 1 2 3

If the displayed value is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. Software filtering effectively combines a fraction of the current input reading with a fraction of the previous displayed reading to generate the new display.

Filter values represent no filtering (0), up to heavy filtering (3). A value of 1 for the filter uses 1/4 of the new input and 3/4 of the previous display to generate the new display. A filter value of 2 uses 1/8 new and 7/8 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

FILTER BAND

bAnd → 10   0 to 199

The filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the filter permanently engaged at the filter level selected above.

SCALING STYLE

StYLE → KEY   KEY APLY

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INP 1 → 0.00   0 to 29999

For Key-in (KEY) style, enter the first Input Value using the front panel buttons. (The Input Range selection sets the decimal location for the Input Value).

For Apply (APLY) style, the meter shows the previously stored Input Value. To retain this value, press the **SEL▲** button to advance to the next parameter. To change the Input Value, press the **RST▼** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL▲** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 1

dSP 1 → 0.00   -19999 to 99999

Enter the first Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

INP 2 → 100.00   0 to 29999

For Key-in (KEY) style, enter the known second Input Value using the front panel buttons.

For Apply (APLY) style, the meter shows the previously stored Input Value for Scaling Point 2. To retain this value, press the **SEL▲** button to advance to the next parameter. To change the Input Value, press the **RST▼** button and apply the input signal to the meter. Adjust the signal source externally until the desired Input Value appears. Press the **SEL▲** button to enter the value being displayed.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2 → 100.00   -19999 to 99999

Enter the second Display Value by using the front panel buttons. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

General Notes on Scaling

1. When using the Apply (APLY) scaling style, input values for scaling points must be confined to the range limits shown.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mA can not equal 0 and 20.)
3. For input levels beyond the programmed Input Values, the meter extends the Display Value by calculating the slope from the two coordinate pairs (INP1 / dSP1 & INP2 / dSP2).

USER INPUT FUNCTION

USr IN → NO

DISPLAY	MODE	DESCRIPTION
NO	No Function	User Input disabled.
P-Loc	Program Mode Lock-out	See Programming Mode Access chart (Module 3).
ZErO	Zero Input (Edge triggered)	Zero the Input Display value causing Display Reading to be Offset.
rESEt	Reset (Edge triggered)	Resets the assigned value(s) to the current input value.
d-HLd	Display Hold	Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
d-SEL	Display Select (Edge Triggered)	Advance once for each activation.
d-LEU	Display Intensity Level (Edge Triggered)	Increase intensity one level for each activation.
Pr int	Print Request	Serial transmit of the active parameters selected in the Print Options menu (Module 5).
P-rSt	Print and Reset	Same as Print Request followed by a momentary reset of the assigned value(s).
rSt-1	Setpoint 1 Reset	Resets setpoint 1 output.
rSt-2	Setpoint 2 Reset	Resets setpoint 2 output.
rSt12	Setpoint 1 and 2 Reset	Reset both setpoint 1 and 2 outputs.

USER INPUT ASSIGNMENT

U-ASN → dSP   HI HI-LO LO dSP

Select the value(s) to which the User Input Function is assigned. The User Input Assignment only applies if a selection of reset, display hold, or print and reset is selected in the User Input Function menu.

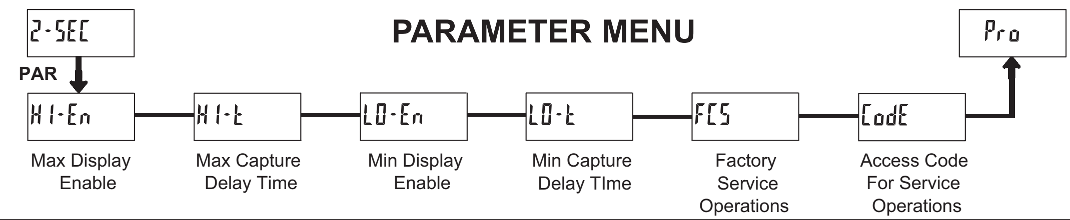
USER INPUT ACTIVE LEVEL

U-Act → LO   HI LO

Select whether the user input is configured as active low or active high.

G

5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)



MAX DISPLAY ENABLE

HI-En
nO

nO YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

HI-t
2.0

0.0 to 999.9 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN DISPLAY ENABLE

LO-En
nO

nO YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

LO-t
2.0

0.0 to 999.9 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

FACTORY SERVICE OPERATIONS

FCS
nO

nO YES

Select YES to perform either of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

CodE
66

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display rESEt and then return to CodE 00. Press the **PAR** button to exit the module.

VIEW MODEL AND VERSION DISPLAY

CodE
50

Entering Code 50 will display the model (LDA) and version (x.x) of the meter. The display then returns to CodE 00. Press the **PAR** button to exit the module.

CALIBRATION

CodE
48

The LD uses stored calibration values to provide accurate measurements. Over time, the electrical characteristics of the components inside the LD will slowly change with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration every 1 to 2 years should be sufficient.

Calibration of the LD involves a calibration which should only be performed by individuals experienced in calibrating electronic equipment. Allow 30 minute warm up before performing any calibration related procedure. The following procedures should be performed at an ambient temperature of 15 to 35 °C (59 to 95 °F).

CAUTION: The accuracy of the calibration equipment will directly affect the accuracy of the LD.

Current Calibration

1. Connect the negative lead of a precision DC current source with an accuracy of 0.01% or better to the COMM terminal. Leave the positive lead of the DC current source unconnected.
2. With the display at CodE 48, press the **PAR** button. Unit will display CAL nO
3. Press the **RST** button to select the range to be calibrated.
4. Press the **PAR** button. Display reads 0.0A
5. With the positive lead of the DC current source unconnected, press **PAR**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, connect the positive lead of the DC current source to the current input and apply full-scale input signal for the range. (Note: For 200 mA range, apply 100 mA as indicated on the display.) Press **PAR**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL nO, press the **PAR** button to exit calibration.

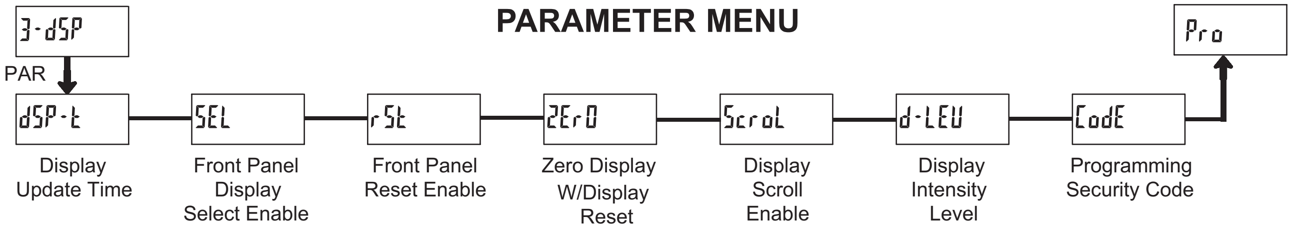
Voltage Calibration

1. Connect a precision DC voltage source with an accuracy of 0.01% or better to the volt input and COMM terminals of the LD. Set the output of the voltage source to zero.
2. With the display at CodE 48, press the **PAR** button. Unit will display CAL nO.
3. Press the **RST** button to select the range to be calibrated.
4. Press the **PAR** button. Display reads 0.0u.
5. With the voltage source set to zero (or a dead short applied to the input), press **PAR**. Display reads CALC for about 8 seconds.
6. When the display reads the selected range, apply full-scale input signal for the range. (Note: For 200V range, apply 100V as indicated on the display.) Press **PAR**. Display reads CALC for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads CAL nO, press the **PAR** button to exit calibration

G

5.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

PARAMETER MENU



DISPLAY UPDATE TIME

dSP-t
1

0.5 1 2 seconds

This parameter sets the display update time in seconds.

FRONT PANEL DISPLAY SELECT ENABLE (SEL)

SEL
YES

YES nO

The YES selection allows the **SEL** button to toggle through the enabled displays.

FRONT PANEL RESET ENABLE (RST)

rSt
dSP

nO LO dSP
HI HI-LO

This selection allows the **RST** button to reset the selected value(s).

ZERO DISPLAY WITH DISPLAY RESET

ZErO
nO

YES nO

This parameter enables the **RST** button or user input to zero the input display value, causing the display reading to be offset.

Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.

DISPLAY SCROLL ENABLE

ScroL
nO

YES nO

The YES selection allows the display to automatically scroll through the enabled displays. The scroll rate is every 4 seconds. This parameter only appears when the MAX or MIN displays are enabled.

DISPLAY INTENSITY LEVEL

d-LEU
5

1 to 5

Enter the desired Display Intensity Level (1-5). The display will actively dim or brighten as levels are changed.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (P-Loc) in the User Input Function parameter (Module 1).

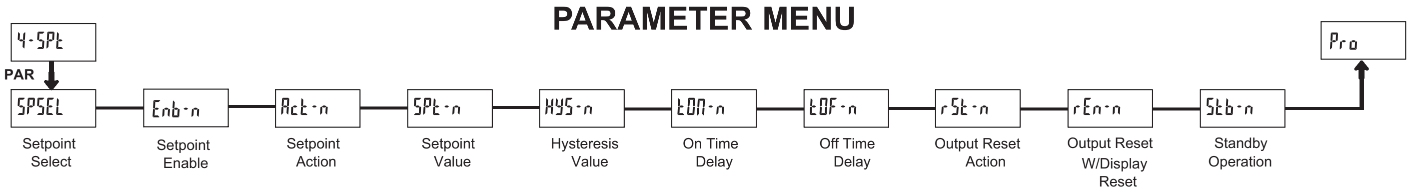
Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the CodE prompt appears (see chart).

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	MODE WHEN "SEL" BUTTON IS PRESSED	FULL PROGRAMMING MODE ACCESS
not P-Loc	______	0	Full Programming	Immediate Access
		1-99	Quick Programming	After Quick Programming with correct code entry at CodE prompt *
		100-999	CodE prompt	With correct code entry at CodE prompt *
P-Loc	Active	0	Programming Lock	No Access
		1-99	Quick Programming	No Access
		100-999	CodE prompt	With correct code entry at CodE prompt *
	Not Active	0-999	Full Programming	Immediate Access

G

5.4 MODULE 4 - SETPOINT OUTPUT PARAMETERS (4-SPt)



SETPOINT SELECT

SPSEL → NO   NO SP-1 SP-2

Enter the setpoint (output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL. Repeat steps for each setpoint to be programmed. Select NO to exit the module.

SETPOINT ENABLE

Enb-n → NO   YES NO

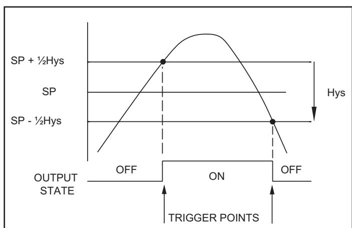
Select YES to enable Setpoint n and access the setup parameters. If NO is selected, the unit returns to SPSEL and Setpoint n is disabled.

SETPOINT ACTION

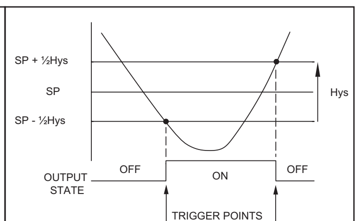
Act-n → HI-Ub   HI-bL LO-bL HI-Ub LO-Ub

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

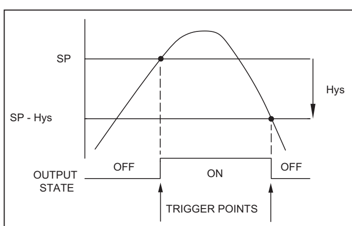
HI-bL	=	High Acting, with balanced hysteresis
LO-bL	=	Low Acting, with balanced hysteresis
HI-Ub	=	High Acting, with unbalanced hysteresis
LO-Ub	=	Low Acting, with unbalanced hysteresis



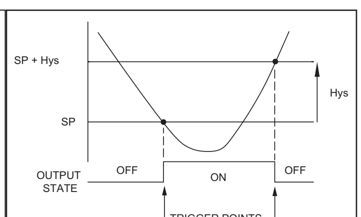
High Acting (Balanced Hys) = HI-bL



Low Acting (Balanced Hys) = LO-bL



High Acting (Unbalanced Hys) = HI-Ub



Low Acting (Unbalanced Hys) = LO-Ub

SETPOINT VALUE

SPt-n → 100   -19999 to 99999

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

HYS-n → 2   1 to 59999

Enter desired hysteresis value. See Setpoint Output Figures for visual explanation of how setpoint output actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n → 0.0   0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OFF TIME DELAY

tOF-n → 0.0   0.0 to 599.9 seconds

Enter the time value in seconds that the output is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the output status per the response time listed in the Specifications.

OUTPUT RESET ACTION

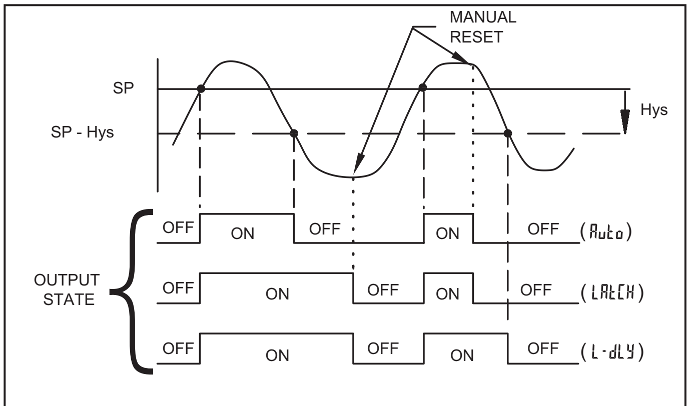
rSt-n → Auto   Auto LAtCH L-dLY

Enter the reset action of the output. See figure for details.

Auto = Automatic action; This action allows the output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Output Figures. The "on" output may be manually reset (off) immediately by the front panel **RST** button or user input.The output remains off until the trigger point is crossed again.

LAtCH = Latch with immediate reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the corresponding “on” output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

L-dLY = Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel **RST** button or user input manual reset, serial reset command or meter power cycle. When the user input or **RST** button is activated (momentary action), the meter delays the event until the corresponding “on” output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous L-dLY reset if it is not activated at power up.)



Setpoint Output Reset Actions

OUTPUT RESET WITH DISPLAY RESET

rEn-n → YES   NO   YES

This parameter enables the **RST** button or user input to reset the output when the display is reset.

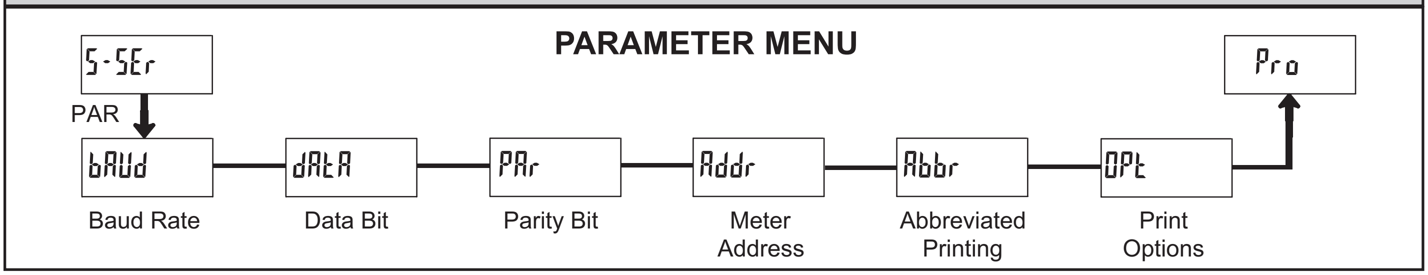
Note: For this parameter to operate, the **RST** button or User Input being used must be set to dSP and the Input value must be displayed. If these conditions are not met, the output will not reset.

STANDBY OPERATION

Stb-n → NO   NO   YES

When YES, the output is disabled (after a power up) until the trigger point is crossed. Once the output is on, the output operates normally per the Setpoint Action and Output Reset Action.

5.5 MODULE 5 - SERIAL SETUP PARAMETERS (5-SEr)



Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the LD with those of the host computer or other serial device.

BAUD RATE

bAUd → 9600

300	1200	4800	19200
600	2400	9600	38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA → 7-bit   7-bit   8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr → Odd   NO   Odd   EVEN

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to NO, an additional stop bit is used to force the frame size to 10 bits.

G

METER ADDRESS

Addr

00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr

no

no YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select no for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS

OPt

no

no YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as no will not be sent.

The "Print All" (P ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. The Setpoint value will not be sent unless the setpoint is enabled

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
InP	Input	YES	INP
HI	Maximum	no	MAX
LO	Minimum	no	MIN
SPt-1	Setpoint 1	no	SP1
SPt-2	Setpoint 2	no	SP2

Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a min or max value or the output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure

Register Identification Chart

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Input	INP	T, R	5 digit
B	Maximum	MAX	T, R	5 digit
C	Minimum	MIN	T, R	5 digit
D	Setpoint 1	SP1	T, R, V	5 digit positive/4 digit negative
E	Setpoint 2	SP2	T, R, V	5 digit positive/4 digit negative

Command String Examples:

1. Node address = 17, Write 350 to the Setpoint 1 value
   String: N17VD350$
2. Node address = 5, Read Input, response time of 50 msec min
   String: N5TA*
3. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to transmit details listed in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

G

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-15	9 byte data field; 7 bytes for number, one byte for sign, one byte for decimal point
16	<CR> (carriage return)
17	<LF> (line feed)
18	<SP>* (Space)
19	<CR>* (carriage return)
20	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 15) is 9 characters long. This field consists of a minus sign (for negative values), a floating decimal point (if applicable), and five positions for the requested value. The data within bytes 9 to 15 is right-aligned with leading spaces for any unfilled positions. When a requested value exceeds the meter's display limits, decimal points are transmitted instead of a numeric value.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-9	9 byte data field, 7 bytes for number, one byte for sign, one byte for decimal point
10	<CR> (carriage return)
11	<LF> (line feed)
12	<SP>* (Space)
13	<CR>* (carriage return)
14	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 1 = -250.5
   SP1 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print 250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 times the # of characters) / baud rate

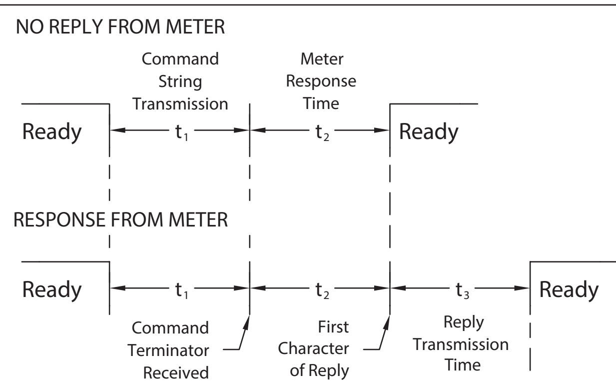
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The '*' terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

t_3 = (10 times the # of characters) / baud rate

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



Timing Diagram Figure

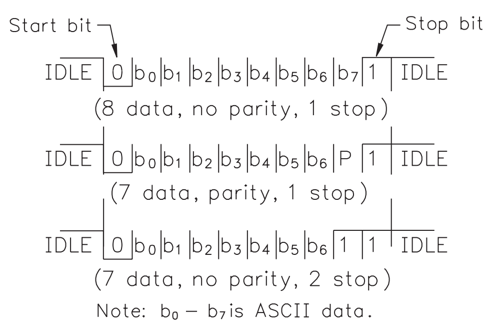
G

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

MODEL LD - LARGE STRAIN GAGE DISPLAY

- *2.25" & 4" HIGH RED LED DIGITS*
- *PROGRAMMABLE SCALING AND DECIMAL POINTS*
- *PROGRAMMABLE USER INPUT*
- *DUAL 5 AMP FORM C RELAY*
- *ALUMINUM TYPE 4X/IP65 CASE CONSTRUCTION*
- *RS232/RS485 SERIAL COMMUNICATIONS*
- *CRIMSON® PROGRAMMING SOFTWARE*
- *UNIVERSALLY POWERED*

GENERAL DESCRIPTION

The Large Display is a versatile display available as a strain gage meter with scaling, serial communications and dual relay outputs. The 5 digit displays are available in either 2.25" or 4" high red LED digits with adjustable display intensities. The 2.25" high models are readable up to 130 feet. The 4" high models are readable up to 180 feet. Both versions are constructed of a Type 4X/IP65 enclosure in light weight aluminum.

All models also come with dual Form C relay outputs and RS232 / RS485 serial communications.

The Crimson software is a Windows based program that allows configuration of the LD meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. Crimson software can be downloaded at www.redlion.net.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Hot Surface

CAUTION: Risk of electric shock.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LD	2 Preset Strain Gage Input; 2.25" High 5 Digit Red LED	LD2SG5P0
LD	2 Preset Strain Gage Input; 4" High 5 Digit Red LED	LD4SG5P0
LD Plug	Panel Meter Plug for LD models	LDPLUG00

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

SPECIFICATIONS

1. **DISPLAY**: 5 digit, 2.25" (57 mm) or 4" (101 mm) intensity adjustable Red LED (-99999 to 99999)
2. **POWER REQUIREMENTS**:
   AC POWER: 40 to 250 VAC 50/60 Hz, 27 VA
   DC POWER: 21.6 to 250 VDC, 12 W
   Isolation: 2300 Vrms for 1 min.; Power IN to all inputs and outputs
3. **INPUT RANGES**:

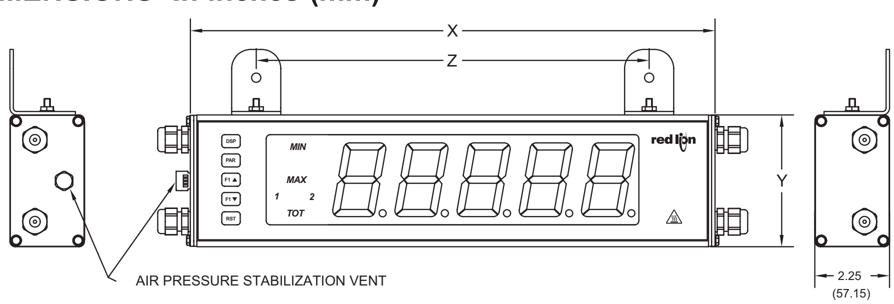
INPUT RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 65 °C)	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
±24 mVDC	0.02% of reading +3 µV	0.07% of reading +4 µV	100 Mohm	30 V	1 µV
±240 mVDC	0.02% of reading +30 µV	0.07% of reading +40 µV	100 Mohm	30 V	10 µV

* After 20 minute warm-up. Accuracy is specified in two ways: Accuracy over an 18 to 28 °C and 10 to 75% RH environment; and accuracy over a 0 to 65 °C and 0 to 85% RH (non-condensing environment). Accuracy over the 0 to 65 °C range includes the temperature coefficient effect of the meter.

4. **CONNECTION TYPE**: 4-wire bridge (differential)
   2-wire (single-ended)
5. **COMMON MODE RANGE (**w.r.t. input common): 0 to +5 VDC
   Rejection: 80 dB (DC to 120 Hz)
6. **BRIDGE EXCITATION** :
   Jumper Selectable: 5 VDC @ 65 mA max., ±2%
   10 VDC @ 125 mA max., ±2%
   Temperature coefficient (ratio metric): 20 ppm/°C max.
7. **A/D CONVERTER**: 16 bit resolution
8. **UPDATE RATES**:
   A/D conversion rate: 20 readings/sec.
   Step response: 200 msec. max. to within 99% of final readout value
   (digital filter and internal zero correction disabled)
   700 msec. max. (digital filter disabled, internal zero correction enabled)
   Display update rate: 1 to 20 updates/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.

G

DIMENSIONS In inches (mm)



PART NUMBER	X (Length)	Y (Height)	Z (Center)
LD2	16 (406.4)	4 (101.6)	12 (304.3)
LD4	26 (660.4)	7.875 (200)	22 (558.8)

Max./Min. capture delay time: 0 to 3275 sec.

9. **USER INPUTS**: Three programmable user inputs
Max. Continuous Input: 30 VDC
Isolation To Sensor Input Common: Not isolated.
Response Time: 50 msec. max.
Logic State: Jumper selectable for sink/source logic

INPUT STATE	SINKING INPUTS 22 KΩ pull-up to +5 V	SOURCING INPUTS 22 KΩ pull-down
Active	V_{IN} < 0.9 VDC	V_{IN} > 3.6 VDC
Inactive	V_{IN} > 3.6 VDC	V_{IN} < 0.9 VDC

10. **TOTALIZER**:
Function:
Time Base: second, minute, hour, or day
Batch: Can accumulate (gate) input display from a user input
Time Accuracy: 0.01% typical
Decimal Point: 0 to 0.0000
Scale Factor: 0.001 to 65.000
Low Signal Cut-out: -19,999 to 99,999
Total: 9 digits, display alternates between high order and low order readouts

11. **DISPLAY MESSAGES**:
"OLOL" - Appears when measurement exceeds + signal range.
"ULUL" - Appears when measurement exceeds - signal range
". . . ." - Appears when display values exceed + display range.
"- . . ." - Appears when display values exceed - display range.
"E . . ." - Appears when Totalizer exceeds 9 digits.
"h . . ." - Denotes the high order display of the Totalizer.

12. **COMMUNICATIONS**:
Type: RS485 or RS232
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Parity: no, odd or even
Baud Rate: 300 to 38.4 K
Bus Address: Selectable 0 to 99, Max. 32 meters per line (RS485)

13. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters and max/min values when power is removed.

14. **OUTPUT**:
Type: Dual FORM-C relay
Isolation To Sensor & User Input Commons: 1400 Vrms for 1 min.
Working Voltage: 150 Vrms
Contact Rating: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load)
Life Expectancy: 100,000 minimum operations
Response Time:
Turn On Time: 4 msec max.
Turn Off Time: 4 msec max.

15. **ENVIRONMENTAL CONDITIONS**:
Operating temperature: 0 to 65 °C
Storage temperature: -40 to 70 °C
Operating and storage humidity: 0 to 85% max. RH (non-condensing)
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g (1g relay)
Shock to IEC 68-2-27: Operational 30 g (10 g relay)
Altitude: Up to 2,000 meters

16. **CONNECTIONS**:Internal removable terminal blocks
Wire Strip Length: 0.4" (10 mm)
Wire Gage: 24-12 AWG copper wire, 90°C rated insulation only
Torque: 5.3 inch-lbs (0.6 N-m) max.
Cable Diameter: Outside diameter must be 0.181" (4.6 mm) to 0.312" (7.9 mm) to maintain Type 4 rating of cord grips.

17. **CONSTRUCTION**: Aluminum enclosure, and steel side panels with textured black polyurethane paint for scratch and corrosion resistance protection. Meets Type 4X/IP65 specifications. Installation Category II, Pollution Degree 2.

18. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved:
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class A
Safety requirements for electrical equipment for measurement control, and laboratory use:
EN 61010-1: General Requirements
EN 61010-2-030: Particular Requirements for Testing and Measuring Circuits
Type 4X Enclosure rating (Face only)
IP65 Enclosure rating (Face only)
Refer to EMC Installation Guidelines section of the bulletin for additional information.

19. **WEIGHT**:
LD2 - 4.5 lbs (2.04 kg)
LD4 - 10.5 lbs (4.76 kg)

1.0 Installing the Meter

INSTALLATION

The meter meets Type 4X/IP65 requirements when properly installed. LDPLUG00 plugs should be installed in open water-tight connectors.

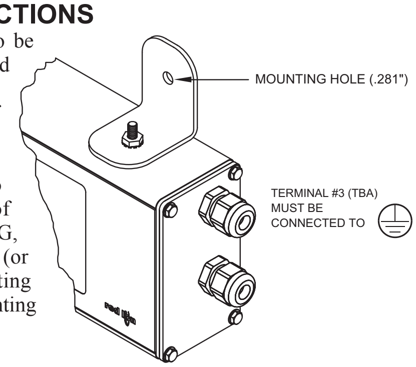
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature. Placing the unit near devices that generate excessive heat should be avoided. The unit should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the front overlay. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

MOUNTING INSTRUCTIONS

This display is designed to be wall mounted or suspended from a ceiling truss or other suitable structure capable of supporting the LDSG. Caution should be exercised when hanging the display to provide for the safety of personnel. If hanging the LDSG, run the suspension cables (or chains) through the mounting bracket holes. For wall mounting use #10-32 size bolts.

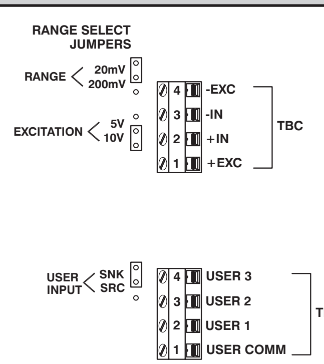


2.0 Setting the Jumpers

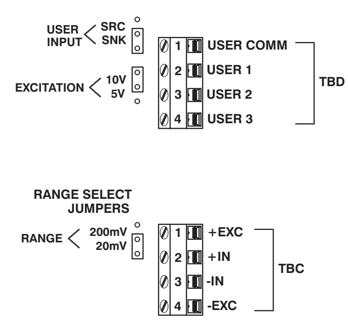
INPUT RANGE JUMPER

The jumpers to select input range, excitation, voltage and user input configuration must be selected before wiring the meter. The jumpers for the LD2 model are located on the left side of the unit, and the jumpers for the LD4 model are located on the right side of the unit.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.



LD2 JUMPERS



LD4 JUMPERS

G

3.0 Wiring the Meter

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

WIRING OVERVIEW

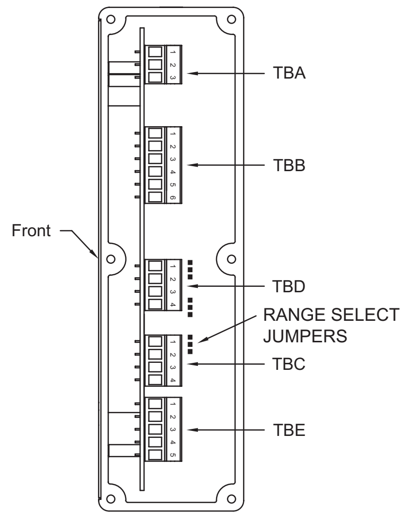
Electrical connections are made via pluggable terminal blocks located inside the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker. When wiring the meter, compare the numbers on the label on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.4" (10 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm). Use copper conductors only, with insulation rated at 90°C.

WIRING CONNECTIONS

Internal removable terminal blocks are used for power and signal wiring. Access to terminal blocks is through conduit fittings. Remove end plates with ¼" nut driver. For LD4 versions, all wiring is on right side of unit. For LD2 versions, power and relay wiring is on the right side and the input, serial, and user input is on the left side.

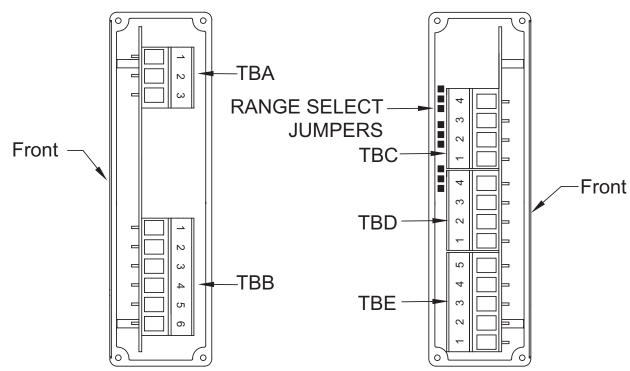
Connect drain wire from shielded cable(s) to screw on side plate for proper grounding.

LD4



RIGHT SIDE VIEW

LD2

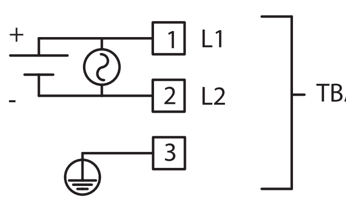


RIGHT SIDE VIEW LEFT SIDE VIEW

3.1 POWER WIRING

The power wiring is made via the 3 position terminal block (TBA) located inside the unit (right side).

Power
Terminal 1: VAC/DC +
Terminal 2: VAC/DC -
Terminal 3: Protective Conductor Terminal

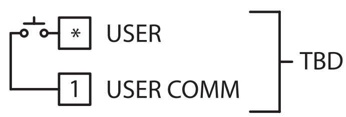


3.2 USER INPUT WIRING

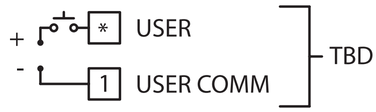
The User Input is located: LD2 - left side, LD4 - right side

Terminal 1: User Comm
Terminal 2: User 1
Terminal 3: User 2
Terminal 4: User 3

Sinking Logic



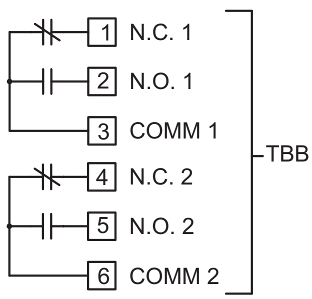
Sourcing Logic



3.3 SETPOINT (OUTPUT) WIRING

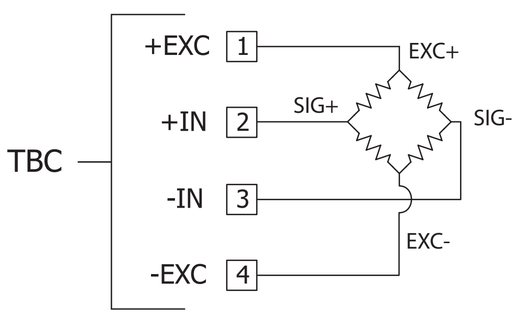
The setpoint relays use a six position terminal block (TBB) located inside the (right side).

Terminal 1: NC 1
Terminal 2: NO 1
Terminal 3: Relay 1 Common
Terminal 4: NC 2
Terminal 5: NO 2
Terminal 6: Relay 2 Common



3.4 INPUT WIRING

Before connecting signal wires, the Range and Excitation Jumpers should be verified for proper position.



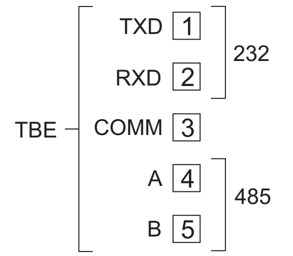
** For single ended input, tie terminal 3 (-IN) to Terminal 4 (-EXC).*

CAUTION: Analog common is NOT isolated from user input common. In order to preserve the safety of the meter application, the DC common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Input and Input Common terminals. Appropriate considerations must then be given to the potential of the input common with respect to earth ground. Always connect the analog signal common to terminal 4 (-EXC).

G

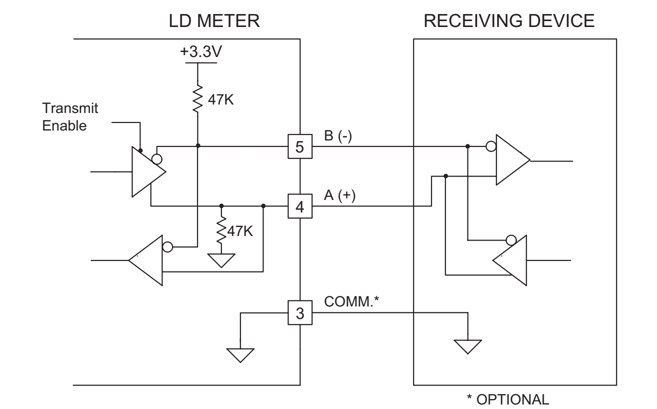
3.5 SERIAL WIRING

The serial connections are made via terminal block TBE located inside the unit on the left side for the LD2 and on the right side for the LD4.



RS485 Communications

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 19.2K baud. The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



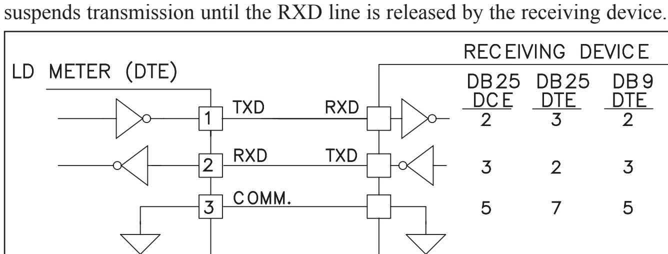
Terminal Block Connection Figure (RS485)

RS232 Communications

RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The LD emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

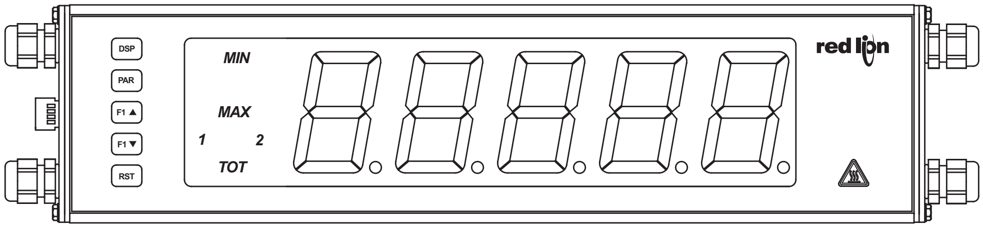
Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function.

As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is "busy". The receiving device asserts that it is busy by setting the RXD line to a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.



Terminal Block Connection Figure (RS232)

4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY



KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
DSP	Index display through max/min/total/input readouts*	Quit programming and return to display mode
PAR	Access parameter list	Store selected parameter and index to next parameter
F1▲	Function key 1; hold for 3 seconds for Second Function 1**	Increment selected parameter value
F2▼	Function key 2; hold for 3 seconds for Second Function 2**	Decrement selected parameter value
RST	Reset (Function key)**	Hold with F1▲, F2▼ to scroll value by x1000

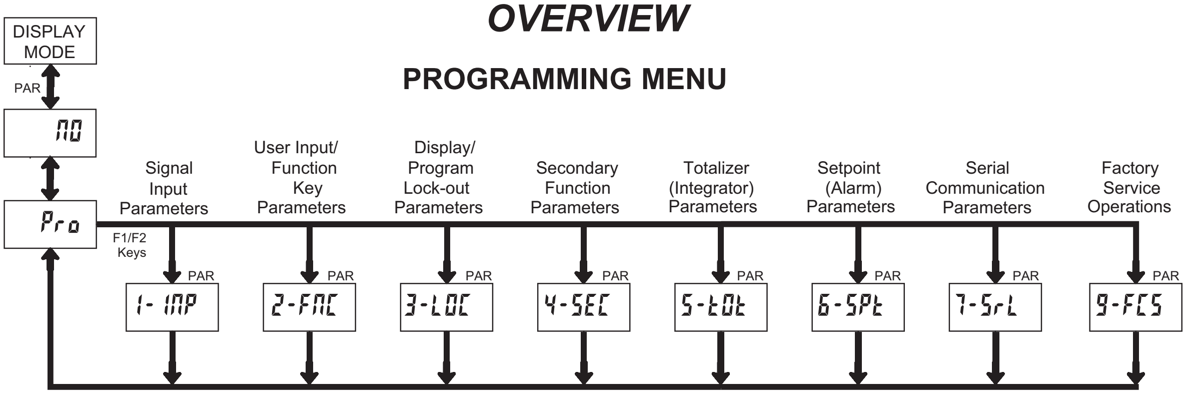
* Display Readout Legends may be locked out in Factory Settings.

** Factory setting for the F1, F2, and RST keys is NO mode.

5.0 PROGRAMMING THE METER

OVERVIEW

PROGRAMMING MENU



DISPLAY MODE

The meter normally operates in the Display Mode. In this mode, the meter displays can be viewed consecutively by pressing the **DSP** key. The annunciators to the left of the display indicate which display is currently shown; Max Value (MAX), Min Value (MIN), or Totalizer Value (TOT). Each of these displays can be locked from view through programming. (See Module 3) The Input Display Value is shown with no annunciator.

PROGRAMMING MODE

Two programming modes are available.

Full Programming Mode permits all parameters to be viewed and modified. Upon entering this mode, the front panel keys change to Programming Mode operations. This mode should not be entered while a process is running, since the meter functions and User Input response may not operate properly while in Full Programming Mode.

Quick Programming Mode permits only certain parameters to be viewed and/or modified. When entering this mode, the front panel keys change to Programming Mode operations, and all meter functions continue to operate properly. Quick Programming Mode is configured in Module 3. The Display Intensity Level "d-LEv" parameter is available in the Quick Programming Mode only when the security code is non-zero. For a description, see Module 9—Factory Service Operations. Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming Mode.

PROGRAMMING TIPS

The Programming Menu is organized into eight modules (See above). These modules group together parameters that are related in function. It is recommended to begin programming with Module 1 and proceed through each module in sequence. If lost or confused while programming, press the **DSP** key to exit programming mode and start over.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 9. This is a good starting point if encountering programming problems. Throughout the module description sections which follow, the factory setting for each parameter is shown below the parameter display.

G

ALTERNATING SELECTION DISPLAY

In the module description sections which follow, the dual display with arrows appears for each programming parameter. This is used to illustrate the display alternating between the parameter (top display) and the parameter's Factory Setting (bottom display). In most cases, selections or value ranges for the parameter will be listed on the right.

Indicates Program Mode Alternating Display

Parameter rANGE

0.02u Selection/Value

STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (PAR KEY)

The Programming Mode is entered by pressing the **PAR** key. If this mode is not accessible, then meter programming is locked by either a security code or a hardware lock. (See Modules 2 and 3 for programming lock-out details.)

MODULE ENTRY (ARROW & PAR KEYS)

Upon entering the Programming Mode, the display alternates between Pro and the present module (initially NO). The arrow keys (**F1▲** and **F2▼**) are used to select the desired module, which is then entered by pressing the **PAR** key.

PARAMETER (MODULE) MENU (PAR KEY)

Each module has a separate parameter menu. These menus are shown at the start of each module description section which follows. The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. From this point, programming may continue by selecting and entering additional modules. (See **MODULE ENTRY** above.)

PARAMETER SELECTION ENTRY (ARROW & PAR KEYS)

For each parameter, the display alternates between the parameter and the present selection or value for that parameter. For parameters which have a list of selections, the arrow keys (**F1▲** and **F2▼**) are used to sequence through the list until the desired selection is displayed. Pressing the **PAR** key stores and activates the displayed selection, and also advances the meter to the next parameter.

NUMERICAL VALUE ENTRY (ARROW, RST & PAR KEYS)

For parameters which require a numerical value entry, the arrow keys can be used to increment or decrement the display to the desired value. When an arrow key is pressed and held, the display automatically scrolls up or scrolls down. The longer the key is held, the faster the display scrolls.

The **RST** key can be used in combination with the arrow keys to enter large numerical values. When the **RST** key is pressed along with an arrow key, the display scrolls by 1000's. Pressing the **PAR** key stores and activates the displayed value, and also advances the meter to the next parameter.

PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pro NO)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pro NO displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the **PAR** key should be pressed to store the change before pressing the **DSP** key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-INP)

PARAMETER MENU

1-INP → PAR → … → Pro

rANGE	dECPt	round	FILtr	bAnd	PtS	StYLE	INP x	dSP x
Input Range	Display Decimal Point	Display Rounding	Filter Setting	Filter Band	Scaling Points	Scaling Style	Input x Value	Display x Value

INPUT RANGE

rANGE
0.02u

SELECTION	RANGE RESOLUTION
0.02u	±24 mV
0.2u	±240 mV

Select the input range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution. This selection and the position of the Input Range Jumper must match.

DISPLAY DECIMAL POINT

dECPt
0

0 0.0 0.00 0.000 0.0000

Select the decimal point location for the Input, **MAX** and **MIN** displays. (The **TOT** display decimal point is a separate parameter.) This selection also affects round, dSP1 and dSP2 parameters and setpoint values.

DISPLAY ROUNDING*

round
1

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

FILTER SETTING*

FILtr
1.0

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

G

FILTER BAND*

bAnd

10

0.0 to 25.0 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units. A band setting of '0' keeps the digital filter permanently engaged.

SCALING POINTS*

PtS

2

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (InP) and an associated desired Display Value (dSP).

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (InP) and an associated desired Display Value (dSP). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs.

SCALING STYLE

StYLE

KEY

KEY key-in data

APLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence or changing of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APLY) scaling style must be used. After using the Apply (APLY) scaling style, this parameter will default back to KEY but the scaling values will be shown from the previous applied method.

INPUT VALUE FOR SCALING POINT 1

InP 1

0.00

- 19999 to 99999

For Key-in (KEY), enter the known first Input Value by using the arrow keys. The Input Range selection sets up the decimal location for the Input Value. With 0.02 V Input Range, 0 mV would be entered as 0.000. For Apply (APLY), apply the input signal to the meter, adjust the signal source externally until the desired Input Value appears. In either method, press the **PAR** key to enter the value being displayed.

Note: APLY style - Pressing the **RST** *key will advance the display to the next scaling display point without storing the input value.*

DISPLAY VALUE FOR SCALING POINT 1

dSP 1

0.00

- 19999 to 99999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. The decimal point follows the dECPt selection.

INPUT VALUE FOR SCALING POINT 2

InP 2

100.00

- 19999 to 99999

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (APLY), adjust the signal source externally until the next desired Input Value appears. (Follow the same procedure if using more than 2 scaling points.) With 0.02 V Input Range, 20 mV would be entered as 20.000.

DISPLAY VALUE FOR SCALING POINT 2

dSP 2

100.00

- 19999 to 99999

Enter the second coordinating Display Value by using the arrow keys. This is the same for KEY and APLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

General Notes on Scaling

1. Input Values for scaling points should be confined to the limits of the Input Range Jumper position.
2. The same Input Value should not correspond to more than one Display Value. (Example: 20 mV can not equal 0 and 10.) This is referred to as read out jumps (vertical scaled segments).
3. The same Display Value can correspond to more than one Input Value. (Example: 0 mV and 20 mV can equal 10.) This is referred to as readout dead zones (horizontal scaled segments).
4. The maximum scaled Display Value spread between range maximum and minimum is limited to 65,535. For example using 20 mV range the maximum +20 mV can be scaled to is 32,767 with 0 mV being 0 and Display Rounding of 1. (Decimal points are ignored.) The other half of 65,535 is for the lower half of the range 0 to -20 mV even if it is not used. With Display Rounding of 2, +20 mV can be scaled for 65,535 (32,767 x 2) but with even Input Display values shown.
5. For input levels beyond the last programmed Input Value, the meter extends the Display Value by calculating the slope from the last two sequential coordinate pairs. If three coordinate pair scaling points were entered, then the Display Value calculation would be between InP2 / dSP2 & InP3 / dSP3. The calculations stop at the limits of the Input Range Jumper position.

* *Factory Setting can be used without affecting basic start-up.*

G

6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)

PARAMETER MENU

2-FNC → PAR → USr-1 — USr-2 — USr-3 — F1 — F2 — rSt — Sc-F1 — Sc-F2 → Pro

USER INPUTS: USr-1, USr-2, USr-3

FUNCTION KEYS: F1, F2, rSt, Sc-F1, Sc-F2

The three user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state.

The front panel function keys are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

***Note**: In the following explanations, not all selections are available for both user inputs and front panel function keys. Alternating displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USr-1 will represent all three user inputs. F1 will represent all five function keys.*

NO FUNCTION

USr-1 / NO — F1 / NO

No function is performed if activated. This is the factory setting for all user inputs and function keys. No function can be selected without affecting basic start-up.

PROGRAMMING MODE LOCK-OUT

USr-1 / PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USr-1 / rEL — F1 / rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Offset Value and is automatically stored as the new Display Offset Value (OFFSt). If another Zero (tare) Display is performed, the display will again change to zero and the Display reading will shift accordingly.

RELATIVE/ABSOLUTE DISPLAY

USr-1 / d-rEL — F1 / d-rEL

This function will switch the Input Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input Display will normally show the Relative unless switched by this function. Regardless of the display selected, all meter functions continue to operate based on relative values. The Absolute is a gross value (based on Module 1 **DSP** and **INP** entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative display. AbS (absolute) or rEL (relative) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USr-1 / d-HLd

The shown display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USr-1 / A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USr-1 / SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USr-1 / bAt — F1 / bAt

The Input Display value is one time added (batched) to the Totalizer at transition to activate (momentary action). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden.

SELECT TOTALIZER DISPLAY

USr-1 / d-tot

The Totalizer display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Totalizer continues to function including associated outputs independent of being displayed.

G

RESET TOTALIZER

USr-1 / rtot1   F1 / r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USr-1 / rtot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USr-1 / E-tot

The Totalizer continues to operate as long as activated (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USr-1 / d-HI

The Maximum display is selected as long as activated (maintained action). When the user input is released, the Input Display returns. The **DSP** key overrides the active user input. The Maximum continues to function independent of being displayed.

RESET MAXIMUM

F1 / r-HI

When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MAXIMUM DISPLAY

USr-1 / r-HI

When activated (momentary action), the Maximum value is set to the present Input Display value. Maximum continues from that value while active (maintained action). When the user input is released, Maximum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Maximum function.

SELECT MINIMUM DISPLAY

USr-1 / d-Lo

The Minimum display is selected as long as activated (maintained action). When the user input is released, the Input Display is returned. The **DSP** key overrides the active user input. The Minimum continues to function independent of being displayed.

RESET MINIMUM

F1 / r-Lo

When activated (momentary action), rESEt flashes and the Minimum reading is set to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET, SELECT, ENABLE MINIMUM DISPLAY

USr-1 / r-Lo

When activated (momentary action), the Minimum value is set to the present Input Display value. Minimum continues from that value while active (maintained action). When the user input is released, Minimum detection stops and holds its value. This selection functions independent of the selected display. The **DSP** key overrides the active user input display but not the Minimum function.

RESET MAXIMUM AND MINIMUM

USr-1 / r-HL   F1 / r-HL

When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

CHANGE DISPLAY INTENSITY LEVEL

USr-1 / d-LEU   F1 / d-LEU

When activated (momentary action), the display intensity changes to the next intensity level (of 4). The four levels correspond to Display Intensity Level (d-LEu) settings of 0, 3, 8, and 15. The intensity level, when changed via the User Input/ Function Key, is not retained at power-down, unless Quick Programming or Full Programming mode is entered and exited. The meter will power-up at the last saved intensity level.

SETPOINT SELECTIONS

The following selections can be programmed for user inputs or front panel function keys. Refer to Module 6 for an explanation of their operation.

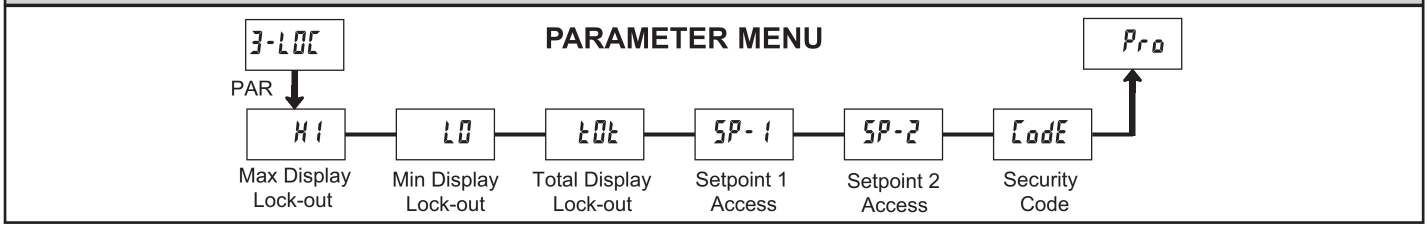
LISt - Select main or alternate setpoints
r-1 - Reset Setpoint 1 (Alarm 1)
r-2 - Reset Setpoint 2 (Alarm 2)
r-ALL - Reset Setpoint All (Alarm All)

PRINT REQUEST

USr-1 / Print   F1 / Print

The meter issues a block print through the serial port when activated. The data transmitted during a print request is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

6.3 MODULE 3 - DISPLAY AND PROGRAM LOCK-OUT PARAMETERS (3-LOC)



Module 3 is the programming for Display lock-out and "Full" and "Quick" Program lock-out.

When in the Display Mode, the available displays can be read consecutively by repeatedly pressing the **DSP** key. An annunciator indicates the display being shown. These displays can be locked from being visible. It is recommended that the display be set to LOC when the corresponding function is not used.

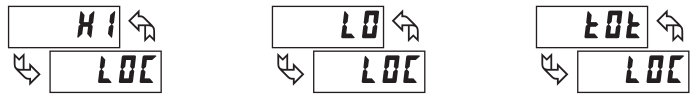
SELECTION	DESCRIPTION
rEd	Visible in Display Mode
LOC	Not visible in Display Mode

"Full" Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input. When locked and the **PAR** key is pressed, the meter enters a Quick Programming Mode. In this mode, the setpoint values can still be read and/or changed per the selections below. The Display Intensity Level (d-LEU) parameter also appears whenever Quick Programming Mode is enabled and the security code is greater than zero.

SELECTION	DESCRIPTION
rEd	Visible but not changeable in Quick Programming Mode
Ent	Visible and changeable in Quick Programming Mode
LOC	Not visible in Quick Programming Mode

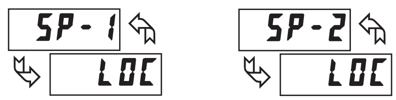
* *Factory Setting can be used without affecting basic start-up.*

MAXIMUM DISPLAY LOCK-OUT*
MINIMUM DISPLAY LOCK-OUT*
TOTALIZER DISPLAY LOCK-OUT*



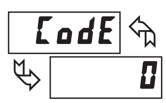
These displays can be programmed for LOC or rEd. When programmed for LOC, the display will not be shown when the **DSP** key is pressed regardless of Program Lock-out status. It is suggested to lock-out the display if it is not needed. The associated function will continue to operate even if its display is locked-out.

SP-1 or SP-2 SETPOINT ACCESS*



The setpoint displays can be programmed for LOC, rEd or Ent (See the following table).

PROGRAM MODE SECURITY CODE*



0 to 250

By entering any non-zero value, the prompt CodE 0 will appear when trying to access the Program Mode. Access will only be allowed after entering a matching security code or universal code of 222. With this lock-out, a user input would not have to be configured for Program Lock-out. However, this lock-out is overridden by an inactive user input configured for Program Lock-out.

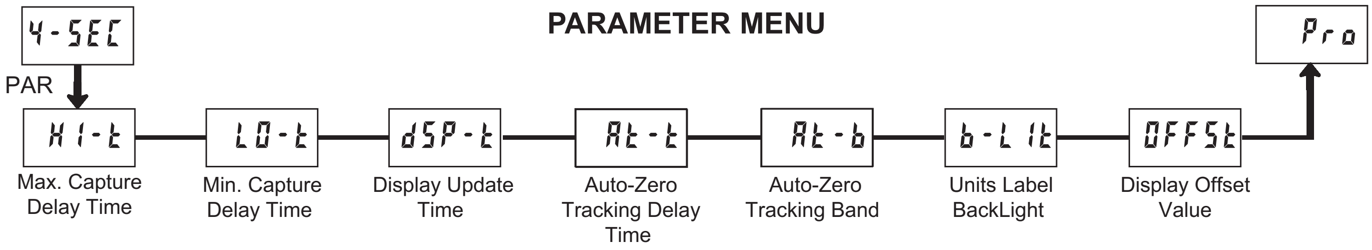
PROGRAMMING MODE ACCESS

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN PAR KEY IS PRESSED	"FULL" PROGRAMMING MODE ACCESS
0	not PLOC	————	"Full" Programming	Immediate access.
>0	not PLOC	————	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Active	Quick Programming w/Display Intensity	After Quick Programming with correct code # at CODE prompt.
>0	PLOC	Not Active	"Full" Programming	Immediate access.
0	PLOC	Active	Quick Programming	No access
0	PLOC	Not Active	"Full" Programming	Immediate access.

Throughout this document, Programming Mode (without Quick in front) always refers to "Full" Programming (all meter parameters are accessible).

G

6.4 MODULE 4 - SECONDARY FUNCTION PARAMETERS (4-SEC)



MAX CAPTURE DELAY TIME*

HI-t / 0.0

0.0 to 3275.0 sec.

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE DELAY TIME*

LO-t / 0.0

0.0 to 3275.0 sec.

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE*

dSP-t / 2

1 2 5 10 20 updates/sec.

This parameter determines the rate of display update. When set to 20 updates/second, the internal re-zero compensation is disabled, allowing for the fastest possible output response.

AUTO-ZERO TRACKING

At-t / 0

0 to 250 sec.

AUTO-ZERO BAND

At-b / 0.02

1 to 4095

The meter can be programmed to automatically compensate for zero drift. Drift may be caused by changes in the transducers or electronics, or accumulation of material on weight systems.

Auto-zero tracking operates when the readout remains within the tracking band for a period of time equal to the tracking delay time. When these conditions are met, the meter re-zeroes the readout. After the re-zero operation, the meter resets and continues to auto-zero track.

The auto-zero tracking band should be set large enough to track normal zero drift, but small enough to not interfere with small process inputs.

For filling operations, the fill rate must exceed the auto-zero tracking rate. This avoids false tracking at the start of the filling operation.

$$\text{Fill Rate} \geq \frac{\text{tracking band}}{\text{tracking time}}$$

Auto-zero tracking is disabled by setting the auto-zero tracking parameter = 0.

UNITS LABEL BACKLIGHT*

b-LIt / OFF

On OFF

This parameter is not used on this unit.

DISPLAY OFFSET VALUE*

OFFSt / 0.00

-19999 to 99999

Unless a Zero Display was performed or an offset from Module 1 scaling is desired, this parameter can be skipped. The Display Offset Value is the difference from the Absolute (gross) Display value to the Relative (net) Display value for the same input level. The meter will automatically update this Display Offset Value after each Zero Display. The Display Offset Value can be directly keyed-in to intentionally add or remove display offset. See Relative / Absolute Display and Zero Display explanations in Module 2.

* *Factory Setting can be used without affecting basic start-up.*

G

6.5 MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-tOt)

PARAMETER MENU

5-tOt → PAR → dECPt — tbASE — SCFAC — Locut — P-UP → Pro

dECPt	tbASE	SCFAC	Locut	P-UP
Totalizer Decimal Point	Totalizer Time Base	Totalizer Scale Factor	Totalizer Low Cut Value	Totalizer Power Up Reset

The totalizer accumulates (integrates) the Input Display value using one of two modes. The first is using a time base. This can be used to compute a time-temperature product. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of temperature integration, useful in curing and sterilization applications. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT*

dECPt
0.00

0   0.0   0.00   0.000   0.0000

For most applications, this matches the Input Display Decimal Point (dECPt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

tbASE
_ın

SEC - seconds (÷ 1)   hour - hours (÷ 3600)
_ın - minutes (÷ 60)   dAY - days (÷ 86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR*

SCFAC
1.000

0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In these cases, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a different value than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE*

Locut
-1999.9

-19999 to 99999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET*

P-UP
NO

NO   Do not reset buffer
rSt   Reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to reset.

* *Factory Setting can be used without affecting basic start-up.*

TOTALIZER HIGH ORDER DISPLAY

When the total exceeds 5 digits, the front panel annunciator **TOT** flashes. In this case, the meter continues to totalize up to a 9 digit value. The high order 4 digits and the low order 5 digits of the total are displayed alternately. The letter "h" denotes the high order display. When the total exceeds a 9 digit value, the Totalizer will show "E . . ." and will stop.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:
Input Display - the present input reading
Totalizer Scale Factor - 0.001 to 65.000
Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at a constant rate of 10.0 kilograms per minute moving across a scale. The Totalizer is used to determine how many kilograms in tenths has traveled over the scale. Because the Input Display and Totalizer are both in tenths of kilograms, the Totalizer Scale Factor is 1. With kilograms per minute, the Totalizer Time Base is minutes (60). By placing these values in the equation, the Totalizer will accumulate every second as follows:

$\frac{10.0 \times 1.000}{60}$ = 0.1667 kilograms accumulates each second

This results in:
10.0 kilograms accumulates each minute
600.0 kilograms accumulates each hour

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPt) location from the Input Display Decimal Point (dECPt), the required Totalizer Scale Factor is multiplied by a power of ten.

Example:

Input (dECPt) = 0

Totalizer dECPt	Scale Factor
0.0	10
0	1
x10	0.1
x100	0.01
x1000	0.001

Input (dECPt) = 0.0

Totalizer dECPt	Scale Factor
0.00	10
0.0	1
0	0.1
x10	0.01
x100	0.001

Input (dECPt) = 0.00

Totalizer dECPt	Scale Factor
0.000	10
0.00	1
0.0	0.1
0	0.01
x10	0.001

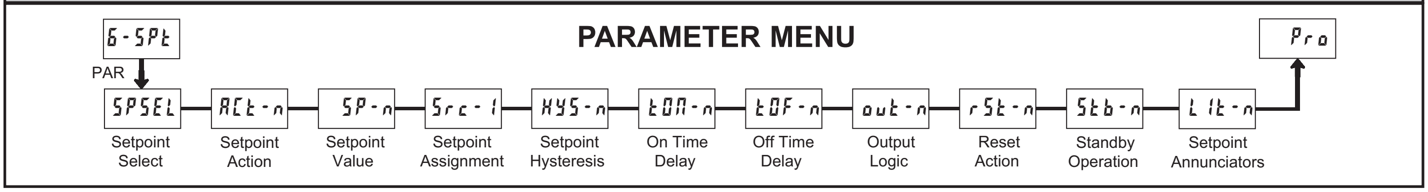
(x = Totalizer display is round by tens or hundreds)

2. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.

Example: Average temperature per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for rtot2. The timer will control the start (reset) and the stopping (hold) of the totalizer.

G

6.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPt)



For maximum input frequency, unused Setpoints should be configured for OFF action. The setpoint assignment and the setpoint action determine certain setpoint feature availability.

SETPOINT SELECT

SPSEL
NO

NO SP-1 SP-2

Enter the setpoint (alarm output) to be programmed. The n in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to SPSEL NO. Repeat step for each setpoint to be programmed. The NO chosen at SPSEL will return to Pro NO. The number of setpoints available is setpoint output card dependent.

SETPOINT ACTION

ACt-n
OFF

OFF Ab-HI Ab-LO AU-HI AU-LO
dE-HI dE-LO bAND totLo totHI

Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action.

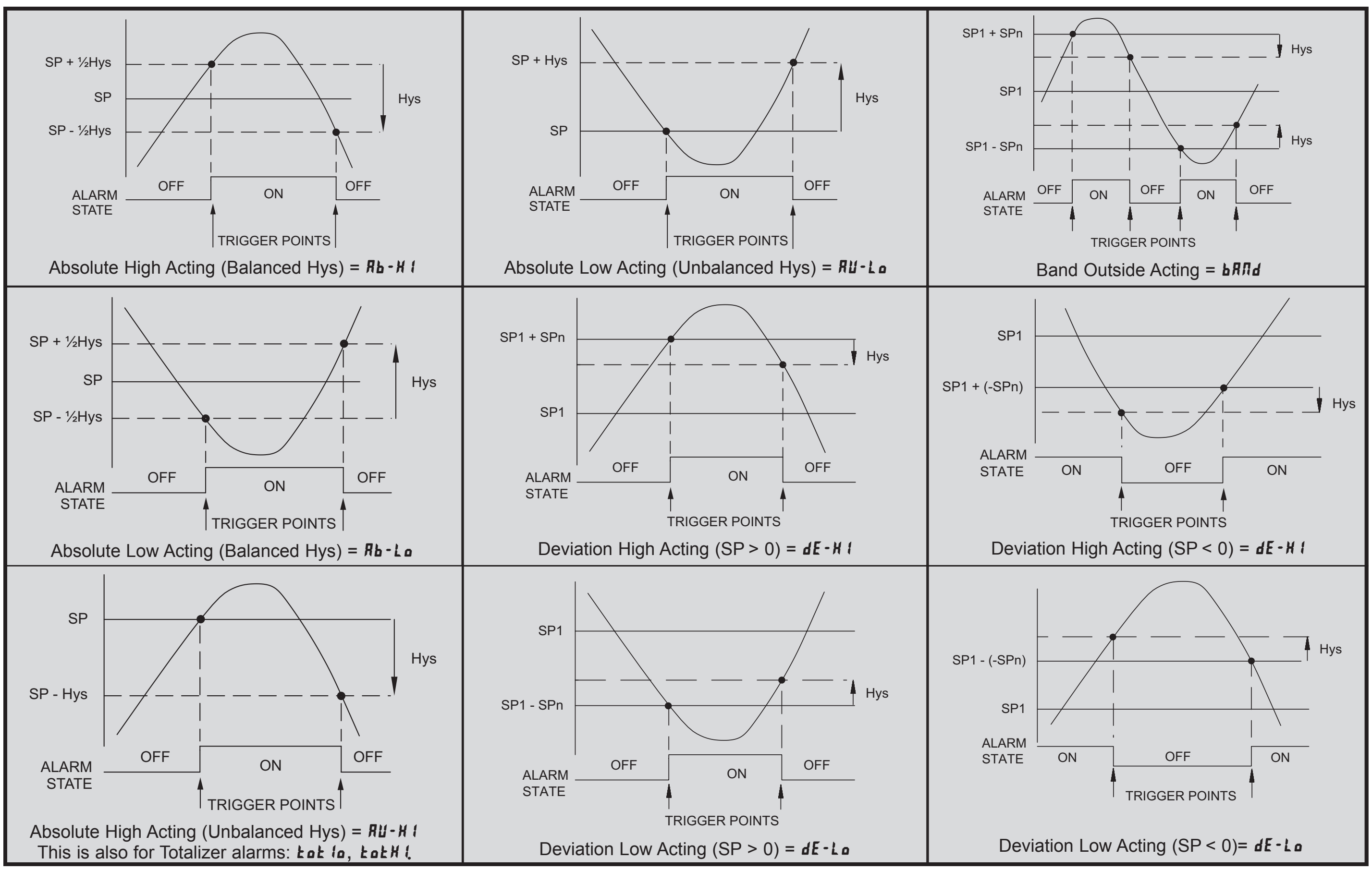
OFF	=	Setpoint always off, (returns to SPSEL NO)
Ab-HI	=	Absolute high, with balanced hysteresis
Ab-LO	=	Absolute low, with balanced hysteresis
AU-HI	=	Absolute high, with unbalanced hysteresis
AU-LO	=	Absolute low, with unbalanced hysteresis
dE-HI	=	Deviation high, with unbalanced hysteresis *
dE-LO	=	Deviation low, with unbalanced hysteresis *
bAND	=	Outside band, with unbalanced hysteresis *
totLo	=	Lower Totalizer absolute high, unbalance hysteresis**
totHI	=	Upper Totalizer absolute high, unbalance hysteresis**

* Deviation and band action setpoints are relative to the value of setpoint 1. It is not possible to configure setpoint 1 as deviation or band actions. It is possible to use setpoint 1 for an absolute action, while its value is being used for deviation or band.

** The lower Totalizer action totLo allows setpoints to function off of the lower 5 digits of the Totalizer. The upper Totalizer action totHI allows setpoints to function off of the upper 4 digits of the Totalizer. To obtain absolute low alarms for the Totalizer, program the totLo or totHI output logic as reverse.

Setpoint Alarm Figures

With reverse output logic rEu, the below alarm states are opposite.



G

SETPOINT VALUE

SP-n
10.00

-19999 to 99999

Enter desired setpoint alarm value. These setpoint values can also be entered in the Display Mode during Program Lock-out when the setpoint is programmed as Ent in Parameter Module 3. When a setpoint is programmed as deviation or band acting, the associated output tracks SP1 as it is changed. The value entered is the offset, or difference from SP1.

SETPOINT ASSIGNMENT

Src-1
AbS

AbS rEL

Enter desired source for Setpoint. The Setpoint can be triggered from the Relative (Input) or Absolute/Gross (Abs) value.

HYSTERESIS VALUE

HYS-n
0.02

1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balance and unbalance) are affected by the hysteresis. When the setpoint is a control output, usually balance hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

tON-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

tOF-n
0.0

0.0 to 3275.0 sec.

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

out-n
nor

nor rEu

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEu logic reverses the output logic. In rEu, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

rSt-n
AUto

AUto LAtC1 LAtC2

Enter the reset action of the alarm output.

AUto = Automatic action; This action allows the alarm output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input.The alarm remains reset off until the trigger point is crossed again.

LAtC1 = Latch with immediate reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtC2 = Latch with delay reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the event until the corresponding "on" alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)

STANDBY OPERATION

Stb-n
NO

NO YES

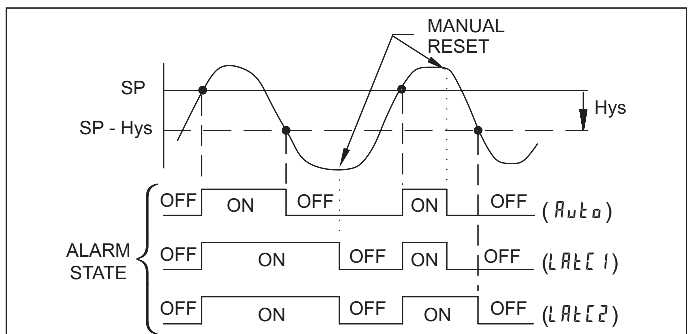
When YES, the alarm is disabled (after a power up) until the trigger point is crossed. Once the alarm is on, the alarm operates normally per the Setpoint Action and Reset Mode.

SETPOINT ANNUNCIATORS

LIt-n
nor

OFF nor rEu FLASH

The OFF mode disables display setpoint annunciators. The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEu mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASH mode flashes the corresponding setpoint annunciators of "on" alarm outputs.



Setpoint Alarm Reset Actions

Alternate Setpoints

An Alternate list of setpoint values can be stored and recalled as needed. The Alternate list allows an additional set of setpoint values. (The setpoint numbers nor rear terminal numbers will change in the Alternate list.) The Alternate list can only be activated through a function key or user input programmed for LISt in Module 2. When the Alternate list is selected, the Main list is stored and becomes inactive. When changing between Main and Alternate, the alarm state of Auto Reset Action alarms will always follow their new value. Latched "on" alarms will always stay latched during the transition and can only be reset with a user input or function key. Only during the function key or user input transition does the display indicate which list is being used.

6.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL)

PARAMETER MENU

7-SrL → PAR → bAUd (Baud Rate) → dAtA (Data Bit) → PAr (Parity Bit) → Addr (Meter Address) → Abru (Abbreviated Printing) → OPt (Print Options) → GroSS (Print Gross Value) → tArE (Print Tare Value) → INP (Print Input Value) → tot (Print Total Value) → H ILO (Print Max & Min Values) → SPNt (Print Setpoint Values) → Pro

BAUD RATE

bAUd
9600

300 1200 4800 19200
600 2400 9600

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting.

DATA BIT

dAtA
7

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match that of other serial communication equipment. Since the meter receives and transmits 7-bit ASCII encoded data, 7 bit word length is sufficient to request and receive data from the meter.

PARITY BIT

PAr
Odd

Odd EUEN NO

Set the parity bit to match that of the other serial communications equipment used. The meter ignores the parity when receiving data, and sets the parity bit for outgoing data. If no parity is selected with 7-bit word length the meter transmits and receives data with 2 stop bits. (For example: 10 bit frame with mark parity)

METER ADDRESS

Addr
0

0 to 99

Enter the serial node address. With a single unit on a bus, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abru
YES

YES NO

Select abbreviated transmissions (numeric only) or full field transmission. When the data from the meter is sent directly to a terminal for display, the extra characters that are sent identify the nature of the meter parameter displayed. In this case, select NO. When the data from the meter goes to a computer, it may be desirable to suppress the node address and mnemonic when transmitting. In this case, set this parameter to YES.

PRINT OPTIONS

OPt
NO

YES NO

YES - Enters the sub-menu to select those meter parameters to appear in the block print. For each parameter in the sub-menu select YES for the parameter to appear with the block print, and NO to disable the parameter.

Gross Value	GroSS	YES	NO
Tare Value	tArE	YES	NO
Input Value	INP	YES	NO
Max and Min Values	H ILO	YES	NO
Total Value	tot	YES	NO
Setpoint values	SPNt	YES	NO

G

Sending Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a the command terminator character * or $.

Command Chart

Command	Description	Notes
N	Node Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character.
V	Value change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character
P	Block Print Request (read)	Initiates a block print output. Registers are defined in programming.

Register Identification Chart

ID	Value Description	Register ID	Applicable Commands/Comments	
A	Input	INP	T, P, R	(Reset command zeros the input [“REL” or Tare])
B	Total	TOT	T, P, R	(Reset command resets total to zero)
C	Max Input	MAX	T, P, R	(Reset command resets MAX to current reading)
D	Min Input	MIN	T, P, R	(Reset command resets MIN to current reading)
E	Setpoint 1	SP1	T, P, V, R	(Reset command resets the setpoint output)
F	Setpoint 2	SP2	T, P, V, R	(Reset command resets the setpoint output)
J	Control Status Register	CSR	T, V	
L	Absolute (gross) input display value	GRS	T, P	
Q	Offset/Tare	TAR	T, P, V	

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences of * and $ terminating characters.

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1, response delay of 2 msec min
   String: N17VE350$
2. Node address = 5, Read Input value, response delay of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 2 output, response delay of 50 msec min
   String: RF*

Sending Numeric Data

Numeric data sent to the meter must be limited to 5 digits (-19,999 to 99,999). If more than 5 digits are sent, the meter accepts the last 5. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter’s scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5 In this case, write a value = 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. In this case, the response contains only the numeric field. The meter response mode is established in programming.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 10 bytes for number, one byte for sign, one byte for decimal point (The T command may be a different byte length)
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned =0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register ID (Serial Mnemonic).

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative value have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

(CSR) Control Status Register

The Control Status Register is used to directly control the meter's setpoint outputs and interrogate the state of the setpoint outputs. The register is bit mapped with each bit position within the register assigned to a particular control function. The control function are invoked by writing to each bit position. The bit position definitions are:

bit 0: Setpoint 1 Output Status
- 0 = output off
- 1 = output on

bit 1: Setpoint 2 Output Status
- 0 = output off
- 1 = output on

bit 2: Not Used

bit 3: Not Used

bit 4: Manual Mode
- 0 = automatic mode
- 1 = manual mode

bit 5: Always stays 0, even if 1 is sent.

bit 6: Not Used

bit 7: Always stays 0, even if 1 is sent.

Although the register is bit mapped starting with bit 7, HEX < > characters are sent in the command string. Bits 7 and 5 always stay a zero, even if a "1" is sent. This allows ASCII characters to be used with terminals that may not have extended character capabilities.

Writing a "1" to bit 4 of CSR selects manual mode. In this mode, the setpoint outputs are defined by the values written to the bits b0 and b1. Internal control of these outputs is then overridden.

In automatic mode, the setpoint outputs can only be reset off. Writing to the setpoint output bits of the CSR has the same effect as a Reset command (R). The contents of the CSR may be read to interrogate the state of the setpoint outputs.

Examples:

1. Set manual mode, turn all setpoints off:
   V is command write, J is CSR and * is terminator.

		7	6	5	4	3	2	1	0:bit location	
VJ<30>* or VJ0*	ASCII 0 =	0	0	1	1	0	0	0	0	or <30>

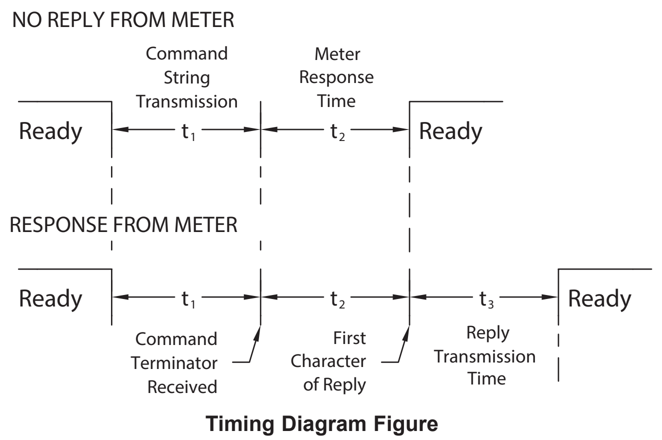
2. Turn SP1 output on and SP2 output off:

		7	6	5	4	3	2	1	0:bit location	
VJ<31>* or VJ1*	ASCII 1 =	0	0	1	1	0	0	0	1	or <31>

Note: Avoid writing values <0A> (LF), <0D> (CR), <24> ($) and <2E> (*) to the CSR. These values are interpreted by the meter as end of command control codes and will prematurely end the write operation.

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). The meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.



Timing Diagram Figure

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 * # of characters) / baud rate

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 50 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The standard command line terminating character is '*'. This terminating character results in a response time window of 50 msec minimum and 100 msec maximum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time window (t_2) of 2 msec minimum and 50 msec maximum. The faster response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. t_3 = (10 * # of characters) / baud rate. At the end of t_3, the meter is ready to receive the next command.

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

G

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

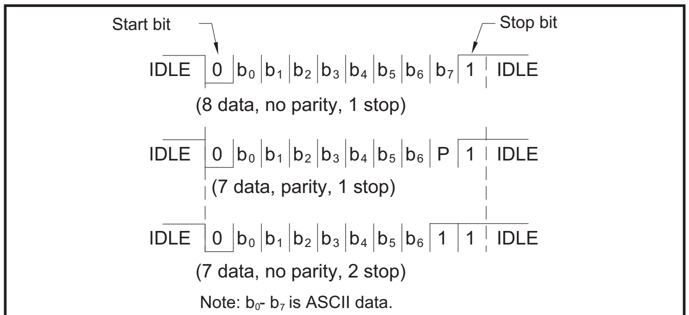
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional error detection parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

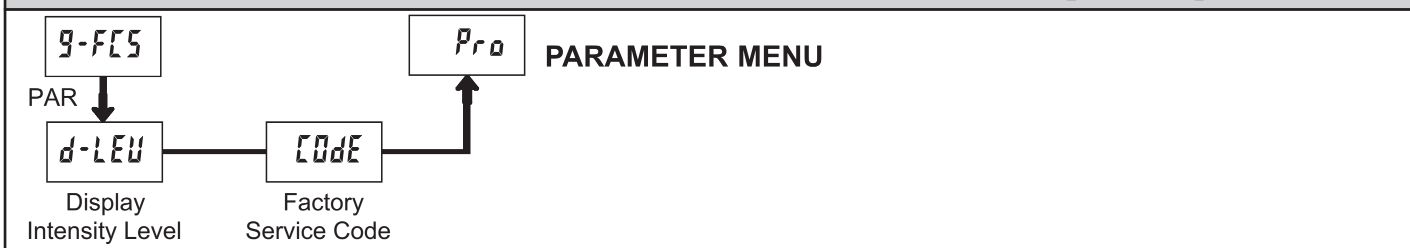
Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

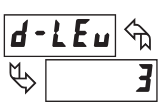
Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit.

6.9 MODULE 9 - FACTORY SERVICE OPERATIONS (9-FCS)

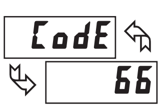


DISPLAY INTENSITY LEVEL



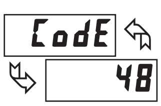
Enter the desired Display Intensity Level (0-15) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in Quick Programming Mode when enabled.

RESTORE FACTORY DEFAULTS



Use the arrow keys to display CodE 66 and press **PAR**. The meter will display rESEt and then return to CodE 50. Press **DSP** key to return to Display Mode. This will overwrite all user settings with the factory settings.

CALIBRATION



The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored using the Apply (APLY) Scaling Style.

Calibration may be aborted by disconnecting power to the meter before exiting Module 9. In this case, the existing calibration settings remain in effect.

Input Calibration

WARNING: Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.

Before starting, connect -SIG (terminal 3) to COMM (terminal 4). This allows a single ended signal to be used for calibration. Connect the calibration signal to +SIG (terminal 2) and -SIG (terminal 3). Verify the Input Range jumper is in the desired position. Allow a 30 minute warm-up period before calibrating the meter. no and **PAR** can be chosen to exit the calibration mode without any changes taking place. Perform the following procedure:

1. Press the arrow keys to display CODE 48 and press **PAR**.
2. Choose the range to be calibrated by using the arrow keys and press **PAR**.
3. When the zero range limit appears on the display, apply 0 mV between +SIG and -SIG.
4. Press **PAR** and ---- will appear, wait for next prompt.
5. When the top range limit appears on the display, apply the corresponding +SIG and -SIG voltage (20 mV or 200 mV).
6. Press **PAR** and ---- will appear, on the display for about 10 seconds.
7. When NO appears, press **PAR** twice to exit programming.
8. Repeat the above procedure for each range to be calibrated or to recalibrate the same range. It is only necessary to calibrate the input ranges being used.
9. When all desired calibrations are completed, remove -SIG to COMM connection and external signal source.
10. Restore original configuration and jumper settings.

G

MODEL LD - LARGE SERIAL SLAVE DISPLAY

c UL US LISTED
IND. CONT. EQ.
51EB

- *2.25" or 4" HIGH RED LED DIGITS*
- *DISPLAYS UP TO 6 DIGITS OF SERIAL ASCII DATA*
- *DUAL DISPLAY BUFFER ALLOWS ALTERNATING DISPLAYS*
- *RS232 OR RS485 SERIAL INTERFACE*
- *CONNECTS DIRECTLY TO RED LION PRODUCTS WITH SERIAL*
- *PROGRAMMABLE USER INPUT*
- *UNIVERSALLY POWERED*
- *ALUMINUM NEMA 4X/IP65 CASE CONSTRUCTION*

CE

GENERAL DESCRIPTION

The Large Serial Slave Display is a versatile display that accepts serial ASCII data from a host device and displays the received characters. The displayable data includes numeric, 7-segment alphabetic and certain punctuation characters.

The 6-digit displays are available in either 2.25" or 4" high red LED digits with adjustable display intensity. The 2.25" high models are readable up to 130 feet. The 4" high models are readable up to 180 feet. Both versions are constructed of a NEMA 4X/IP65 enclosure in light weight aluminum.

The Serial Slave has two internal display buffers, allowing two separate display values or messages to be viewed. The main (primary) display typically shows dynamic data (count, rate, process, etc.), usually received directly from another meter. The secondary display typically shows a fixed message or value, such as a system or machine identifier, or a target production value. The main and secondary displays can be toggled either manually or automatically at a user selected toggle speed. Both displays are retained in memory when power is removed from the unit.

For single meter remote display applications, the Serial Slave can be connected directly to a Red Lion (or compatible) meter with RS232 or RS485 serial communications. The slave can display the meter value on its main display without requiring a PC or other serial interface.

Multiple slaves are connected using an RS485 serial bus. If unique meter addresses are assigned, specific data can be displayed by a single slave on the bus. When multiple slaves are assigned the same address, common data can be displayed by multiple units in different locations.

Serial communications parameters are fully programmable, with baud rates up to 38.4 Kbps. Special command characters allow display selection and display intensity adjustment through the serial input. In addition to the serial input, a programmable User Input is provided to perform a variety of meter functions.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

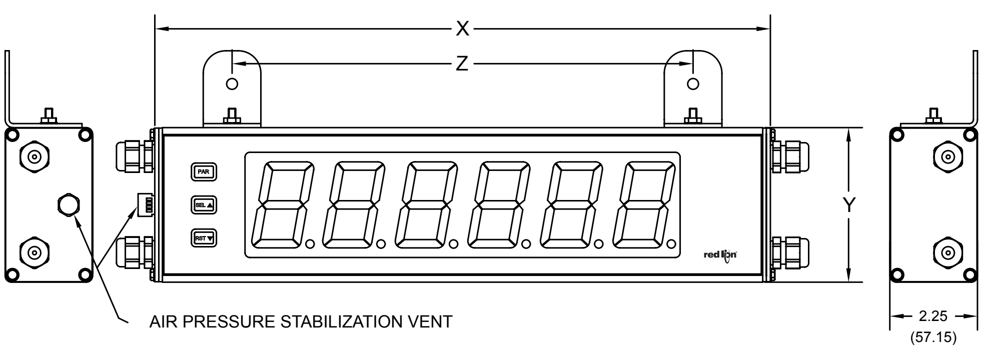
Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

SPECIFICATIONS

1. **DISPLAY**: 6-digit 2.25" (57 mm) or 4" (101 mm) adjustable intensity Red LED
2. **POWER REQUIREMENTS**:
   AC POWER: 50 to 250 VAC 50/60 Hz, 26 VA
   DC POWER: 21.6 to 250 VDC, 11 W
   Isolation: 2300 V_{RMS} for 1 min. to all inputs and outputs
3. **SERIAL INPUT:**
   RS485 SERIAL COMMUNICATIONS
   Type: Multi-point balanced interface (isolated)
   Baud Rate: 300 to 38400
   Data Format: 7/8 bits; odd, even, or no parity
   Bus Address: 0 to 99; max 32 meters per line
   RS232 SERIAL COMMUNICATIONS
   Type: Half duplex (isolated)
   Baud Rate: 300 to 38400
   Data Format: 7/8 bits; odd, even, or no parity
4. **USER INPUT** (Programmable Function Input):
   Active low logic, internal 7.8 KΩ pull-up resistor to +12V.
   Trigger levels: V_{IL} = 1.0 V max; V_{IH} = 2.4 V min; V_{MAX} = 28 VDC
   Response time: 10 msec typ; 50 msec debounce (activation & release)
5. **MEMORY**: Nonvolatile E^2PROM retains all programming parameters, main and secondary displays when power is removed.

DIMENSIONS In inches (mm)



PART NUMBER	X (Length)	Y (Height)	Z (Center)
LD2SS6P0	16 (406.4)	4 (101.6)	12 (304.8)
LD4SS6P0	26 (660.4)	7.875 (200)	22 (558.8)

G

6. **CERTIFICATIONS AND COMPLIANCES**:

SAFETY

UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Enclosure rating (Face only), UL50

IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP65 Enclosure rating (Face only), IEC 529

ELECTROMAGNETIC COMPATIBILITY

Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1 kV L-L, 2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions		Criterion A 0.5 cycle
Emissions:		
Emissions	EN 55011	Class B

Notes:

1. Criterion A: Normal operation within specified limits.

7. **CONNECTIONS**:
   Internal removable terminal blocks used for power and signal wiring.
   Remove end plates with ¼" nut driver.
   For LD2 versions power is on the right side and serial wiring is on the left side. For LD4 versions, all wiring is on the right side of the unit.
   Wire Strip Length: 0.4" (10 mm)
   Wire Gage: 24-12 AWG copper wire, 90°C rated insulation only
   Torque: 5.3 inch-lbs (0.6 N-m) max
   Cable Diameter: Outside diameter must be 0.181" (4.6 mm) to 0.312" (7.9 mm) to maintain NEMA 4 rating of cord grips.
8. **ENVIRONMENTAL CONDITIONS**:
   Operating temperature: 0 to 65 °C
   Storage temperature: -40 to 70 °C
   Operating and storage humidity: 0 to 85% max. RH (non-condensing)
   Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's (1g relay).
   Shock According to IEC 68-2-27: Operational 30 g's (10g relay), 11 msec in 3 directions.
   Altitude: Up to 2,000 meters
9. **CONSTRUCTION**: Aluminum enclosure, and steel side panels with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4X/IP65 specifications. Installation Category II, Pollution Degree 2.
10. **WEIGHT**:
    LD2SS6P0: 4.5 lbs (2.04 kg)
    LD4SS6P0: 10.5 lbs (4.76 kg)

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LD	2.25" High 6-Digit Red LED Serial Slave Display, RS232/RS485 Serial Communications	LD2SS6P0
LD	4" High 6-Digit Red LED Serial Slave Display, RS232/RS485 Serial Communications	LD4SS6P0
LD Plug	Panel Meter Plug for LD models	LDPLUG00

1.0 INSTALLING THE METER

INSTALLATION

The meter meets NEMA 4X/IP65 requirements when properly installed.

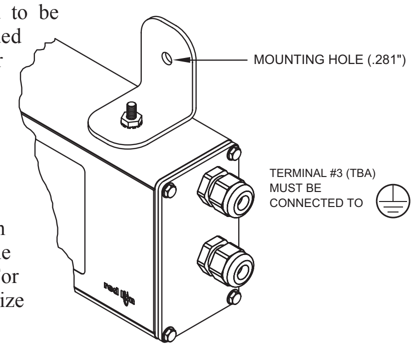
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the operating temperature. Placing the unit near devices that generate excessive heat should be avoided. The unit should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents.

Continuous exposure to direct sunlight may accelerate the aging process of the front overlay. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

MOUNTING INSTRUCTIONS

This display is designed to be wall mounted or suspended from a ceiling truss or other suitable structure capable of supporting the LDSS. Caution should be exercised when hanging the display to provide for the safety of personnel. If hanging the LDSS, run the suspension cables (or chains) through the mounting bracket holes. For wall mounting use #10-32 size bolts.



G

2.0 WIRING THE METER

EMC INSTALLATION GUIDELINES

Although this meter is designed with a high degree of immunity to Electro-Magnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the meter may be different for various installations. The meter becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

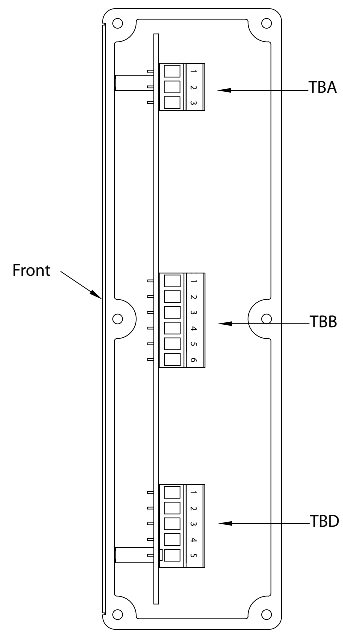
1. The meter should be properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.

c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.

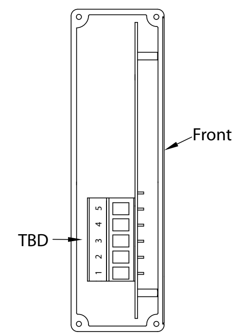
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be ran in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC# FCOR0000)
      TDK # ZCAT3035-1330A
      Steward # 28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC# LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom # 1 VR3
   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC# SNUB0000.

WIRING OVERVIEW

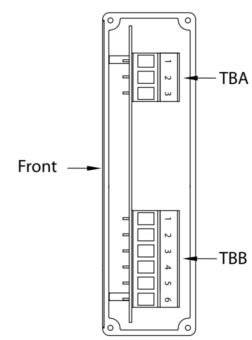
Electrical connections are made via pluggable terminal blocks located inside the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker. When wiring the meter, compare the numbers on the label on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.4" (10 mm) bare lead exposed (stranded wires should be tinned with solder.) Insert the lead under the correct screw clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.) Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm). Use copper conductors only, with insulation rated at 90°C.



LD4SS6P0 Right Side



LD2SS6P0 Left Side



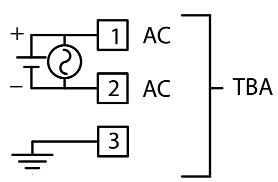
LD2SS6P0 Right Side

2.1 POWER WIRING

The power wiring is made via the 3 position terminal block (TBA) located inside unit (right side).

AC Power

Terminal 1: VAC/DC +
Terminal 2: VAC/DC -
Terminal 3: Earth Ground

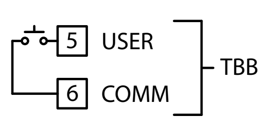


2.2 USER INPUT WIRING

The User Input is wired to Terminals 5 and 6 of TBB as shown.

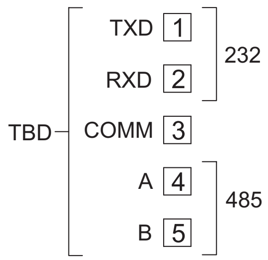
Terminal 5: User Input
Terminal 6: User Common

Sinking Logic



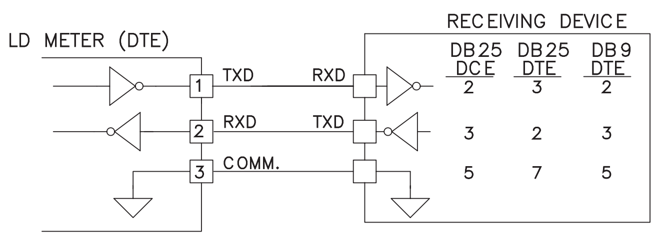
2.3 SERIAL WIRING

The serial connections are made via terminal block TBD located inside the unit on the left side for the LD2 and on the right side for the LD4.



RS232 Communications

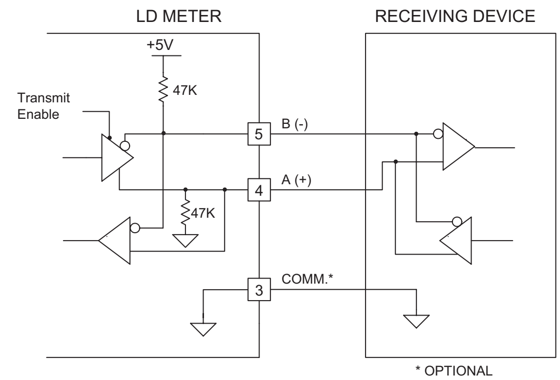
RS232 is intended to allow two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The LD emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection.



RS232 Terminal Block Connection Figure

RS485 Communications

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the LDSS is limited to 38.4k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



RS485 Terminal Block Connection Figure

3.0 REVIEWING THE FRONT PANEL KEYS AND DISPLAY

KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
PAR	Access Programming Mode	Store selected parameter and index to next parameter
SEL▲	Select display (main or secondary)	Advance through selection list/select digit position in parameter value
RST▼	Reset display(s) per front panel reset setting	Increment selected digit of parameter value

G

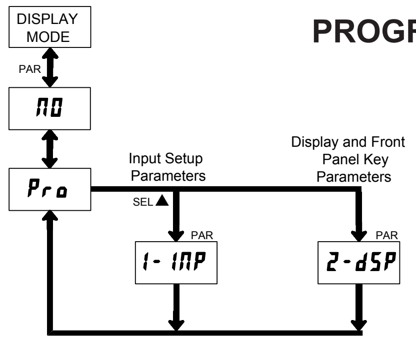
DISPLAY DESIGNATOR

“ 2 ” - To the far right of the display indicates the secondary display is shown.

If display scroll is enabled, the display will toggle automatically between the main and secondary display at the selected scroll interval.

4.0 Programming the Meter

PROGRAMMING MENU



PROGRAMMING MODE ENTRY (PAR KEY)

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing the **PAR** key. If it is not accessible, then it is locked by either a security code or a hardware lock (See Module 2).

MODULE ENTRY (SEL▲ & PAR KEYS)

The Programming Menu is organized into two modules. These modules group together parameters that are related in function. The display will alternate between Pro and the present module. The **SEL▲** key is used to select the desired module. The displayed module is entered by pressing the **PAR** key.

MODULE MENU (PAR KEY)

Each module has a separate module menu (which is shown at the start of each module discussion). The **PAR** key is pressed to advance to a particular parameter to be changed, without changing the programming of preceding parameters. After completing a module, the display will return to Pro NO. Programming may continue by accessing additional modules.

SELECTION / VALUE ENTRY

For each parameter, the display alternates between the present parameter and the selections/value for that parameter. The **SEL▲** and **RST▼** keys are used to move through the selections/values for that parameter. Pressing the **PAR** key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the value is displayed with one digit flashing (initially the right most digit). Pressing the **RST▼** key increments the digit by one or the user can hold the **RST▼** key and the digit will automatically scroll. The **SEL▲** key will select the next digit to the left. Pressing the **PAR** key will enter the value and move to the next parameter.

PROGRAMMING MODE EXIT (PAR KEY)

The Programming Mode is exited by pressing the **PAR** key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS

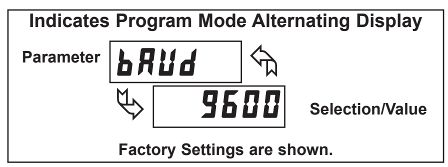
It is recommended to start with Module 1 and proceed through each module in sequence. When programming is complete, it is recommended to record the parameter programming and lock out parameter programming with the user input or programming security code.

FACTORY SETTINGS

Factory Settings may be completely restored in Module 2. This is useful when encountering programming problems or in the event of corrupted program data.

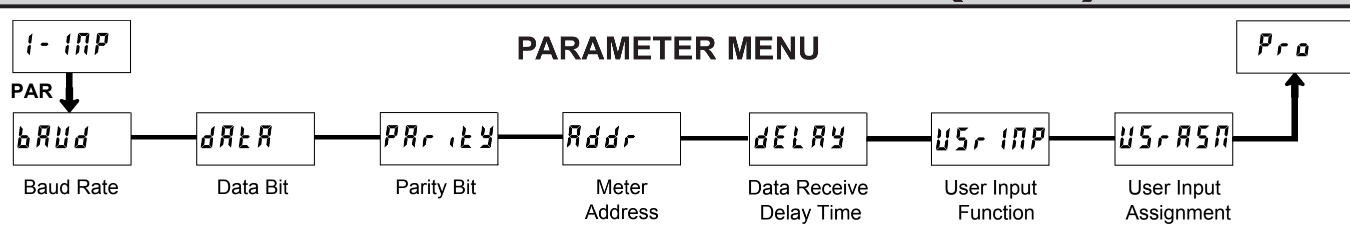
ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter's Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.



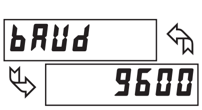
4.1 MODULE 1 - Input Setup Parameters (1-INP)

PARAMETER MENU



Module 1 is the programming module for the Input Setup Parameters. This includes the Serial Input setup parameters and the User Input function. Set the Serial Input parameters to match the settings of the host device.

BAUD RATE



300	1200	4800	19200
600	2400	9600	38400

Set the baud rate to match that of the host device. Normally, the baud rate is set to the highest value that all the serial communications equipment is capable of transmitting and receiving.

DATA BIT

7-bit 8-bit

Select either 7- or 8-bit data word length to match that of the host device.

G

PARITY BIT

PAr ity ⇦ Odd EUEn nO

⇨ Odd

This parameter only appears when the Data Bit parameter is set to 7-bit. Set the parity bit to match that of the host device. If parity is set to nO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr ⇦ 0 to 99

⇨ 00

Enter the meter (node) address. With a single slave unit, an address is not required and a value of zero should be used. This is the case with an RS232 connection, where only one Serial Slave is connected to the host.

With multiple Serial Slaves connected on an RS485 bus, a unique address number must be assigned to each unit in order to send data to a specific slave on the bus. If multiple slaves are assigned the same address (including zero), common data can be sent to, and displayed by multiple slave units on the bus.

DATA RECEIVE DELAY TIME

dELAY ⇦ 00.01 to 59.99

⇨ 00.05

Upon receiving a terminator character <CR>, the Serial Slave disables serial data reception for the time duration entered in this parameter. Using a delay allows the Serial Slave to ignore additional characters such as a <LF> or second <CR>, which often follow a serial data string. This value is entered in seconds and hundredths of seconds format, with a 10 msec minimum delay time.

(See "Data Receive Delay Timing" in the Communications section for additional timing details.)

USER INPUT FUNCTION

USr InP ⇦ nO

⇨ nO

DISPLAY	MODE	DESCRIPTION
nO	No Function	User Input disabled.
ProLoc	Program Mode Lock-out	See Programming Mode Access chart (Module 2).
rSt-E	Momentary Reset (Edge triggered)	Momentary reset of the assigned display(s).
rSt-L	Maintained Reset	Level active reset of the assigned display(s).
d-HOLd	Display Hold	Freeze the assigned display(s) as long as the input is active.
d-SEL	Display Select (Edge triggered)	Toggle between main and secondary display (if enabled).
d-LEU	Display Intensity Level (Edge triggered)	Increase intensity one level for each activation.

USER INPUT ASSIGNMENT

USrASn ⇦ Pri both SEC dSP

⇨ dSP

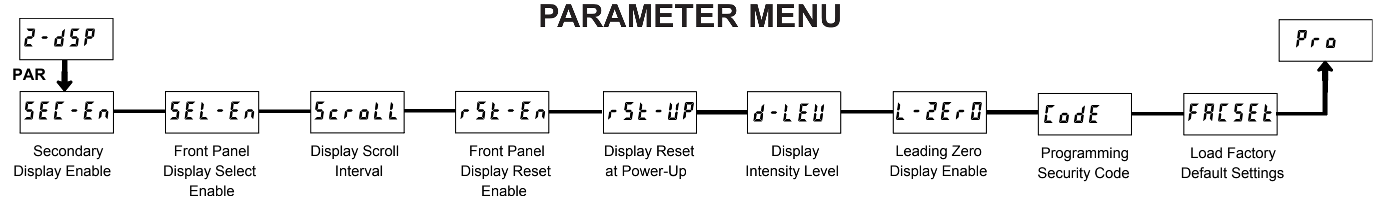
Select the display to which the User Input Function applies. The User Input Assignment only appears if the secondary display is enabled and a selection of reset or display hold is chosen for the User Input Function.

Assignment choices include the main (primary) and/or secondary display, or the display which is shown at the moment the User Input is activated (dSP).

Note: For reset selection, main display resets to zero. Secondary display resets to all blanks.

4.2 MODULE 2 - DISPLAY AND FRONT PANEL KEY PARAMETERS (2-dSP)

PARAMETER MENU



SECONDARY DISPLAY ENABLE

SEC-En ⇦ nO YES

⇨ YES

Select YES to enable the secondary display. A "2" on the far right of the display always appears when the secondary display is shown.

DISPLAY SCROLL INTERVAL

ScroLL ⇦ nO 4-SEC 8-SEC 2-SEC 6-SEC 10-SEC

⇨ nO

Select the time interval at which the display automatically toggles between the main and secondary displays. Select nO to disable automatic scrolling. This parameter only appears if the secondary display is enabled.

FRONT PANEL DISPLAY SELECT ENABLE (SEL▲)

SEL-En ⇦ nO YES

⇨ YES

Select YES to allow the **SEL▲** key to toggle between the main and secondary displays. This parameter only appears if the secondary display is enabled.

FRONT PANEL DISPLAY RESET ENABLE (RST▼)

rSt-En ⇦ nO SEC dSP Pri both

⇨ dSP

This parameter allows the **RST▼** key to reset the main (primary) and/or secondary display (if enabled), or the display which is currently shown (dSP). Select nO to disable the **RST▼** key.

Note: Main display resets to zero. Secondary display resets to all blanks.

G

DISPLAY RESET AT POWER-UP

rSt-UP
NO

NO SEC
Pri both

This parameter allows the Main and/or Secondary display (if enabled) to automatically reset when power is applied to the unit.

DISPLAY INTENSITY LEVEL

d-LEU
5

1 to 5

Enter the desired display intensity level. The display will actively brighten or dim as the level is changed.

LEADING ZERO DISPLAY ENABLE

L-2ErO
NO

NO YES

Select NO to insert blanks in place of any leading zeros received in a serial data string. This is typical when sending numeric values to the slave. Select YES to enable display of any leading zeros in the string. This parameter setting only applies to the Main display.

PROGRAMMING SECURITY CODE

CodE
000

000 to 999

The Security Code determines the user access to Programming mode. This code can be used independently or along with the Program Mode Lock-out (ProLoc) selection in the User Input Function parameter (Module 1).

Programming a Security Code other than 0, requires this code to be entered at the CodE prompt in order to access Programming mode.

USER INPUT FUNCTION	USER INPUT STATE	SECURITY CODE	PROGRAMMING ACCESS WHEN "PAR" PRESSED
not ProLoc	———	0	Immediate Access
		1-999	With correct code entry at CodE prompt *
ProLoc	Active	0	Programming Locked No Access
		1-999	With correct code entry at CodE prompt *
	Not Active	0-999	Immediate Access

** Entering Code 222 allows access regardless of security code.*

LOAD FACTORY DEFAULT SETTINGS

FACSEt
NO

NO YES

The YES selection returns the slave to the factory default settings. The unit will displays rESEt and returns to Pro, with the factory settings loaded.

Serial Slave Communications

Displayable Characters

The ASCII characters that the Serial Slave can display are as follows:

Numeric: 0 to 9

Alphabetic (7-segment): A, b, C, c, d, E, e, F, G, g, H, h, I , i, J, K, L, l, N, n, O, o, P, q, r, S, t, U, u, V, v, Y, Z

Non-displayable alphabetic characters will be replaced with a blank if received. These include M, W and X.

Note: Both uppercase and lowercase ASCII characters are accepted. If a displayable difference exists, characters will be shown in the case received.

Punctuation: period, comma, and colon (all displayed as decimal point); minus (dash), blank

Display and Serial Buffer Capacity

The Serial Slave display is right aligned and has the capacity of displaying six characters. When less than six characters are received, blank spaces are placed in front of the characters. If more than six characters are received, only the last six are displayed.

The unit has two internal display buffers, allowing two separate values or messages to be viewed. The main display is always enabled and viewable. The secondary display may be enabled or disabled through programming. When enabled, this display is indicated by a "2" on the far right of the display. The main and secondary displays can be toggled either manually or automatically at a user selectable toggle speed. A serial command can also be sent to select which display is shown. Both displays are retained in memory when power is removed from the unit.

The Serial Slave has an internal 64 character buffer for received data. If more than 64 characters are sent, the additional characters are discarded until a string terminator <CR> is received. At that point, the last six characters at the end of the buffer are displayed.

A carriage return <CR> is the only valid string terminator for the Serial Slave. However, if an <*> or <$> is received, the slave will empty and reset its internal character buffer without processing the string. These characters are used as valid command terminators for serial commands sent to other Red Lion meters. Since these commands are not applicable to the Serial Slave, the slave discards the command and prepares its character buffer for a new data string.

Data and Command String Formatting

Data sent to the Serial Slave must be formatted as either main display data, secondary display data or command strings sent to perform specific display functions. The format for sending data is shown below:

N xx I d6 d5 d4 d3 d2 d1 <CR>

N - Required to address a specific slave unit in a multiple unit loop.
xx - Two-digit meter address. Single digit address requires leading zero.
I - Format identifier character (see below). Omit for main display data.
d6-d1 - The last 6 characters before the <CR> will be shown, if displayable.
<CR> - Carriage Return (0DH) used as string terminator character.

The format identifier character <I>dictates how the Serial Slave interprets a data string as follows:

(omit) - No character indicates main display data
\# - Indicates secondary display data
@ - Display select command, followed by display identifier character main <1> or secondary <2> (ex: @1<CR> select main display)
% - Display intensity command, followed by intensity level character <1> to <5> (ex: %3<CR> set display intensity level to 3)

Downloading Data from a G3 to an LDSS

Communications:
Port: RS232 Comms Raw Serial Port
Port Driver: <system> Raw Serial Port

Programming:

```
PortPrint(2, "N01" + IntToText(Var1, 10, 6) + "\r");
```

This program is called from the Global On Tick. It sends "N01" (the address of the LDSS), followed by the ASCII equivalent of Var1, then a carriage return.

G

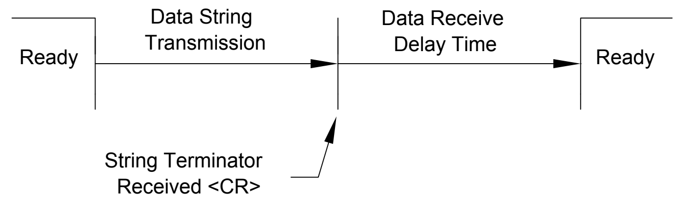
Data Receive Delay Timing

Upon receiving a string terminator character <CR>, the Serial Slave requires a delay time to process the received data and prepare for the next string. During this delay, the meter disables serial data reception.

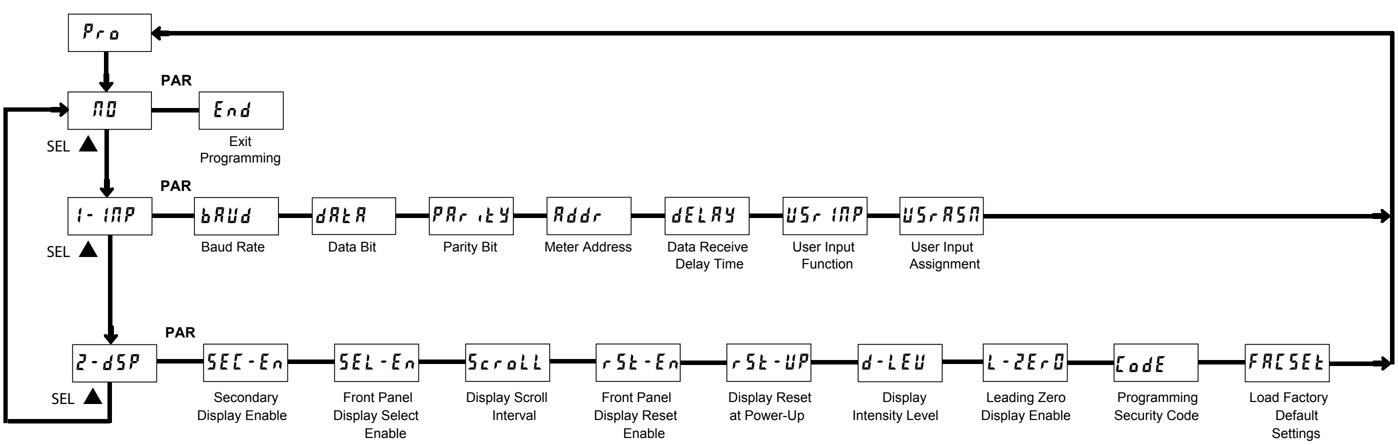
The Data Receive Delay Time is programmable in Module 1, with a minimum delay of 10 mSec. By extending this delay, the Serial Slave can ignore data sent by the host which is not intended for display. This data includes additional characters such as a <LF> or redundant <CR>, which might follow a serial data string. This could also include additional data strings sent as part of a data block, where only the first string is intended for the Serial Slave display. In this case, the delay time should be programmed to exceed the total transmission time for the entire data block. This results in the Serial Slave displaying the first string of the data block and disabling data reception during transmission of the additional strings.

The Receive Delay Time must be set to expire at a point where no data is being sent to the Serial Slave. This prevents the unit from enabling data reception in the middle of a character or data string, which could result in an incorrect display when the string is processed.

Timing Diagram for Data Reception



LD SERIAL SLAVE PROGRAMMING QUICK OVERVIEW



G

MODEL LPAX- 5 DIGIT LARGE PAX DISPLAY FOR ANALOG INPUTS

c UL US LISTED
IND. CONT. EQ.
51EB

CE

- *LARGE LED DISPLAY READABLE TO 70 FEET*
- *VARIOUS ANALOG INPUT MODULES;*
  DC VOLTAGE AND CURRENT
  PROCESS SIGNALS
  TRUE RMS VOLTAGE AND CURRENT
  THERMOCOUPLE OR RTD
  STRAIN GAGE/BRIDGE
- *ALARMS, ANALOG OUTPUT, AND COMMUNICATION*
- *CUSTOM UNITS LABEL WITH BACKLIGHT*
- *PROGRAMMABLE USER INPUTS*
- *PROGRAMMABLE FUNCTION KEYS*
- *UNIVERSAL AC/DC POWERED MODELS*
- *CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4/IP65*

GENERAL DESCRIPTION

The LPAX Display is a versatile display that can increase productivity by offering the plant floor or production area a large visual display of their current status. Whether your measurement is temperature, weight, or flow, the LPAX can satisfy your requirement. With the use of a units label and backlighting, the display can be tailored to show the actual engineering unit, which further enhances the display. This LPAX display accepts various analog inputs through the use of input modules (MPAX) which allow the unit to adapt to most any application. The MPAX Modules offer the same features as our highly successful PAX Series Panel Meters. Additional plug-in option cards can add alarms, analog output, and communication/bus capabilities, making the LPAX a truly Intelligent Panel Meter.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

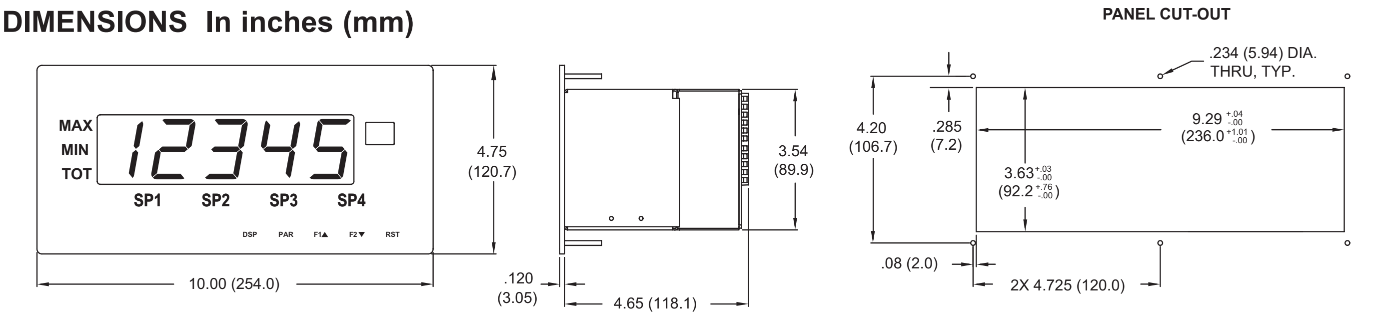
Additional specifications, wiring, programming, and information for the individual MPAX models are contained in the corresponding standard PAX literature. This PAX literature is shipped with the ordered MPAX model.

1. **DISPLAY**: 1.5" (38 mm) Red LED
   5-Digit: (-19999 to 99999)
2. **POWER REQUIREMENTS**:
   AC Modules: 85 to 250 VAC, 50/60 Hz, 18 VA
   DC Modules: 11 to 36 VDC or 24 VAC ±10%, 50/60 Hz, 14 W
3. **INPUT**: Accepts analog input modules, see “Selecting your display components.”
4. **ANNUNCIATORS**:
   LPAX0500: MAX, MIN, TOT, SP1, SP2, SP3, and SP4
   Optional units label with backlight
5. **KEYPAD**: Five tactile membrane switches integrated into the front panel
6. **CERTIFICATIONS AND COMPLIANCES**:
   UL Recognized Component, File #E179259, UL61010A-1, CSA 22.2 No. 1010-1
   Recognized to US and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4 Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Certificate #US/8843/UL
   CB Scheme Test Report #04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   EMC specifications determined by the MPAX module.

WARNING: Disconnect all power to the unit before installing

G

DIMENSIONS In inches (mm)



7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: Determined by the MPAX module
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% max. RH (non-condensing)
Altitude: Up to 2000 meters
8. **MOUNTING REQUIREMENTS**:
Max. panel thickness is 0.375" (9.5 mm)
Min. panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm)
9. **MODULE INSTALLATION**:
24-pin shrouded connector on LPAX engages connector on MPAX module upon installation. Shroud ensures proper alignment by providing a lead-in for the module connector.
10. **CONNECTIONS**: All wiring connections are made to the MPAX module via high compression cage-clamp terminal blocks. Wiring instructions are provided with the MPAX module.

CAUTION: DISCONNECT ALL POWER BEFORE INSTALLING OR REMOVING MODULE

11. **CONSTRUCTION**: Steel front panel, enclosure, and rear cover with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4/IP65 specifications for indoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and keps nuts included.
12. **WEIGHT**: 2.7 lbs (1.2 kg) (*less module*)

About the MPAX Input Modules

The MPAX Module serves as the input to the LPAX Display. There are several different modules to cover a variety of inputs. The MPAX module provides input scaling which allows the LPAX to display most any engineering unit. Once the MPAX is inserted into the LPAX, the unit has the same functions and capabilities of our PAX Series Intelligent Panel Meters. A full set of PAX programming instructions will be included with the MPAX Module.

Note: The MPAX provides the operating power for the LPAX, therefore you must select either the AC or DC MPAX corresponding with your application and available power.

Selecting Your Display Components

To build a complete display unit, you will need an LPAX and an MPAX Input Module. The LPAX is only a display and will not operate without an MPAX Module. Please use the following chart to identify the appropriate MPAX Module (including supply power) and LPAX Display that will satisfy your application.

SIGNAL TYPE	INPUT RANGES	MPAX MODULES *		LPAX DISPLAYS
		85-250 VAC	11 to 36 VDC/ 24 VAC	
Universal DC Inputs	DC Voltage 200 mV, 2 V, 20 V, 300 V DC Current 200 μA, 2 mA, 20 mA, 200 mA, 2 Amp Resistance 100 ohm, 1000 ohm, 10 K ohm	MPAXD000	MPAXD010	LPAX0500
Process Inputs	0-20 mA or 0-10 VDC	MPAXP000	MPAXP010	LPAX0500
Temperature Inputs	Thermocouples-T, E, J, K, R, S, B, N, C, or Custom Scaling RTD's-100 ohm Pt (platinum) 385/392, 120 ohm Nickel 672, or 10 ohm Copper 427	MPAXT000	MPAXT010	LPAX0500
Strain Gage/ Load Cell	24 mV or 240 mV	MPAXS000	MPAXS010	LPAX0500
True RMS AC Voltage/Current	AC Voltage 200 mV, 2 V, 20 V, 300 V AC Current 200 uA, 2 mA, 20 mA, 200 mA, 5 Amp	MPAXH000	N/A	LPAX0500

*For detailed Module specifications, see corresponding PAX literature. (i.e. For MPAXD specifications, see the PAXD literature)

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

Plug-in cards.

Adding Option Cards

The MPAX series meters can be fitted with up to three optional plug-in cards. However, only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The cards can be installed initially or at a later date. Each optional plug-in card is shipped with installation and programming instructions.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, a Windows® based program, the RS232 or RS485 Cards must be used.

PAXCDC1* - RS485 Serial
PAXCDC2* - RS232 Serial
PAXCDC30 - DeviceNet
PAXCDC4* - Modbus
PAXCDC50 - Profibus-DP

*Units available in various connector configurations.

SETPOINT CARDS (PAXCDS)

The MPAX series has four setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on the input, max, min, or total display value. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

UNITS LABEL (LX)

The LPAX Display has an area on the front panel designed for a custom units label. The units label is applied directly to the panel in the embossed area. The units backlight is then turned on via programming.

Available on 5-digit version only. Refer to the LPAX Accessories Bulletin for a list of available units labels.

PROGRAMMING SOFTWARE (CRIMSON)

Crimson is a Windows® based program that allows configuration of the LPAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the LPAX meter. The LPAX program can then be saved in a PC file for future use. A PAX serial plug-in card is required to program the meter using the software.

1.0 ASSEMBLING THE DISPLAY

***CAUTION:** The MPAX main circuit board and the option cards contain static sensitive components. Before handling the module or the cards, discharge static charges from your body by touching a grounded bare metal object. Handle the module by the rear plastic cover only, and the option cards by the board edges. Dirt, oil or other contaminants that contact the circuit boards or components can adversely affect circuit operation.*

***WARNING:** Exposed line voltage exists on the MPAX main circuit board and the option cards. **DO NOT** apply power to the module OR load circuits until the module is properly installed in the LPAX case.*

***NOTE:** All module and option card labels must be installed as shown for safety purposes.*

Prior to installing the LPAX Display, it is recommended that the MPAX and any option cards be assembled first. This will allow you the opportunity to insure all the boards are fitted properly into their connectors.

Installing the Option Cards

If your application requires option cards, they should be installed into the MPAX before it is installed into the LPAX Display. Refer to the literature enclosed with the option cards for installation instruction.

Installing the MPAX

To install the MPAX Module, align the module with the opening in the LPAX case, as illustrated. The module must be oriented as shown, with terminal #1 toward the top of the LPAX case. Carefully slide the module into the LPAX case. The LPAX and MPAX connectors will begin to engage about ¼" from the bottom. At this point, apply a small amount of pressure to the rear of the MPAX module to fully engage the connection. Be sure the module fully snaps into the slots at the rear of the LPAX case. The display is ready for installation.

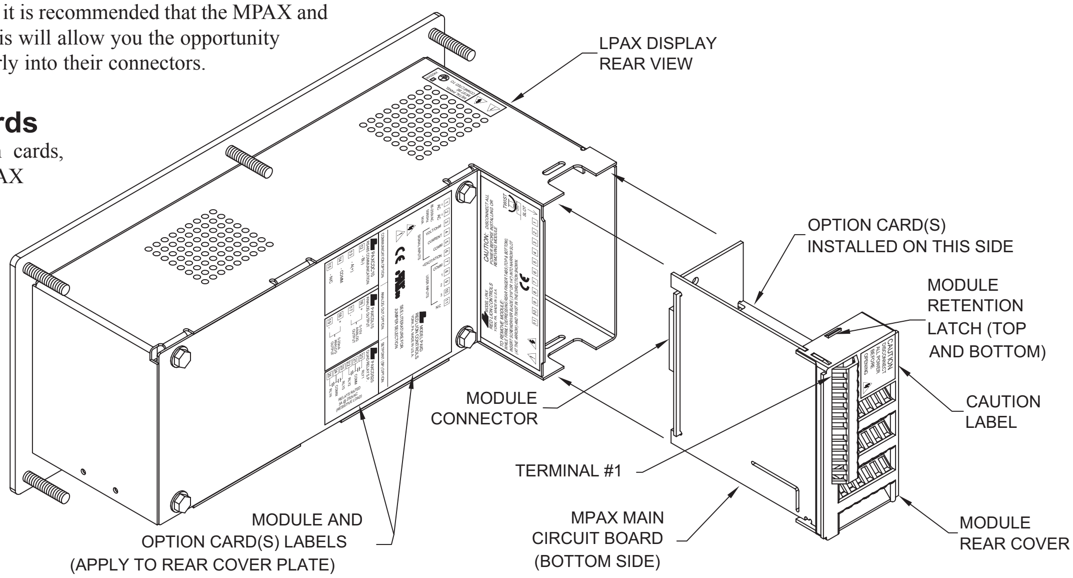


Figure 1, Installing an MPAX Module and Option Cards

Installing the Labels

Each option card and the MPAX are shipped with a connection label. These labels must be applied to the rear of the LPAX in the positions shown in the drawing.

Removing The MPAX Module

To remove the MPAX Module from the LPAX Display, first remove all power and load circuits. Then insert a flat screwdriver blade ($^{3}/_{16}$" or $^{1}/_{4}$") into the narrow slot between the LPAX rear cover plate and the module's plastic cover as illustrated in Figure 2. Twist the screwdriver in the direction shown to disengage the internal connectors while firmly squeezing and pulling back on the rear finger tabs (top and bottom). Carefully slide the module out of the LPAX case, keeping it properly aligned with the case opening.

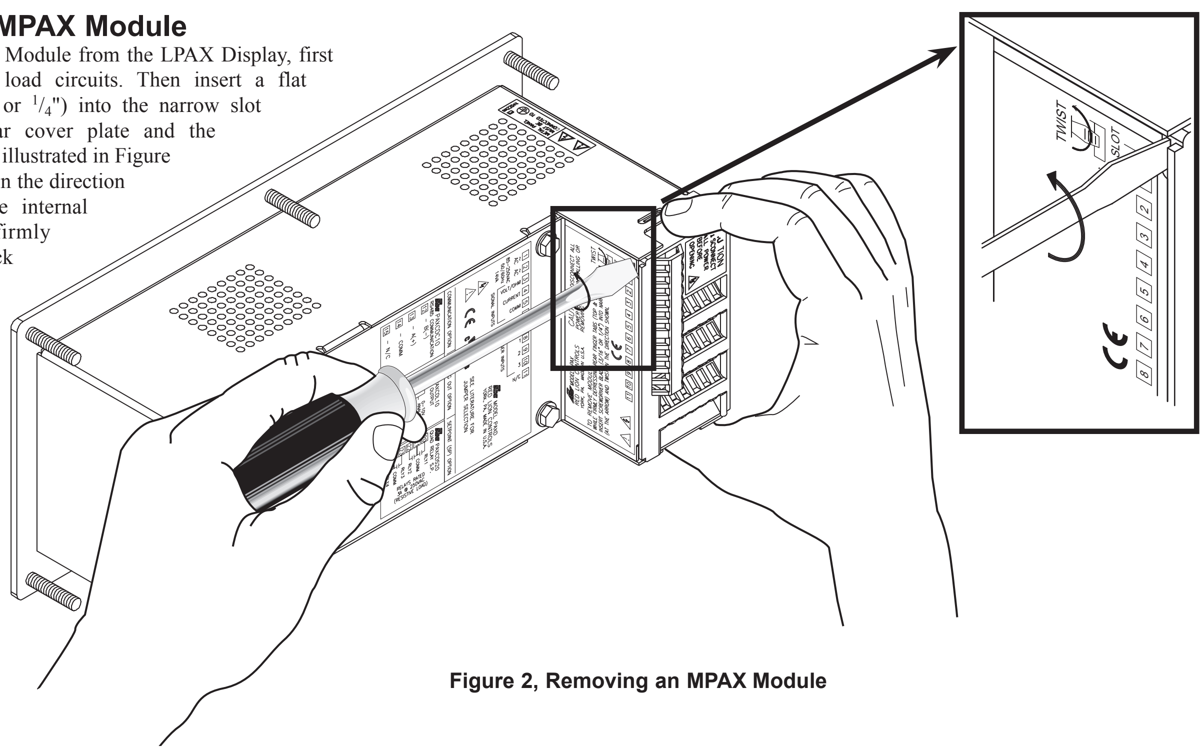


Figure 2, Removing an MPAX Module

G

2.0 INSTALLING THE DISPLAY

LPAX DISPLAY INSTALLATION

The LPAX display is intended to be mounted into a panel or enclosure. The display is provided with a gasket to provide a water-tight seal. The recommended minimum panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm).

For panel mounting, prepare the panel cut-out to the dimensions shown. The supplied template may be used to mark the cut-out and hole locations on the panel. After the panel cut-out has been deburred, slide the panel gasket over the rear of the display and onto the mounting studs. Insert the display into the panel cut-out as illustrated in Figure 3. Install six # 10-32 keps nuts (supplied) and tighten evenly for uniform gasket compression. Do not over-tighten the nuts.

By using additional mounting accessories, the LPAX can be surface-wall mounted, suspended, or bottom mounted. Separate installation instructions are provided with the mounting accessories.

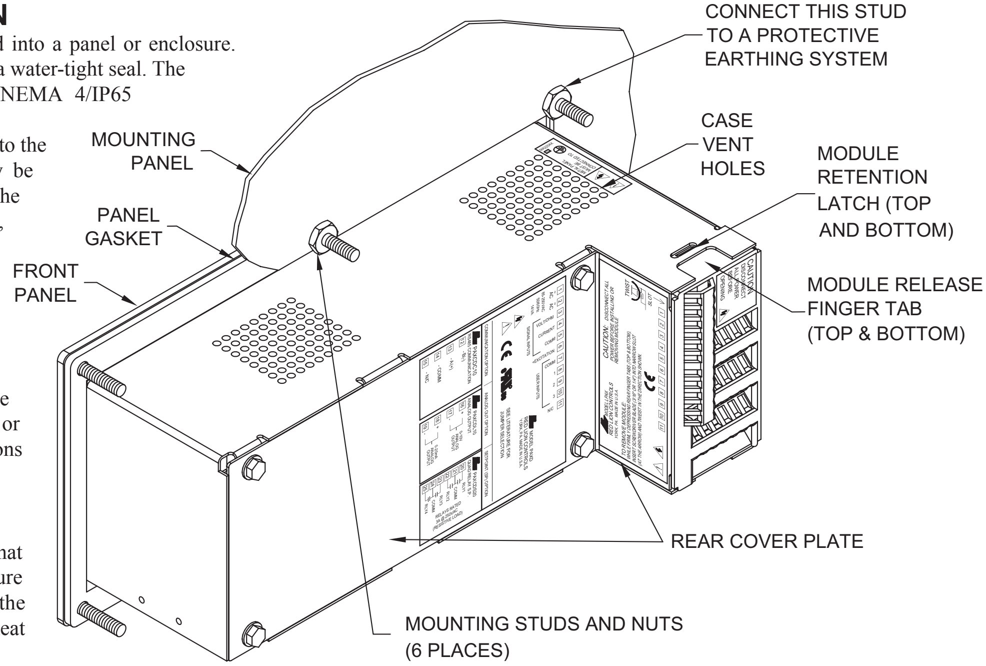


Figure 3, Installing The LPAX Into A Panel

Environment And Cleaning

The display should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the system near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

3.0 WIRING AND PROGRAMMING THE DISPLAY

Once assembled, the LPAX and MPAX have all the same functions and capabilities of our PAX Series Intelligent Panel Meters. Therefore, you will find the appropriate PAX information packed with the MPAX Module. Simply follow the instructions to wire and program the display for your application.

TROUBLESHOOTING

For technical assistance, contact technical support.

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Display	LPAX	5-Digit, Large Display for Analog MPAX Modules	LPAX0500
Analog Input Module	MPAX	Universal DC Input Module, AC Powered	MPAXD000
		Universal DC Input Module, DC/24 VAC Powered	MPAXD010
		Process Input Module, AC Powered	MPAXP000
		Process Input Module, DC/24 VAC Powered	MPAXP010
		Thermocouple and RTD Module, AC Powered	MPAXT000
		Thermocouple and RTD Module, DC/24 VAC Powered	MPAXT010
		AC True RMS Voltage and Current Module, AC Powered	MPAXH000
		Strain Gage Input Module, AC Powered	MPAXS000
		Strain Gage Input Module, DC/24 VAC Powered	MPAXS010
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	LX*	Custom Units Label	Listed Separately
	SFCRD**	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200
	ENC9	NEMA 4 Enclosure for LPAX	ENC90000
	SHR	Shroud for LPAX	SHRLPAX0
	MB	Mounting Bracket for LPAX	MBLPAX00

* See the LPAX Accessory Bulletin or our web site for available units labels.
** Crimson software is available for download from http://www.redlion.net/

MODEL LPAX- 6 DIGIT LARGE PAX DISPLAY FOR DIGITAL INPUTS

- LARGE LED DISPLAY READABLE TO 70 FEET
- VARIOUS DIGITAL INPUT MODULES;
  - COUNT AND RATE INPUT
  - CLOCK/TIMER
  - SERIAL SLAVE
- ALARMS, ANALOG OUTPUT, AND COMMUNICATION
- PROGRAMMABLE USER INPUTS
- PROGRAMMABLE FUNCTION KEYS
- UNIVERSAL AC/DC POWERED MODELS
- PC SOFTWARE FOR METER CONFIGURATION
- NEMA 4/IP65

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The LPAX Display is a versatile display that can increase productivity by offering the plant floor or production area a large visual display of their current status. Whether your measurement is rate, count, or time, the LPAX can satisfy your requirement. These LPAX displays accept various digital inputs through the use of input modules (MPAX) which allow the unit to adapt to most any application. The MPAX Modules offer the same features as our highly successful PAX Series Panel Meters. Additional plug-in option cards can add alarms, analog output, and communication/bus capabilities, making the LPAX a truly Intelligent Panel Meter.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

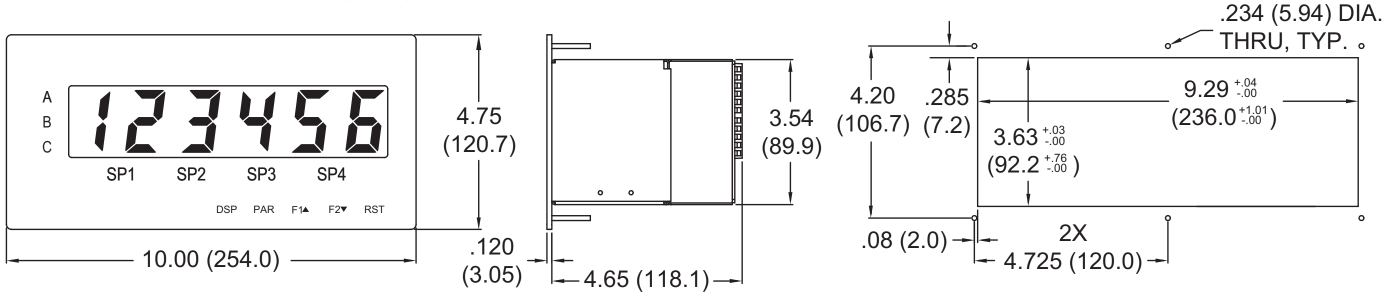
CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

SPECIFICATIONS

Additional specifications, wiring, programming, and information for the individual MPAX models are contained in the corresponding standard PAX literature. This PAX literature is shipped with the ordered MPAX model.

1. **DISPLAY**: 1.5" (38 mm) Red LED
   6-Digit (LPAX0600): (-99999 to 999999)
   6-Digit (LPAXCK00): (0 to 999999)
2. **POWER REQUIREMENTS**:
   AC Modules: 85 to 250 VAC, 50/60 Hz, 18 VA
   DC Modules: 11 to 36 VDC or 24 VAC ±10%, 50/60 Hz, 14 W
3. **INPUT**: Accepts digital input modules, see “Selecting Your Display Components and Option Cards.”
4. **ANNUNCIATORS**:
   LPAX0600: A, B, C, SP1, SP2, SP3, and SP4
   LPAXCK00: TMR, CNT, DAT, SP1, SP2, SP3, and SP4
5. **KEYPAD**: Five tactile membrane switches integrated into the front panel
6. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File #E179259, UL61010A-1, CSA 22.2 No. 1010-1
   Recognized to US and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
   LISTED by Und. Lab. Inc. to U.S and Canadian safety standards
   Type 4 Enclosure rating (Face Only), UL50
   IECEE CB Scheme Test Certificate # US/8843/UL
   CB Scheme Test Report # 04ME11209-20041018
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   IP65 Enclosure rating (Face only), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
   EMC specifications determined by the MPAX module.

DIMENSIONS In inches (mm)



G

7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: Determined by the MPAX module
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% max. RH (non-condensing)
Altitude: Up to 2000 meters
8. **MOUNTING REQUIREMENTS**:
Max. panel thickness is 0.375" (9.5 mm)
Min. panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm)
9. **MODULE INSTALLATION**:
24-pin shrouded connector on LPAX engages connector on MPAX module upon installation. Shroud ensures proper alignment by providing a lead-in for the module connector.
10. **CONNECTIONS**: All wiring connections are made to the MPAX module via high compression cage-clamp terminal blocks. Wiring instructions are provided with the MPAX module.

CAUTION: DISCONNECT ALL POWER BEFORE INSTALLING OR REMOVING MODULE

11. **CONSTRUCTION**: Steel front panel, enclosure, and rear cover with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4/IP65 specifications for indoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and keps nuts included.
12. **WEIGHT**: 2.7 lbs (1.2 kg) (*less module*)

About the MPAX Input Modules

The MPAX Module serves as the input to the LPAX Display. There are several different modules to cover a variety of inputs. The MPAX module provides input scaling which allows the LPAX to display most any engineering unit. Once the MPAX is inserted into the LPAX, the unit has the same functions and capabilities of our PAX Series Intelligent Panel Meters. A full set of PAX programming instructions will be included with the MPAX module.

Note: The MPAX provides the operating power for the LPAX, therefore you must select either the AC or DC MPAX corresponding with your application and available power.

Selecting Your Display Components and Option Cards

To build a complete display unit, you will need an LPAX and an MPAX Input Module. The LPAX is only a display and will not operate without an MPAX module. Please use the following chart to identify the appropriate MPAX module (including supply power) and LPAX Display that will satisfy your application.

SIGNAL TYPE	MPAX MODULES*		LPAX DISPLAYS	OPTIONAL PLUG-IN CARD COMPATABILITY			
	85-250 VAC	11 to 36 VDC / 24 VAC		SETPOINT	COMMS	ANALOG	REAL-TIME CLOCK
Count/Rate/Serial Slave	MPAXI020	MPAXI030	LPAX0600	YES	YES	YES	-
Count	MPAXC020	MPAXC030	LPAX0600	YES	-	-	-
Rate	MPAXR020	MPAXR030	LPAX0600	YES	-	-	-
Clock/Timer	MPAXCK00	MPAXCK10	LPAXCK00**	YES	YES	-	YES
Timer	MPAXTM00	MPAXTM10	LPAXCK00**	YES	YES	-	-

*For detailed module and plug-in card specifications, see corresponding PAX literature. (i.e. For MPAXI specifications, see the PAXI literature)

**The LPAXCK will only operate with the Clock/Timer MPAX input module.

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The MPAX series meters can be fitted with up to three optional plug-in cards. However, only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The cards can be installed initially or at a later date. Each optional plug-in card is shipped with installation and programming instructions.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson (for MPAXI) or SFPAX (for MPAXCK or MPAXTM), the RS232 or RS485 Cards must be used.

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC40 - Modbus (Terminal)
PAXCDC4C - Modbus (Connector)
PAXCDC50 - Profibus-DP

G

SETPOINT CARDS (PAXCDS)

The MPAX series has four setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

Dual relay, FORM-C, Normally open & closed
Quad relay, FORM-A, Normally open only
Isolated quad sinking NPN open collector
Isolated quad sourcing PNP open collector

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on the input, max, min, or total display value. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

PROGRAMMING SOFTWARE

CRIMSON - MPAXI Only

Crimson is a Windows® based program that allows configuration of the LPAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the LPAX meter. The LPAX program can then be saved in a PC file for future use. A PAX serial plug-in card is required to program the meter using the software.

SFPAX - MPAXCK and MPAXTM Only

The SFPAX is a Windows® based program that allows configuration of the LPAX meter from a PC. Using the SFPAX makes it easier to program the LPAX meter and allows saving the PAX program in a PC file for future use. On-line help is available within the software. A PAX serial plug-in card is required to program the meter using the software.

1.0 ASSEMBLING THE DISPLAY

CAUTION: *The MPAX main circuit board and the option cards contain static sensitive components. Before handling the module or the cards, discharge static charges from your body by touching a grounded bare metal object. Handle the module by the rear plastic cover only, and the option cards by the board edges. Dirt, oil or other contaminants that contact the circuit boards or components can adversely affect circuit operation.*

WARNING: *Exposed line voltage exists on the MPAX main circuit board and the option cards.* ***DO NOT*** *apply power to the module OR load circuits until the module is properly installed in the LPAX case.*

NOTE: *All module and option card labels must be installed as shown for safety purposes.*

Prior to installing the LPAX Display, it is recommended that the MPAX and any option cards be assembled first. This will allow you the opportunity to insure all the boards are fitted properly into their connectors.

Installing the Option Cards

If your application requires option cards, they should be installed into the MPAX before it is installed into the LPAX Display. Refer to the literature enclosed with the option cards for installation instruction.

Installing the MPAX

To install the MPAX Module, align the module with the opening in the LPAX case, as illustrated. The module must be oriented as shown, with terminal #1 toward the top of the LPAX case. Carefully slide the module into the LPAX case. The LPAX and MPAX connectors will begin to engage about ¼" from the bottom. At this point, apply a small amount of pressure to the rear of the MPAX module to fully engage the connection. Be sure the module fully snaps into the slots at the rear of the LPAX case. The display is ready for installation.

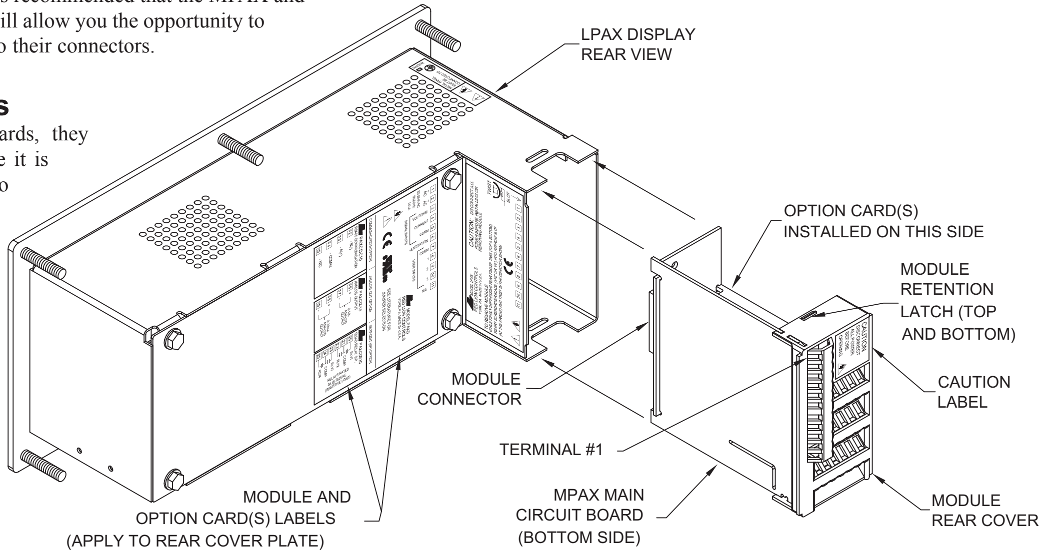


Figure 1, Installing an MPAX Module and Option Cards

Installing the Labels

Each option card and the MPAX are shipped with a connection label. These labels must be applied to the rear of the LPAX in the positions shown in the drawing.

Removing The MPAX Module

To remove the MPAX Module from the LPAX Display, first remove all power and load circuits. Then insert a flat screwdriver blade ($^{3}/_{16}$" or $^{1}/_{4}$") into the narrow slot between the LPAX rear cover plate and the module's plastic cover as illustrated in Figure 2. Twist the screwdriver in the direction shown to disengage the internal connectors while firmly squeezing and pulling back on the rear finger tabs (top and bottom). Carefully slide the module out of the LPAX case, keeping it properly aligned with the case opening.

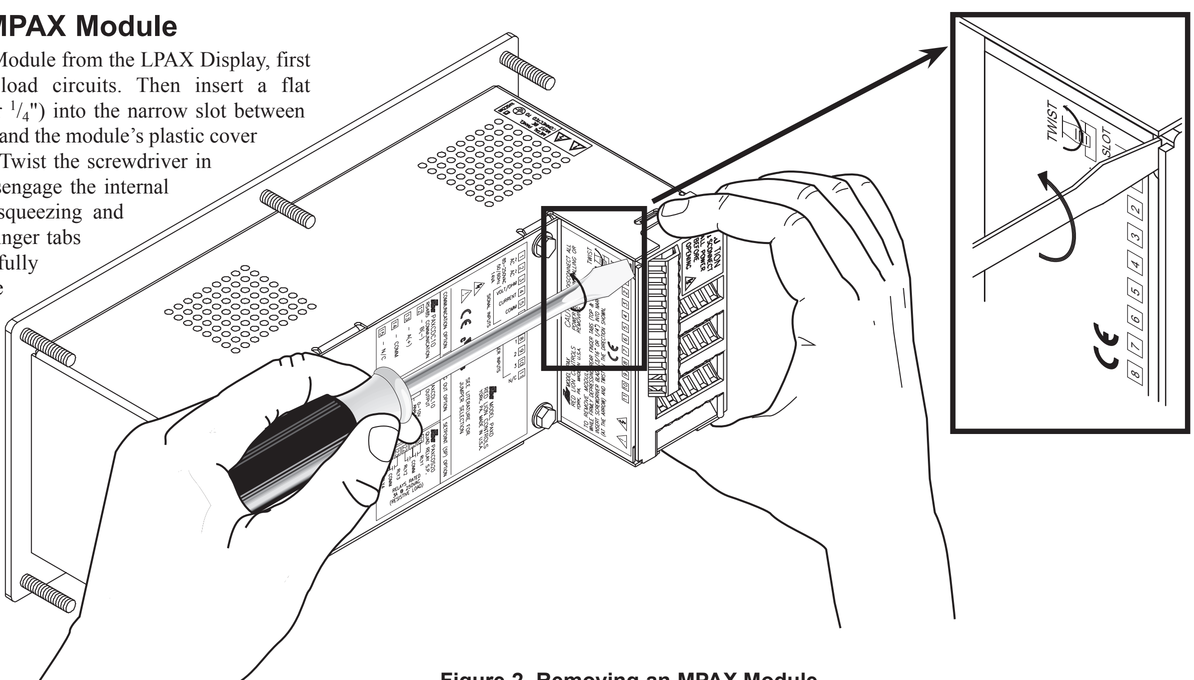


Figure 2, Removing an MPAX Module

G

2.0 INSTALLING THE DISPLAY

LPAX DISPLAY INSTALLATION

The LPAX display is intended to be mounted into a panel or enclosure. The display is provided with a gasket to provide a water-tight seal. The recommended minimum panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm).

For panel mounting, prepare the panel cut-out to the dimensions shown. The supplied template may be used to mark the cut-out and hole locations on the panel. After the panel cut-out has been deburred, slide the panel gasket over the rear of the display and onto the mounting studs. Insert the display into the panel cut-out as illustrated in Figure 3. Install six # 10-32 keps nuts (supplied) and tighten evenly for uniform gasket compression. Do not over-tighten the nuts.

By using additional mounting accessories, the LPAX can be surface-wall mounted, suspended, or bottom mounted. Separate installation instructions are provided with the mounting accessories.

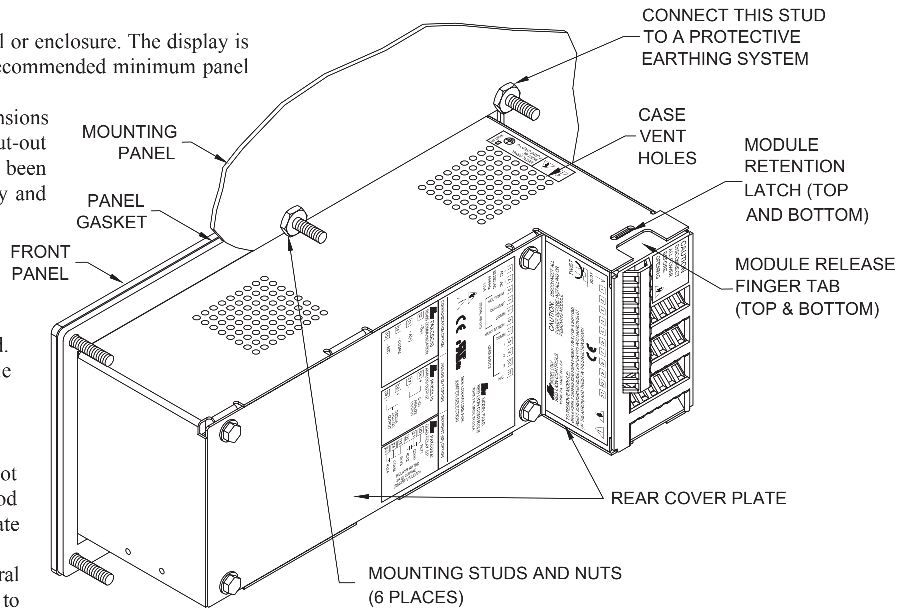


Figure 3, Installing The LPAX Into A Panel

Environment And Cleaning

The display should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the system near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

3.0 WIRING AND PROGRAMMING THE DISPLAY

Once assembled, the LPAX and MPAX have all the same functions and capabilities of our PAX Series Intelligent Panel Meters. Therefore, you will find the appropriate PAX information packed with the MPAX Module. Simply follow the instructions to wire and program the display for your application.

TROUBLESHOOTING

For technical assistance, contact technical support.

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Display	LPAX	6-Digit Display for Digital MPAX Modules	LPAX0600
		6-Digit Display for MPAXCK (Clock/Timer) and MPAXTM Only	LPAXCK00
Digital Input Module	MPAX	Count/Rate Indicator Module, AC Powered	MPAXI020
		Count/Rate Indicator Module, DC/24 VAC Powered	MPAXI030
		Count Indicator Module, AC Powered	MPAXC020
		Count Indicator Module, DC/24 VAC Powered	MPAXC030
		Rate Indicator Module, AC Powered	MPAXR020
		Rate Indicator Module, DC/24 VAC Powered	MPAXR030
		Clock/Timer Module, AC Powered	MPAXCK00
		Clock/Timer Module, DC/24 VAC Powered	MPAXCK10
		Timer Module, AC Powered	MPAXTM00
		Timer Module, DC/24 VAC Powered	MPAXTM10
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC*	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL*	Analog Output Card	PAXCDL10
	PAXUSB*	PAX USB Programming Card (Not included in PAX product UL E179259 file).	PAXUSB00
	PAXRTC*	Real Time Clock Card for MPAXCK (Clock/Timer) Only	PAXRTC00
Accessories	SFCRD**	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP (for MPAXI)	SFCRD200
	ENC9	NEMA 4 Enclosure for LPAX	ENC90000
	SHR	Shroud for LPAX	SHRLPAX0
	MB	Mounting Bracket for LPAX	MBLPAX00

*Refer to "Selecting Your Display Components and Option Cards."
**Available as a FREE download from the Red Lion website. www.redlion.net

G

MODEL LPAXDA- 5 DIGIT LARGE PAX DISPLAY FOR DUAL ANALOG INPUTS

- *LARGE LED DISPLAY READABLE TO 70 FEET*
- *DUAL PROCESS SIGNAL INPUT MODULE*
- *ALARMS, ANALOG OUTPUT, AND COMMUNICATION*
- *CUSTOM UNITS LABEL WITH BACKLIGHT*
- *PROGRAMMABLE USER INPUTS*
- *PROGRAMMABLE FUNCTION KEYS*
- *UNIVERSAL AC/DC POWERED MODELS*
- *CRIMSON SOFTWARE FOR METER CONFIGURATION*
- *NEMA 4/IP65*

C UL US LISTED
IND. CONT. EQ.
51EB

GENERAL DESCRIPTION

The LPAXDA Display is a versatile display that can increase productivity by offering the plant floor or production area a large visual display of their current status. With the use of a units label and backlighting, the display can be tailored to show the actual engineering unit, which further enhances the display. This LPAXDA display accepts various analog inputs through the use of input modules (MPAXDP) which allow the unit to adapt to most any application. The MPAXDP Modules offer the same features as our highly successful PAXDP Series Panel Meters. Additional plug-in option cards can add alarms, analog output, and communication/bus capabilities, making the LPAXDA a truly Intelligent Panel Meter.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

CAUTION: Read complete instructions prior to installation and operation of the unit.

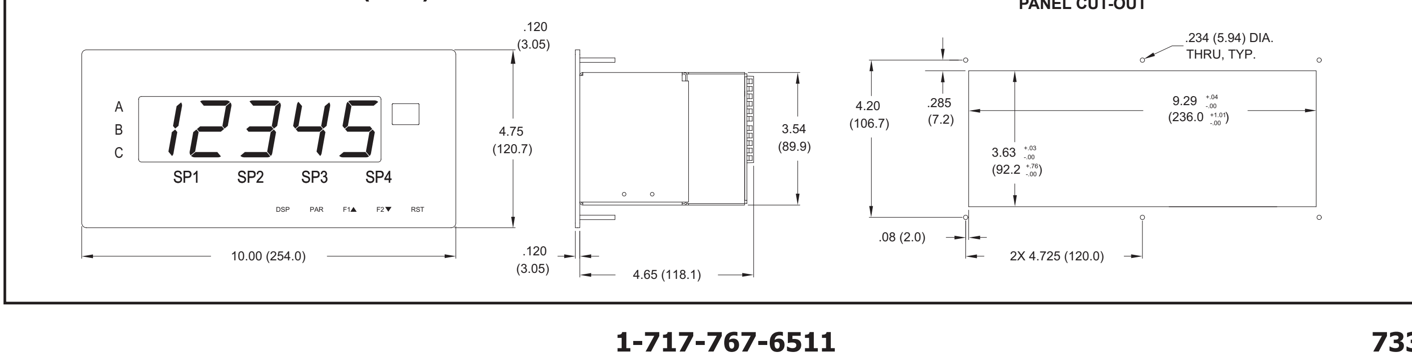
CAUTION: Risk of electric shock.

SPECIFICATIONS

Additional specifications, wiring, programming, and information for the individual MPAX models are contained in the corresponding standard PAX literature. This PAX literature is shipped with the ordered MPAX model.

1. **DISPLAY**: 1.5" (38 mm) Red LED
   5-Digit: (-19999 to 99999)
2. **POWER REQUIREMENTS**:
   AC Modules: 85 to 250 VAC, 50/60 Hz, 21 VA
   DC Modules: 18 to 36 VDC, 13 W or 24 VAC ±10%, 50/60 Hz, 16 VA
3. **INPUT**: Accepts analog input modules, see “Selecting your display components.”
4. **ANNUNCIATORS**:
   LPAXDA00: A, B, C, SP1, SP2, SP3, and SP4
   Optional units label with backlight
5. **KEYPAD**: Five tactile membrane switches integrated into the front panel
6. **CERTIFICATIONS AND COMPLIANCES**:
   UL Recognized Component, File #E179259, UL3101-1, CSA 22.2 No. 1010-1
      Recognized to US and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
      LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
   Type 4 Enclosure rating (Face only), UL50
   IECEE CB Scheme Test Certificate #UL/8843/UL
      CB Scheme Test Report #04ME11209-20041018
         Issued by Underwriters Laboratories, Inc.
      IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
      IP65 Enclosure rating (Face only), IEC 529
   ELECTROMAGNETIC COMPATIBILITY
      EMC specifications determined by the MPAX module.
   WARNING: Disconnect all power to the unit before installing

DIMENSIONS In inches (mm)



G

7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: Determined by the MPAX module
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% max. RH (non-condensing)
Altitude: Up to 2000 meters
8. **MOUNTING REQUIREMENTS**:
Max. panel thickness is 0.375" (9.5 mm)
Min. panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm)
9. **MODULE INSTALLATION**:
24-pin shrouded connector on LPAX engages connector on MPAX module upon installation. Shroud ensures proper alignment by providing a lead-in for the module connector.
10. **CONNECTIONS**: All wiring connections are made to the MPAX module via high compression cage-clamp terminal blocks. Wiring instructions are provided with the MPAX module.

CAUTION: DISCONNECT ALL POWER BEFORE INSTALLING OR REMOVING MODULE

11. **CONSTRUCTION**: Steel front panel, enclosure, and rear cover with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4/IP65 specifications for indoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and keps nuts included.
12. **WEIGHT**: 2.7 lbs (1.2 kg) (*less module*)

About the MPAX Input Modules

The MPAX Module serves as the input to the LPAX Display. The MPAX module provides input scaling which allows the LPAX to display most any engineering unit. Once the MPAX is inserted into the LPAX, the unit has the same functions and capabilities of our PAX Series Intelligent Panel Meters. A full set of PAX programming instructions will be included with the MPAX Module.

Note: The MPAX provides the operating power for the LPAX, therefore you must select either the AC or DC MPAX corresponding with your application and available power.

Selecting Your Display Components

To build a complete display unit, you will need an LPAXDP and an MPAXDP Input Module. The LPAX is only a display and will not operate without an MPAX Module. Please use the following chart to identify the appropriate MPAX Module (including supply power) and LPAX Display that will satisfy your application.

SIGNAL TYPE	INPUT RANGES	MPAX MODULES *		LPAX DISPLAY
		85-250 VAC	11 to 36 VDC/ 24 VAC	
Dual Process Inputs	0-20 mA or 0-10 VDC	MPAXDP00	MPAXDP10	LPAXDA00

*For detailed Module specifications, see corresponding PAX literature. (i.e. For MPAXDP specifications, see the PAXDP literature)

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

Plug-in cards.

Adding Option Cards

The MPAX series meters can be fitted with up to three optional plug-in cards. However, only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The cards can be installed initially or at a later date. Each optional plug-in card is shipped with installation and programming instructions.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, a Windows® based program, the RS232 or RS485 Cards must be used.

PAXCDC1* - RS485 Serial
PAXCDC2* - RS232 Serial
PAXCDC30 - DeviceNet
PAXCDC4* - Modbus
PAXCDC50 - Profibus-DP

*Units available in various connector configurations.

SETPOINT CARDS (PAXCDS)

The MPAX series has four setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on the input, max, min, or total display value. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

UNITS LABEL (LX)

The LPAX Display has an area on the front panel designed for a custom units label. The units label is applied directly to the panel in the embossed area. The units backlight is then turned on via programming.

Refer to the LPAX Accessories Bulletin for a list of available units labels.

PROGRAMMING SOFTWARE

Crimson 2 (SFCRD2) is a Windows® based program for configuring and updating the firmware of the MPAXDP meter from a PC. Using Crimson 2 makes programming the MPAXDP meter easier and allows the user to save the MPAXDP database in a PC file for future use. Crimson is available as a free download from Red Lion's website, or it can be purchased on CD.

The first time Crimson 2 is run from the File menu, select "New" to display a dialog and select the MPAXDP. The screen will display icons that represent the various programming sections of the MPAXDP. Double-click on an icon to configure the programming parameters pertaining to the selection. Tool Tip help is available for each of the program parameters. A PAX serial plug-in card is required to program the meter using the software.

1.0 ASSEMBLING THE DISPLAY

CAUTION: The MPAX main circuit board and the option cards contain static sensitive components. Before handling the module or the cards, discharge static charges from your body by touching a grounded bare metal object. Handle the module by the rear plastic cover only, and the option cards by the board edges. Dirt, oil or other contaminants that contact the circuit boards or components can adversely affect circuit operation.

WARNING: Exposed line voltage exists on the MPAX main circuit board and the option cards. ***DO NOT*** *apply power to the module OR load circuits until the module is properly installed in the LPAX case.*

NOTE*: All module and option card labels must be installed as shown for safety purposes.*

Prior to installing the LPAX Display, it is recommended that the MPAX and any option cards be assembled first. This will allow you the opportunity to insure all the boards are fitted properly into their connectors.

Installing the Option Cards

If your application requires option cards, they should be installed into the MPAX before it is installed into the LPAX Display. Refer to the literature enclosed with the option cards for installation instruction.

Installing the MPAX

To install the MPAX Module, align the module with the opening in the LPAX case, as illustrated. The module must be oriented as shown, with terminal #1 toward the top of the LPAX case. Carefully slide the module into the LPAX case. The LPAX and MPAX connectors will begin to engage about ¼" from the bottom. At this point, apply a small amount of pressure to the rear of the MPAX module to fully engage the connection. Be sure the module fully snaps into the slots at the rear of the LPAX case. The display is ready for installation.

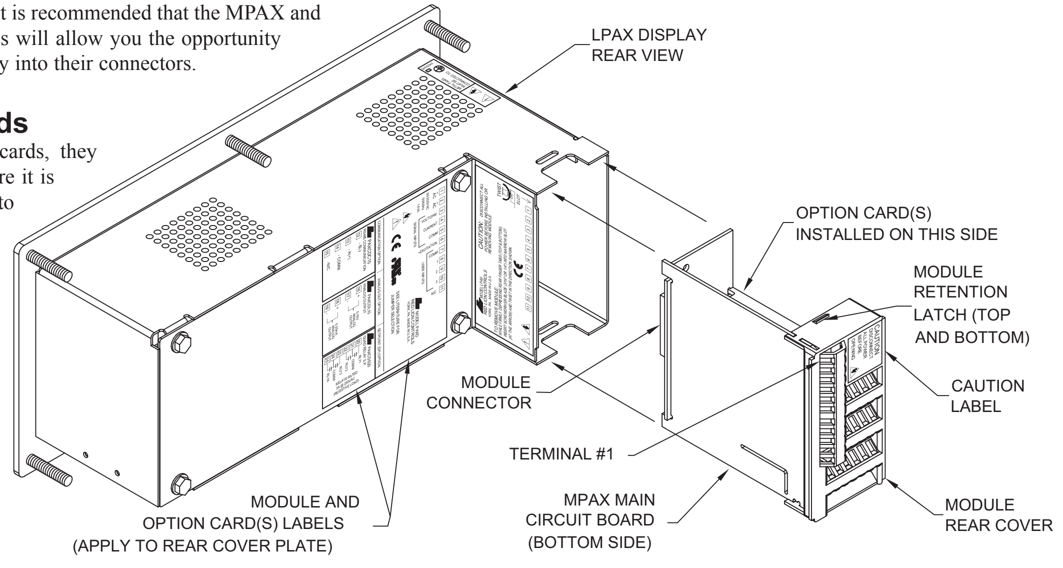


Figure 1, Installing an MPAX Module and Option Cards

Installing the Labels

Each option card and the MPAX are shipped with a connection label. These labels must be applied to the rear of the LPAX in the positions shown in the drawing.

Removing The MPAX Module

To remove the MPAX Module from the LPAX Display, first remove all power and load circuits. Then insert a flat screwdriver blade ($^{3}/_{16}$" or $^{1}/_{4}$") into the narrow slot between the LPAX rear cover plate and the module's plastic cover as illustrated in Figure 2. Twist the screwdriver in the direction shown to disengage the internal connectors while firmly squeezing and pulling back on the rear finger tabs (top and bottom). Carefully slide the module out of the LPAX case, keeping it properly aligned with the case opening.

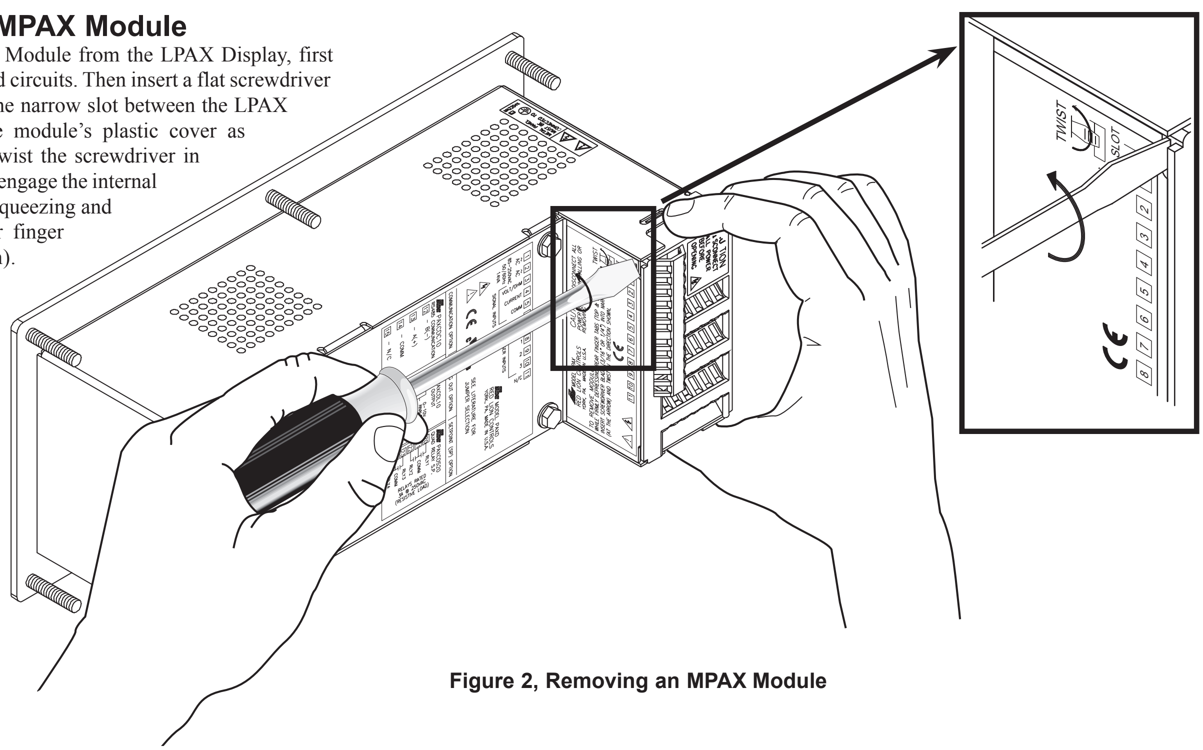


Figure 2, Removing an MPAX Module

G

2.0 INSTALLING THE DISPLAY

LPAX DISPLAY INSTALLATION

The LPAX display is intended to be mounted into a panel or enclosure. The display is provided with a gasket to provide a water-tight seal. The recommended minimum panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm).

For panel mounting, prepare the panel cut-out to the dimensions shown. The supplied template may be used to mark the cut-out and hole locations on the panel. After the panel cut-out has been deburred, slide the panel gasket over the rear of the display and onto the mounting studs. Insert the display into the panel cut-out as illustrated in Figure 3. Install six # 10-32 keps nuts (supplied) and tighten evenly for uniform gasket compression. Do not over-tighten the nuts.

By using additional mounting accessories, the LPAX can be surface-wall mounted, suspended, or bottom mounted. Separate installation instructions are provided with the mounting accessories.

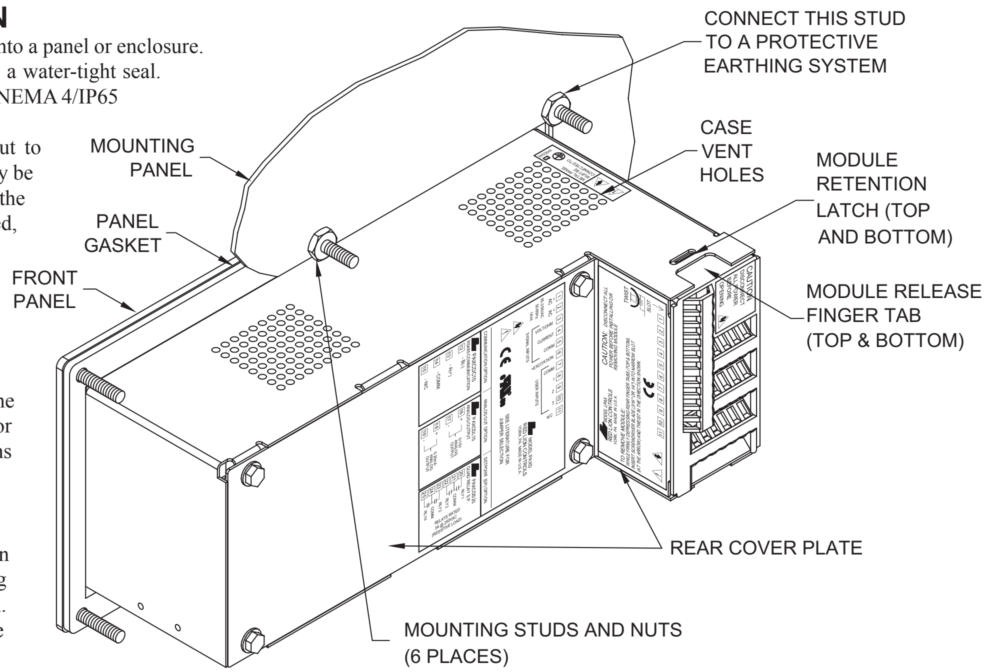


Figure 3, Installing The LPAX Into A Panel

Environment And Cleaning

The display should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the system near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

3.0 WIRING AND PROGRAMMING THE DISPLAY

Once assembled, the LPAX and MPAX have all the same functions and capabilities of our PAX Series Intelligent Panel Meters. Therefore, you will find the appropriate PAX information packed with the MPAX Module. Simply follow the instructions to wire and program the display for your application.

TROUBLESHOOTING

For technical assistance, contact technical support.

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Display	LPAXDA	5-Digit, Large Display for Analog MPAXDP Modules	LPAXDA00
Analog Input Module	MPAXDP	Dual Process Input Module, AC Powered	MPAXDP00
		Dual Process Input Module, DC/24 VAC Powered	MPAXDP10
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	LX	Custom Units Label *	Listed Separately
	SFCRD2	PC Configuration Software for Windows 98, ME, 2000, XP	SFCRD200
	ENC9	NEMA 4 Enclosure for LPAX	ENC90000
	SHR	Shroud for LPAX	SHRLPAX0
	MB	Mounting Bracket for LPAX	MBLPAX00

* See the LPAX Accessory Bulletin or our web site for available units labels.

MODEL EPAX- 5 DIGIT EXTRA LARGE PAX DISPLAY FOR ANALOG INPUTS

c UL US LISTED
IND. CONT. EQ.
51EB

- *LARGE LED DISPLAY READABLE TO 180 FEET*
- *VARIOUS ANALOG INPUT MODULES;*
  - *DC VOLTAGE AND CURRENT*
  - *PROCESS SIGNALS*
  - *TRUE RMS VOLTAGE AND CURRENT*
  - *THERMOCOUPLE OR RTD*
  - *STRAIN GAGE/BRIDGE*
- *ALARMS, ANALOG OUTPUT, AND COMMUNICATION*
- *PROGRAMMABLE USER INPUTS*
- *UNIVERSAL AC POWERED (85 to 250 VAC)*
- *CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65*

GENERAL DESCRIPTION

The EPAX is a versatile display that can increase productivity by offering the plant floor or production area a large visual display of their current status. Whether your measurement is voltage, current, process, temperature, or strain gage, the EPAX can satisfy your requirement. The EPAX accepts various analog inputs through the use of input modules (MPAX) which allow the unit to adapt to most any application. The MPAX Modules offer the same features as our highly successful PAX Series Panel Meters. Additional plug-in option cards can add alarms, analog output, and communication/bus capabilities, making the EPAX a truly Intelligent Panel Meter.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

CAUTION: Risk of Danger
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

Additional specifications, wiring, programming, and information for the individual MPAX models are contained in the corresponding standard PAX literature. This PAX literature is shipped with the ordered MPAX model.

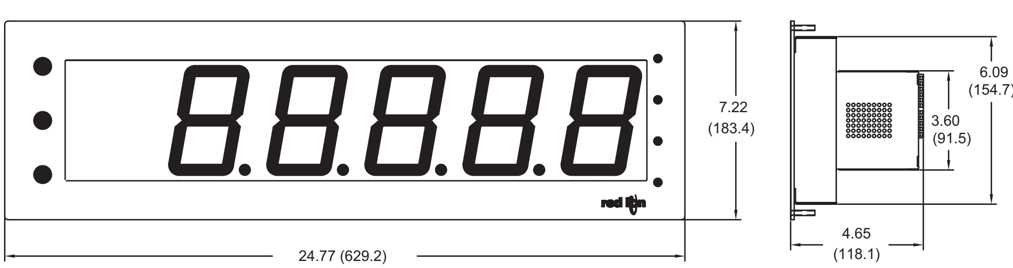
1. **DISPLAY**: 4" (101 mm) Red LED
   5-Digit (EPAX0500): -19999 to 99999
2. **POWER REQUIREMENTS**:
   AC MPAX Modules: 85 to 250 VAC, 50/60 Hz, 18 VA
   EPAX Display: 85 to 250 VAC, 50/60 Hz, 10 VA
3. **INPUT**: Accepts analog input modules, see "Selecting Your Display Components and Option Cards."
4. **ANNUNCIATORS**:
   Display Indication: Three vertical dots on the left side of the unit identify the displays for the following modes:

TOP	Maximum
MIDDLE	Minimum
BOTTOM	Total

   Setpoint Indication: Four vertical dots on the right side of the unit identify the setpoint "ON" condition, with SP 1 being the top position through SP 4 at the bottom.
5. **EPAX Programming**: The unit is a large display, designed to be remotely mounted. Therefore, the unit does not have a programming keypad. Unit programming should be accomplished by one of the following methods:
   Rear Terminal Block: External switches can be wired via the terminal block to allow unit programming. A minimum of 3 switches would be required.
   Optional Programming Remote (EPAXPGM0): This option provides a 10 foot interconnecting cable and programming box. The Programming Remote contains buttons similar to the PAX, allowing easy programming of the EPAX display.
   Optional Serial Programming: Like all PAX units, you can purchase an RS232 or RS485 Comms Card and program the unit via Crimson, a Windows® based software program.

G

DIMENSIONS In inches (mm)



6. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 1010-1
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Indoor Enclosure rating (Face only), UL50
IECEE CB Scheme Test Certificate #US/8843A/UL
CB Scheme Test Report #04ME11209-20041018
Issued by Underwriters Laboratories, Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY
EMC specifications determined by the MPAX module.
7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: Determined by the MPAX module
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% max. RH (non-condensing)
Altitude: Up to 2000 meters
8. **MOUNTING REQUIREMENTS**:
Max. panel thickness is 0.375" (9.5 mm)
Min. panel thickness for NEMA 4/IP65 sealing is 0.060" (1.52 mm)
9. **MODULE INSTALLATION**:
24-pin shrouded connector on EPAX engages connector on MPAX module upon installation. Shroud ensures proper alignment by providing a lead-in for the module connector.
10. **CONNECTIONS**: Wiring connections are made to the EPAX terminal block and MPAX module via high compression cage-clamp terminal blocks.
MPAX Module Wiring: Instructions are provided in the corresponding PAX Bulletin.
EPAX Terminal Block Wiring:
Wire Strip Length: 0.3" (7.5 mm)
Wire Gage: 30-12 AWG copper wire
Maximum Torque: 5-7 inch-lbs (0.58-0.81 N-m)

CAUTION: DISCONNECT ALL POWER BEFORE INSTALLING OR REMOVING MODULE

11. **CONSTRUCTION**: Aluminum front panel, enclosure, and rear cover with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4X/IP65 specifications for indoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and keps nuts included.
12. **WEIGHT**: 5 lbs (2.25 kg) (*less module*)

About the MPAX Input Modules

The MPAX Module serves as the input to the EPAX Display. There are several different modules to cover a variety of inputs. The MPAX module provides input scaling which allows the EPAX to display most any engineering unit. Once the MPAX is inserted into the EPAX, the unit has the same functions and capabilities of our PAX Series Intelligent Panel Meters. A full set of PAX programming instructions will be included with the MPAX module.

Selecting Your Display Components and Option Cards

To build a complete display unit, you will need an EPAX and an MPAX Input Module. The EPAX is only a display and will not operate without an MPAX module. Please use the following chart to identify the appropriate MPAX module and EPAX Display that will satisfy your application.

SIGNAL TYPE	MPAX MODULES*	EPAX DISPLAYS	OPTIONAL PLUG-IN CARD COMPATABILITY		
	85-250 VAC		SETPOINT	COMMS	ANALOG
Universal DC Inputs	MPAXD000	EPAX0500	YES	YES	YES
Process Inputs	MPAXP000	EPAX0500	YES	YES	YES
Temperature Inputs	MPAXT000	EPAX0500	YES	YES	YES
Strain Gage/Loadcell	MPAXS000	EPAX0500	YES	YES	YES
True RMS AC Voltage/Current	MPAXH000	EPAX0500	YES	YES	YES
Dual Process Inputs	MPAXDP00	EPAX0500	YES	YES	YES

* For detailed module and plug-in card specifications, see corresponding PAX literature. (i.e. For MPAXD specifications, see the PAXD literature)

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section of the PAX Bulletin. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

SETPOINT ALARMS PLUG-IN CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

ANALOG OUTPUT PLUG-IN CARD (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slopes output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

COMMUNICATION PLUG-IN CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, the RS232 or RS485 Cards must be used.

PAXCDC10 - RS485 Serial (Terminal) PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal) PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC40 - Modbus (Terminal) PAXCDC4C - Modbus (Connector)
PAXCDC50 - Profibus-DP

PROGRAMMING SOFTWARE

Crimson is a Windows® based program that allows configuration of the EPAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the EPAX meter. The EPAX program can then be saved in a PC file for future use. A PAX serial plug-in card is required to program the meter using the software.

1.0 ASSEMBLING THE DISPLAY

CAUTION: *The MPAX main circuit board and the option cards contain static sensitive components. Before handling the module or the cards, discharge static charges from your body by touching a grounded bare metal object. Handle the module by the rear plastic cover only, and the option cards by the board edges. Dirt, oil or other contaminants that contact the circuit boards or components can adversely affect circuit operation.*

WARNING: *Exposed line voltage exists on the MPAX main circuit board and the option cards.* ***DO NOT*** *apply power to the module OR load circuits until the module is properly installed in the EPAX case.*

NOTE: *All module and option card labels must be installed as shown for safety purposes.*

Prior to installing the EPAX Display, it is recommended that the MPAX and any option cards be assembled first. This will allow you the opportunity to insure all the boards are fitted properly into their connectors.

Installing the Option Cards

If your application requires option cards, they should be installed into the MPAX before it is installed into the EPAX Display. Refer to the literature enclosed with the option cards for installation instruction.

Installing the MPAX

Remove the MPAX case (plastic) from the rear of the EPAX by removing the two screws and pulling off the metal holding bracket. Install the MPAX into plastic case by aligning the front connector of the MPAX with the hole in the front of the plastic case. The module must be oriented as shown with terminal #1 toward the top of the EPAX case. Next, insert the MPAX case into the EPAX by lightly pushing the connector of the MPAX into the connector of the EPAX PC board. Place holding bracket over the plastic case and install the two screws.

Installing the Labels

Each option card and the MPAX are shipped with a connection label. These labels must be applied to the rear of the EPAX in the positions shown in the drawing.

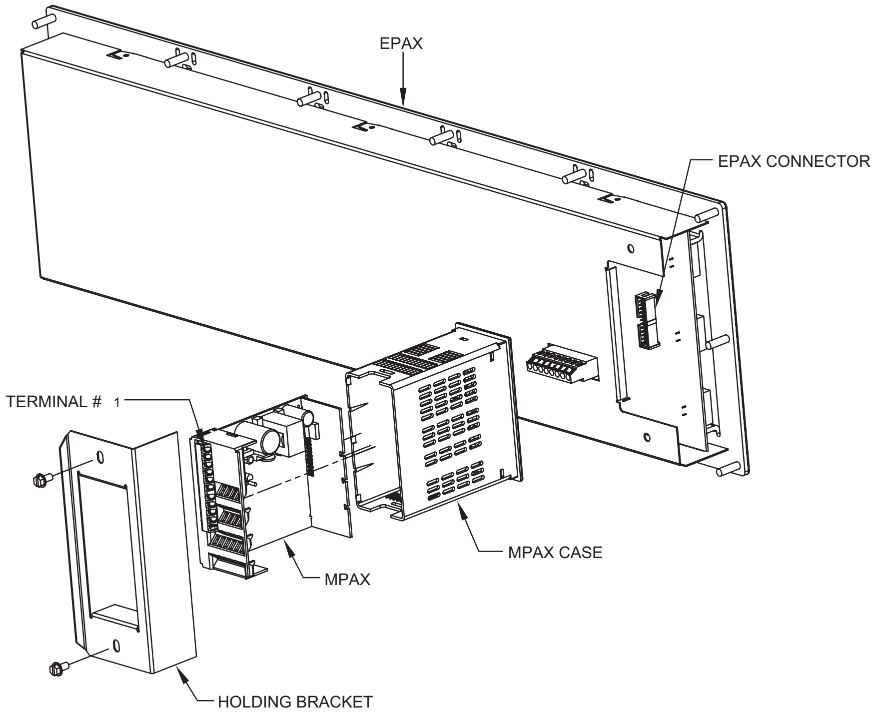


Figure 1, Installing an MPAX Module and Option Cards

Removing The MPAX Module

To remove the MPAX Module from the EPAX Display, first remove all power and load circuits. Then insert a flat screwdriver blade ($^{3}/_{16}$" or $^{1}/_{4}$") into the narrow slot between the EPAX rear cover plate and the module's plastic cover as illustrated in Figure 2. Twist the screwdriver in the direction shown to disengage the internal connectors while firmly squeezing and pulling back on the rear finger tabs (top and bottom). Carefully slide the module out of the EPAX case, keeping it properly aligned with the case opening.

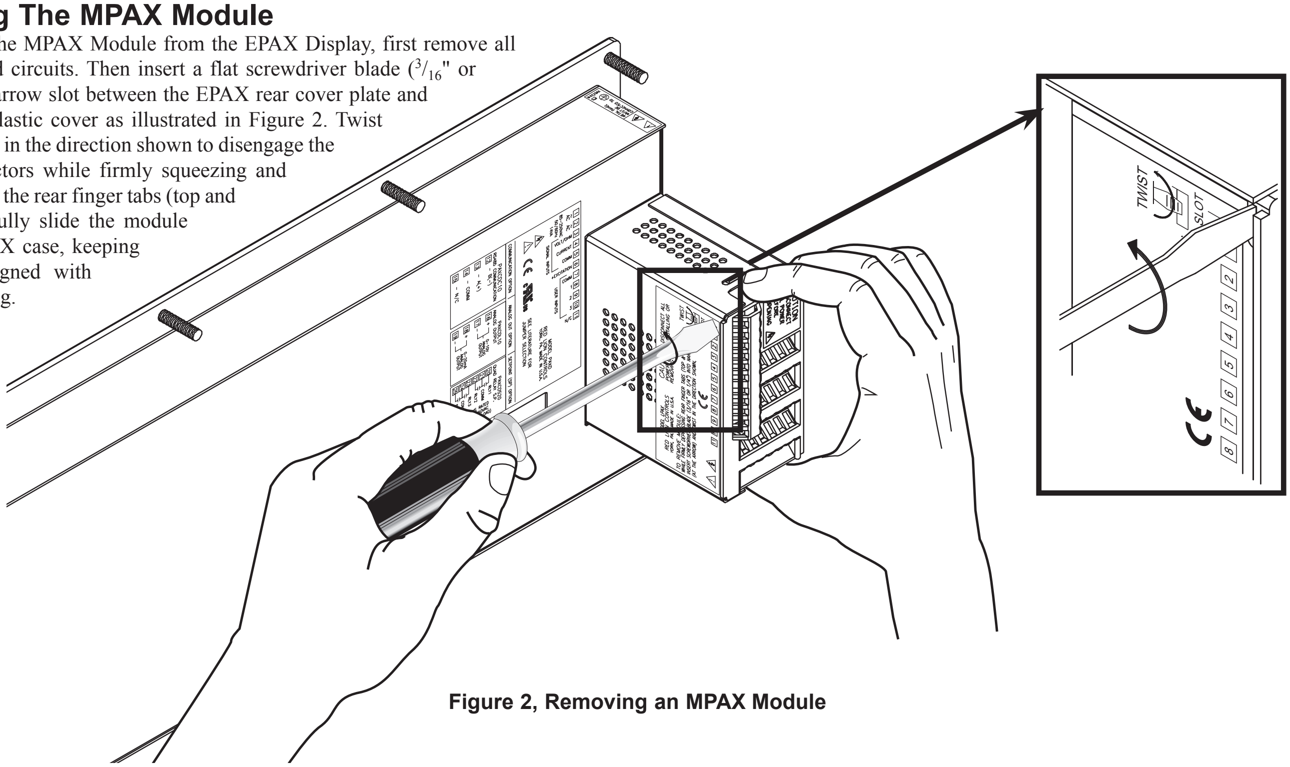


Figure 2, Removing an MPAX Module

2.0 INSTALLING THE DISPLAY

EPAX DISPLAY INSTALLATION

The EPAX display is intended to be mounted into a panel or enclosure. The display is provided with a gasket to provide a water-tight seal. The recommended minimum panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm).

For panel mounting, prepare the panel cut-out to the dimensions shown in Figure 3. The supplied template may be used to mark the cut-out and hole locations on the panel. After the panel cut-out has been deburred, slide the panel gasket over the rear of the display and onto the mounting studs. Insert the display into the panel cut-out as illustrated in Figure 4. Install 14 # 10-32 keps nuts (supplied) and tighten evenly for uniform gasket compression. Do not over-tighten the nuts.

By using additional mounting accessories, the EPAX can be surface-wall mounted, suspended, or bottom mounted. Separate installation instructions are provided with the mounting accessories.

DIMENSIONS In inches (mm)

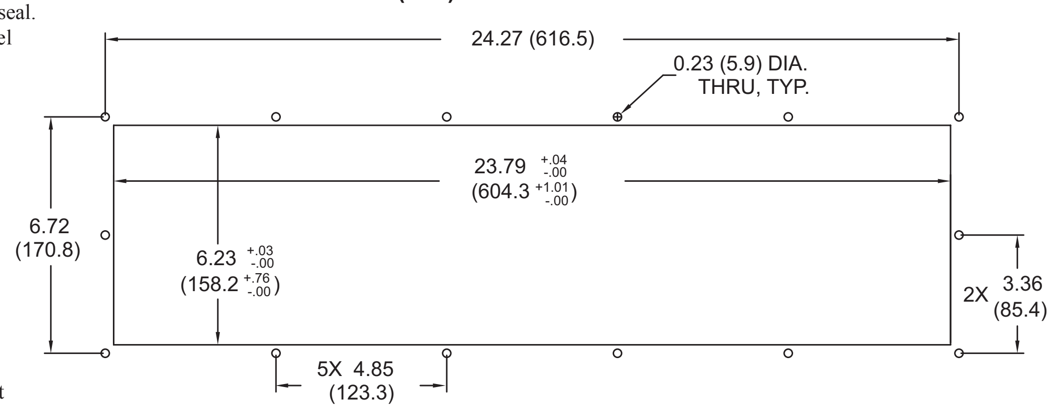


Figure 3, Panel Cut-out for the EPAX

Environment And Cleaning

The display should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the system near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

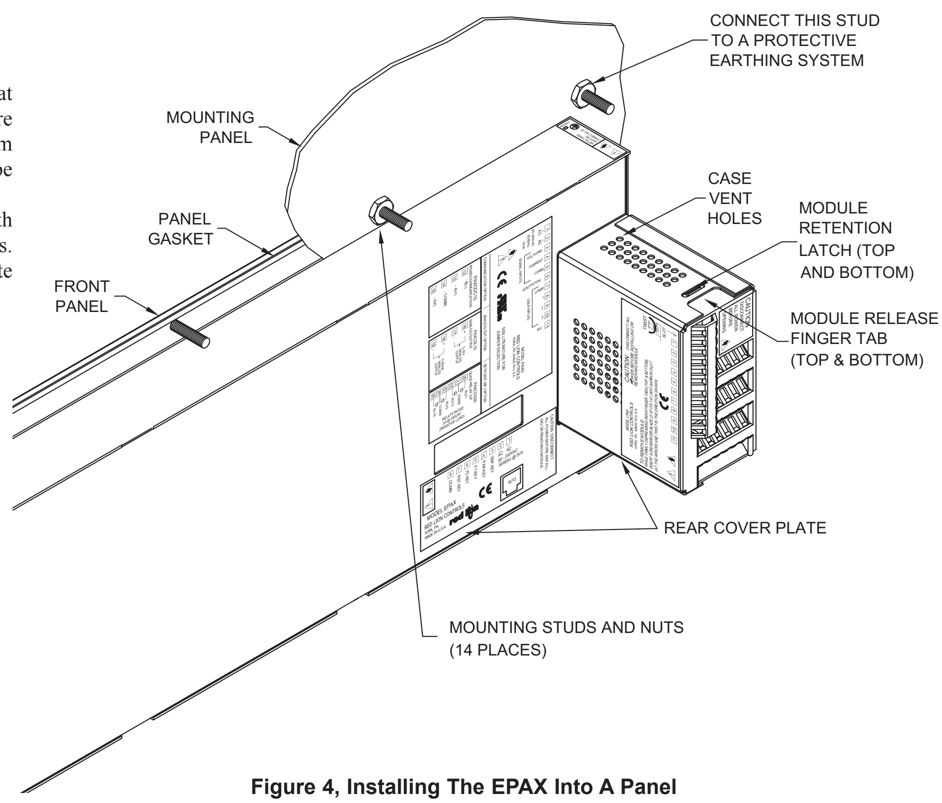


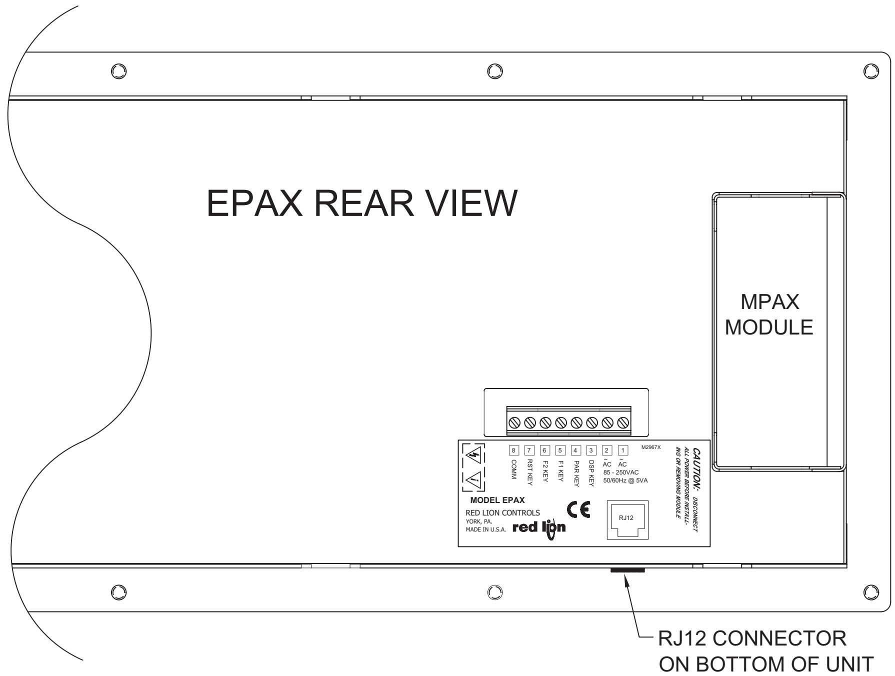
Figure 4, Installing The EPAX Into A Panel

G

3.0 WIRING AND PROGRAMMING THE DISPLAY

Once assembled, the EPAX and MPAX have all the same functions and capabilities of our PAX Series Intelligent Panel Meters. Therefore, you will find the appropriate PAX information packed with the MPAX Module. Simply follow the instructions to wire and program the display for your application.

Note: Both the EPAX and the MPAX module require power. It is recommended to connect the primary AC power to the EPAX terminal block, then jumper to the MPAX module.



EPAX PROGRAMMING

The unit is a large display, designed to be remotely mounted. Therefore, the unit does not have a programming keypad. Unit programming must be accomplished by one of the following three methods:

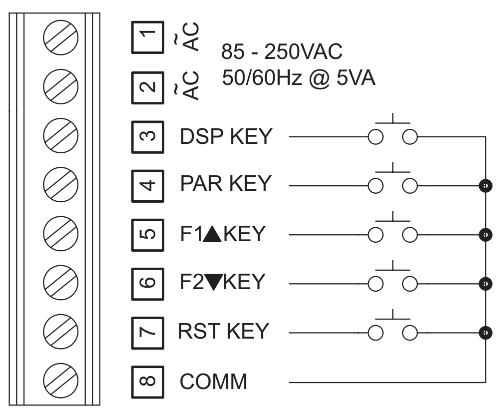
Optional Programming Remote (EPAXPGM0)

This optional programming remote plugs into the EPAX through an RJ12 connector and a 10 foot cable. The buttons on the programming box function the same as the PAX unit. Simply program the EPAX exactly as the PAX instructions indicate. The programming box can be left connected to the EPAX for future programming changes or can be disconnected and used to program additional EPAX units.

Rear Terminal Block

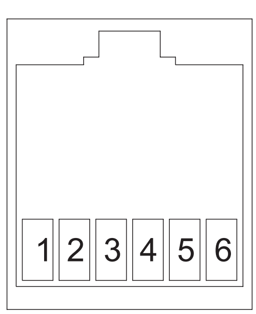
External normally open switches can be wired via the terminal block to allow unit programming. A minimum of 3 switches would be required. Each external switch must be wired between the key and the common terminal.

EPAX TERMINAL BLOCK



RJ12 CONNECTOR ON BOTTOM OF UNIT

RJ12 FEMALE	
PIN	NAME
1	DSP KEY
2	PAR KEY
3	F1 KEY
4	F2 KEY
5	RST KEY
6	COMM



Optional Serial Programming

Like all PAX units, you can purchase an RS232 or RS485 Communications Card and program the unit via Crimson, a Windows® based software program.

G

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Display	EPAX	5-Digit Extra Large Display for Analog MPAX Modules	EPAX0500
Analog Input Module	MPAX	Universal DC Input Module, AC Powered	MPAXD000
		Dual Process Input Module, AC Powered	MPAXDP00
		Process Input Module, AC Powered	MPAXP000
		Thermocouple and RTD Module, AC Powered	MPAXT000
		AC True RMS Voltage and Current Module, AC Powered	MPAXH000
		Strain Gage/Bridge Input Module, AC Powered	MPAXS000
Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
Plug-In Cards	PAXCDC*	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card (Terminal Block)	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL*	Analog Output Card	PAXCDL10
Accessories	PGM	Programming Remote for EPAX with 10 foot cable	EPAXPGM0
	SFCRD**	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200
	ENC12	NEMA 4/IP65 Enclosure for EPAX	ENC12000
	SHR	Shroud for EPAX	SHREPAX0
	EN/SH	EPAX NEMA 4/IP65 Enclosure and Shroud	EPAXENSH

*Refer to “Selecting Your Display Components and Option Cards.”
**Crimson software is available for download from http://www.redlion.net/

TROUBLESHOOTING

For technical assistance, contact technical support.

G

MODEL EPAX- 6 DIGIT EXTRA LARGE PAX DISPLAY FOR DIGITAL INPUTS

c UL US LISTED
IND. CONT. EQ.
51EB

- LARGE LED DISPLAY READABLE TO 180 FEET
- VARIOUS DIGITAL INPUT MODULES;
  COUNT AND RATE INPUT
  CLOCK/TIMER
  SERIAL SLAVE
- ALARMS, ANALOG OUTPUT, AND COMMUNICATION
- PROGRAMMABLE USER INPUTS
- UNIVERSAL AC POWERED (85 to 250 VAC)
- PC SOFTWARE FOR METER CONFIGURATION
- NEMA 4X/IP65

GENERAL DESCRIPTION

The EPAX Display is a versatile display that can increase productivity by offering the plant floor or production area a large visual display of their current status. Whether your measurement is rate, count, or time, the EPAX can satisfy your requirement. The EPAX displays accept various digital inputs through the use of input modules (MPAX) which allow the unit to adapt to most any application. The MPAX Modules offer the same features as our highly successful PAX Series Panel Meters. Additional plug-in option cards can add alarms, analog output, and communication/bus capabilities, making the EPAX a truly Intelligent Panel Meter.

SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

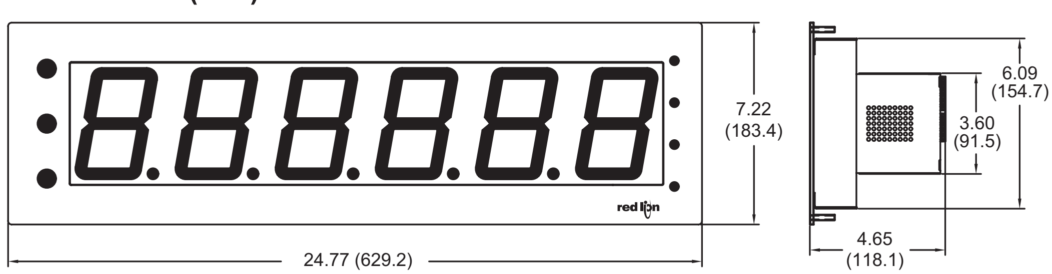
Additional specifications, wiring, programming, and information for the individual MPAX models are contained in the corresponding standard PAX literature. This PAX literature is shipped with the ordered MPAX model.

1. **DISPLAY**: 4" (101 mm) Red LED
   6-Digit (EPAX0600): (-99999 to 999999)
2. **POWER REQUIREMENTS**:
   AC MPAX Modules: 85 to 250 VAC, 50/60 Hz, 18 VA
   EPAX Display: 85 to 250 VAC, 50/60 Hz, 10 VA
3. **INPUT**: Accepts digital input modules, see "Selecting Your Display Components and Option Cards."
4. **ANNUNCIATORS**:
   Display Indication: Three vertical dots on the left side of the unit identify the displays for the following modules:

	COUNT/RATE	CLOCK
TOP	Display A	Timer
MIDDLE	Display B	Count
BOTTOM	Display C	Date

   Setpoint Indication: Four vertical dots on the right side of the unit identify the setpoint "ON" condition, with SP 1 being the top position through SP 4 at the bottom.
5. **EPAX Programming**: The unit is a large display, designed to be remotely mounted. Therefore, the unit does not have a programming keypad. Unit programming should be accomplished by one of the following methods:
   Rear Terminal Block: External switches can be wired via the terminal block to allow unit programming. A minimum of 3 switches would be required.
   Optional Programming Remote (EPAXPGM0): This option provides a 10 foot interconnecting cable and programming box. The Programming Remote contains buttons similar to the PAX, allowing easy programming of the EPAX display.
   Optional Serial Programming: Like all PAX units, you can purchase an RS232 or RS485 Comms Card and program the unit via Windows® based software programs.

DIMENSIONS In inches (mm)



G

6. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 1010-1
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
UL Listed, File #E137808, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Type 4X Indoor Enclosure rating (Face only), UL50
IECEE CB Scheme Test Certificate #US/8843/UL
CB Scheme Test Report #04ME11209-20041018
Issued by Underwriters Laboratories, Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
IP65 Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY
EMC specifications determined by the MPAX module.

7. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: Determined by the MPAX module
Storage Temperature Range: -40 to 60°C
Operating and Storage Humidity: 0 to 85% max. RH (non-condensing)
Altitude: Up to 2000 meters

8. **MOUNTING REQUIREMENTS**:
Max. panel thickness is 0.375" (9.5 mm)
Min. panel thickness for NEMA 4/IP65 sealing is 0.060" (1.52 mm)

9. **MODULE INSTALLATION**:
24-pin shrouded connector on EPAX engages connector on MPAX module upon installation. Shroud ensures proper alignment by providing a lead-in for the module connector.

10. **CONNECTIONS**: Wiring connections are made to the EPAX terminal block and MPAX module via high compression cage-clamp terminal blocks.
MPAX Module Wiring: Instructions are provided in the corresponding PAX Bulletin.
EPAX Terminal Block Wiring:
Wire Strip Length: 0.3" (7.5 mm)
Wire Gage: 30-12 AWG copper wire
Maximum Torque: 5-7 inch-lbs (0.58-0.81 N-m)

CAUTION: DISCONNECT ALL POWER BEFORE INSTALLING OR REMOVING MODULE

11. **CONSTRUCTION**: Aluminum front panel, enclosure, and rear cover with textured black polyurethane paint for scratch and corrosion resistance protection. Sealed front panel meets NEMA 4X/IP65 specifications for indoor use when properly installed. Installation Category II, Pollution Degree 2. Panel gasket and keps nuts included.

12. **WEIGHT**: 5 lbs (2.25 kg) (*less module*)

About the MPAX Input Modules

The MPAX Module serves as the input to the EPAX Display. There are several different modules to cover a variety of inputs. The MPAX module provides input scaling which allows the EPAX to display most any engineering unit. Once the MPAX is inserted into the EPAX, the unit has the same functions and capabilities of our PAX Series Intelligent Panel Meters. A full set of PAX programming instructions will be included with the MPAX module.

Selecting Your Display Components and Option Cards

To build a complete display unit, you will need an EPAX and an MPAX Input Module. The EPAX is only a display and will not operate without an MPAX module. Please use the following chart to identify the appropriate MPAX module and EPAX Display that will satisfy your application.

SIGNAL TYPE	MPAX MODULES*	EPAX DISPLAYS	OPTIONAL PLUG-IN CARD COMPATABILITY			
	85-250 VAC		SETPOINT	COMMS	ANALOG	REAL-TIME CLOCK
Count/Rate/Serial Slave	MPAXI020	EPAX0600	YES	YES	YES	-
Count	MPAXC020	EPAX0600	YES	-	-	-
Rate	MPAXR020	EPAX0600	YES	-	-	-
Real-Time Clock/Timer	MPAXCK00	EPAX0600	YES	YES	-	YES
Timer	MPAXTM00	EPAX0600	YES	YES	-	-

* For detailed module and plug-in card specifications, see corresponding PAX literature. (i.e. For MPAXI specifications, see the PAXI literature)

OPTIONAL PLUG-IN CARDS AND ACCESSORIES

WARNING: Disconnect all power to the unit before installing Plug-in cards.

Adding Option Cards

The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section of the PAX Bulletin. Only one card from each function type can be installed at one time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

SETPOINT ALARMS PLUG-IN CARDS (PAXCDS)

The PAX and MPAX series has 4 available setpoint alarm output plug-in cards. Only one of these cards can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

ANALOG OUTPUT PLUG-IN CARD (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slopes output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

COMMUNICATION PLUG-IN CARDS (PAXCDC)

A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson (for MPAXI) or SFPAX (for MPAXCK or MPAXTM), the RS232 or RS485 Cards must be used.

MPAXI/C/R Note: For Modbus communications, use RS485 Communications Output Card and configure Communication Type parameter (tYPE) for Modbus.

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
* PAXCDC40 - Modbus (Terminal)
* PAXCDC4C - Modbus (Connector)
PAXCDC50 - Profibus-DP

** MPAXCK/MPAXTM only.*

PROGRAMMING SOFTWARE

CRIMSON - MPAXI Only

Crimson is a Windows® based program that allows configuration of the EPAX meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the EPAX meter. The EPAX program can then be saved in a PC file for future use. A PAX serial plug-in card is required to program the meter using the software.

SFPAX - MPAXCK and MPAXTM Only

The SFPAX is a Windows® based program that allows configuration of the EPAX meter from a PC. Using the SFPAX makes it easier to program the EPAX meter and allows saving the PAX program in a PC file for future use. On-line help is available within the software. A PAX serial plug-in card is required to program the meter using the software.

1.0 ASSEMBLING THE DISPLAY

CAUTION: *The MPAX main circuit board and the option cards contain static sensitive components. Before handling the module or the cards, discharge static charges from your body by touching a grounded bare metal object. Handle the module by the rear plastic cover only, and the option cards by the board edges. Dirt, oil or other contaminants that contact the circuit boards or components can adversely affect circuit operation.*

WARNING: *Exposed line voltage exists on the MPAX main circuit board and the option cards.* ***DO NOT*** *apply power to the module OR load circuits until the module is properly installed in the EPAX case.*

NOTE: *All module and option card labels must be installed as shown for safety purposes.*

Prior to installing the EPAX Display, it is recommended that the MPAX and any option cards be assembled first. This will allow you the opportunity to insure all the boards are fitted properly into their connectors.

Installing the Option Cards

If your application requires option cards, they should be installed into the MPAX before it is installed into the EPAX Display. Refer to the literature enclosed with the option cards for installation instruction.

Installing the MPAX

Remove the MPAX case (plastic) from the rear of the EPAX by removing the two screws and pulling off the metal holding bracket. Install the MPAX into plastic case by aligning the front connector of the MPAX with the hole in the front of the plastic case. The module must be oriented as shown with terminal #1 toward the top of the EPAX case. Next, insert the MPAX case into the EPAX by lightly pushing the connector of the MPAX into the connector of the EPAX PC board. Place holding bracket over the plastic case and install the two screws.

Installing the Labels

Each option card and the MPAX are shipped with a connection label. These labels must be applied to the rear of the EPAX in the positions shown in the drawing.

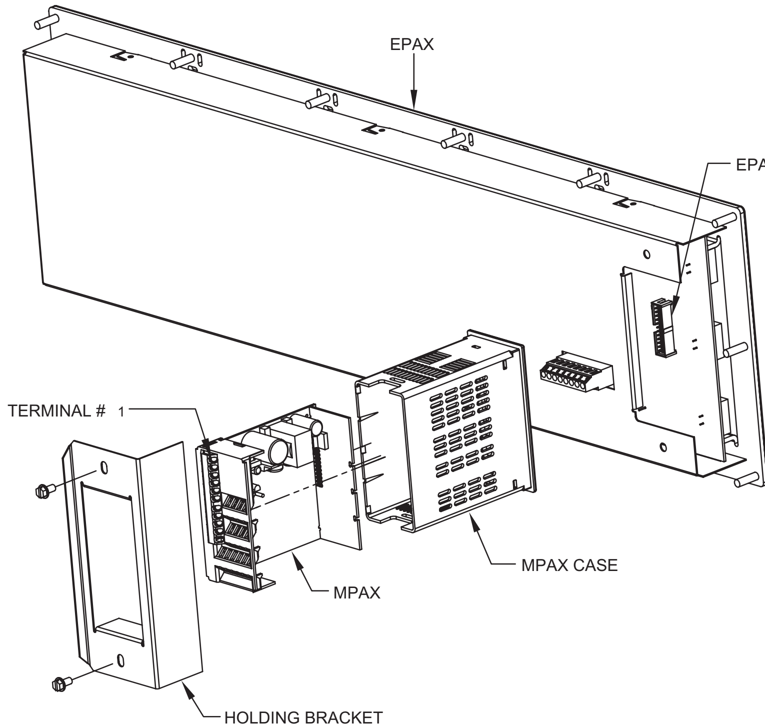


Figure 1, Installing an MPAX Module and Option Cards

Removing The MPAX Module

To remove the MPAX Module from the EPAX Display, first remove all power and load circuits. Then insert a flat screwdriver blade ($^{3}/_{16}$" or $^{1}/_{4}$") into the narrow slot between the EPAX rear cover plate and the module's plastic cover as illustrated in Figure 2. Twist the screwdriver in the direction shown to disengage the internal connectors while firmly squeezing and pulling back on the rear finger tabs (top and bottom). Carefully slide the module out of the EPAX case, keeping it properly aligned with the case opening.

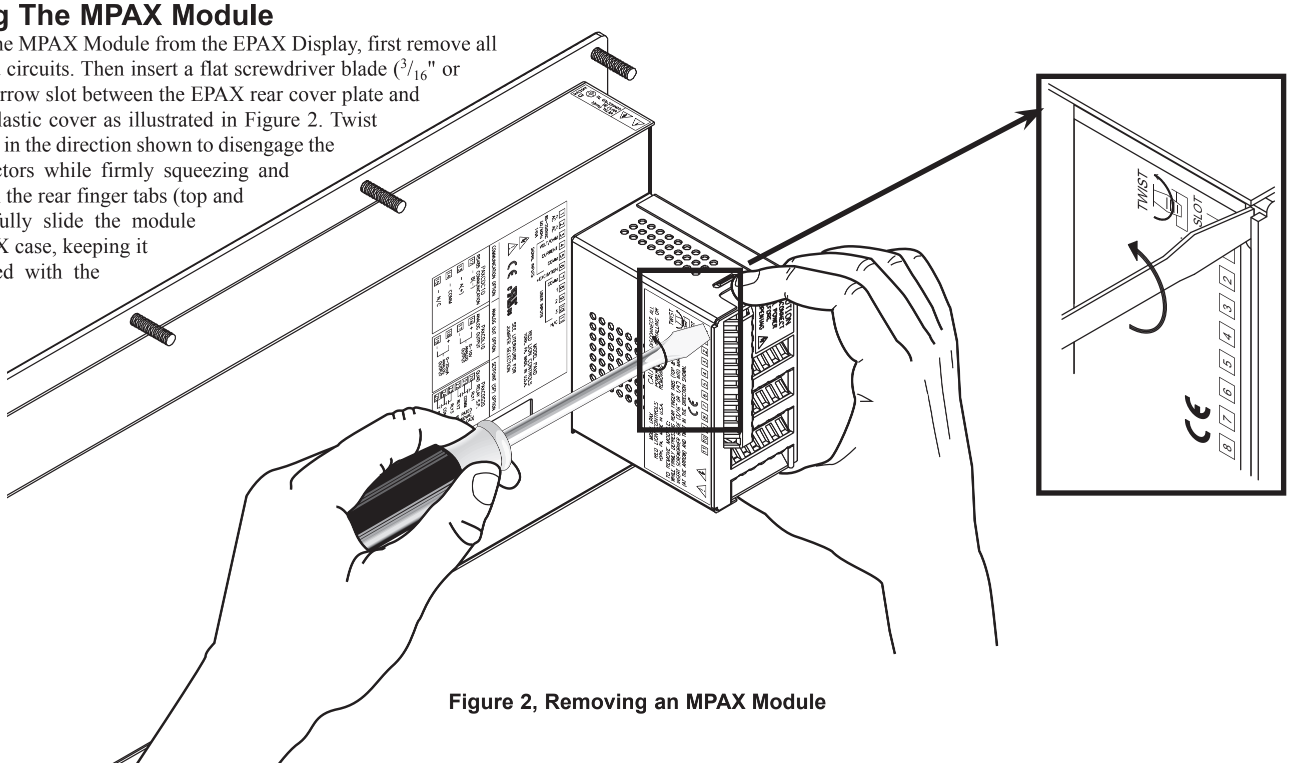


Figure 2, Removing an MPAX Module

G

2.0 INSTALLING THE DISPLAY

EPAX DISPLAY INSTALLATION

The EPAX display is intended to be mounted into a panel or enclosure. The display is provided with a gasket to provide a water-tight seal. The recommended minimum panel thickness for NEMA 4/IP65 sealing is 0.060" (1.57 mm).

For panel mounting, prepare the panel cut-out to the dimensions shown in Figure 3. The supplied template may be used to mark the cut-out and hole locations on the panel. After the panel cut-out has been deburred, slide the panel gasket over the rear of the display and onto the mounting studs. Insert the display into the panel cut-out as illustrated in Figure 4. Install 14 # 10-32 keps nuts (supplied) and tighten evenly for uniform gasket compression. Do not over-tighten the nuts.

By using additional mounting accessories, the EPAX can be surface-wall mounted, suspended, or bottom mounted. Separate installation instructions are provided with the mounting accessories.

DIMENSIONS In inches (mm)

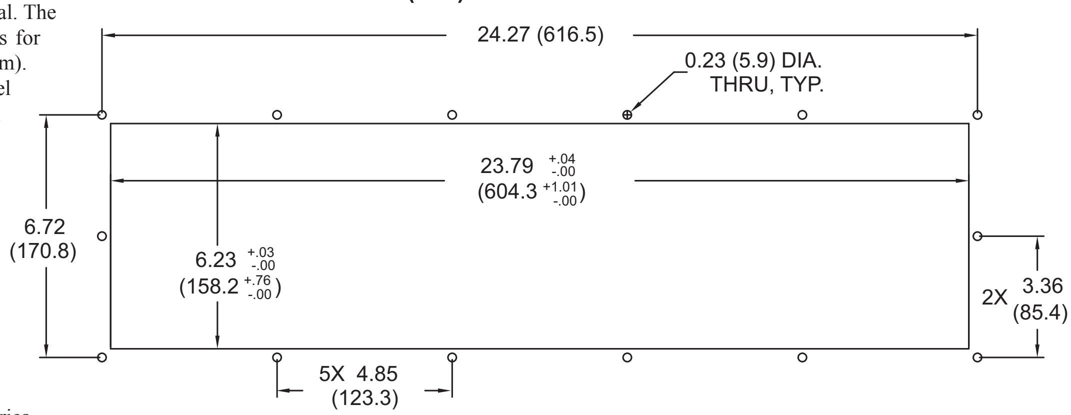


Figure 3, Panel Cut-out for the EPAX

Environment And Cleaning

The display should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the system near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

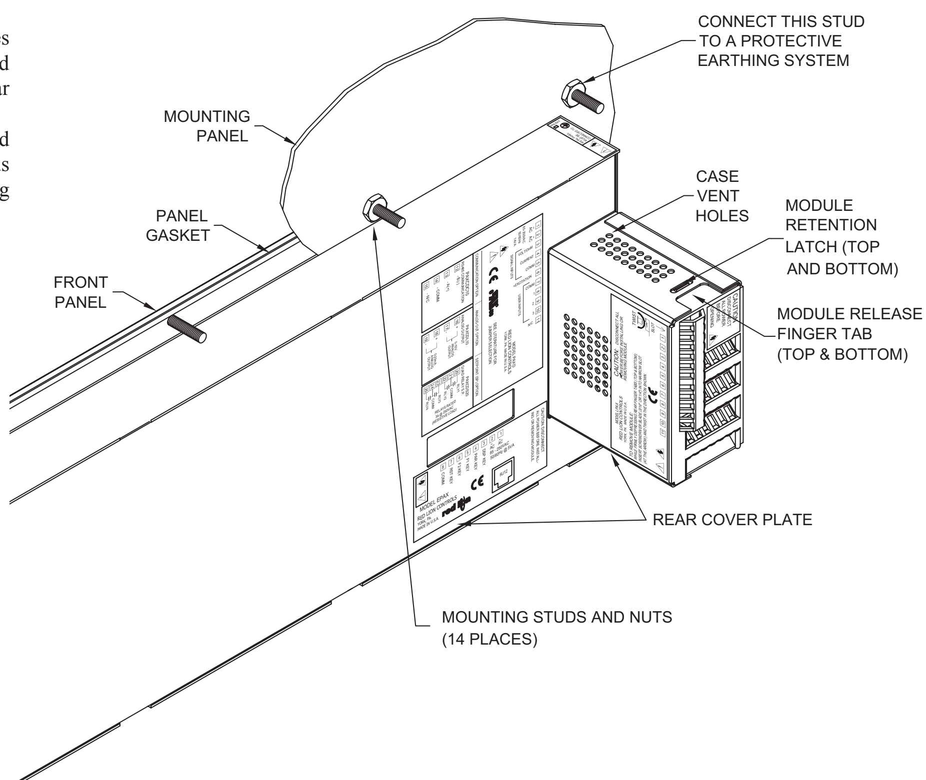
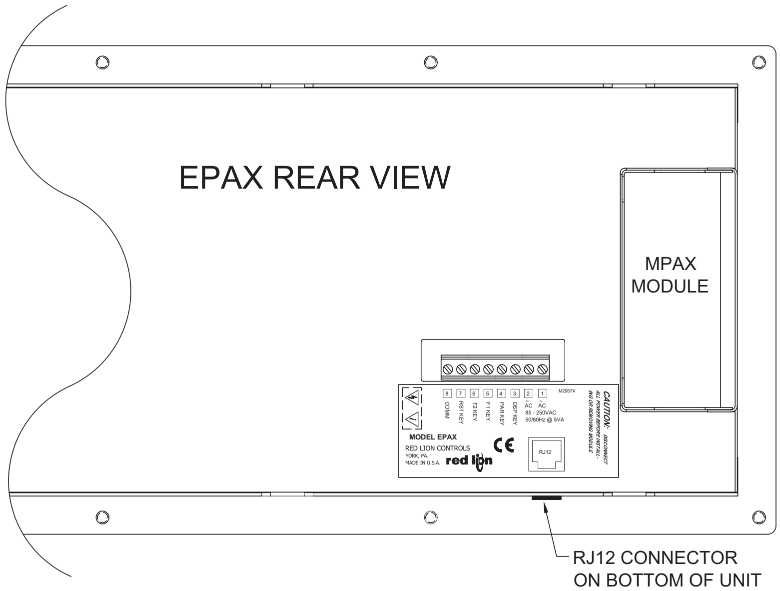


Figure 4, Installing The EPAX Into A Panel

G

3.0 WIRING AND PROGRAMMING THE DISPLAY

Note: Both the EPAX and the MPAX module require power. It is recommended to connect the primary AC power to the EPAX terminal block, then jumper to the MPAX module.



EPAX PROGRAMMING

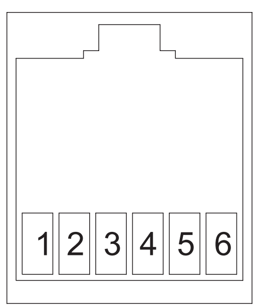
The unit is a large display, designed to be remotely mounted. Therefore, the unit does not have a programming keypad. Unit programming must be accomplished by one of the following three methods:

Optional Programming Remote (EPAXPGM0)

This optional programming remote plugs into the EPAX through an RJ12 connector and a 10 foot cable. The buttons on the programming box function the same as the PAX unit. Simply program the EPAX exactly as the PAX instructions indicate. The programming box can be left connected to the EPAX for future programming changes or can be disconnected and used to program additional EPAX units.

RJ12 CONNECTOR ON BOTTOM OF UNIT

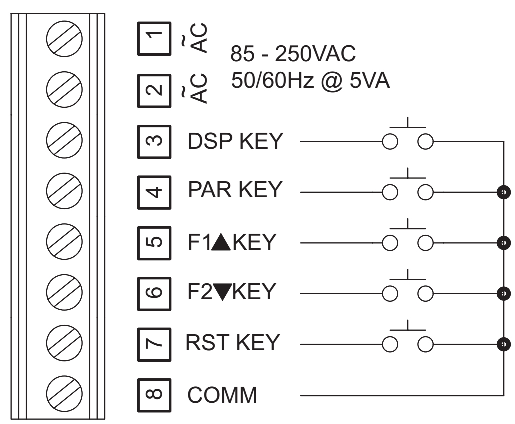
RJ12 FEMALE	
PIN	NAME
1	DSP KEY
2	PAR KEY
3	F1 KEY
4	F2 KEY
5	RST KEY
6	COMM



Rear Terminal Block

External normally open switches can be wired via the terminal block to allow unit programming. A minimum of 3 switches would be required. Each external switch must be wired between the key and the common terminal.

EPAX TERMINAL BLOCK



Optional Serial Programming

Like all PAX units, you can purchase an RS232 or RS485 Comms Card and program the unit via Windows® based software programs.

G

ORDERING INFORMATION

TYPE	MODEL NO.	DESCRIPTION	PART NUMBERS
Display	EPAX	6-Digit Extra Large Display for Digital MPAX Modules	EPAX0600
Digital Input Module	MPAX	Count/Rate Indicator Module, AC Powered	MPAXI020
		Count Indicator Module, AC Powered	MPAXC020
		Rate Indicator Module, AC Powered	MPAXR020
		Real-Time Clock Module, AC Powered	MPAXCK00
		Timer Module, AC Powered	MPAXTM00
Optional Plug-In Cards	PAXCDS	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC*	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Modbus Communications Card	PAXCDC40
		Extended Modbus Communications Card with Dual RJ11 Connector	PAXCDC4C
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL*	Analog Output Card	PAXCDL10
	PAXUSB	PAX USB Programming Card (Not included in PAX product UL E179259 file).	PAXUSB00
	PAXRTC*	Real-Time Clock Card (Replacement Only)	PAXRTC00
Accessories	PGM	Programming Remote for EPAX with 10 foot cable	EPAXPGM0
	SFCRD**	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP (for MPAXI020 Module)	SFCRD200
	SFPAX**	PC Configuration Software for Windows 95/98 on 3.5" disk (for MPAXCK00 and MPAXTM00 Modules)	SFPAX
	ENC12	NEMA 4/IP65 Enclosure for EPAX	ENC12000
	SHR	Shroud for EPAX	SHREPAX0
	EN/SH	EPAX NEMA 4/IP65 Enclosure and Shroud	EPAXENSH

*Refer to "Selecting Your Display Components and Option Cards."
**Available as a FREE download from the Red Lion website. www.redlion.net

TROUBLESHOOTING

For technical assistance, contact technical support.

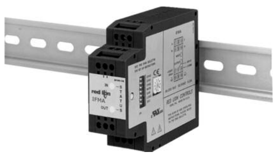
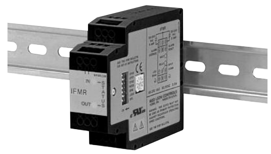
G

SIGNAL CONDITIONERS

The Trusted Source for Innovative Control Solutions

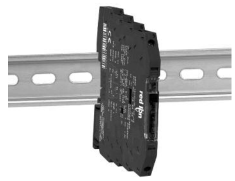
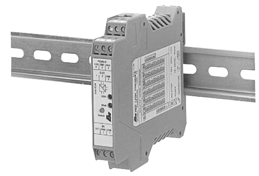
QUICK Specs

Signal Conditioners

	FREQUENCY INPUT		ANALOG INPUT	
	IFMA	**IFMR**	**AFCM**	**IAMS**
				
Description	Frequency to Analog Converter	Speed Switch	Analog to Frequency Converter	Universal Conversion Module
Dimensions (Height) x (Width)	79 mm (H) x 28 mm (W) x 107 mm(D)	79 mm (H) x 28 mm (W) x 107 mm(D)	93 mm (H) x 6.2 mm (W) x 93 mm(D)	109 mm (H) x 24 mm (W) x 104 mm(D)
Input	Programmable to accept a variety of sensors 25 KHz Max.	Programmable to accept a variety of sensors 25 KHz Max.	0 to 10 mA, 0 to 20 mA, 2 to 10 mA 4 to 20 mA, 0 to 5 VDC, 1 to 5 VDC, 0 to 10 VDC and 2 to 10 VDC	DC Current, DC Voltage, Process, RTD, Thermocouple, Linear Resistance and Potentiometer
Outputs	0 to 5 VDC, 0 to 10 VDC, 0 to 20 mA or 4 to 20 mA	Single Form C Relay	0 to 50 Hz, 0 to 100 Hz, 0 to 250 Hz, 0 to 500 Hz, 0 to 1KHz, 0 to 2.5 KHz, 0 to 5 KHz and 0 to 10 KHz	Setpoint - Dual Form "A" Relay Output Analog - 0 to 20 mA, 4 to 20 mA, 0 to 5 VDC, 0 to 10 VDC or the reverse of each
Other Features/ Options	Low Frequency Cut-out, Overrange Indication, 3 Way Isolation	Hysteresis and Offset	3 Way Isolation	3 Way Isolation
Power Source	85 to 250 VAC	85 to 250 VAC	19.2 to 30 VDC	21.6 to 253 VAC or 19.2 to 300 VDC
Recommended Applications	Converts a Frequency Input to an Analog Current or Voltage	Provides a Contact Ouput at a Setpoint Speed, Overspeed, Underspeed, or Zero Speed	Used to Isolate and Convert Various Analog Signals to Frequencies Signals	Used to Isolate and Convert Various Analog Signals to Standard Control Signals
Page Number	Page 755	Page 763	Page 771	Page 774

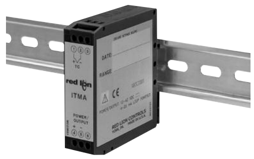
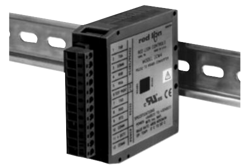
Signal Conditioners

ANALOG INPUT

	IAMA	IAMA6	AAMA	AIMI
				
Description	DC Current, DC Voltage and Process Converter	DC Current, DC Voltage and Process Converter	Universal Conversion Module	Loop Powered Isolator
Dimensions (Height)x(Width)	79 mm (H) x 28 mm (W) x 107 mm(D)	93 mm (H) x 6 mm (W) x 102 mm(D)	99 mm (H) x 18 mm (W) x 115 mm (D)	79 mm (H) x 25 mm (W) x 93 mm(D)
Input	0 to 500 mV 0 to 100 VDC or 0 to 100 mA DC	0 to 5 VDC, 0 to 10 VDC, 0 to 20 mA or 4 to 20 mA	0 to 500 mV, 0 to 20 VDC, 0 to 20 mA, +/- 500 mV, or +/- 20 VDC	0 to 20 mA or 4 to 20 mA
Outputs	0 to 5 VDC, 0 to 10 VDC, 0 to 1 mA DC, 0 to 20 mA or 4 to 20 mA	0 to 5 VDC, 0 to 10 VDC, 0 to 20 mA or 4 to 20 mA	0 to 10 VDC, +/-10 VDC, or 4 to 20 mA	0 to 20 mA
Other Features/ Options	3 Way Isolation, Linear or Square Root Extraction	3 Way Isolation	3 Way Isolation, Accepts Positive and Negative Signals	2 Way Isolation
Power Source	11 to 36 VDC, 24 VAC	19.2 to 30 VDC	18 to 30 VDC	Loop Powered
Recommended Applications	Used to Isolate and Convert Various Analog Signals to Standard Control Signals	Used to Isolate and Convert Various Analog Signals to Standard Control Signals	Used to Isolate and Convert Various Analog Signals to Standard Control Signals	Provides Ground Potential Isolation of Analog Control Circuits
Page Number	Page 784	Page 792	Page 795	Page 773

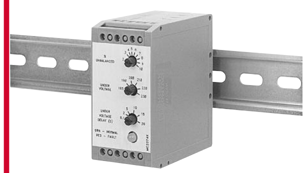
QUICK Specs

Signal Conditioners

	ANALOG INPUT		COMMUNICATION	
	IRMA	ITMA	ICM4/5	ICM8
				
Description	RTD to Analog Converter	Thermocouple to Analog Converter	Serial Converter Modules	Serial to Ethernet Converter for Red Lion Products
Dimensions (Height) x (Width)	Model Dependent	Model Dependent	79 mm (H) x 25 mm (W) x 98 mm (D)	135 mm (H) x 45 mm (W) x 106 mm (D)
Input	2, 3, or 4 Wire RTD 100 Ohm Platinum (385 or 392) or Resistance	J, K, T, E, or mV	RS232, RS485	Protocols - RS232, RS485, and Ethernet
Outputs	4 to 20 mA or mV	4 to 20 mA or mV	RS232, RS485	Protocols - RS232, RS485, and Ethernet
Other Features/ Options	2 Way Isolation, Sensor Break Detection	2 Way Isolation, Sensor Break Detection	N/A	N/A
Power Source	12 to 42 VDC 9 to 32 VDC, Loop Powered	12 to 42 VDC 9 to 32 VDC, Loop Powered	9 to 32 VDC	24 VDC
Recommended Applications	Used to Convert an RTD Input to a 4 to 20 mA Output	Used to Convert a Thermocouple Input to a 4 to 20 mA Output	Used to Convert Serial Communications	Used to enable Red Lion Products to Communication via Ethernet
Page Number	Page 804	Page 816	Page 829/833	Page 837

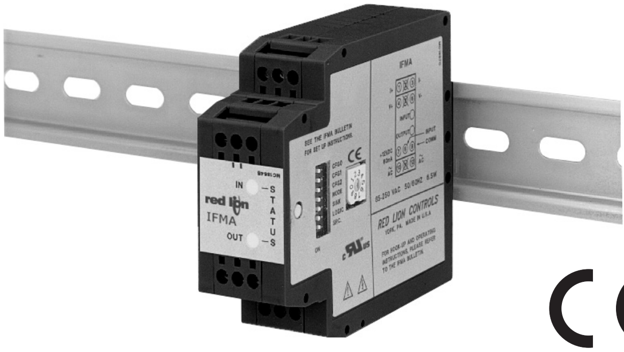
QUICK Specs

Signal Conditioners

	COMMUNICATION	FAULT
	GCM	**APMR**
		
Description	Serial Converter Modules	3 Phase Fault Detection Module
Dimensions (Height) x (Width)	25 mm (H) x 54 mm (W) x 110 mm (D) w/socket	79 mm (H) x 40 mm (W) x 85 mm (D)
Input	Serial 20 mA Current Loop	
Outputs	RS232, (GCM232) RS422/485, (GCM422)	SPDT 10A Relay
Other Features/ Options	N/A	N/A
Power Source	9 to 28 VDC (GCM232) 9 to 26 VDC (GCM422)	230VAC 380VAC 480VAC
Recommended Applications	Used to Convert 20 mA Current Loop to RS232 or RS422/485	Protect Against Phase Loss, Unbalance, Under Voltage and Phase Reversal in 3 Phase Equipment
Page Number	*	Page 800

This page intentionally left blank.

MODEL IFMA - DIN-RAIL FREQUENCY TO ANALOG CONVERTER



- *SIMPLE ON-LINE RANGE SETTING (Using Actual Input Signal or Signal Generator)*
- *USER SETTABLE FULL SCALE FREQUENCY FROM 1 Hz to 25 KHz*
- *FOUR OUTPUT OPERATING RANGES (0 to 5 V, 0 to 10 V, 0 to 20 mA, and 4 to 20 mA)*
- *PROGRAMMABLE INPUT CIRCUIT ACCEPTS OUTPUTS FROM A VARIETY OF SENSORS*
- *85 to 250 VAC and 9 to 32 VDC POWERED VERSIONS AVAILABLE*
- *LOW FREQUENCY CUT-OUT AND OVERRANGE INDICATION*
- *3-WAY ELECTRICAL ISOLATION (POWER/INPUT/OUTPUT)*
- *INPUT AND OUTPUT INDICATION LEDs*

UL Recognized Component, File # E137808

DESCRIPTION

The Model IFMA accepts a frequency input, and outputs an analog voltage or current in proportion to the input frequency, with 0.1% accuracy. The full scale input frequency can be set to any value from 1 Hz to 25 KHz, either with a frequency source, or digitally with the on-board rotary switch and push-button.

The IFMA utilizes a seven position DIP switch, a rotary switch, a push-button and two indication LEDs to accomplish input circuit configuration, operational parameter set-up, and Input/Output indication. The input circuitry is DIP switch selectable for a variety of sources.

The indication LEDs are used during normal operation to display the input and output status of the IFMA. These LEDs are also used to provide visual feedback to the user of the existing parameter settings during parameter set-up.

The IFMA operates in one of four output modes. The programmable minimum and maximum response times provide optimal response at any input frequency.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat profile rail according to EN 50 022 - 35 x7.5 and 35 x 15, and G profile rail according to EN 50 035 - G 32.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

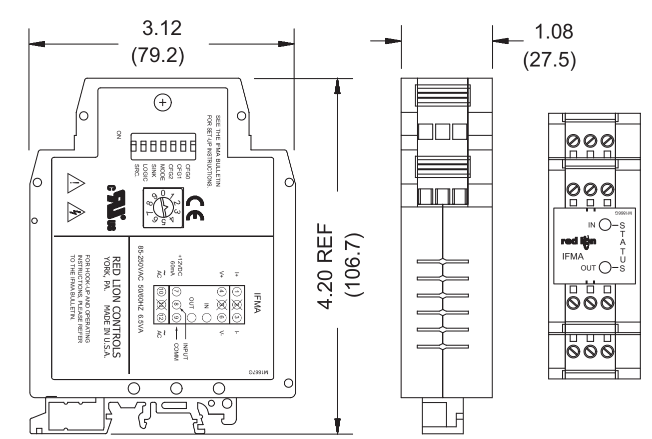
SPECIFICATIONS

1. **POWER**:
   AC Operation: 85 to 250 VAC, 48 to 62 Hz; 6.5 VA
   DC Operation: 9 to 32 VDC; 2.5 W
   Power Up Current: Ip = 600 mA for 50 msec. max.
2. **SENSOR POWER**: (AC version only) +12 VDC ±25% @ 60 mA max.
3. **OPERATING FREQUENCY RANGE**:
   From 0 Hz to 25 KHz; user selectable.
4. **SIGNAL INPUT**: DIP switch selectable to accept signals from a variety of sources, including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups, and all standard RLC sensors.
   Current Sourcing: Internal 1 KΩ pull-down resistor for sensors with current sourcing output. *(Max. sensor output current = 24 mA @ 24 V output.)*
   Current Sinking: Internal 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*
   Low Bias: Input trigger levels V_{IL} = 0.25 V, V_{IH} = 0.75 V; for increased sensitivity when used with magnetic pickups.
   Hi Bias: Input trigger levels V_{IL} = 2.5 V, V_{IH} = 3.0 V; for logic level signals.
   Max. Input Signal: ±90 V; 2.75 mA max. *(With both Current Sourcing and Current Sinking resistors switched off.)*
5. **SIGNAL VOLTAGE OUTPUT (Selectable)**:
   0 to 5 VDC @ 10 mA max.
   0 to 10 VDC @ 10 mA max.
6. **SIGNAL CURRENT OUTPUT (Selectable)**:
   0 to 20 mA @ 10 VDC min.
   4 to 20 mA@ 10 VDC min.
7. **OUTPUT COMPLIANCE**:
   Voltage: 10 V across a min. 1KΩ load (10 mA). Factory calibrated for loads greater than 1 MΩ.
   Current: 20 mA through a max. 500Ω load (10 VDC).
8. **ACCURACY**: ±0.1% of full scale range (±0.2% for 0 to 5 VDC range).
9. **RESOLUTION**:
   Voltage : 3.5 mV min.
   Current: 5 µA min.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
		9 to 32 VDC	85 to 250 VAC
IFMA	Pulse Rate to Analog Converter	IFMA0035	IFMA0065

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

SPECIFICATIONS (Cont'd)

10. **RESPONSE TIME**: 5 msec +1 period to 10 sec +1 period; user selectable
11. **INPUT IMPEDANCE**: 33 KΩ min. with the sink and source DIP switches in the OFF position (See Block Diagram).
12. **INPUT AND POWER CONNECTIONS**: Screw in terminal blocks.
13. **ISOLATION BREAKDOWN VOLTAGE (Dielectric Withstand)**: 2200 V between power & input, and power & output; 500 V between input & output for 1 minute.
14. **CERTIFICATIONS AND COMPLIANCES**:

SAFETY

UL Recognized Component, File #E137808, UL508, CSA C22.2 No. 14
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.

IECEE CB Scheme Test Report # 97ME50135-042297
Issued by Underwriters Laboratories, Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

EMC EMISSIONS:

Meets EN 50081-2: Industrial Environment.
CISPR 11 Radiated and conducted emissions

EMC IMMUNITY:

Meets EN 50082-2: Industrial Environment.
ENV 50140 - Radio-frequency radiated electromagnetic field [1]
ENV 50141 - Radio-frequency conducted electromagnetic field
EN 61000-4-2 - Electrostatic discharge (ESD) [2]
EN 61000-4-4 - Electrical fast transient/burst (EFT)
EN 61000-4-8 - Power frequency magnetic field

Notes:

1. For operation without loss of performance:
Unit is mounted on a rail in a metal enclosure (Buckeye SM7013-0 or equivalent) and I/O cables are routed in metal conduit connected to earth ground.

2. This device was designed for installation in an enclosure. To avoid electrostatic discharge, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure (ex. making adjustments, setting switches, etc.) typical anti-static precautions should be observed before touching the unit.

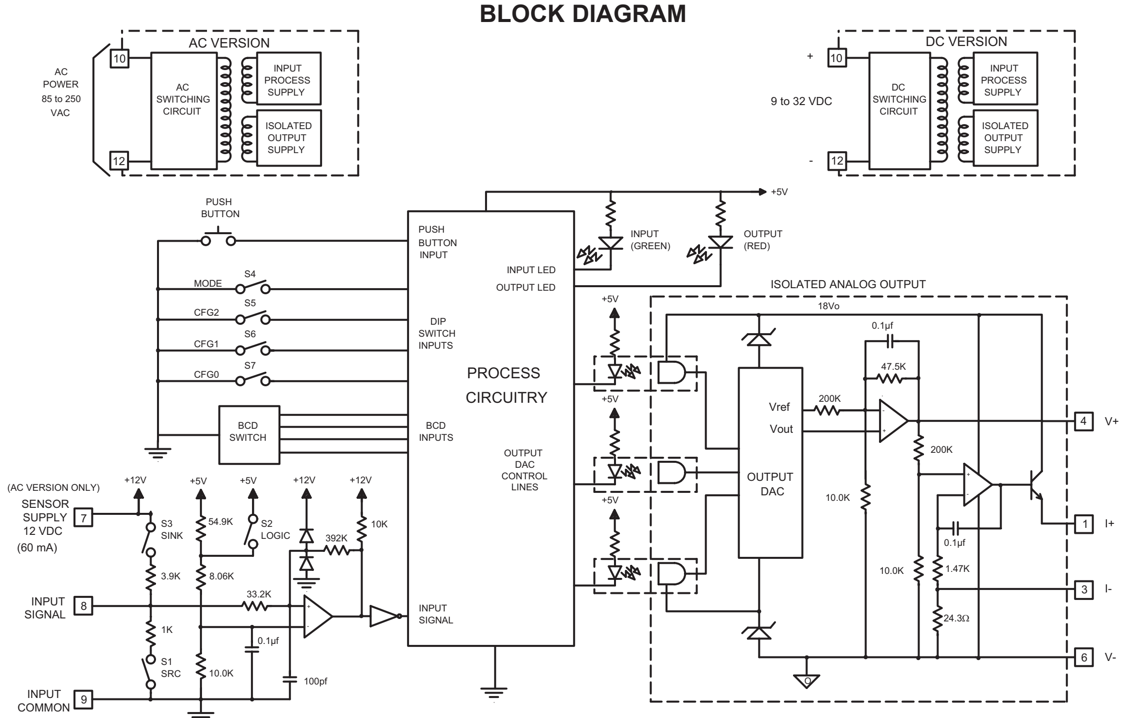
Refer to the EMC Installation Guidelines section of this bulletin for additional information.

15. **ENVIRONMENTAL CONDITIONS**:

Operating Temperature: 0 to 50°C
Storage Temperature: -40 to 80°C
Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
Vibration according to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 3 g's.
Shock according to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
Altitude: Up to 2000 meters

16. **CONSTRUCTION**: Case body is black, high impact plastic. Installation Category II, Pollution Degree 2
17. **WEIGHT**: 6 oz. (0.17 Kg)

BLOCK DIAGRAM



OVERVIEW

The Model IFMA continuously monitors a frequency input and outputs a voltage or current signal in proportion to the input signal. The output is accurate to ±0.1% of full scale for Operating Modes 2, 3, and 4. Operating Mode 1 is accurate to ±0.2% of full scale. The green Input LED blinks at the rate of the input frequency. At about 100 Hz, the Input LED will appear to be solid on. At very low frequencies, the Input LED blinks slowly and may also appear to be solid on. A loss of signal may also cause the Input LED to remain on, depending on the DIP switch set-up. In this case, the red LED also turns on.

The Minimum Response Time parameter sets the minimum update time of the output. The actual response time is the Minimum Response Time plus up to one full period of the input signal. The IFMA counts the negative edges occurring during the update time period, and computes the average frequency value for that time. This action filters out any high frequency jitter that may be present in the input signal. The longer the Minimum Response Time, the more filtering occurs.

The Maximum Response Time parameter sets the Low Frequency Cut-out response time for the unit. If a new edge is not detected within the time specified by the Maximum Response Time setting, the unit sets the output to the existing Low Frequency Cut-out Value setting depending on the selected range and calibration setting.

The unit also indicates Low Frequency Cut-out by turning ON the output LED. The Maximum Response Time can be set shorter than the Minimum Response Time. In this case, as long as the input signal period is shorter than the Maximum Response Time, the unit continues to indicate the input frequency at its output. But, if the input period at any time exceeds the Maximum Response Time, the unit immediately takes the output to the Low Frequency Cut-out Value, regardless of the Minimum Response Time setting.

The IFMA is calibrated at the factory for all of the selected ranges. However, the user can adjust the minimum calibration to any value less than the Full Scale value, and the Full Scale value to any value greater than the minimum value. If the minimum and full scale values are brought closer together, the accuracy of the unit decreases proportionate to the decreased range of the unit (See Calibration).

EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. The unit becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful installation or troublesome installation.

Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker.

POWER AND OUTPUT CONNECTIONS

AC Power

Primary AC power is connected to terminals 10 and 12 (labeled AC). For best results, the AC Power should be relatively "clean" and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

DC Power

The DC power is connected to terminals 10 and 12. The DC plus (+) power is connected to terminal 10 and the minus (-) is connected to terminal 12.

It is recommended that separate supplies be used for sensor power and unit power. Using the same supply for both will negate isolation between input and power.

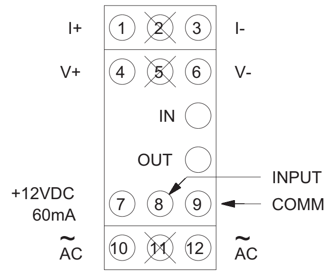
Current Output

When using Operating Mode 3 or 4, the output device is connected to terminals 1(I+) and 3 (I-).

Voltage Output

When using Operating Mode 1 or 2, the output device is connected to terminals 4 (V+) and 6 (V-).

Note: *Although signals are present at voltage and current outputs at the same time, only the selected mode is in calibration at any one time.*
Example: Operating Mode 2 is selected. The voltage level present at the voltage terminals is in calibration, but the signal appearing at the current terminals does not conform to either of the current output modes.



INPUT CIRCUITS, SENSOR CONNECTIONS AND CONFIGURATION SWITCH SET-UP

The Model IFMA uses a comparator amplifier connected as a Schmidt trigger circuit to convert the input wave form into the pulse form required for proper circuit operation. Three set-up switches are used to configure the input circuit to accept signals from a wide variety of sources, as follows:

S1 - ON: Connects a 1 KΩ pull-down resistor for sensors with sourcing outputs. (Maximum sensor output current is 24 mA @ 24 VDC output.)

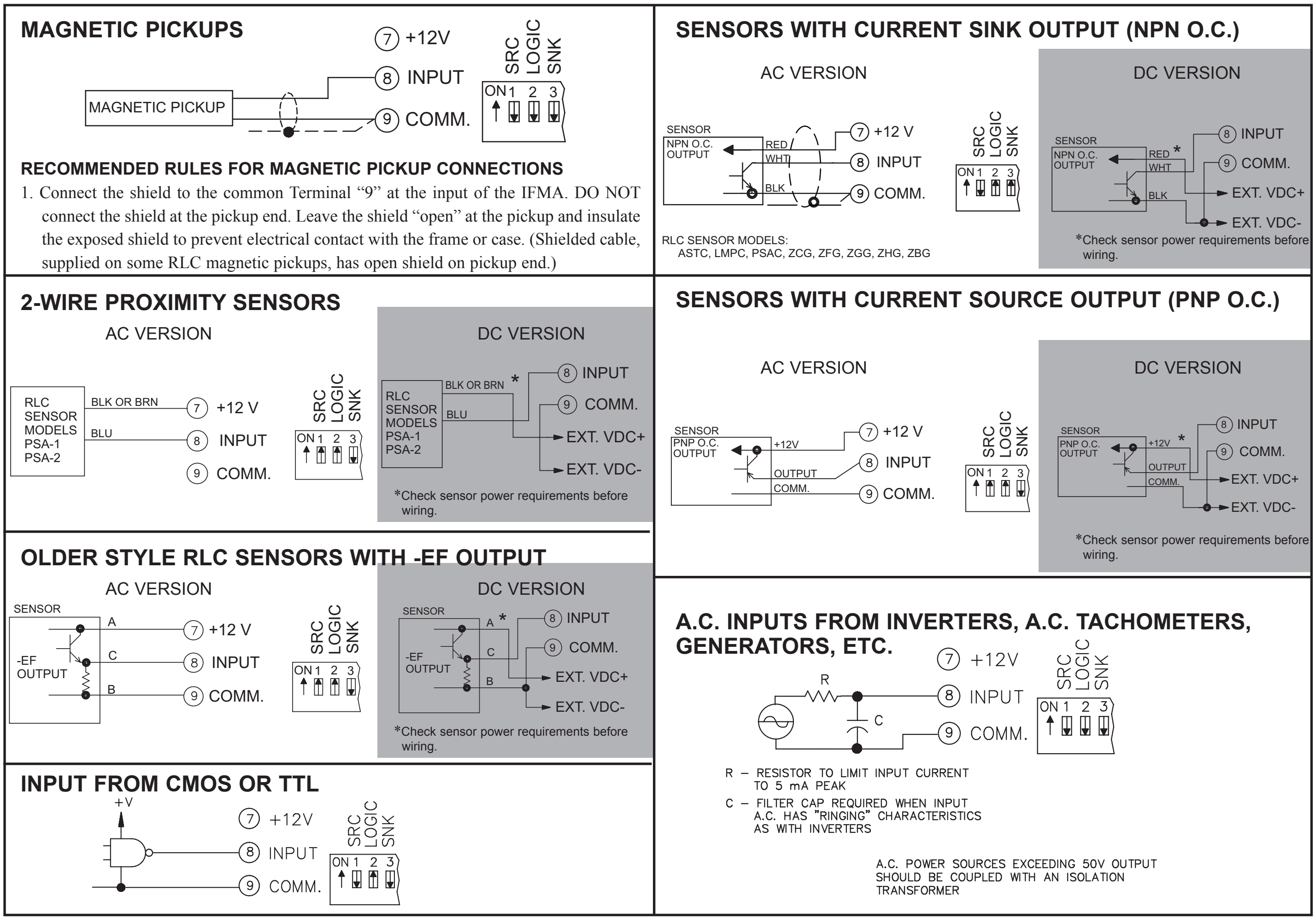
S2 - ON: For logic level signals. Sets the input bias levels to V_{IL} = 2.5 V, V_{IH} = 3.0 V.

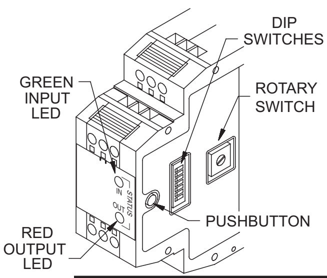
OFF: For increased sensitivity when used with magnetic pickups. Sets the input bias levels to V_{IL} = 0.25 V, V_{IH} = 0.75 V.

S3 - ON: Connects a 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*

CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS

Note: *Separate power supplies must be used for sensor power and input power to maintain the isolation breakdown voltage specification. If isolation between power and input is not needed, then a single supply can be used for both unit and sensor power.*





CONFIGURING THE IFMA

To begin set-up, place DIP switch 4 to the on (up) position. DIP switches 5, 6, and 7 access unit configuration settings. Upon entry to a set-up parameter, the Input LED blinks the current numerical value of a setting at a 1 Hz rate. A setting of "1" is indicated by one blink (½ sec on, ½ sec off), through a setting of "9", which is indicated by nine blinks. A setting of "0" is indicated by a single short flash (40 msec on, 1 sec off). The decimal point position is the last number blinked. After the entire value is indicated, the IFMA pauses two seconds and repeats the value.

During entry of a new value, if the Mode switch (S4) or any of the CFG DIP switch positions are changed before the push button is pressed, the IFMA aborts the entry process and retains the previous setting.

DIP SWITCH	DESCRIPTION	SECTION
4 5 6 7	Operating Mode	(1.0)
4 5 6 7	Input Range Setting Using an Input Signal or Frequency Generator	(2.0)
4 5 6 7	Input Range Setting Using the Rotary Switch	(3.0)
4 5 6 7	Minimum Response Time	(4.0)
4 5 6 7	Maximum Response Time (Low Frequency Cut-Out Setting)	(5.0)
4 5 6 7	Analog Output Minimum Value	(6.0)
4 5 6 7	Analog Output Full Scale Value	(6.0)

Note: ***To return to normal operation, place DIP switch 4 in the down (RUN) position.***

( ) Indicates Configuration Section

OUTPUT INDICATION

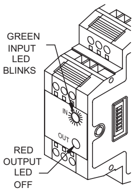
Over range on the output : The Output LED (red) turns on and the Output is "clamped" at the maximum level.

Low Frequency Cut-Out : The Output LED (red) turns on to indicate the input frequency is below the Zero Frequency setting.

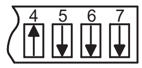
Invalid Entry during Set-up : The Input LED (green) and the Output LED (red) alternately blink until a valid entry is made.

FACTORY SETTINGS		
Parameter	Setting	Value
Operating Mode	4	4 to 20 mA
Input Range	10.000	10 KHz
Minimum Response	0	5 msec
Maximum Response	0	1024 times Input Range Period (102 msec, 9.8 Hz)

1.0 Operating Mode (Analog Output)



Step 1.2

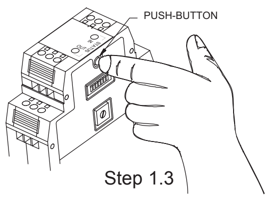


Step 1.1

1.1 Place DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.

1.2 Green input LED blinks the Setting corresponding to the Operating Mode shown below, pauses and repeats the value.

Setting	Operating Mode
1	0 to 5 VDC
2	0 to 10 VDC
3	0 to 20 mA
4	4 to 20 mA



Step 1.3

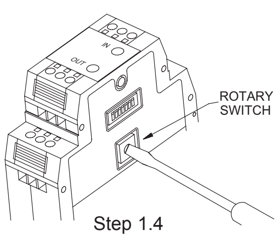
◆ ***Factory calibration values are restored when the Operating Mode is changed.***

◆ ***If existing operating mode setting is your desired requirement, this section is complete*. Otherwise, continue with Step 1.3.***

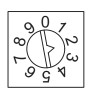
1.3 Press the push-button. The Green input LED blinks rapidly to indicate the Operating mode setting is now accessed.

1.4 Turn the rotary switch to the selected numerical value for the output desired (see the list in Step 1.2).

1.5 Press the push-button. The Green input LED blinks value entered, pauses, and repeats the new Operation setting.



Step 1.4



Setting '2' Selected

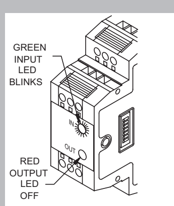
◆ ***If the new Operating mode setting is acceptable, this section is complete*.***

◆ ***If the new Operating mode setting is not the desired setting, repeat from Step 1.3.***

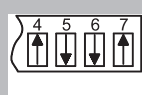
◆ ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 1.4 and 1.5.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

2.0 On-Line Input Range Setting Using Actual Input Signal Or Frequency Generator



Step 2.2



Step 2.1

2.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.

2.2 The Green input LED blinks the existing Input Range setting as shown in the examples below. Six full digits of numerical information blink with a short pause between digits and a longer pause before repeating. The first five digits are the existing input range setting of the frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

Factory Setting Example

1 blink	1	Frequency setting
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	Resolution
4 sec pause		

Frequency					Resolution
1	0	0	0	0	0

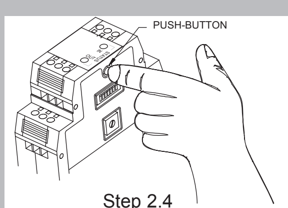
Result: 10.000 KHz

Additional Example:

2 blinks	2	Frequency setting
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
2 blinks	2	Resolution
4 sec pause		

Frequency					Resolution
2	5	0	5	0	2

Result: 250.50 Hz



Step 2.4

◆ ***If the existing Input Range setting is your desired requirement, this section is complete*. Otherwise, continue with Step 2.3.***

PREFERRED METHOD

2.3 Apply the maximum input signal.

2.4 Press the push-button. The Green input LED blinks rapidly. The acquisition process takes two seconds plus one period of the input signal.

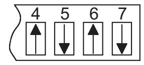
◆ ***If the new input range setting is valid, the Green input LED turns on solid. Continue to Step 2.5.***

◆ ***If Red output LED blinks, the new input range setting is invalid, outside the acceptable 1 Hz to 25 KHz range. Repeat Steps 2.3 and 2.4.***

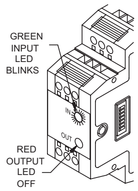
2.5 Press the push-button. The Green input LED blinks the new Input Range setting. This section is complete*. Verify the Input Range setting as shown in Step 2.2.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

3.0 Input Range Setting Using The Rotary Switch



Step 3.1



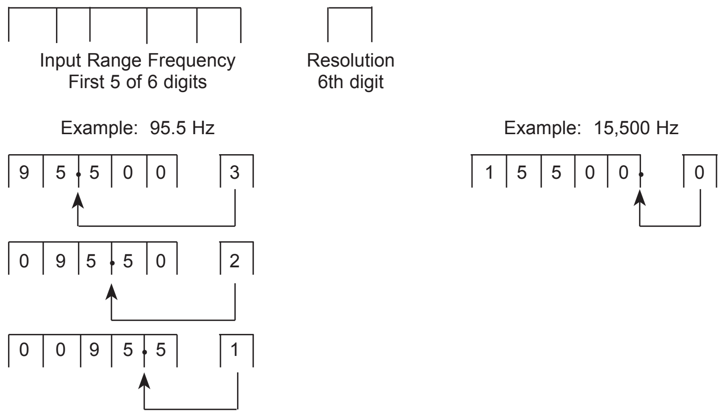
Step 3.2

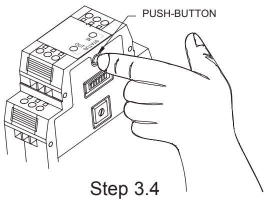
3.1 Place DIP switch 4 to the ON(up) position and DIP switches 5, 6, and 7 as shown.

3.2 The Green input LED blinks the existing Input Range setting, pauses and repeats. Six full digits of numerical information blink with a short pause between digits and a longer pause at the end, before repeating. The first five digits are the existing input range setting magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

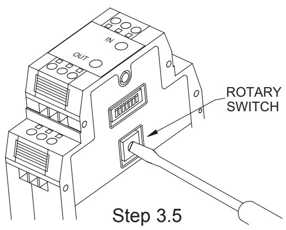
◆ ***If the existing Input Range setting is your desired requirement, this section is complete*. Otherwise, continue with Step 3.3.***

3.3 Determine the Input Range frequency and record in the space provided below.

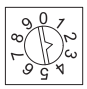




Step 3.4



Step 3.5


Setting '2' Selected

3.4 Press the push-button. The Green input LED blinks rapidly. Input Range setting is now accessed.

3.5 Turn the rotary switch to the first selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. First of six digits is entered.

3.6 Turn the rotary switch to the second selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. Second of six digits is entered.

3.7 Repeat Step 3.6 three more times, then go to Step 3.8. This enters a total of five of the required six numerical digits.

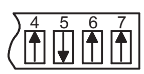
3.8 Turn the rotary switch to the selected numerical value for resolution requirement. Press the push-button. The Green input LED blinks the new Input Range setting (as described in Step 2.2), pauses, and repeats the value.

ALTERNATIVE METHOD IF INPUT SIGNAL IS NOT AVAILABLE

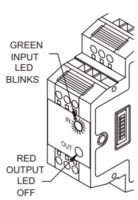
◆ ***If the new Input Range setting is acceptable, this section is complete*.***
◆ ***If the new Input Range setting is not the desired setting, repeat Steps 3.4, through 3.8.***
◆ ***If the Red output LED blinks, the numerical value entered is invalid. Repeat Steps 3.3 through 3.8.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

4.0 Minimum Response Time Setting



Step 4.1



Step 4.2

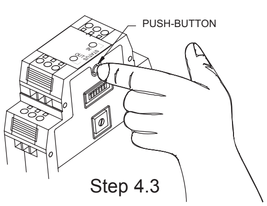
4.1 Position DIP switch 4 to the ON(up) position and DIP switches 5, 6, and 7 as shown.

4.2 The Green input LED blinks the corresponding Minimum Response Time Setting (see following list), pauses and repeats.

Setting	Time
0	5 msec
1	10 msec
2	20 msec
3	50 msec
4	100 msec

Setting	Time
5	200 msec
6	500 msec
7	1 sec
8	5 sec (not valid for input range > 3906 Hz)
9	10 sec (not valid for input range > 3906 Hz)

◆ ***If the existing Minimum Response Time setting is your desired requirement, this section is complete*. Otherwise, continue with Step 4.3.***

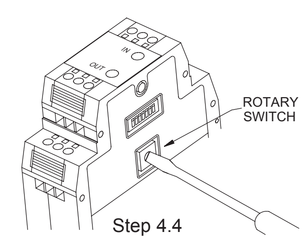


Step 4.3

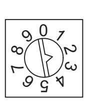
4.3 Press the push-button. The Green input LED blinks rapidly. Minimum Response Time setting is now accessed.

4.4 Turn the rotary switch to the selected numerical value for Minimum Response Time desired (see list in Step 4.2).

4.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new Minimum Response Time setting.



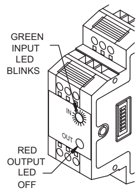
Step 4.4


Setting '2' Selected

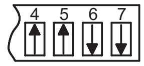
◆ ***If the new Minimum Response Time setting is acceptable, this section is complete*.***
◆ ***If the new Minimum Response Time setting is not acceptable, repeat from step 4.3.***
◆ ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 4.4 and 4.5.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

5.0 Maximum Response Time Setting (Low Frequency Cut-Out Setting)



Step 5.2

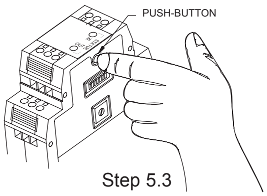


Step 5.1

5.1 Place DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.
5.2 The Green input LED blinks the corresponding Maximum Response Time Setting (see following list), pauses and repeats.

Setting	Time
0	1024 times Input Range period (40 msec min., 10 sec max.)
1	10 msec (100 Hz)
2	20 msec (50 Hz)
3	50 msec (20 Hz)
4	100 msec (10 Hz)

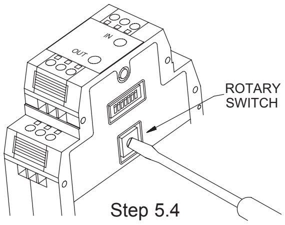
Setting	Time
5	200 msec (5 Hz)
6	500 msec (2 Hz)
7	1 sec (1 Hz)
8	5 sec (.2 Hz)
9	10 sec (.1 Hz)



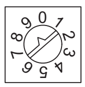
Step 5.3

◆ ***If the existing Maximum Response Time setting is your desired requirement, this section is complete*. Otherwise, continue with Step 5.3.***

5.3 Press the push-button. The Green input LED blinks rapidly. Maximum Response Time setting is now accessed.
5.4 Turn the rotary switch to the selected numerical value for Maximum Response Time desired. (see list in Step 5.2)
5.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new Maximum Response Time setting.



Step 5.4



Setting '9' Selected

◆ ***If the new Maximum Response Time setting is acceptable, this section is complete*.***
◆ ***If the new Maximum Response Time setting is not acceptable, repeat from Step 5.3.***
◆ ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 5.4 and 5.5.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

6.0 Calibration

The IFMA is factory calibrated for all operating modes. These settings are permanently stored in the unit's configuration memory. The IFMA automatically selects the proper calibration setting for the selected Operation mode.

The Minimum and Full Scale output values established at the factory can be changed using the calibration routines. The Minimum output value can be adjusted to any value less than the Full Scale output value, and the Full Scale value can be adjusted to any value greater than the Minimum value.

Changing the factory calibration settings does affect the accuracy of the unit. Specified accuracy for modes 2, 3, and 4 holds until the factory calibration range has been halved. This does not apply to mode 1, since it already uses only half of the IFMA's output range. When increasing the output range, the new calibration settings can not exceed the factory Full Scale value by more than 10%. The 0 to 5 VDC range can be doubled.

The IFMA can store user calibration settings for only one mode at a time. If calibration is changed for one operating mode, and the user then selects a different operating mode, the unit reverts to factory calibration settings. Calibration steps can be combined (added) to obtain a total calibration change. This is done by repeated push-button entries of the same value, or different values, before saving the change. The calibration steps as shown in the table at right are approximations. A current or volt meter should be connected to the appropriate output pins to verify the actual calibration setting.

Approximate Calibration Increments

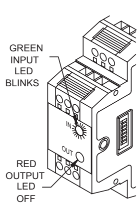
ROTARY SWITCH	VOLTAGE	CURRENT
1	3 mV	5 µA
2	5 mV	10 µA
3	10 mV	25 µA
4	25 mV	50 µA
5	50 mV	100 µA
6	100 mV	200 µA
7	200 mV	400 µA
8	400 mV	800 µA

Calibration Direction

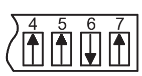
The default direction for calibration changes is up (increasing values) on entry to either calibration routine. This direction can be toggled from within the routine with the following steps:

1. Enter the calibration routine you wish to change (Minimum or Full Scale).
2. Press the push-button. The Green input LED blinks rapidly.
3. Turn the rotary switch to position 9. Press the push-button.
4. The Output LED indicates the direction of calibration:

OFF = Increasing Value
ON = Decreasing Value

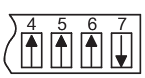


Step 6.2



Step 6.2

Analog Output Minimum Value

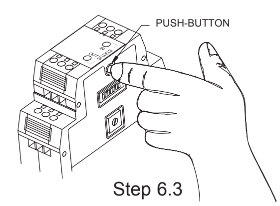


Step 6.2

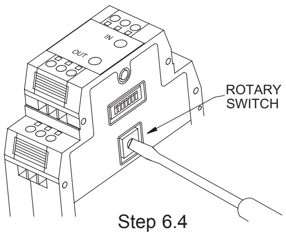
Analog Output Full Scale Value

6.1 Connect a current or voltmeter of appropriate accuracy to the desired output pins (voltage or current)
6.2 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown. The Green input LED blinks slowly.

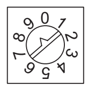
6.0 Calibration (Cont'd)



Step 6.3



Step 6.4



Setting '9' Selected

6.3 Press the push-button to enable the rotary switch. The Green input LED now blinks at a faster rate, indicating that calibration values are accessible.

6.4 Turn rotary switch to appropriate numerical setting for calibration (see list in Step 6.0), while monitoring the output signal. Press the push-button. Calibration is raised or lowered by this approximate value, depending on calibration direction.

- ***If this setting meets your requirements, go to step 6.5. If more calibration is required, repeat step 6.4 until the calibration meets your requirements.***
- ***If you overshoot your desired value, reverse calibration direction as shown in 6.0 and continue calibration until the value meets your requirements.***

6.5 Turn the rotary switch to 0 and press the push-button. This saves the new user calibration setting.

- ***If you want to return to factory calibration, exit Calibration and then re-enter. Turn rotary switch to 0 and press push-button twice. This reloads the factory calibration setting for the selected mode of operation.***
- ***When calibrating the Minimum output value, if the red output LED blinks while in the down direction, the requested calibration setting is beyond the output's absolute minimum value. The calibration setting is held at the absolute minimum value. Reverse calibration direction and repeat from step 6.4.***
- ***When calibrating Full Scale, if the red output LED blinks while in the up direction, the requested calibration setting is beyond the output's absolute maximum value. The calibration setting is held at the maximum value. Reverse calibration direction and repeat from step 6.4.***
- ***If an attempt is made to calibrate the Full Scale value lower than the Minimum value, or conversely, the Minimum value higher than the Full Scale value, the red output LED blinks, and the IFMA sets the two values equal. Reverse calibration direction and repeat from step 6.4.***

Calibration Example (Scaling):

A customer using the 0 to 10 VDC output range of the IFMA wants the Minimum value to be at 1 VDC. To do this, connect a voltmeter to the output of the IFMA to monitor the output voltage. Access Configuration Mode by placing DIP switch 4 to the ON (up) position. Access Analog Output Minimum value by placing DIP switches 5 and 7 up, and DIP switch 6 down. Press the push-button to enable changes to the calibration value. Turn the rotary switch to position 8 and press the push-button. The voltmeter should reflect an increase of about 400 mV. With the rotary switch still at position 8, press the push-button again. The voltmeter should now read approximately 800 mV. Turn the rotary switch to a position lower than 8 to effect a smaller change in calibration. Continue adjusting the rotary switch and pressing the push-button until 1 VDC is displayed on the voltmeter. Turn the rotary switch to position 0 and press the push-button. This action saves the new calibration setting for the Minimum value.

TROUBLESHOOTING

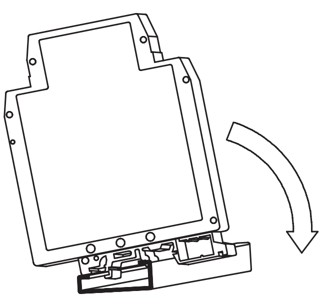
For further technical assistance, contact technical support at the appropriate company numbers listed.

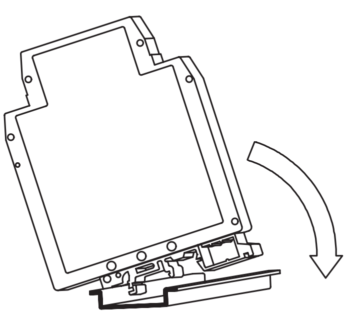
INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

G Rail Installation

To install the IFMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out and away from the rail.





T Rail Installation

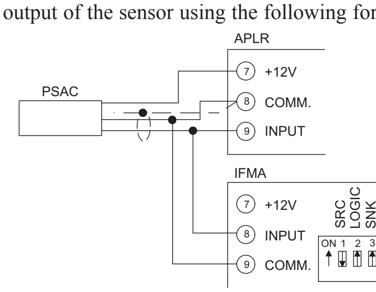
To install the IFMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.

APPLICATION

A customer needs a unit to output a signal to a chart recorder for a flow rate system. There is an existing APLR rate indicator receiving an input from a PSAC inductive proximity sensor. The IFMA Frequency to Analog Converter is connected in parallel with the APLR to output the signal to the chart recorder.

The flow rate is measured in gal/min. and needs to be converted to a 0 to 10 VDC signal. The Operating Mode of the IFMA is set for a 0 to 10 VDC output signal. The PSAC measures 48 pulses/gal. with a maximum flow rate of 525 gal/min. The Maximum Response Time is set to setting '9' (10 sec). The chart recorder will record 0 VDC at 0.125 gal/min, and 10 VDC at 525 gal/min.

The Input Range can be set one of two ways. By entering the calculated maximum frequency with the rotary switch, or by applying the maximum frequency signal of the process to the input of the IFMA. To set the input with the rotary switch, first determine the maximum frequency generated by the maximum output of the sensor using the following formula:

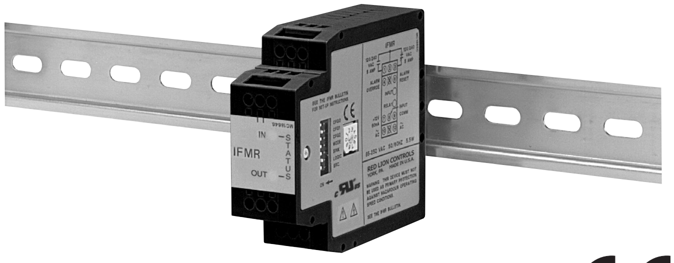


$$\text{Max. Freq.} = \frac{\text{unit/measure x pulses/unit}}{\text{seconds/measure}}$$

$$\text{Max. Freq.} = \frac{\text{525 GPM x 48 PPG}}{\text{60 sec.}} = \text{420 Hz}$$

Set the Input Range with the rotary switch to 420 Hz.

MODEL IFMR - DIN-RAIL SPEED SWITCH



- SIMPLE ON-LINE TRIP FREQUENCY SETTING (USING ACTUAL INPUT SIGNAL OR FREQUENCY GENERATOR)
- USER SETTABLE TRIP FREQUENCY FROM 0.1 Hz to 25 KHz
- OVER-SPEED, UNDER-SPEED, AND ZERO-SPEED DETECTION
- RELAY LATCHING, ALARM OVERRIDE, AND ALARM RESET FUNCTIONS
- PROGRAMMABLE INPUT CIRCUIT ACCEPTS OUTPUTS FROM A VARIETY OF SENSORS
- HYSTERESIS AND OFFSET FUNCTIONS AVAILABLE
- 85 to 250 VAC and 9 to 32 VDC VERSIONS AVAILABLE
- INPUT AND RELAY STATUS INDICATION LED'S

UL Recognized Component,
File # E137808

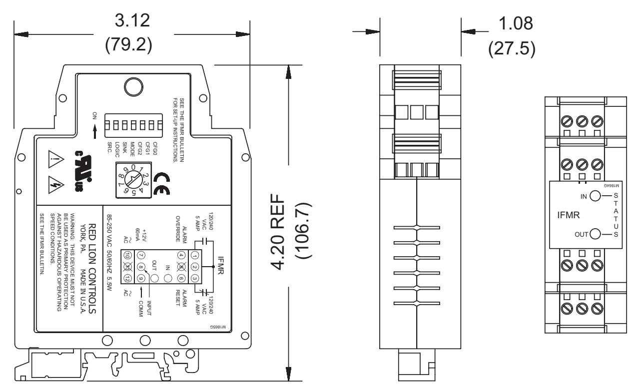
DESCRIPTION

The Model IFMR accepts a frequency input, and controls a single relay (SPDT) based on the value of the input frequency. The Trip frequency can be set to any value from 0.1 Hz to 25 KHz. The IFMR can be set to trip on overspeed, or underspeed (including zero speed). Offset and hysteresis values can be incorporated into the trip setting to eliminate output chatter. LED indicators for both the Input signal and the Relay status are provided. Two separate input connections for external push-buttons are also provided. One external input overrides the trip detection function, and holds the relay in the release state as long as the input is pulled to common. The other external input clears a latched trip condition when pulled to common.

The IFMR utilizes a seven position DIP switch, a rotary switch, a push-button and two indication LEDs to accomplish input circuit configuration, operational parameter set-up, input signal, and relay status indication. The input circuitry is DIP switch selectable for a variety of sources.

The indication LEDs are used during normal operation to display the input signal and relay status of the IFMR. These LEDs are also used to provide visual feedback to the user of the current parameter settings during parameter set-up.

DIMENSIONS In inches (mm)



CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

The IFMR operates in one of six output modes, as selected by the user. The programmable Minimum Response Time provides optimum response vs. input filtering for any input frequency. The offset and hysteresis settings provide flexible adjustment of the relay trip and release points.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat profile rail according to EN 50 022 - 35 x 7.5 and 35 x 15, and G profile rail according to EN 50 035 - G32.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

WARNING: SPEED SWITCHES MUST NEVER BE USED AS PRIMARY PROTECTION AGAINST HAZARDOUS OPERATING CONDITIONS. Machinery must first be made safe by inherent design, or the installation of guards, shields, or other devices to protect personnel in the event of a hazardous machine speed condition. The speed switch may be installed to help prevent the machine from entering the unsafe speed.

SPECIFICATIONS

1. **POWER:**
   AC Powered Versions: 85 to 250 VAC; 48 to 62 Hz; 5.5 VA
   DC Powered Versions: 9 to 32 VDC; 2.0 W
   Power Up Current: Ip = 600 mA for 50 msec max.
2. **SENSOR POWER:** *(AC version only)* +12 VDC ±25% @ 60 mA max.
3. **OPERATING FREQUENCY RANGE:** 0 Hz to 25 KHz
4. **SIGNAL INPUT:** DIP switch selectable to accept signals from a variety of sources, including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups, and all standard RLC sensors.
   Current Sourcing: Internal 1 KΩ pull-down resistor for sensors with current sourcing output. *(Max. sensor output current = 24 mA @ 24 V output.)*
   Current Sinking: Internal 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*
   Low Bias: Input trigger levers V_{IL} = 0.25 V, V_{IH} = 0.75 V; for increased sensitivity when used with magnetic pickups.
   Hi Bias: Input trigger levels V_{IL} = 2.5 V, V_{IH} = 3.0 V; for logic level signals.
   Max. Input Signal: ±90 V; 2.75 mA max. *(with both Current Sourcing and Current Sinking resistors switched off)*.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
		9 to 32 VDC	85 to 250 VAC
IFMR	Speed Switch	IFMR0036	IFMR0066

SPECIFICATIONS (Cont'd)

5. **CONTROL INPUTS:** Active low (V_{IL} = 0.5 V max.) internally pulled up to 5 VDC through a 100 KΩ resistor (I_{SNK} = 50 µA). Response Time = 1 msec.
   Alarm Reset: Unlatches the relay when pulled to common while the input frequency is in the release region.
   Alarm Override: Causes the IFMR to unconditionally release the relay when pulled to common.
6. **RELAY CONTACT OUTPUT:** FORM "C" (SPDT) contacts max. rating. 5 A @ 120/240 VAC or 28 VDC *(resistive load)*, 1/8 H.P. @ 120 VAC *(inductive load)*. The operate time is 5 msec nominal and the release time is 3 msec nominal.
7. **RELAY LIFE EXPECTANCY:** 100,000 cycles at max. rating. *(As load level decreases, life expectancy increases.)*
8. **ACCURACY:** ±0.1% of the trip frequency setting.
9. **INPUT IMPEDANCE:** 33 KΩ min. with the sink and source DIP switches in the OFF positions. *(See Block Diagram)*
10. **MINIMUM RESPONSE TIME:** From 5 msec. +1 period to 10 sec. +1 period in ten steps *(excluding relay operate time)*.
11. **HYSTERESIS AND OFFSET:** From 0.25% to 33.33% of Trip Frequency in nine steps. Hysteresis and/or Offset can also be set to 0 *(Disabled)*.
12. **INPUT AND POWER CONNECTIONS:** Screw in terminal blocks
13. **ISOLATION BREAKDOWN VOLTAGE (Dielectric Withstand):** 2200 V between power & input, and power & output; 500 V between input & output for 1 minute.
14. **CERTIFICATIONS AND COMPLIANCES:**
   SAFETY
   UL Recognized Component, File #E137808, UL508, CSA 22.2 No. 14
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   IECEE CB Scheme Test Report # 97ME50135-042297
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

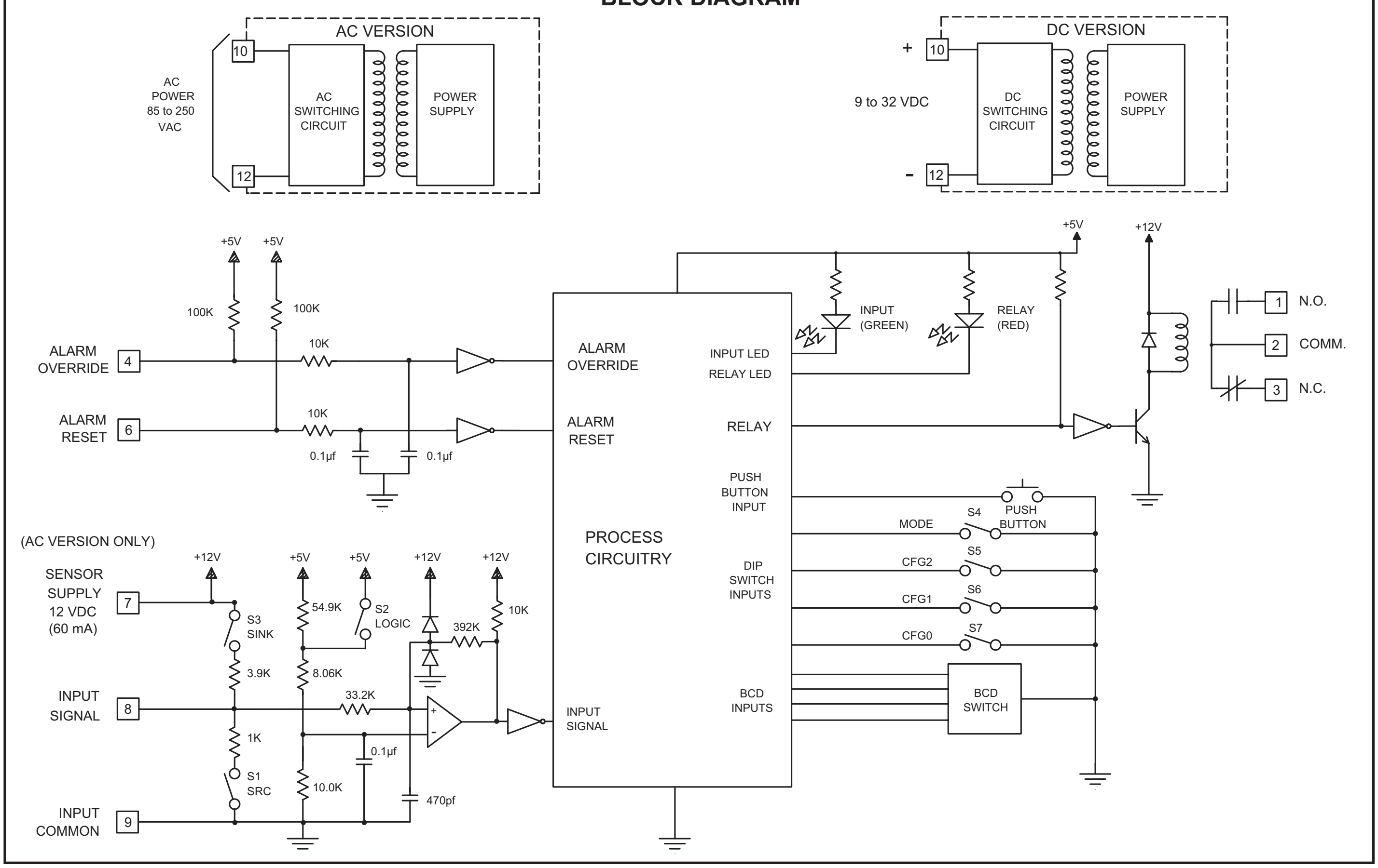
ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact[1]
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m^2
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A
		Power mains class A

Notes:
1. This device was designed for installation in an enclosure. To avoid electrostatic discharge, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure (ex. making adjustments, setting switches, etc.) typical anti-static precautions should be observed before touching the unit.
2. For operation without loss of performance:
Unit is mounted on a rail in a metal enclosure (Buckeye SM7013-0 or equivalent) and I/O cables are routed in metal conduit connected to earth ground.
Refer to the EMC Installation Guidelines section of this bulletin for additional information.

15. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature: 0 to 50°C
   Storage Temperature: -40 to 80°C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
   Vibration according to IEC 68-2-6: Operational 5 to 150 Hz in X, Y, Z direction for 1.5 hours, 2 g.
   Shock according to IEC 68-2-27: Operational 30 g (10 g relay), 11 msec in 3 directions.
   Altitude: Up to 2000 meters
16. **CONSTRUCTION:** Case body is black, high impact plastic. Installation Category II, Pollution Degree 2
17. **WEIGHT:** 6 oz. (0.17 Kg)

BLOCK DIAGRAM



OVERVIEW

The Model IFMR continuously monitors the input signal and controls an output relay based on the frequency of the input signal, the chosen Operation Mode (Underspeed or Overspeed), and the Trip and Release points the user has selected. The green Input LED blinks at the rate of the input frequency. At about 100 Hz, the Input LED will appear to be solid on. At very low frequencies, the Input LED blinks slowly and may also appear to be solid on. A loss of signal may also cause the Input LED to remain on, depending on the DIP switch set-up. In this case, the red Relay LED also turns on. The IFMR indicates the status of the relay with the Relay LED (Red). Whenever the relay is in the Trip state, the IFMR turns ON the Relay LED. In the Release state, the Relay LED is OFF.

For Overspeed detection, when the input frequency (averaged over the Minimum Response Time) exceeds the Trip point, the IFMR trips the relay. With the relay in the Trip condition, the input frequency must fall below the Release point for the relay to release.

For Underspeed detection, the relay trips when the input frequency (averaged over the Minimum Response Time) falls below the Trip point. The relay releases only after the input frequency has exceeded the Release point. Two of the Underspeed operating modes allow the machine or system that supplies the input signal to reach normal operating speed before the IFMR responds to an Underspeed condition. For Zero Speed applications, bear in mind that Zero Speed detection and Underspeed detection are identical.

The Minimum Response Time parameter sets the minimum update time of the output. The actual response time is the Minimum Response Time plus up to one full period of the input signal. The IFMR counts the negative edges occurring during the update time period, and computes the average frequency value for that time. This action filters out any high frequency jitter that may be present in the input signal. The longer the Minimum Response Time, the more filtering occurs.

The Offset value is added to the Trip Frequency to determine the Trip Point for Overspeed operation. For Underspeed operation the Trip point becomes the Trip Frequency minus the Offset value.

If No Hysteresis has been selected, the Trip and Release points are identical, which can lead to cycling or “chattering” of the relay at input frequencies hovering around the Trip point. If Hysteresis is selected, the Release point is set to the Trip point (including Offset) minus the Hysteresis value for Overspeed detection. For Underspeed detection, the Release point is set to the Trip point (including Offset) plus the Hysteresis value.

Two input pins (Alarm Override and Alarm Reset) are provided for the optional connection of push-buttons. The Alarm Override pin causes the IFMR to unconditionally Release the relay, regardless of the input frequency, or the state of the relay, when pulled to common. When the Alarm Override pin is released from common, the operation of the IFMR returns to normal, and the status of the relay is updated based on the input frequency.

The Alarm Reset pin is only active when the IFMR is in one of the Latch operation modes. With the Latch function selected, the relay “latches” into the Trip state whenever a Trip condition is detected. The relay remains latched until the Alarm Reset pin is pulled to common while the input frequency is in the Release region. The Alarm Reset pin is ignored while the input frequency is in the Trip region.

EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. The unit becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful installation or a troublesome installation.

Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application.

   Listed below are the recommended methods of connecting the shield, in order of their effectiveness.

   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).

   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.

   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In very electrically noisy environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:

   Ferrite Suppression Cores for signal and control cables:

   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0

   Line Filters for input power cables:

   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker.

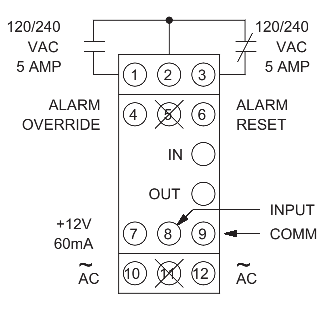
POWER AND OUTPUT CONNECTIONS

AC Power

Primary power is connected to terminals 10 and 12 (labeled AC). For best results, the AC Power should be relatively “clean” and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

DC Power

The DC power is connected to Terminals 10 and 12. The DC plus (+) is connected to Terminal 10 and the minus (-) is connected to Terminal 12. It is recommended that separate supplies be used for sensor power and unit power. Using the same supply for both will negate isolation between input and power.



Output Wiring

Terminals 1, 2, and 3 are used to connect to the relay output. Terminal 1 is the normally open contact. Terminal 3 is the normally closed contact, and Terminal 2 is the output relay common.

INPUT CIRCUITS, SENSOR CONNECTIONS AND CONFIGURATION SWITCH SET-UP

The Model IFMR Speed Switch uses a comparator amplifier connected as a Schmidt trigger circuit to convert the input wave form into the pulse form required for proper circuit operation. Three set-up switches are used to configure the input circuit to accept signals from a wide variety of sources, as follows:

S1 - ON: Connects a 1 KΩ pull-down resistor for sensors with sourcing outputs. *(Maximum sensor output current is 24 mA @ 24 VDC output.)*

S2 - ON: For logic level signals, sets the input bias levels to V_{IL} = 2.5 V, V_{IH} = 3.0 V.

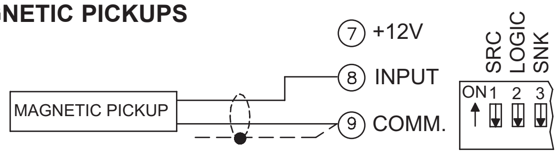
OFF: For increased sensitivity when used with magnetic pickups, sets the input bias levels to V_{IL} = 0.25 V, V_{IH} = 0.75 V.

S3 - ON: Connects a 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*

CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS

Note: *Separate power supplies must be used for sensor power and input power to maintain the isolation breakdown voltage specification. If isolation between power and input is not needed, then a single supply can be used for both unit and sensor power.*

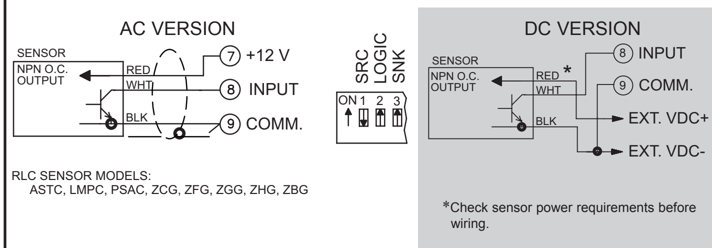
MAGNETIC PICKUPS



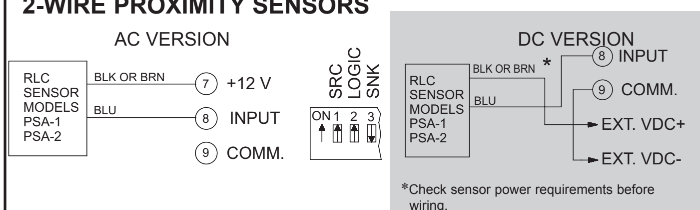
RECOMMENDED RULES FOR MAGNETIC PICKUP CONNECTIONS

1. Connect the shield to the common Terminal "9" at the input of the IFMR. DO NOT connect the shield at the pickup end. Leave the shield "open" at the pickup and insulate the exposed shield to prevent electrical contact with the frame or case. (Shielded cable, supplied on some RLC magnetic pickups, has open shield on pickup end.)

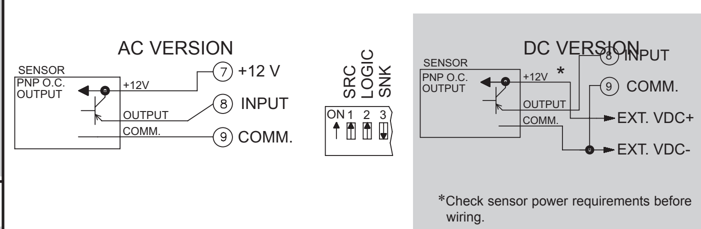
SENSORS WITH CURRENT SINK OUTPUT (NPN O.C.)



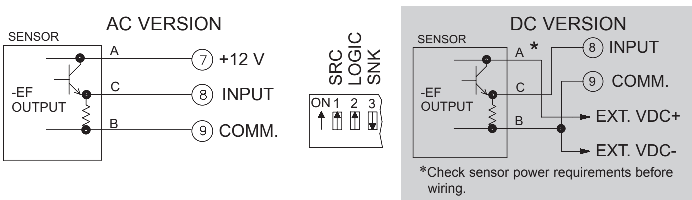
2-WIRE PROXIMITY SENSORS



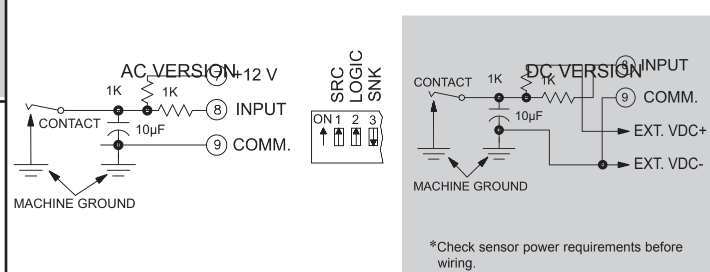
SENSORS WITH CURRENT SOURCE OUTPUT (PNP O.C.)



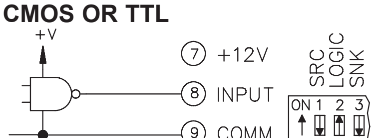
OLDER STYLE RLC SENSORS WITH -EF OUTPUT

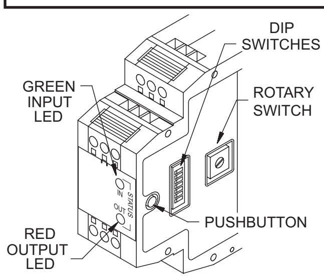


SWITCH CONTACT INPUT



INPUT FROM CMOS OR TTL





CONFIGURING THE IFMR

Upon entry to a set-up parameter, the Input LED blinks the current numerical value of a setting at a 1 Hz rate. A setting of "1" is indicated by one blink (½ sec on, ½ sec off), through a setting of "9", which is indicated by nine blinks. A setting of "0" is indicated by a single short flash (40 msec on, 1 sec off). After the entire value is indicated, the IFMR pauses two seconds and repeats the value.

During entry of a new value, if the Mode switch (S4) or any of the CFG DIP switch positions are changed before the push button is pressed, the IFMR aborts the entry process and retains the previous setting.

To begin set-up, place DIP switch 4 to the on (up) position. DIP switches 5, 6, and 7 access unit configuration settings.

DIP SWITCH	DESCRIPTION	SECTION
4 5 6 7	Operating Mode	(1.0)
4 5 6 7	Set Trip Frequency Using an Input Signal or Frequency Generator	(2.0)
4 5 6 7	Set Trip Frequency Using the Rotary Switch	(3.0)
4 5 6 7	Set Minimum Response Time	(4.0)
4 5 6 7	Set Relay Trip Point	(5.0)
4 5 6 7	Set Relay Release Point	(6.0)

***Note:** To return to normal operation, place DIP switch 4 in the down (RUN) position.*

( ) Indicates Configuration Section

RELAY INDICATION

Overspeed: The Relay LED (red) turns on to indicate the input signal has exceeded the trip frequency.

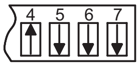
Underspeed: The Relay LED (red) turns on to indicate the input signal is below the trip frequency setting.

Invalid Entry during Set-up: The Input LED (green) and the Relay LED (red) alternately blink until a valid entry is made.

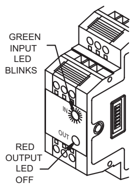
FACTORY SETTINGS		
	Setting	Parameter
Operating Mode	1	Low Speed Operation, Trip on Overspeed
Trip Frequency	10000	10 KHz
Minimum Response	0	5 msec
Trip Point Offset	0	None
Trip Point Hysteresis	1	0.25%

H

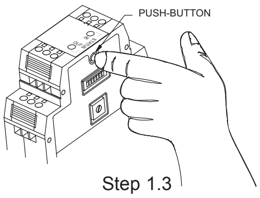
1.0 Operating Mode



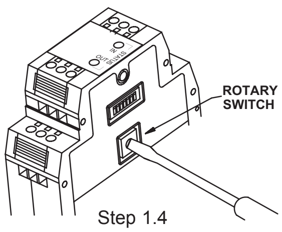
Step 1.1



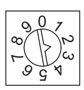
Step 1.2



Step 1.3



Step 1.4



Setting '2' Selected

1.1 Place DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.

1.2 Green input LED blinks the setting corresponding to the Operating Mode shown below, pauses and repeats the value.

Setting	Operating Mode
1	OVERSPEED trip, automatic Release upon return to normal
2	OVERSPEED latched trip, Release only after ALM Reset pulled to Common
3	UNDERSPEED trip, automatic Release upon return to normal
4	UNDERSPEED trip, start-up condition* ignored, automatic Release upon return to normal
5	UNDERSPEED latched trip, Release only after ALM Reset pulled to Common
6	UNDERSPEED latched trip, start-up condition* ignored, Release only after ALM Reset pulled to Common

* Refers to initial application of power to the IFMR, not the input frequency.

◆ ***If existing operating mode setting is your desired requirement, this section is complete*. Otherwise, continue with Step 1.3.***

1.3 Press the push-button. The Green input LED blinks rapidly to indicate the Operating mode setting is now accessed.

1.4 Turn the rotary switch to the selected numerical value for output desired (see the list in Step 1.2).

1.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new operation setting.

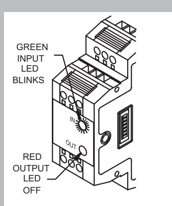
◆ ***If the new Operating mode setting is acceptable, this section is complete*.***

◆ ***If the new Operating mode setting is not the desired setting, repeat Steps 1.3, 1.4, and 1.5.***

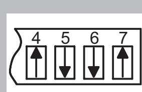
◆ ***If Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 1.4 and 1.5.***

* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

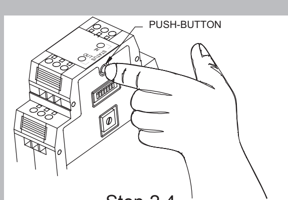
2.0 On-Line Trip Frequency Setting Using Actual Input Signal or Frequency Generator



Step 2.2



Step 2.1



Step 2.4

PREFERRED METHOD

2.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.

2.2 Green input LED blinks the existing Trip Frequency setting as shown in the examples below. Six full digits of numerical information blink with a 2 sec. pause between digits and a 4 sec. pause at the end, before repeating. The first five digits are the existing Trip Frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

Factory Setting Example

1 blink	1	Frequency setting
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	Resolution
4 sec pause		

Frequency					Resolution
1	0	0	0	0	0

Result: 10,000 Hz

Additional Example

2 blinks	2	Frequency setting
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
2 blinks	2	Resolution
4 sec pause		

Frequency					Resolution
2	5	0	5	0	2

Result: 250.50 Hz

◆ ***If existing Trip Frequency setting is your desired requirement, this section is complete*. Otherwise, continue with Step 2.3.***

2.3 Apply the desired Trip Frequency to the signal input pin.

2.4 Press the push-button. The Green input LED blinks rapidly. The acquisition process takes two seconds plus one period of the input signal.

◆ ***If the new Trip Frequency setting is valid, the Green input LED turns on solid. Continue to Step 2.5.***

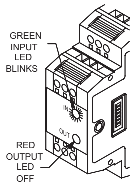
◆ ***If Red relay LED blinks, the new Trip Frequency is invalid, outside the acceptable 0.1 Hz to 25 KHz range. Repeat Steps 2.3 and 2.4.***

2.5 Press the push-button. The Green input LED blinks the new Trip Frequency setting. This section is complete*.

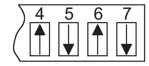
◆ ***To verify Trip Frequency setting, see Step 2.2.***

* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

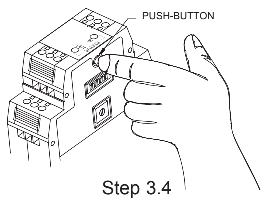
3.0 Set Trip Frequency Using The Rotary Switch



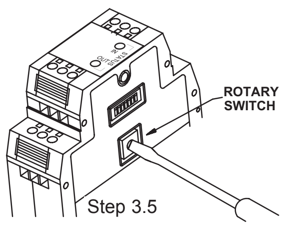
Step 3.2



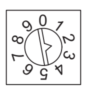
Step 3.1



Step 3.4



Step 3.5



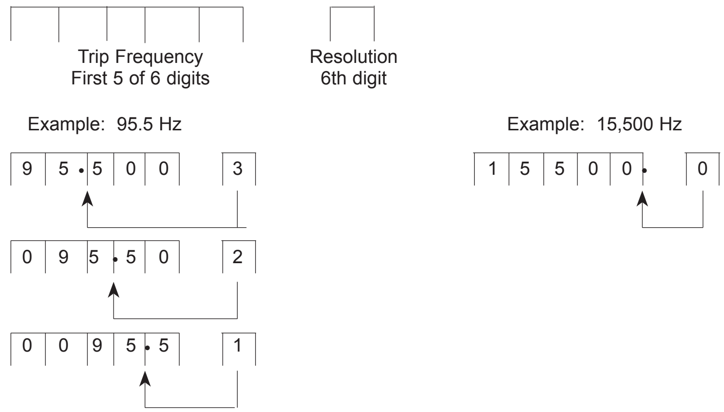
Setting '2' Selected

ALTERNATIVE METHOD IF INPUT SIGNAL IS NOT AVAILABLE

3.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.
3.2 The Green input LED blinks the existing Trip Frequency setting, pauses and repeats. Six full digits of numerical information blink with a 2 sec. pause between digits and a 4 sec. pause at the end, before repeating. The first five digits are the existing Trip Frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

◆ ***If the existing Trip Frequency setting is your desired requirement, this section is complete*. Otherwise, continue with Step 3.3.***

3.3 Determine the Trip Frequency and record in the space provided below.

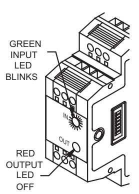


3.4 Press the push-button. The Green input LED blinks rapidly. Trip Frequency setting is now accessed.
3.5 Turn the rotary switch to the first selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. First of six numerical digits is entered.
3.6 Turn the rotary switch to the second selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. Second of six numerical digits is entered.
3.7 Repeat Step 3.6 three more times then go to Step 3.8. This enters a total of five of the required six numerical digits.
3.8 Turn the rotary switch to the selected numerical value for resolution requirement. Press the push-button. The Green input LED blinks the new Trip Frequency setting (as described in Step 2.2), pauses, and repeats the value.
Ferrite Suppression Cores for signal and control cables:

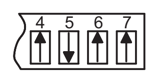
◆ ***If the new Trip Frequency setting is acceptable, this section is complete*.***
◆ ***If the new Trip Frequency setting is not the desired setting, repeat Steps 3.4, through 3.8.***
◆ ***If the Red relay LED blinks, the numerical value entered is invalid. Repeat Steps 3.3 through 3.8.***

* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

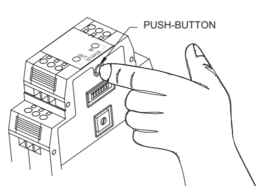
4.0 Set Minimum Response Time



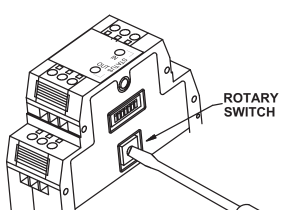
Step 4.2



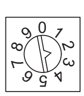
Step 4.1



Step 4.3



Step 4.4



Setting '2' Selected

4.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.
4.2 The Green input LED blinks the existing Minimum Response Time setting (see following list), pauses and repeats.

Setting	Time
0	5 msec
1	10 msec
2	20 msec
3	50 msec
4	100 msec

Setting	Time
5	200 msec
6	500 msec
7	1 sec
8	5 sec (not valid for trip frequency > 3906 Hz)
9	10 sec (not valid for trip frequency > 3906 Hz)

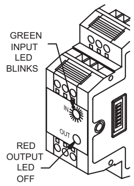
Note: Minimum Response Times do not include the relay's operate response time of 5 msec., or the release response time of 3 msec.

4.3 Press the push-button. The Green input LED blinks rapidly. Minimum Response Time setting is now accessed.
4.4 Turn the rotary switch to the selected numerical value for Minimum Response Time desired (see list in Step 4.2).
4.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new setting.

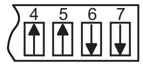
◆ ***If the new Minimum Response Time setting is acceptable, this section is complete*.***
◆ ***If the new Minimum Response Time setting is not the desired setting, repeat Steps 4.3, 4.4, and 4.5.***
◆ ***If the Red relay LED blinks, the rotary switch numerical value is invalid. Repeat Steps 4.4 and 4.5.***

* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

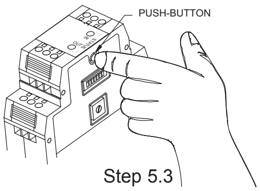
5.0 Set Relay Trip Point (Offset)



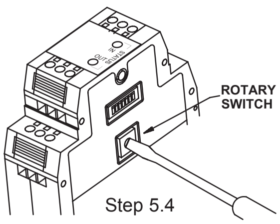
Step 5.2



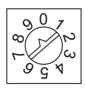
Step 5.1



Step 5.3



Step 5.4



Setting '9' Selected

For Overspeed operation, the Relay Trip point is internally set to the Trip Frequency plus the Offset value. For Underspeed operation, the Relay Trip point is internally set to the Trip Frequency minus the Offset value. The Offset value is equal to the Trip Frequency multiplied by the selected Offset percentage.

Example: The Offset value is calculated as shown below.

Trip Frequency = 250 Hz
Rotary Switch Setting = 4 (2.00%)
Offset Value = 250 Hz x 2.00% (0.02) = 5 Hz

Trip Point:
OVERSPEED = 250 + 5 = 255 Hz
UNDERSPEED = 250 - 5 = 245 Hz

5.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.
5.2 The Green input LED blinks the existing setting (see following list), pauses and repeats.

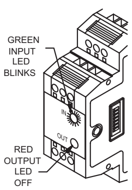
Setting	Percentage
0	0.00% (NO Offset)
1	0.25% (0.0025)
2	0.50% (0.0050)
3	1.00% (0.0100)
4	2.00% (0.0200)
5	5.00% (0.0500)
6	10.00% (0.1000)
7	20.00% (0.2000)
8	25.00% (0.2500)
9	33.33% (0.3333)

5.3 Press the push-button. The Green input LED blinks rapidly. Trip Point Offset setting is now accessed.
5.4 Turn the rotary switch to the selected numerical value for Trip Point Offset desired (see list in Step 5.2).
5.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new setting.

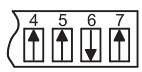
◆ ***If the new Trip Point Offset setting is acceptable, this section is complete*.***
◆ ***If the new Trip Point Offset setting is not the desired setting, repeat Steps 5.3, 5.4, and 5.5.***
◆ ***If the Red relay LED blinks, the rotary switch numerical value is invalid. Repeat Steps 5.4 and 5.5.***

* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

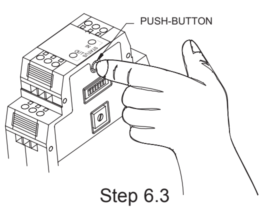
6.0 Set Relay Release Point (Hysteresis)



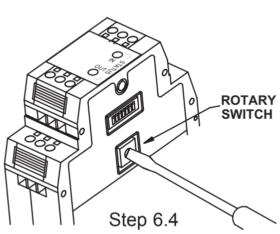
Step 6.2



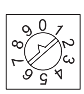
Step 6.1



Step 6.3



Step 6.4



Setting '9' Selected

For Overspeed operation, the Relay Release point is set to the Relay Trip point minus the Hysteresis value. For Underspeed operation, the Relay Release point is set to the Relay Trip point plus the Hysteresis value. The hysteresis value is calculated by multiplying the hysteresis percentage by the current trip frequency. If No Hysteresis (setting = 0) is selected, the Relay Trip and Release points are identical, which can lead to chattering or cycling of the relay at input frequencies hovering around the Relay Trip point.

Example: Using the Trip Frequency and Offset value as shown in the example above, the hysteresis value is calculated as shown below.

Rotary Switch Setting = 3 (1.00%)
Hysteresis Value = 250 Hz x 1.00% (0.01) = 2.5 Hz

Release Point:
OVERSPEED = 250 + 5 - 2.5 = 252.5 Hz
UNDERSPEED = 250 - 5 + 2.5 = 247.5 Hz

6.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.
6.2 The Green input LED blinks the existing setting (see following list), pauses, and repeats.

Setting	Percentage
0	0.00% (NO Hysteresis)
1	0.25% (0.0025)
2	0.50% (0.0050)
3	1.00% (0.0100)
4	2.00% (0.0200)
5	5.00% (0.0500)
6	10.00% (0.1000)
7	20.00% (0.2000)
8	25.00% (0.2500)
9	33.33% (0.3333)

6.3 Press the push-button. The Green input LED blinks rapidly. Trip Point Hysteresis setting is now accessed.
6.4 Turn the rotary switch to the selected numerical value for Hysteresis desired (see list in Step 6.2).
6.5 Press the push-button. The Green input LED blinks the value entered, pauses and repeats the new setting.

◆ ***If the new Trip Point Hysteresis setting is acceptable, this section is complete*.***
◆ ***If the new Trip Point Hysteresis setting is not the desired setting, repeat Steps 6.3, 6.4, and 6.5.***
◆ ***If the Red relay LED blinks, the rotary switch numerical value is invalid. Repeat Steps 6.4 and 6.5.***

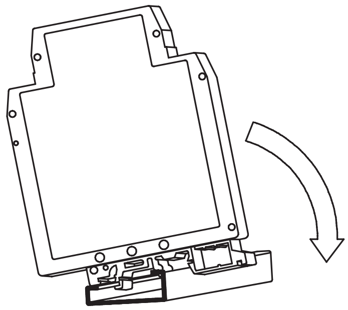
* Section complete; place DIP switch 4 to the down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

INSTALLATION

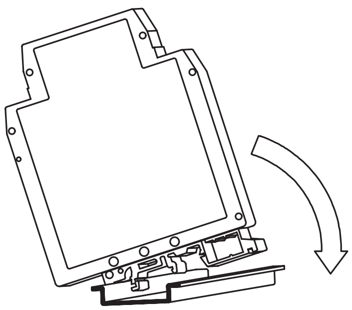
The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

G Rail Installation

To install the IFMR on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



T Rail Installation



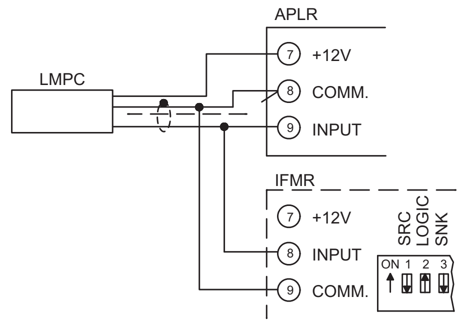
To install the IFMR on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

APPLICATION 1

An APLR is connected to an LMPC (logic magnetic pickup) that is sensing the speed of a 60 tooth gear attached to a shaft. The shaft speed



should not exceed 2000 RPM.

The IFMR is placed in parallel with the APLR to activate an alarm when an overspeed condition is detected, and to turn off the alarm when the speed returns to normal. The Mode of Operation is set for Mode #1 (overspeed trip, automatic release upon return to normal).

To set the value of the alarm, either apply the maximum input signal as described in Section 2.0 or determine the Trip Frequency using the following formula:

$$\text{Trip Freq.} = \frac{\text{units/measure x pulses/unit}}{\text{seconds/measure}}$$

$$\text{Trip Freq.} = \frac{\text{2000 RPM x 60 PPR}}{\text{60 sec}} = \text{2000 Hz}$$

Set the Trip Frequency with the rotary switch for 2000 Hz.

With Trip point Offset set at 0.00% (No Offset) and Trip Point Hysteresis set at 0.25%; activation of the relay occurs at 2000 Hz, and release occurs at 1995 Hz.

APPLICATION 2

The IFMR can be used in a speed monitoring system to detect when the system drops below setpoint.

The IFMR is wired to a PSAC (inductive proximity sensor) that is sensing a key way on the shaft of a motor. The motor is turning at 1750 RPM. When the speed of the motor drops below 1250 RPM, the IFMR latches the output until the user resets the output with an external push button.

The mode of operation of the IFMR is set for 5 (UNDERSPEED Latched trip, release only after Alarm Reset pulled to common). Determine the Trip Frequency using the following formula:

$$\text{Trip Freq.} = \frac{\text{RPM x PPR}}{60}$$

$$\text{Trip Freq.} = \frac{\text{1250 RPM x 1 PPR}}{\text{60 sec.}} = \text{20.83 Hz.}$$

Set the Trip Frequency with the rotary switch for 20.83 Hz.

MODEL AFCM - Analog to Frequency Converter Module

- VOLTAGE/CURRENT TO FREQUENCY CONVERTER
- 3-WAY ISOLATION OF INPUT / OUTPUT SIGNALS
- UNIVERSAL CONVERSION MODULE - INPUTS AND OUTPUTS SELECTED VIA DIP SWITCH SETTINGS
- ULTRA SLIM DESIGN – ONLY 0.244" WIDE
- 19 to 30 VDC POWER

UL Recognized Component,
File # E257265

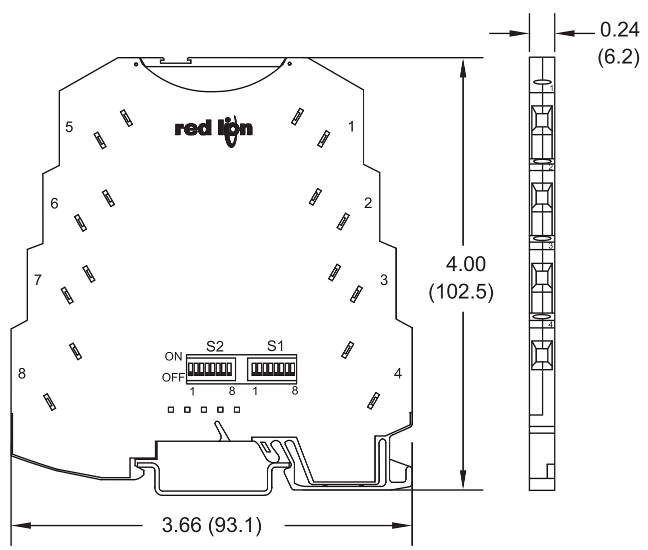
DESCRIPTION

The configurable analog to frequency converter is used to convert analog standard signals to frequency signals or pulse width modulated (PWM) signals. Input signal ranges are 0 - 20 mA, 4 - 20 mA, 0 - 10 mA, 2 - 10 mA, 0 - 10 V, 2 - 10 V, 0 - 5 V, or 1 - 5 V.

The DIP switches are accessible on the side of the housing and allow the following parameters to be configured:

– Input signal
– Output values
– Output type (frequency or PWM)
– Filter type (for smoothing interferences on the input signal)
– Input over/under range fault detection

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
AFCM	Analog to Frequency Converter Module	AFCM0000

SAFETY SUMMARY

The device may only be installed and put into operation by qualified personnel. The corresponding national regulations must be observed.

CAUTION: Risk of Danger. Read complete instructions prior to installationand operation of the unit.	**CAUTION:** Risk of electric shock.

SPECIFICATIONS

INPUT

1. **INPUT SIGNAL RANGE (Configurable)**: 0 - 20 mA, 4 - 20 mA, 0 - 10 mA, 2 - 10 mA, 0 - 10 V, 2 - 10 V, 0 - 5 V, 1 - 5 V
2. **MAX. INPUT SIGNAL**:
   Current inputs: 100 mA
   Voltage inputs: 30 VDC
3. **INPUT RESISTANCE**:
   Current inputs: 50 Ω, approx.
   Voltage inputs: 110 KΩ, approx.

OUTPUT

1. **OUTPUT SIGNAL RANGE (Configurable)**:
   Frequencies: 0 - 10 kHz, 0 - 5 kHz, 0 – 2.5 kHz, 0 - 1 kHz, 0 - 500 Hz 0 - 250 Hz, 0 - 100 Hz, 0 - 50 Hz
   PWM: 7.8 kHz, 3.9 kHz, 1.9 kHz, 977 Hz, 488 Hz, 244 Hz, 122 Hz, 61 Hz
2. **MIN. LOAD**:
   Frequency: 6 KΩ
   PWM: 2 KΩ
3. **MAX. LOAD CURRENT**: 20 mA
4. **OUTPUT**: NPN open collector transistor
5. **MAX. SWITCHING VOLTAGE**: 30 V
6. **OVER-RANGE/UNDER-RANGE FAULT DETECTION**: Configurable
7. **OUTPUT PROTECTION**: Short circuit and polarity protection

GENERAL DATA

1. **SUPPLY VOLTAGE**: 19.2 - 30 VDC
2. **NOMINAL VOLTAGE**: 24 VDC
3. **CURRENT CONSUMPTION**: < 10 mA
4. **POWER CONSUMPTION**: < 200 mW
5. **TRANSMISSION ERROR**: < 0.1%
6. **TEMPERATURE COEFFICIENT (MAX.)**: < 0.02%/K
7. **STEP RESPONSE**:
   0% to 99%: < 15 msec + (1/T)
   With Largest Filter: < 1 sec + (1/T)
8. **TEST VOLTAGE (INPUT / OUTPUT / SUPPLY)**: 1.5 kV, 50 Hz, 1 min
9. **AMBIENT TEMPERATURE RANGE**:
   Operation: -20 t +65°C (-4 to 148°F)
   Storage: -40 to +85°C (-4 to 183°F)
10. **FAULT DETECTION**: Red LED under clear cover top

11. **CERTIFICATIONS AND COMPLIANCES**:

Conformance With EMC Guideline 89/336/EEC And Low Voltage Directive 73/23/EEC

Immunity to Interference According to EN 61000-6-2

Discharge of static electricity (ESD)	EN 61000-4-2	Criterion B[1]
Electromagnetic HF field	EN 61000-4-3	Criterion A[2]
Fast transients (Burst)	EN 61000-4-4	Criterion B[1]
Surge voltage capacities (Surge)	EN 61000-4-5	Criterion B[1]
Conducted disturbance	EN 61000-4-6	Criterion A[2]
Noise Emission According to EN 61000-6-4		
Noise emission of housing	EN 55011	Class A[3]

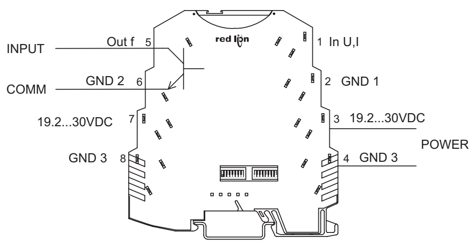
[1] Criterion B: Temporary impairment to operational behavior that is corrected by the device itself.
[2] Criterion A: Normal operating behavior within the defined limits.
[3] Class A: Area of application; industry.

12. **CONNECTIONS**:
    Wire Gauge: 24-12 AWG
    Stripping length: 0.47" (12 mm)
13. **CONSTRUCTION**: Polybutylenterephthalate PBT, black
14. **MOUNTING**: Standard DIN top hat (T) profile rail according to EN50022 - 35x7.5
15. **WEIGHT**: 2 oz. (54 g)

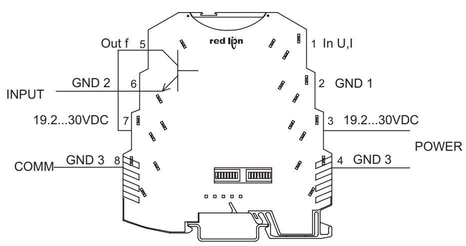
WIRING CONNECTIONS

Primary power is connected to terminals 7 or 3 (19.2 – 30 VDC) and 8 or 4 (GND 3). For best results, the Power should be relatively “clean” and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

The input signal is connected to terminal 1 (In UI) and 2 (GND 1). Connections for the output signal is on terminals 5 (Out f) and 6 (GND 2).



RECEIVING DEVICE SET UP FOR SINK (PULL UP RESISTOR).



RECEIVING DEVICE SET UP FOR SOURCE (PULL DOWN RESISTOR).

CONFIGURATION

DIP Switch S1

Using DIP switch S1, you can set the input values, and the values for Moving Average Filter and Over sampling.

1	2	3	4	ANALOG IN
				0 – 10V
	ON			1 – 5V
		ON		0 – 5V
	ON	ON		2 – 10V
ON			ON	0 – 20 mA
ON	ON		ON	4 – 20 mA
ON		ON	ON	0 – 10 mA
ON	ON	ON	ON	2 – 10 mA

The moving average filter can group values (1, 2, 4, 6) using moving window averaging to form a new measured value. In moving window averaging, the average of a fixed number of measured values is taken, whereby the oldest value is always dropped and the most recent added.

5	6	MOVING WINDOW AVERAGING
		1 value
ON		2 values
	ON	4 values
ON	ON	6 values

7	8	OVER SAMPLING
		1 value
ON		10 values
	ON	50 values
ON	ON	100 values

In order to smooth the measured values, an average can be formed from several measured values (1, 10, 50, 100). This process is called Over sampling. In oversampling, the average is updated every time the selected number of values is reached.

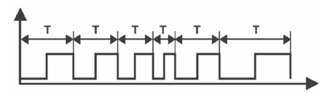
DIP Switch S2

Using DIP switch S2, you can set the output values, the output type and fault detection.

Output Signals

Frequency Output:

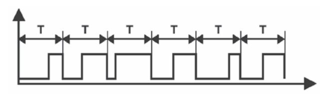
Variable frequency/period duration T



1	2	3	4	FREQUENCY OUTPUT
				0 - 10 kHz
ON				0 - 5 kHz
	ON			0 – 2.5 kHz
ON	ON			0 - 1 kHz
		ON		0 - 500 Hz
ON		ON		0 - 250 Hz
	ON	ON		0 - 100 Hz
ON	ON	ON		0 - 50 Hz

PWM Output (Pulse Wide Modulation):

Variable pulse to pause ratio/fixed period duration T



Change can only be read by PWM input meters.

1	2	3	4	PWM OUTPUT
			ON	7.8 KHz
ON			ON	3.9 KHz
	ON		ON	1.9 KHz
ON	ON		ON	977 Hz
		ON	ON	488 Hz
ON		ON	ON	244 Hz
	ON	ON	ON	122 Hz
ON	ON	ON	ON	61 Hz

Fault Detection

5	6	INPUT OVER RANGE
		Freeze at 100% measuring range end value
ON		105% measuring range end value
	ON	110% measuring range end value
ON	ON	Fault detection OFF (continues past end value)

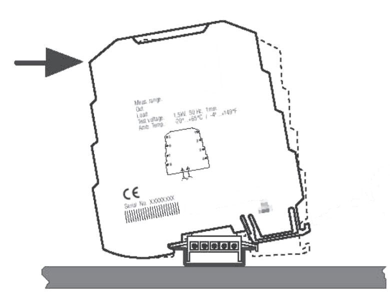
7	8	INPUT UNDER RANGE
		Freeze at 100% measuring range start value
ON		105% measuring range end value
	ON	110% measuring range end value
ON	ON	Fault detection OFF (stops at start value)

INSTALLATION

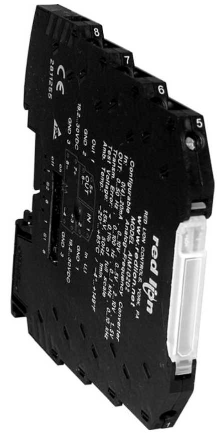
The unit is equipped with a universal mounting foot for attachment to standard DIN style top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

T Rail Installation

To install the AFCM on a “T” style rail, angle the module so that the top groove of the “foot” is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the “foot”, and pry upwards on the module until it releases from the rail.



MODEL AIMI - 0 (4) to 20 mA passive LOOP POWERED Isolator



DESCRIPTION

The AIMI0202 passive isolator is used for the electrical isolation and processing of analog 0(4) to 20 mA standard current signals. The AIMI0202 provides electrical isolation between the control electronics and process I/O. In addition, interference signals above 75 Hz are effectively suppressed.

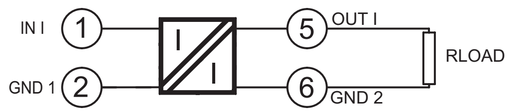
Input and output circuit do not require separate auxiliary power. The AIMI0202 obtains power from the input signal. The modules are snapped onto symmetrical DIN rails in accordance with EN 50022.

VOLTAGE DROP AT INPUT

When using the AIMI0202, ensure the voltage supply is sufficient for handling both the voltage drop of the input and the output load voltage drop. The AIMI0202 input resistance will create around a 1.7 V drop.

The following formula calculates the total voltage drop (input and output). Total voltage drop = (1.7 V + (20 mA * RLOAD))

Where:
1.7 V = Input voltage drop
20 mA * RLOAD = Output load voltage drop



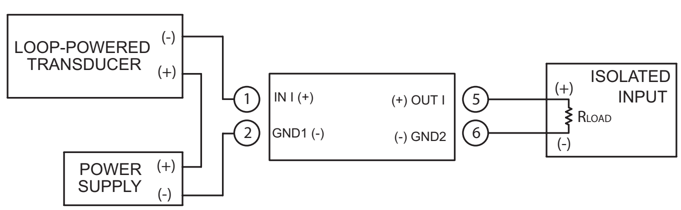
SPECIFICATIONS

1. **INPUT RANGE:** 0(4) to 20 mA
2. **MAXIMUM INPUT CURRENT/VOLTAGE:** 40 mA/18 VDC
3. **VOLTAGE DROP AT INPUT:** 1.7 V + (20 mA * RLOAD)
4. **MAXIMUM INPUT FREQUENCY:** <75 Hz
5. **RESPONSE TIME:** 5 msec. max.
6. **OUTPUT SIGNAL:** 0(4) to 20 mA
   Max. Load Resistance: ≤ 600 Ω
7. **ISOLATION VOLTAGE:** 1.5 KV, 50 Hz, for 1 minute
8. **ACCURACY:** ≤0.1% of full scale
9. **OPERATING TEMPERATURE RANGE:** -20 to +65 °C
10. **TEMPERATURE COEFFICIENT:** ≤0.002%/K of the measured value
11. **CONSTRUCTION:** Case body is black, Polyester PBT
12. **MOUNTING:** Standard DIN style rail, including top hat (T) profile rail according to EN50022 - 35 × 7.5.
13. **WEIGHT:** 2 oz (56 g)

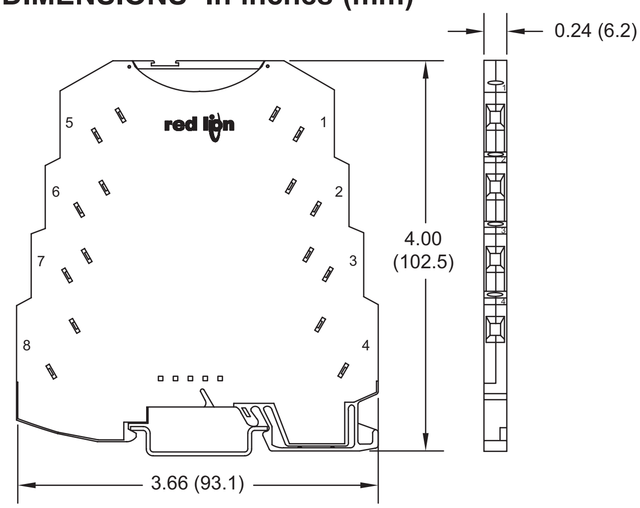
WIRING CONNECTIONS

Connect transducer to input (Terminals 1 & 2), observing polarity. A power supply may be required for loop powered transducers.

The energy for the supply on the input side is taken from the analog input signal. Due to the dynamic input resistance, a power loss of approximately 1.7 V drops at the module input. The module's output is self-powered (active), which is also derived from the input signal.



DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	INPUT	OUTPUT	PART NUMBER
AIMI	0 (4)-20 mA	0 (4)-20 mA	AIMI0202

MODEL IAMS – INTELLIGENT UNIVERSAL SIGNAL CONDITIONING MODULE

- *UNIVERSAL INPUT, PROCESS, mA DC, VDC, TC, 100 (RTD, POTENTIOMETER, AND LINEAR RESISTANCE*
- *UNIVERSAL POWER SUPPLY, 21.6 to 253 VAC/ 19.2 to 300 VDC*
- *3-WAY ISOLATION (POWER/SIGNAL/OUTPUT)*
- *CHOOSE SETPOINTS AND/OR ANALOG OUTPUT MODELS*
- *PROGRAMMING/DISPLAY MODULE (NOT INCLUDED)*
- *PROGRAMMING AVAILABLE IN SEVEN DIFFERENT LANGUAGES*

FM APPROVED
PROCESS CONTROL EQUIPMENT

C UL US LISTED

GENERAL DESCRIPTION

The IAMS — Universal Signal Conditioners unmatched capability provides users the ultimate in flexibility. As a signal conditioner, the unit provides complete isolation and conversion capability to satisfy almost any application. The Universal Input accepts Process, DC Current, DC Voltage, Thermocouples, RTDs, Potentiometers, and Linear Resistance signals allowing the module to be connected to most common sensors. The setpoint model allows dual setpoint control capability through dual Form A relays. The analog model provides a retransmitted analog signal. A third model provides both analog and control capability. The power supply is also universal, accepting 21.6 to 253 VAC/ 19.2 to 300 VDC as its power source. Add the optional programming module and the unit is easily programmed through menu style programming. The module can also be used to provide a display of the process variable when it is not being used for programming.

The IAMS features well over 100 combinations of inputs to outputs configurations. Input specific terminals allow for the various signals and sensors to be connected to the unit while the input ranges and resolutions are adjusted in the input programming loop of the unit. The menu style programming allows the user quick and easy set-up by using the PGMMOD, programming module. The module is required to program the IAMS. However, if you are using more than one IAMS, only one programming module is required. The module can store programming from one unit and load it to a second unit reducing set-up time for multiple installations. When the programming module is not being used for programming, it can indicate the input parameters, just like a panel meter.

The unit's overall full scale accuracy typically exceeds 0.1 % depending on the range selection and scaling. The microprocessor based design provides ease of field scaling and the onboard E^2PROM stores scaling values for future recall. All units come factory precalibrated for all input and output ranges. Factory or custom field scaling can be selected in the Advanced programming loop. The IAMS can be factory recalibrated in the field if desired.

The unit's environmental operating temperature range is -20º C to 60º C. DIN rail mounting saves time and panel space. The units are equipped with mounting feet to attach to top hat profile rail according to EN50022 – 35 x 7.5 and 35 x 15.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

WARNING

INSTALL-ATION

To keep the safety distances, the relay contacts on the devices must not be connected to both hazardous and non-hazardous voltages at the same time.

The IAMS devices must be mounted on a DIN rail according to DIN 46277.

DIMENSIONS In inches (mm)

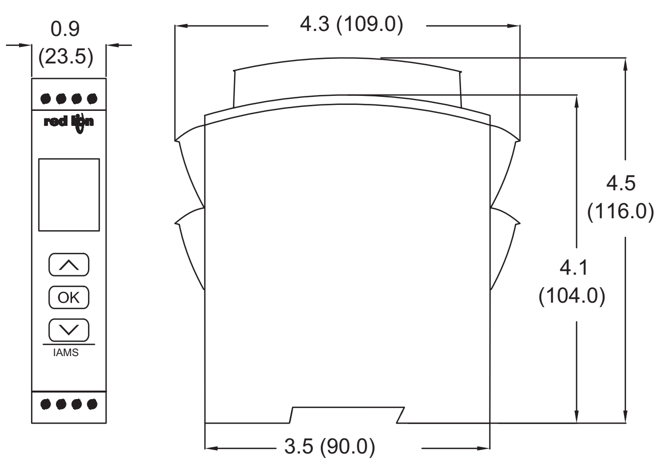


Table Of Contents

Ordering Information

MODEL NO.	DESCRIPTION	PART NUMBER
IAMS	Intelligent Universal Signal Conditioner with Analog Output	IAMS0001
	Intelligent Universal Signal Conditioner w/Dual Setpoints	IAMS0010
	Intelligent Universal Signal Conditioner w/Analog Output and Dual Setpoints	IAMS0011
	Programming Display Module (Not Included) *	PGMMOD00

** At least one module is required to program a unit or a series of units.*

General Specifications

1. **DISPLAY**: See Display/ Programming Module
2. **POWER**:
   AC Power: 21.6 to 253 VAC, 50/60 Hz
   DC Power: 19.2 to 300 VDC,
3. **CONSUMPTION**: ≤2.5 W
4. **FUSE**: 400 mA SB/250 VAC
5. **ISOLATION**: Between input, supply and outputs - 2.3 kVAC/250 VAC
6. **INPUTS:**
   Current Input:
   Programmable Ranges: 0 to 20 and 4 to 20 mA DC
   Measurement range: -1 to 25 mA
   Input resistance: Nom. 20 Ω + PTC 50 Ω
   Sensor error detection: 4 to 20 loop break, yes
   Supply Voltage: 16-25 VDC, 20 mA max (Terminal 43 and 44)
   Voltage Input:
   Programmable Ranges: 0 to 1, 0.2 to 1, 0 to 5, 1 to 5, 1 to 10, and 2 to 10 VDC
   Measurement range: -20 mV to 12 VDC
   Input resistance: Nom. 10 MΩ
   Thermocouple Inputs:
   Thermocouple Type: B, E, J, K, L, N, R, S, T, U, W3, W5, and LR
   Cold Junction Compensation: via internally mounted sensor < ±1.0 ºC
   Sensor Error Detection: All TC types, yes
   Sensor Error Current: When detecting 2 µA, otherwise 0 µA

TYPE	MIN. VALUE	MAX. VALUE	STANDARD
B	+400 °C	+1820 °C	IEC 60584-1
E	-100 °C	+1000 °C	IEC 60584-1
J	-100 °C	+1200 °C	IEC 60584-1
K	-180 °C	+1372 °C	IEC 60584-1
L	-200 °C	+900 °C	DIN 43710
N	-180 °C	+1300 °C	IEC 60584-1
R	-50 °C	+1760 °C	IEC 60584-1
S	-50 °C	+1760 °C	IEC 60584-1
T	-200 °C	+400 °C	IEC 60584-1
U	-200 °C	+600 °C	DIN 43710
W3	0 °C	+2300 °C	ASTM E988-90
W5	0 °C	+2300 °C	ASTM E988-90
LR	-200 °C	+800 °C	GOST 3044-84

RTD, Linear Resistance, Potentiometer Inputs

RTD Types: Pt10, Pt20, Pt50, Pt100, Pt200, Pt250, Pt300, Pt400, Pt500, Pt1000, Ni50, Ni100, Ni120, and Ni1000

INPUT TYPE	MIN. VALUE	MAX. VALUE	STANDARD
Pt100	-200 °C	+850 °C	IEC60751
Ni100	-60 °C	+250 °C	DIN 43760
Lin. R	0 Ω	10000 Ω	-
Potentiometer	10 Ω	100 kΩ	-

Cable Resistance per wire: RTD, 50 Ω max.
Sensor Current: RTD, Nom. 0.2 mA
Sensor Error Detection: RTD, yes
Short Circuit Detection: RTD, < 15 Ω

7. **STEP RESPONSE TIME:** (0 to 90% or 100 to 10%)
Temperature input: ≤ 1 sec
Current/Voltage input: ≤ 400 msec

8. **ACCURACY:** The greater of the general and basic values.

GENERAL VALUES		
Input Type	Absolute Accuracy	Temperature Coefficient
All	≤ ±0.1% of span	≤ ±0.1% of span/°C

BASIC VALUES		
Input Type	Basic Accuracy	Temperature Coefficient
mA	≤ ±4 μA	≤ ±0.4 μA/°C
Volt	≤ ±20 μV	≤ ±2 μV/°C
Pt100	≤ ±0.2 °C	≤ ±0.01 °C/°C
Lin. R	≤ ±0.1 Ω	≤ ±0.01 Ω/°C
Potentiometer	≤ ±0.1 Ω	≤ ±0.01 Ω/°C
TC Type: E, J, K, L, N, T, U	≤ ±1 °C	≤ ±0.5 °C/°C
TC Type: B, R, S, W3, W5, LR	≤ ±2 °C	≤ ±0.2 °C/°C

9. **CALIBRATION TEMPERATURE:** 20 to 28 ºC

10. **RELAY OUTPUTS**: Dual Form A. Contacts rated at 2 A AC or 1 A DC
Hysteresis: 0.1 to 25 % (1 to 2999 display counts)
On and off delay: 0 to 3600 sec
Sensor Error Detection: Break / Make / Hold
Max. Voltage: 250 Vrms
Max. Current: 2 A AC or 1 ADC
Max. Power: 500 VA

11. **ANALOG OUTPUT:**
Current Output:
Signal Range (Span): 0 to 20 mA
Programmable Measurement Range: 0 to 20, 4 to 20, 20 to 0, and 20 to 4 mA
Load Resistance: 800 Ω max.
Output Compliance: 16 VDC max.
Load Stability: = 0.01 % of span, 100 Ω load
Sensor Error Detection: 0 / 3.5 mA/ 23 mA / none
Output Limitation: For 4 to 20 and 20 to 4 mA signals - 3.8 to 20.5 mA
For 0 to 20 and 20 to 0 mA signals - 0 to 20.5 mA
Current Limit: = 28 mA
Voltage Output:
Signal Range: 0 to 10 VDC
Programmable Signal Ranges: 0 to 1, 0.2 to 1, 0 to 10, 0 to 5, 1 to 5, 2 to 10, 1 to 0, 1 to 0.2, 5 to 0, 5 to 1, 10 to 0, and 10 to 2 V
Load: 500 K Ω min

12. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature: -20 to +60 ºC
Operating and Storage Humidity: 95% relative humidity (non-condensing)

13. **CERTIFICATIONS AND COMPLIANCES**:
ELECTROMAGNETIC COMPATIBILITY:
EMC 2004/108/EC Emission and Immunity EN 61326
EMC Immunity Influence <± 0.5% of span
Extended EMC Immunity: NAMUR NE 21,
A criterion, burst <± 1% of span
SAFETY
LVD 2006/95/EC EN 61010-1
Factory Mutual Approved, Report #3034432, FM 3600, 3611, 3810, and ISA 82.02.01
FM, applicable in: Class I, Div. 2, Group A, B, C, D
Class I, Div. 2, Group IIC
Zone 2
Max. ambient temperature for T5 60°C
UL Listed, File # E324843, UL508, CSA C22.2 No. 14-M95
LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
Refer to the EMC Installation Guidelines section of this bulletin for additional information.

14. **CONSTRUCTION**: IP 50/IP20 Touch Safe, case body is black high impact plastic. Pollution Degree 1.

15. **CONNECTIONS:** High compression cage-clamp terminal block. Use 60/75°C copper conductors only.
Wire strip length: 0.3" (7.5 mm)
Wire gage: 26 – 14 AWG stranded wire
Torque: 4.5 inch-lbs (0.5 N-m) max

16. **WEIGHT**: 5 oz (145 g)
5.6 oz (160 g) with programming module

ACCESSORY

Display/ Programming Module

The module easily connects to the front of the IAMS and is used to enter or adjust the programming of the module. For applications that require more than one IAMS, the same programming module can be used to program multiple units. In fact, it can store the configuration from one module and download the same configuration to another module. When the module is not being used for progamming, it can provide a display of the process data and status.

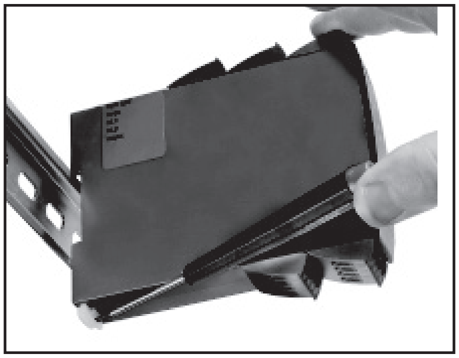
Display: LCD display with 4 lines; line 1 is 0.2" (5.5 mm) and displays the input signal, line 2 is 0.13" (3.33 mm) and displays units, line 3 is 0.13" (3.33 mm) and displays analog output or tag number, line 4 shows communication and relay status

Programming Mode: Three push buttons combined with a simple and easily understandable menu structure and help text guides you effortlessly through the configuration steps. The actual configuration/set-up will be explained in the Programming Section.

Password Protection: Programming access may be blocked by assigning a password. The password is saved in the IAMS to guard against unautherized modifications to the configuration. A default password of "2008" allows access to all configuration menus.

1.0 Installing the Unit

The IAMS is designed to mount to a top hat profile DIN rail. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.



2.0 Installing the Programming Module

The PGMMOD, Programming/Display Module is designed to connect to the front of the IAMS. Insert the top of the programming module first, then allow the bottom to lock into the IAMS.

When programming is complete, leave the programming module in place to display the process data or press the release tab on the bottom of the programming module.

3.0 Wiring the Unit

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the sides of the unit. All conductors should conform to the unit's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes, and regulations. It is recommened that power supplied to the unit (DC or AC) be protected by a fuse or circuit breaker.

When wiring the unit, compare the numbers on the terminal blocks against those shown in wiring drawings for proper wire position. Insert the wire under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

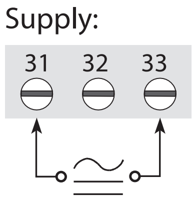
EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. The unit becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful installation or troublesome installation.

Listed below are some EMC guidelines for successful installation in an industrial environment.

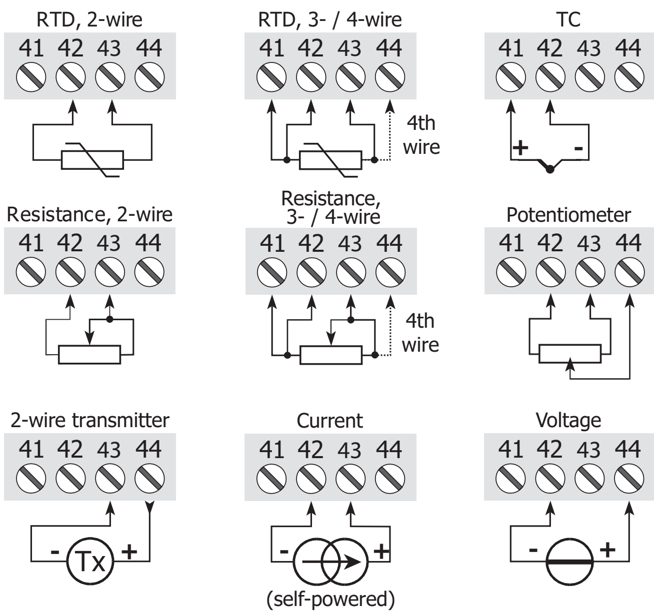
1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubber: RLC#SNUB0000.

3.1 POWER WIRING

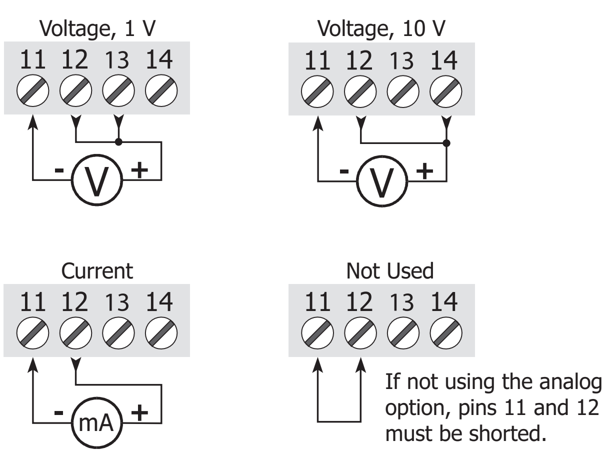


Note: For DC power connections, there are no polarity concerns.

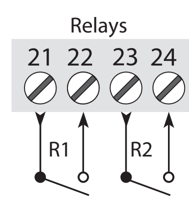
3.2 INPUT SIGNAL WIRING



3.3 ANALOG OUTPUT WIRING



3.4 SETPOINT OUTPUT WIRING



4.0 Reviewing the Front Buttons and Display

DISPLAY: Total of four lines.

	Display Mode	Programming Mode
Line 1	Displays input signal	Shows the selected parameter value
Line 2	Displays input units	Shows the selected parameter
Line 3	Displays output signal	Shows scrolling help text
Line 4	Displays communication and relay status	Shows communication and relay status

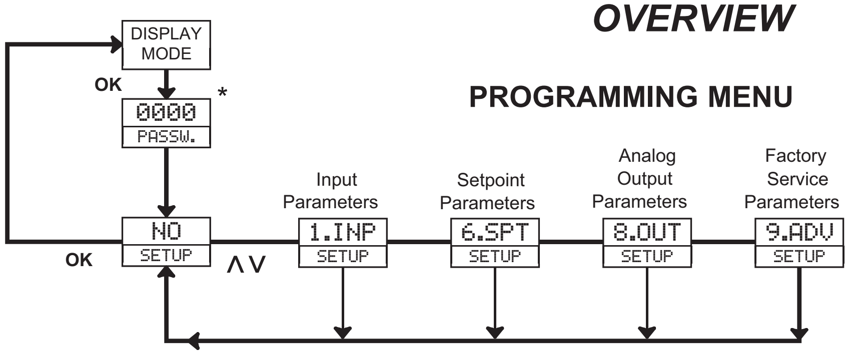
PUSH BUTTONS: Configuration of the unit is by the use of the three function keys. These keys are only active in the programming mode.

- ∧ - increases the numerical value or choose the next selection
- OK - Enters programming mode, saves the chosen value and proceeds to the next selection
- ∨ - decreases the numerical value or choose the previous selection

5.0 Programming the Unit

OVERVIEW

PROGRAMMING MENU



* If password is enabled.

Warning: Save all programming changes before entering 9.ADV SETUP. Do this by exiting the Program Mode at the NO SETUP prompt and then reentering.

STEP BY STEP PROGRAMMING INSTRUCTIONS:

PROGRAMMING MODE ENTRY (OK KEY)

A programming module, PGMMOD00 is required to program the unit. The programing mode is entered by pressing the **OK** key. If the password protection is enabled, entry of the password is required to gain access. If the password protection is disabled, direct access to programming will occur.

MENU ENTRY (ARROW & OK KEYS)

Upon entering the programming mode (set-up), the arrow keys will index between the programming modules. Select the desired module, press the **OK** key enter the module programming.

PARAMETER SELECTION AND ENTRY (ARROW & OK KEYS)

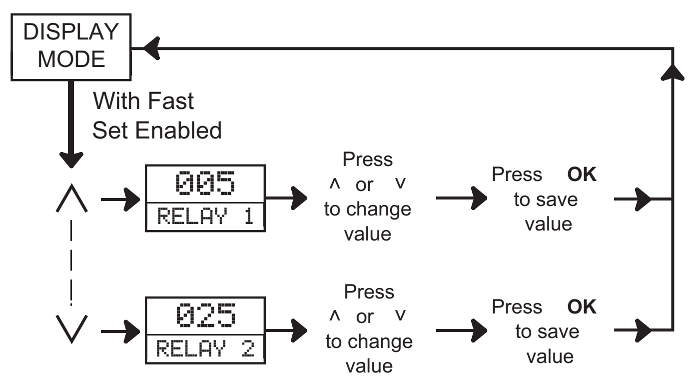
In each of the Programming Modules are parameters that can be configured to the desired action for a specific appplication. Each parameter has a list of selections or a numeric value that can be entered. The parameters are displayed on line #2 and the selection is on line #1. The arrow keys will move through the selection list or increase or decrease the numeric values. Once the selection or numeric value is set to the desired action, press the **OK** key to enter the data and move to the next parameter.

PROGRAMMING MODE EXIT (ARROW & OK KEYS)

After completing a programming module loop, the display will return to the set-up position. At this time additional programming modules can be selected for programming or the selection of "NO" can be entered. Entering "NO" will exit the Programming Mode, save any changes, and enable the Display Mode. (If power loss occurs before returning to the display mode, verify recent parameter changes.)

Note: The unit will return to the Display Mode from any menu after 1 minute without a key press or by pressing and holding the OK key for 2 seconds. In these cases, verify recent parameter changes.

FAST SET MENU



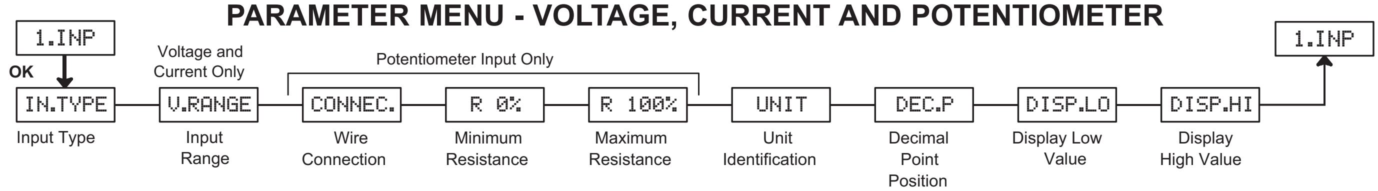
FAST SETPOINT MODE

- ∧ - displays setpoint 1 and increases the shown setpoint value
- OK - saves the changed setpoint value and returns to the Display Mode (Holding for 2 seconds returns to the Display Mode without saving.)
- ∨ - displays setpoint 2 and decreases the shown setpoint value

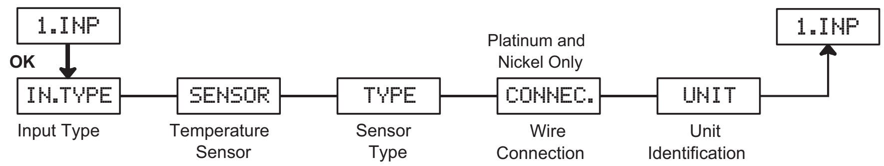
5.1 MODULE 1 - SIGNAL INPUT PARAMETERS

H

PARAMETER MENU - VOLTAGE, CURRENT AND POTENTIOMETER



PARAMETER MENU - TEMPERATURE



INPUT TYPE (IN TYPE)

VOLT
INTYPE

VOLT CURR LIN.R
POTM TEMP

Select the appropriate Input Type for the application.

Note: Changing the input parameters may affect the setpoint and/or analog programming.

INPUT TYPE (VOLT)

VOLT
INTYPE

If input type is selected for voltage, the following parameters appear.

VOLTAGE RANGE (V.RANGE)

2-10
V.RANGE

0-1 0-5 0-10
0.2-1 1-5 2-10

Select the appropriate Voltage Range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution.

INPUT TYPE (CURR)

CURR
INTYPE

If input type is selected for current, the following parameters appear.

CURRENT RANGE (I.RANGE)

4-20
I.RANGE

0-20 4-20

Select the appropriate Current Range that corresponds to the external signal. This selection should be high enough to avoid input signal overload but low enough for the desired input resolution.

INPUT TYPE (LIN.R)

LIN.R
INTYPE

If input type is selected for linear resistance, the following parameters appear.

WIRE CONNECTION (CONNEC.)

3W
CONNEC.

2W 3W 4W

Select the wires the sensor or signals has to connect to the unit.

MINIMUM RESISTANCE (R 0%)

0
R 0%

0.0 to 9998

Enter the low resistance value.

MAXIMUM RESISTANCE (R 100%)

2500
R 100%

0.0 to 9999

Enter the high resistance value.

The next five parameters apply to the voltage, current, linear resistance and potentiometer input types.

UNIT IDENTIFICATION (UNIT)

UNIT
%

Select one of the 69 available units as listed below.

°C	hp	kW	mA	pH
°F	hPa	kWh	mbar	rpm
%	Hz	l	mils	s
A	in	l/h	min	S
bar	in/h	l/min	mm	t
cm	in/min	l/s	mm/s	t/h
ft	in/s	m	mol	uA
ft/h	ips	m/h	mPa	um
ft/min	K	m/min	mV	uS
ft/s	kA	m/s	MW	V
g	kg	m/s2	MWh	W
gal/h	kJ	m3	N	Wh
gal/min	kPa	m3/h	Ohm	yd
GW	kV	m3/min	Pa	

DECIMAL POINT (DEC.P)

111.1
DEC.P

1111 111.1
11.11 1.111

Select the appropriate decimal point location.

DISPLAY LOW (DISP.LO)

0.0
DISP.LO

-199.9 to 999.9

Enter the low display value.

DISPLAY HIGH (DISP.HI)

100.0
DISP.HI

-199.9 to 999.9

Enter the high display value.

The remaining parameters in this module apply to temperature input type only.

INPUT TYPE (TEMP)

TEMP / INTYPE

If input type is selected for temperature, the following parameters appear.

TEMPERATURE SENSOR (SENSOR)

Ni / SENSOR

Pt, Ni, or TC

Select the appropriate temperature sensor.

RTD -Select the appropriate RTD sensor.

TYPE: Pt10 Pt20 Pt50 Pt100
Pt200 Pt250 Pt300
Pt400 Pt500 Pt1000

WIRE CONNECTION: 2W 3W 4W

NICKEL SENSORS -Select the appropriate Nickel sensor.

TYPE: Ni50 Ni100,
Ni120 Ni1000

WIRE CONNECTION: 2W 3W 4W

THERMOCOUPLE -Select the appropriate Thermocouple sensor.

TYPE: TC.B TC.E TC.J TC.K TC.L
TC.N TC.R TC.S TC.T TC.U
TC.W3 TC.W5 TC.Lr

H

UNIT IDENTIFICATION (UNIT)

°C / UNIT

°F or °C

Select the appropriate unit for the temperature being displayed.

5.2 MODULE 6 - SETPOINT PARAMETERS (REQUIRES SETPOINT OPTION)

PARAMETER MENU - SETPOINT (SETP)

6.SPT → REL.UN — R1.FUNC — R1.CONT — R1.SETP — ACT.DIR — R1.HYST — ERR.ACT — ON.DEL — OFF.DEL — R2.FUNC → OK → 6.SPT

REL.UN	R1.FUNC	R1.CONT	R1.SETP	ACT.DIR	R1.HYST	ERR.ACT	ON.DEL	OFF.DEL	R2.FUNC
Relay Assignment	Relay Function	Control	Setpoint Value	Activation Direction	Hysteresis	Error Activation	On Delay	Off Delay	Relay 2 repeat R1

PARAMETER MENU - WINDOW (WIND)

6.SPT → REL.UN — R1.FUNC — R1.CONT — SETP.LO — SETP.HI — R1.HYST — ERR.ACT — ON.DEL — OFF.DEL — R2.FUNC → OK → 6.SPT

REL.UN	R1.FUNC	R1.CONT	SETP.LO	SETP.HI	R1.HYST	ERR.ACT	ON.DEL	OFF.DEL	R2.FUNC
Relay Assignment	Relay Function	Control	Setpoint Low Value	Setpoint High Value	Hysteresis	Error Activation	On Delay	Off Delay	Relay 2 repeat R1

RELAY ASSIGNMENT (REL.UN) *

DISP / REL.UN

DISP or PERC

Select relay assignment to display units or percent of the input.

* This selection is not valid when programmed for temperature.

RELAY 1 FUNCTION (R1.FUNC)

SETP / R1.FUNC

SETP WIND E R R
POW OFF

Select how relay 1 is to function. For SETP the relay is controlled by setpoint one. Select WIND and the relay is controlled by 2 setpoints. For ERR the relay indicates sensor alarm only. Select POW and the relay indicates power status. For OFF the relay is disabled.

RELAY 1 FUNCTION (SETP)

SETP / R1.FUNC

If the relay function is selected for setpoint, the following parameters appear.

RELAY 1 CONTROL (R1.CONT)

N.O. / R1.CONT

N.O. or N.C.

Select relay 1 operation, normally open or normally closed.

RELAY 1 SETPOINT VALUE (R1.SETP)

50.0 / R1.SETP

-200 to 850.0

Enter the relay 1 setpoint value.

ACTIVATION DIRECTION (ACT.DIR)

INCR / ACT.DIR

INCR or DECR

Select the direction relay 1 should activate, increasing signal or decreasing signal.

RELAY 1 HYSTERSIS (R1.HYST)

1.0 / R1.HYST

0.1 to 262.5

Enter relay 1 hysteresis value.

RELAY 1 ERROR ACTIVATION (ERR.ACT)

NONE / ERR.ACT

HOLD, CLOS, OPEN, and NONE

Select relay 1 error mode action.

RELAY 1 ON DELAY (ON.DEL)

0 / ON.DEL

0 to 3600

Enter relay 1 On Delay Time.

RELAY 1 OFF DELAY (OFF.DEL)

0 / OFF.DEL

0 to 3600

Enter relay 1 Off Delay Time.

RELAY 1 FUNCTION (WIND)

WIND / R1.FUNC

If the relay function is selected for window, the following parameters appear.

RELAY 1 CONTROL (R1.CONT)

O.IW
R1.CONT

O.IW or C.IW

Select relay 1 contact to be open inside the window or closed in the window.

SETPOINT LOW VALUE (SETP.LO)

60.0
SETP.LO

-200 to 849.9

Enter the window's low value.

SETPOINT HIGH VALUE (SETP.HI)

60.0
SETP.LO

-199.9 to 850.0

Enter the window's high value.

RELAY WINDOW HYSTERSIS (R1.HYST)

1.0
R1.HYST

0.1 to 262.5

Set the window's hysteresis value.

RELAY 1 ERROR ACTIVATION (ERR.ACT)

NONE
ERR.ACT

HOLD, CLOS, OPEN, and NONE

Select relay 1 error mode action.

RELAY 1 ON DELAY (ON.DEL)

0
ON.DEL

0 to 3600

Enter relay 1 On Delay Time.

RELAY 1 OFF DELAY (OFF.DEL)

0
OFF.DEL

0 to 3600

Enter relay 1 Off Delay Time.

RELAY 1 FUNCTION (ERR)

ERR
R1.FUNC

If the relay function is selected for error mode, the following parameters appear.

RELAY 1 ERROR ACTIVATION (ERR.ACT)

OPEN
ERR.ACT

CLOS OPEN

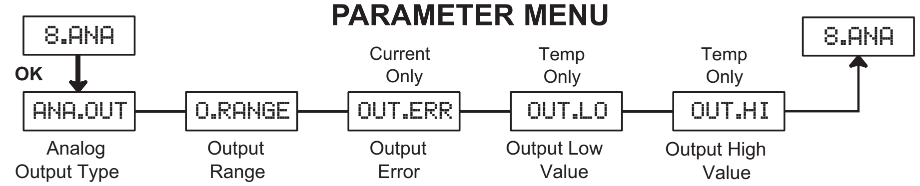
Select relay 1 error mode action.

The POW and OFF selection have no programming capabilites.

For Relay 2, repeat the steps listed for Relay 1.

5.3 MODULE 8 - ANALOG OUTPUT PARAMETERS (REQUIRES ANALOG OUTPUT OPTION)

PARAMETER MENU



ANALOG OUTPUT TYPE (ANA.OUT)

CURR
ANA.OUT

VOLT or CURR

Select either Voltage or Current output.

OUTPUT RANGE (O.RANGE)

0-10
O.RANGE

Select the appropriate range based on the analog output type selected.

VOLTAGE -Select the appropriate voltage range.

RANGE: 0-1, 0.2-1, 0-5, 1-5, 1-10, or 2-10

CURRENT -Select the appropriate current range.

RANGE: 0-20, 4-20, 20-0, or 20-4

OUTPUT ERROR (OUT.ERR) For CURR only

23mA
OUT.ERR

NONE, 0mA, 3.5mA, or 23mA

This parameter is only available if the analog output type is selected for current. Select the proper Error action, if needed.

OUTPUT LOW VALUE (OUT.LO) For TEMP only

0.0
OUT.LO

-200 or 849.0

Enter the value for the output Low Value.

OUTPUT HIGH VALUE (OUT.HI) For TEMP only

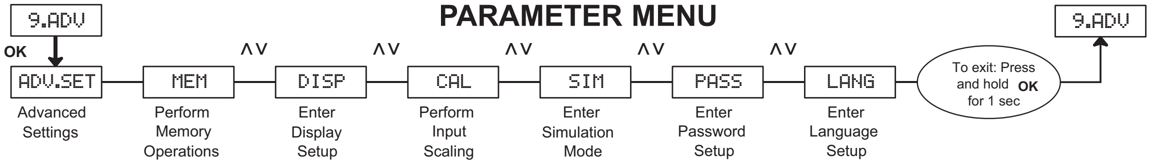
150.0
OUT.HI

-199 or 850.0

Enter the value for the output High Value.

5.4 MODULE 9 - ADVANCED PARAMETERS

PARAMETER MENU



ADVANCED SETTING (ADV.SET)

MEM / ADV.SET — MEM DISP C A L SIM PASS LANG

Select the advanced setting menu to make the desired change.

ADVANCED SETTING (MEMORY)

MEM / ADV.SET

If the advanced setting is selected for memory, the following parameter appears.

MEMORY SETTING (MEMORY)

SAVE / MEMORY — LOAD or SAVE

Select save to save unit set-up to the display module or select load to download saved set-up to the unit.

ADVANCED SETTING (DISP)

DISP / ADV.SET

If the advanced setting is selected for display, the following parameters appear.

LCD CONTRAST (CONTRA.)

3 / CONTRA. — 0 to 9

Select the desired Display Contrast.

LCD BACKLIGHT ADJUSTMENT (LIGHT)

9 / LIGHT — 0 to 9

Select the desired Display Backlight.

TAG NUMBER (TAGNO.)

TAGNO. — A to 9

Enter a custom 6 character device tag.

LINE 3 SET UP (LINE 3)

A.OUT / LINE 3 — A.OUT or TAG

Select the proper display for Line 3.

ADVANCED SETTING (CAL)

CAL / ADV.SET

If the advanced setting is selected for calibration (applied input scaling), the following parameters appear as selected in the input setup. A temperature example is shown.

CALIBRATION LOW (CAL.LO)

No / CAL.LO — No or YES

Calibrate the input low to the process value.

LOW CALIBRATION POINT VALUE (Low Input Signal)

2.0 / °C — -200 to 850.0

Apply the low input signal, then enter the value for the Low Value Point.

CALIBRATION HIGH (CAL.HI)

NO / CAL.HI — NO or YES

Calibrate the input high to the process value.

HIGH CALIBRATION POINT VALUE (High Input Signal)

97.8 / °C — -200 to 850.0

Apply the high input signal, then enter the value for the High Value Point.

USE PROCESS CALIBRATION VARIABLES (USE.CAL)

YES / USE.CAL — NO or YES

Use Process Calibration Varaibles.

ADVANCED SETTING (SIM)

SIM / ADV.SET

If the advanced setting is selected for simulation, the following parameters appear.

INPUT SIMULATION (ENA.SIM)

No / ENA.SIM — YES or No

Enable Input Simulation.

INPUT SIMULATION VALUE (°C)

23.0 / °C — -200 to 850.0

Enter the Input Simulation Value, as selected in the input setup.

RELAY SIMULATION (REL.SIM)

REL.SIM

Use the ▲ and ▼ to toggle between relay 1 and 2.

ADVANCED SETTING (PASS)

PASS / ADV.SET

If the advanced setting is selected for password, the following parameters appear.

PASSWORD PROTECTION (EN.PASS)

No / EN.PASS — YES or No

Enable Password protection.

ENTER NEW PASSWORD (NEW.PAS) *

0000 / NEW.PAS — 0000 to 9999

Enter New Password.

ENABLE FAST SET (EN.FAST)

YES / EN.FAST — YES or No

Enable fast set functionality of the setpoints. .

** Universal code 2008 will allow access to a locked unit.*

ADVANCED SETTING (LANG)

LANG / ADV.SET

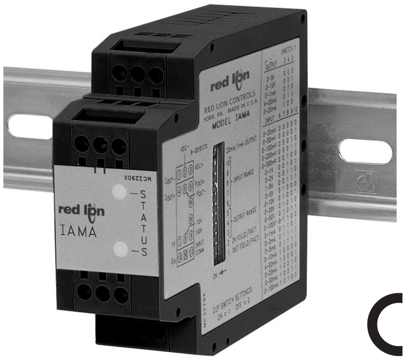
If the advanced setting is selected for LANGUAGE, the following parameter appears.

SELECT PROGRAMMING LANGUAGE (LANGUA)

UK / LANGUA — DE DK ES F R IT SE UK

Set programming language.

MODEL IAMA - UNIVERSAL SIGNAL CONDITIONING module



- *3-WAY ISOLATION OF ANALOG SIGNALS*
- *UNIVERSAL CONVERSION MODULE - INPUTS AND OUTPUTS SELECTED VIA DIP SWITCH SETTINGS*
- *OVER 100 INPUT AND OUTPUT ANALOG CONVERSION COMBINATIONS*
- *CHOOSE LINEAR OR SQUARE ROOT EXTRACTION MODEL*
- *ALL RANGES ARE FACTORY PRECALIBRATED. CUSTOM FIELD CALIBRATION IS AVAILABLE FOR ALL RANGES WHILE MAINTAINING THE FACTORY CALIBRATION FOR FUTURE USE*
- *11 to 36 VDC AND 24 VAC MODULE POWER*

UL Recognized Component,
File # E179259

GENERAL DESCRIPTION

The IAMA – Universal Signal Conditioning Module Series can isolate and convert over 100 combinations of analog signal ranges. The IAMA3535 converts and transmits signals linearly proportional to the input, while the IAMA6262 transmits the scaled square root of the input signal. This allows the IAMA6262 to provide a signal that is linear to flow rate in applications utilizing a differential pressure transducer.

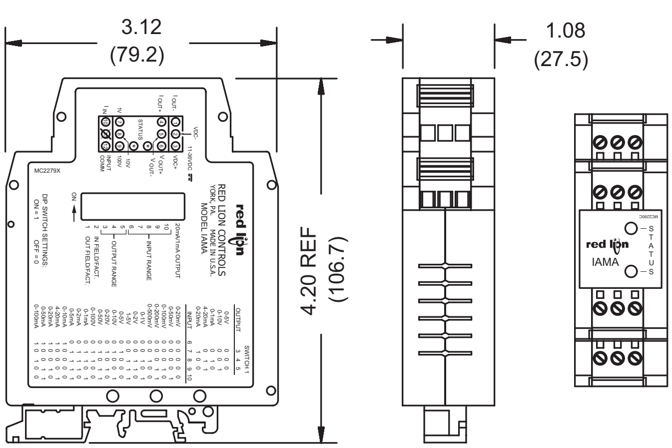
DIP switch range selection eliminates the need to order and stock different modules for each input and output signal range, and allows quick and convenient setup for over 100 standard signal conversions. By utilizing the Field mode of calibration, the user can customize the input and output scaling for odd applications, including reversal of the output relative to the input.

In addition to the conversion capabilities, the IAMA modules feature optically isolated Input/Output signal circuits and transformer isolated Power to Input, Power to Output circuits.

The modules' overall full scale accuracy typically exceed 0.05% depending upon range selection and scaling. The microprocessor based design provides ease of field scaling and the onboard E^{2}PROM stores scaling values for future recall. Both models come factory precalibrated for all input and output ranges. Factory or custom field scaling can be selected by a simple mode switch change. The IAMA can be factory recalibrated in the field if desired.

The modules' environmental operating temperature range is -20°C to +65°C. DIN rail mounting saves time and panel space. The units are equipped with universal mounting feet for attachment to standard DIN style rails, including top hat profile rail according to EN50022 - 35x7.5 and 35 x 15 and G profile rail according to EN50035-G32.

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

ORDERING INFORMATION

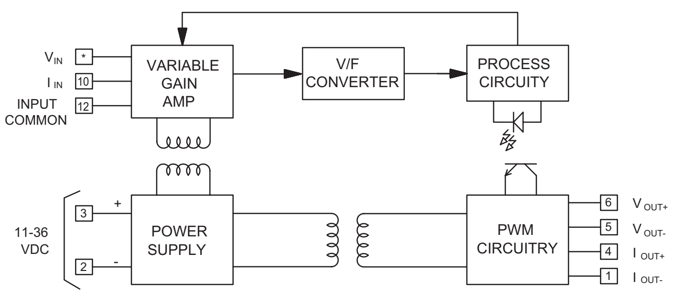
MODEL NO.	DESCRIPTION	PART NUMBER
IAMA	Linear Universal Signal Conditioning Module	IAMA3535
	Square Root Universal Signal Conditioning Module	IAMA6262

SPECIFICATIONS

1. **POWER**: 11 to 36 VDC, 3 W max. or 24 VAC, ±10%, 50/60 Hz, 4.8 VA max.
2. **INPUT/OUTPUT RANGES**: See Tables 2 and 3
3. **ZERO/SPAN ADJUSTMENTS**: Digital (DIP Switch Transition)
4. **MAX INPUT SIGNAL**:
   Current Input: 110 mA DC, 1.1 VDC
   Voltage Inputs: Terminal 7- 1 VDC +10%
   Terminal 8- 10 VDC +10%
   Terminal 9- 100 VDC +10%
5. **INPUT RESISTANCE**:
   Current: 10 Ω
   Voltage: > 100 K
6. **INPUT PROTECTION**: Surge suppressor diodes
7. **OUTPUT**: Self-powered (Active)
8. **MAX OUTPUT CURRENT**:
   Current Output: 22 mA
   Voltage Output: 10 mA
9. **LOAD RESISTANCE**:
   Current Output: ≤ 600 Ω
   Voltage Output: ≥ 1 KΩ
10. **OUTPUT COMPLIANCE**:
    Current: 4 to 20 mA, 0 to 20 mA: 12 V min (≤ 600 Ω)
    0 to 1 mA: 10 V min (≤10 KΩ)
    Voltage: 10 VDC across a min. 1 KΩ load (10 mA). Factory calibrated for loads of > 1 MΩ.
11. **ISOLATION LEVEL INPUT TO OUTPUT**: 1.5 kV @ 50/60 Hz, 1 min
12. **STEP RESPONSE**: To within 99% of full scale: 300 msec

13. **ACCURACY (INCLUDING LINEARITY)**: Factory: ±0.1% of span max. for all ranges except 1 mA, 2 mA, and 20 mV. These ranges are accurate to ±0.2% of span max. All ranges can be field calibrated to 0.1% of span max.
14. **RESOLUTION**: 0.01% full scale input, 0.01% full scale output
15. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: -20 to +65 °C
    Storage Temperature Range: -40 to +85 °C
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from -20 to +65 °C
    Temperature Coefficient: ± 0.01%/°C (100 PPM/°C) max.
    Vibration to IEC 68-2-6: Operational 5 to 150 Hz, 2 g.
    Shock to IEC 68-2-27: Operational 30 g
    Altitude: Up to 2000 meters
16. **CERTIFICATIONS AND COMPLIANCES**:
    CE Approved
    EN 61326-1 Immunity to Industrial Locations
    Emission CISPR 11 Class A
    IEC/EN 61010-1
    UL Recognized Component: File #E179259
    Refer to EMC Installation Guidelines section of this bulletin for additional information.
17. **CONSTRUCTION**: Case body is black high impact plastic
18. **CONNECTIONS**: 14 AWG max
19. **MOUNTING**: Standard DIN top hat (T) profile rail according to EN50022 - 35x7.5 and 35 x 15 and G profile rail according to EN50035-G32.
20. **WEIGHT**: 4.5 oz. (127.57 g)

BLOCK DIAGRAM



* Terminal number is dependent on max. input voltage.

MODULE ISOLATION

IAMA modules feature "3-Way" Signal Isolation. The 3-Way isolation is a combination of optical and transformer isolation. The optical isolation provides common mode voltage (CMV) isolation up to 1.5 kV between the sensor input and the process signal output. The IAMA's power is isolated from the sensor signal input and the process signal output by a DC/DC transformer isolation circuit.

OVERVIEW

The IAMA3535 continuously monitors a voltage or current input and provides a linearly proportional voltage or current output, while the IAMA6262 transmits the scaled square root of the input signal. This allows the IAMA6262 to provide a signal that is linear to flow rate in applications utilizing a differential pressure transducer. Both units have two modes of operation known as Factory and Field modes. Factory mode is used when the default input and output ranges are suitable. Field mode can be independently selected for both the input and output, and allows the user to custom calibrate, or scale the signal. If Factory mode is selected, the IAMAs use factory presets for the selected input or output range. If Field mode is selected, the IAMAs can be custom scaled within a selected input or output range. Field mode also allows the IAMA to reverse its output in relation to its input.

The units are factory precalibrated for minimum and full scale for all input and output ranges. The factory calibration values are permanently stored in E^2PROM and should not be changed in the field, unless unacceptable error or a factory checksum error occurs. See Factory Recalibration for details. Field scaling is achieved by applying minimum and full scale values from a calibration source and storing the values by a single DIP switch transition. Field scaling is available for all input and output ranges and the values are permanently stored in E^2PROM until reprogramming occurs.

After field scaling, the IAMAs can be changed between Factory and Field modes for a particular range, which restores the respective setting. The Factory and Field E^2PROM locations contain the same calibration values when the IAMA is received from the factory. Therefore, until the IAMA is field scaled, factory and field modes perform identically. See SCALING PROCEDURE for detailed instructions on field programming the IAMA.

The units can be scaled to any minimum scale and full scale values within the extent of the selected range. The closer together the minimum and full scale values are to each other, the less accurate the signal will be. For example, if the 0 to 1 V input range is selected, and the unit is scaled for 0 to 0.5 V, the signal has the same resolution as the 0 to 1 V range. Since this resolution will be two times the percentage of span for 0.5 V, more accuracy can be achieved by using the 0 to 0.5 V range.

The input may exceed the full scale value for the selected range by 10% of span, but the IAMA will not update the output beyond 10% over range.

The red and green LED's indicate the status of the modules during scaling and normal operation. Table 1, LED Indications, details the LED indications for various unit conditions.

The IAMA – Signal Conditioning Module Series is designed for use in industrial environments. Suppressor diodes protect both input and output circuits from wiring errors and transient high voltage conditions.

INPUTS

The IAMAs accept a full range of process signal inputs and isolate and convert these signals to common industrial control signals. The input signal combinations are configured by making specific DIP switch selections on the 10 position DIP switch.

OUTPUTS

As with the input choices, the process signal output of the modules is DIP switch selectable. A 1 position DIP switch is used to select between the 1 mA/20 mA output ranges. The maximum output current signal is 22 mA with ≤600 Ω output resistance and the maximum output voltage signal is 11 V with ≥1 KΩ output resistance.

ZERO AND SPAN

The input zero and span are set by first applying the minimum value then transitioning S1-2 to store that value. Next, the full scale value is applied and the DIP switch transition stores the value. The output scaling is performed in a similar manner but the output is driven to the desired minimum and full scale values by the calibration source applied to the input. S1-1 is used to store the minimum and full scale output values.

The span is defined by: span = (full scale - minimum scale).

ILLEGAL RANGE SELECTIONS AND CHANGES

The ranges should only be selected before power is applied. If an invalid input or output range is selected when power is applied the output is set to approximately 0 VDC and the red LED indicates the error according to Table 1. Power must be removed and valid ranges selected for the IAMA to operate properly.

If S1 switches 3 through 10 are changed while the IAMA is operating, the red LED indicates a range change according to Table 1, LED Indications and the output goes to the previously stored range minimum scale value. Normal operation will be resumed if the switches are placed back in the previous positions or power is removed and restored.

CHECKSUM ERRORS

A checksum is performed every time power is applied to the IAMA. If a checksum error occurs, the LEDs will indicate where the error occurred according to Table 1, LED Indications. Operation with a checksum error is not recommended but can be done in critical situations. If an error occurs, re-calibration of the field or factory ranges to be used must be performed.

If a field checksum error occurs, the IAMA will operate only in factory mode. If a factory checksum occurs, the IAMA will operate only in a previously calibrated field mode. Do not perform a field scaling until the factory checksum is cleared. Since a checksum error is a high priority LED indication, the LEDs will indicate the error until it is cleared. This will exclude other LED information.

TABLE 1, LED INDICATIONS

CONDITION	GREEN LED	RED LED
Normal Operation	On	Off
Scaling Mode	Alternate with Red	Alternate with Green
Under Range	Off	Slow Flash (0.8 sec rate)
Over Range	Off	Fast Flash (0.4 sec rate)
Illegal Range Change	Off	On
Invalid Range	Off	On
Factory Checksum	Off	On, short off
Field Checksum	On, short off	Off
User Factory Calibration	Fast Flash for 2 sec	Off

GETTING STARTED

One method for the Input (1 or 2 below) should be configured, and one method for the Output (3 or 4 below) should be configured.

1. FACTORY preprogrammed settings for the Input, see Section 1.0
2. FIELD scaling method for the Input, see Section 2.0
3. FACTORY preprogrammed setting for the Output, see Section 3.0
4. FIELD scaling method for the Output, see Section 4.0

Note: The ranges should only be changed while power is removed from the IAMA.

TABLE 2, OUTPUT RANGE SETTINGS

	OUTPUT RANGE	RANGE DIP SWITCHES		
		3	4	5
VOLTAGE OUTPUTS	0 - 5 V	0	0	0
	0 - 10 V	0	0	1
CURRENT OUTPUTS	0 - 1 mA	0	1	0
	4 - 20 mA	0	1	1
	0 - 20 mA	1	0	0

Note: DIP switch settings 0 = OFF 1 = ON

TABLE 3, INPUT RANGE SETTINGS

	RANGE	RANGE DIP SWITCHES				
		6	7	8	9	10
INPUT VOLTAGE	0 - 20 mV	0	0	0	0	0
	0 - 50 mV	0	0	0	0	1
	0 - 100 mV	0	0	0	1	0
	0 - 200 mV	0	0	0	1	1
	0 - 500 mV	0	0	1	0	0
	0 - 1 V	0	0	1	0	1
	0 - 2 V	0	0	1	1	0
	1 - 5 V	0	0	1	1	1
	0 - 5 V	0	1	0	0	0
	0 - 10 V	0	1	0	0	1
	0 - 20 V	0	1	0	1	0
	0 - 50 V	0	1	0	1	1
	0 - 100 V	0	1	1	0	0
INPUT CURRENT	0 - 1 mA	0	1	1	0	1
	0 - 2 mA	0	1	1	1	0
	0 - 5 mA	0	1	1	1	1
	0 - 10 mA	1	0	0	0	0
	4 - 20 mA	1	0	0	0	1
	0 - 20 mA	1	0	0	1	0
	0 - 50 mA	1	0	0	1	1
	0 - 100 mA	1	0	1	0	0

Note: DIP switch settings 0 = OFF 1 = ON

FIELD OR FACTORY MODE SELECTION

SELECTING FIELD MODE (2 Methods):

1. Scale the input or output according to SCALING PROCEDURE 2.0 or 4.0
2. Before applying power, set the input or output (or both) field/factory switch to the up (field) position. Field calibration values will be restored upon power-up. If the IAMA has not been previously field calibrated, the E^2PROM will contain the factory calibration values which will be restored.

SELECTING FACTORY MODE (2 Methods):

1. Before applying power to the IAMA set the input or output (or both) field/factory switch to the down (factory) position. Factory calibration values will be restored upon power-up.
2. While power is applied to the IAMA and it is operating in the field input and/or output mode, set the desired field/factory switch(s) to the down (factory) position. The factory calibration values will be restored.

EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" (6 mm) of bare wire exposed. Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.

POWER AND OUTPUT CONNECTIONS

Power

Primary power is connected to terminals 2 and 3 (labeled VDC- and VDC+). For best results, the Power should be relatively "clean" and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

Current Output

Wiring for a current output is connected to terminals 1 (IOUT-) and 4 (IOUT+). DIP switch S2 should be set for the desired full scale output current. (20 mA = ON; 1 mA = OFF).

Voltage Output

Wiring for a voltage output is connected to terminals 5 (VOUT-) and 6 (VOUT+).

Note: *Although signals are present at voltage and current outputs at the same time, only the selected range is in calibration at any one time.*
Example: A 0 to 10 VDC output is selected. The voltage level present at the voltage output terminals is in calibration, but the signal appearing at the current output terminals does not conform to any of the current output ranges.

INPUT CONNECTIONS

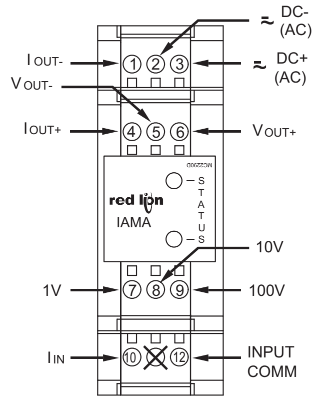
Current Input

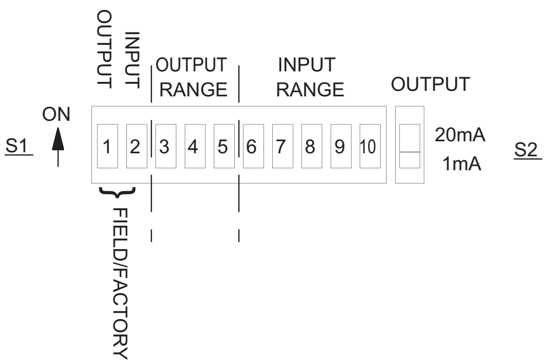
Wiring for a current input is connected to terminals 10 (IIN) and 12 (INPUT COMMON).

Voltage Input

Wiring for a voltage input is connected to terminal 12 (INPUT COMMON) and one of the three available voltage terminals listed below, depending on maximum input voltage.

Terminal 7: 1 VDC max.
Terminal 8: 10 VDC max.
Terminal 9: 100 VDC max.





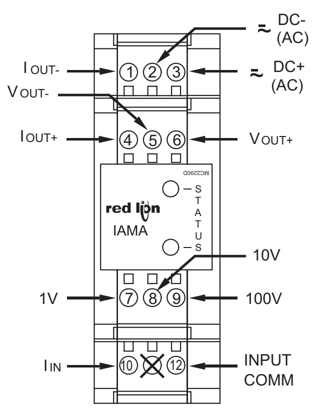
SCALING PROCEDURE

The accuracy of the IAMA is dependent on the accuracy of the calibration source and the voltage or current meter used in the scaling process.

If an out of range (see Table 1 for LED indications) or illegal (full scale less than minimum scale) scaling is attempted, the factory calibration values will be stored in place of the field values. This will prohibit erroneous operation of the IAMA. The scaling procedure will have to be repeated.

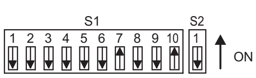
The final storage of the zero and full scale values to E^2PROM is not done until the last transition of the mode/calibration DIP switches (S1-1 or S1-2). Therefore, the scaling can be aborted any time before the full scale value is saved. This is accomplished by cycling power to the IAMA. The IAMA will restore the factory or previous field scaling values at power up depending on the setting of the DIP switches. See Mode Selection for more detailed instructions for selecting factory and field modes at power up. See Table 2 and 3 for the input and output range DIP switch settings.

1.0 INPUT SET-UP USING FACTORY CONFIGURATION



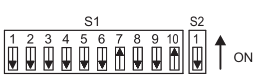
1.1 Remove power.

1.2 Connect signal wires to the correct input terminals based on the maximum signal input.
Terminal 7: max. signal input 1 VDC
Terminal 8: max. signal input 10 VDC
Terminal 9: max. signal input 100 VDC
Terminal 10: max. signal input 100 mA
Terminal 12: signal common



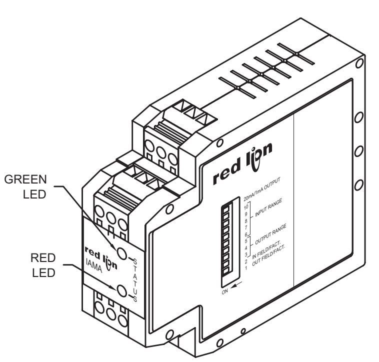
Step 1.3

1.3 Set Input Range switches (S1 switches 6 through 10) to the desired Input Range (See Table 3). (0 to 10 VDC range shown).



Step 1.4

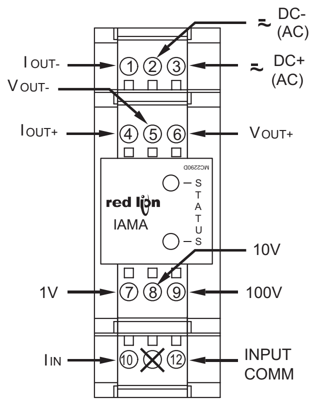
1.4 Set Input Field/Fact. switch (S1 switch 2) to the off position.

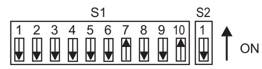


1.5 Apply power to the IAMA.
Solid illumination of Green LED if signal is within the minimum and maximum limits of the selected input range.
Slow blinking of Red LED if signal decreases below minimum limit of selected input range.
Rapid blinking of Red LED if signal increases above maximum limit of selected input range.

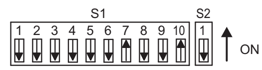
1.6 Input set-up complete. Go to Step 3.0 or Step 4.0.

2.0 INPUT SCALING USING FIELD CONFIGURATION

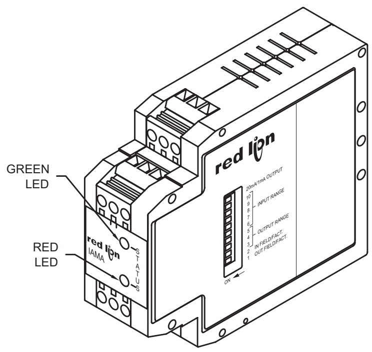


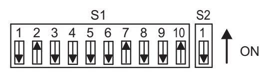


Step 2.3

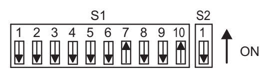


Step 2.4

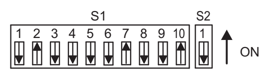




Step 2.6



Step 2.8



Step 2.10

2.1 Remove power.

2.2 Connect signal source to the correct input terminals based on the maximum signal input.
Terminal 7: max. signal input 1 VDC
Terminal 8: max. signal input 10 VDC
Terminal 9: max. signal input 100 VDC
Terminal 10: max. signal input 100 mA
Terminal 12: signal common

2.3 Set Input Range switches (S1 switches 6 through 10) to the desired input range (See Table 3). Select the lowest possible range that will support the desired maximum signal. Example: if the desired span is 20 mV to 85 mV, the best range selection is 0 to 100 mV. The 0 to 200 mV will also suffice, but the accuracy will be reduced. (0 to 10 VDC range shown).

2.4 Set Input Field/Fact. switch (S1 switch 2) to the off position.

2.5 Apply power to the IAMA and allow a warm up period of five minutes. Follow the manufacturer's warm up procedure for the calibration source.

2.6 Set Input Field/Fact. switch (S1 switch 2) to the on position.
The Red and Green LEDs will alternately blink.

2.7 Apply desired minimum scale signal.

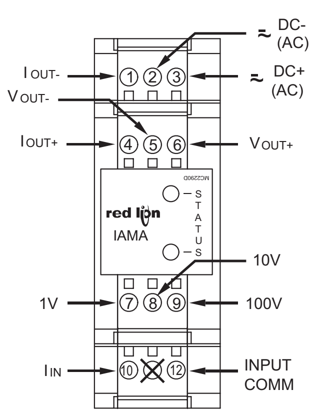
2.8 Set Input Field/Fact. switch (S1 switch 2) to the off position.
The Red and Green LEDs will alternately blink.
If the signal is equal or below the minimum limit of the selected range, the Red LED blinks slowly and the Green LED turns off. Removing power aborts scaling, begin at Step 2.1.

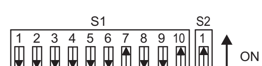
2.9 Apply maximum scale input.
The Red and Green LEDs will alternately blink.

2.10 Set Input Field/Fact. switch (S1 switch 2) to the on position.
Red LED extinguishes and Green LED becomes solid. Your scaled values are now saved and recalled if the Input Field/Fact. switch (S1 switch 2) is in the on position when power is applied.
Red LED will blink slowly if signal is equal to or below minimum limit and blinks rapidly if signal increases above maximum limit.

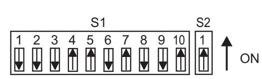
2.11 Input scaling complete. Go to Step 3.0 or Step 4.0.

3.0 OUTPUT SET-UP USING FACTORY CONFIGURATION





Step 3.3 & 3.4



Step 3.5

3.1 Remove power.

3.2 For voltage output values, go to Step 3.4
For current output values, continue at Step 3.3

3.3 Set 20 mA/1 mA switch (S2) to desired full scale output.
(20 mA - on; 1 mA - off)

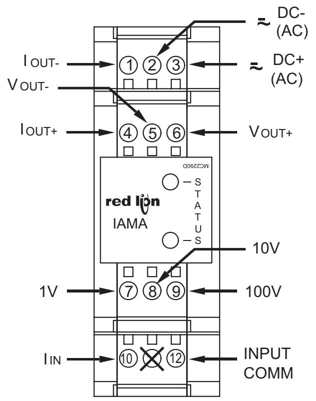
3.4 Set Output Field/Fact. switch (S1 switch 1) to the off position.

3.5 Set Output Range switches (S1 switches 3, 4, and 5) to the desired Output Range (See Table 2). (4 to 20 mA range shown)

3.6 Connect external device to appropriate IAMA output terminals.
Terminal 6: + Voltage
Terminal 5: - Voltage
Terminal 4: + Current
Terminal 1: - Current

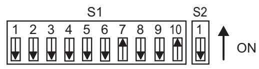
3.7 Apply power to the IAMA and allow a warm up period of five minutes. Output set-up complete.

4.0 OUTPUT SCALING USING FIELD CONFIGURATION



4.1 Remove power.

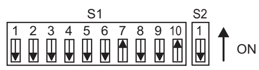
4.2 For voltage output scaling, go to Step 4.4.
For current output scaling, continue at Step 4.3.



Step 4.4

4.3 Set 20 mA/1 mA switch (S2) to desired full scale output.
(20 mA - on; 1 mA - off)

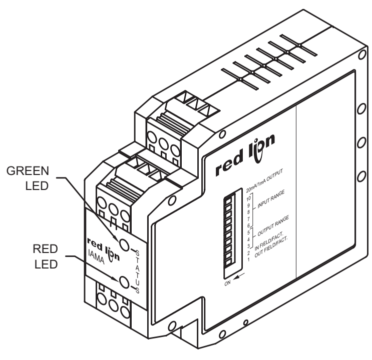
4.4 Set Output Field/Fact. switch (S1 switch 1) to the off position.



Step 4.5

4.5 Set Output Range switches (S1 switches 3, 4, and 5) to the desired Output Range (See Table 2). Select the lowest possible range that will support the desired full scale output. Example: if the desired span is 1 V to 4 V, the best range selection is 0 to 5 V. (0 to 5 VDC range shown)

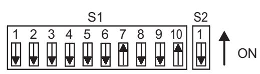
4.6 Connect volt or current meter to appropriate IAMA output terminals.
Terminal 6: + Voltage
Terminal 5: - Voltage
Terminal 4: + Current
Terminal 1: - Current



4.7 An input signal is required to complete output scaling. If previous scaled input is used (completed in Step 2.0), Input Field/Fact. switch (S1 switch 2) and Input Range switches (S1 switches 6 through 10) must remain in the same positions. If another signal source is used, set Input Field/Fact. switch (S1 switch 2) to off position and Input Range switches (S1 switches 6 through 10) to the desired input range (See Table 3).

4.8 Connect input signal source to the correct input terminals based on the maximum signal input.
Terminal 7: max. signal input 1 VDC
Terminal 8: max. signal input 10 VDC
Terminal 9: max. signal input 100 VDC
Terminal 10: max. signal input 100 mA
Terminal 12: signal common

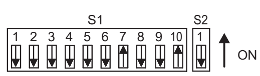
4.9 Apply power to the IAMA and allow a warm up period of five minutes.



Step 4.10

4.10 Set Output Field/Fact. switch (S1 switch 1) to the on position.
The Red and Green LEDs will alternately blink.
If Red LED blinks slowly, increase signal until Red and Green LEDs alternately blink.

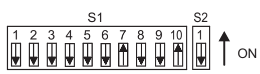
4.11 Adjust the input signal until the desired * minimum output level is displayed on the volt or current meter.
The Red and Green LEDs will alternately blink.



Step 4.12

4.12 Set Output Field/Fact. switch (S1 switch 1) to the off position.
The Red and Green LEDs alternately blink.
If the signal is equal to or below the minimum limit of the selected range, the Red LED blinks slowly and the Green LED turns off. Removing power aborts scaling. Start over at Step 4.1.

4.13 Adjust the input signal until the desired * maximum output level is displayed on the volt or current meter.



Step 4.14

4.14 Set Output Field/Fact. switch (S1 switch 1) to the on position.
Red LED extinguishes and Green LED becomes solid. Your scaled values are now saved and will be recalled if the Output Field/Fact. switch (S1 switch 1) is in the on position when power is applied.

4.15 Output scaling is complete.

*** If the minimum output is higher than the maximum output the module reverses its output behaviour accordingly.**

H

RECALIBRATING FACTORY STORED VALUES

WARNING: Read the complete procedure at least once before attempting to recalibrate the factory values. This procedure should only be performed due to factory checksum error or unacceptable error. This procedure should be performed by qualified technicians using accurate calibration equipment.

The following list outlines conditions that are unique to factory recalibration:

1. Unlike the field scaling procedures, there are no software under and over range indications while performing a factory recalibration. Therefore, care must be taken to insure the selected range extents are not exceeded. The minimum scale and full scale calibration values must be set to the extents of the range being calibrated.
   For example: If the Input Range DIP switches are set for the 4-20 mA range, minimum scale must be set at 4 mA, and full scale must be set at 20 mA.
2. At least one input calibration must be completed before calibrating any output range. When calibrating the input voltage range, it is recommended that a range above 1 V be used to provide better accuracy.
3. If multiple input or output ranges are to be calibrated, DO NOT REMOVE POWER TO CHANGE THE RANGE. Place the appropriate Field/Fact. DIP switch; S1-1 for outputs, and S1-2 for inputs to the down position, and set the remaining DIP switches for the range to be calibrated. *Note: Be sure to change the terminal wiring to match the Input or Output range DIP switch settings before performing the calibration procedure. Set calibration source to 0 V or 0 mA before changing wiring.*

INPUT RECALIBRATION

1. To enter the factory calibration mode, set switches S1-1 and S1-2 down, S1-3 through S1-5 up, and S1-6 through S1-10 down.
2. Connect a signal source to the correct input terminals based on the maximum signal input to be calibrated. If an output range will be calibrated after the input range is calibrated, connect a voltage or current meter to the appropriate output terminals at this time.
3. Apply power to the IAMA. After the version number indication, the green LED will flash rapidly for 2 seconds indicating the factory calibration mode has been entered. Allow the IAMA to warm up for 5 minutes minimum and follow the manufacturer's warm up procedure for the calibration source.
4. Set the Input Range DIP switches to the desired input range according to Table 3.
5. Complete Steps 2.6 through 2.10 of Input Scaling Using Field Configuration. *Note: There will be no over or under range indication of the LED's during this procedure, so use care not to exceed the range extents.*
6. If an output is to be calibrated, continue from #2 of Output Recalibration below. If no further input or output calibration is to be completed, return S1-1 and S1-2 to the down position and remove power from the IAMA. Apply power and check for accurate operation of the newly calibrated range or ranges.

OUTPUT RECALIBRATION

1. Complete 1 through 5 of the input recalibration procedure for at least one range.
2. For current output, set 20 mA/1 mA switch (S2) to desired full scale output. (20 mA - on; 1 mA - off)
3. Set Output Field/Fact. switch (S1 switch 1) to the off position.
4. Set the Output Range DIP switches to the desired output range according to Table 2.
5. Complete Steps 4.10 through 4.14 of Output Scaling Using Field Configuration. *Note: There will be no over or under range indication of the LED's during this procedure, so use care not to exceed the range extents.*
6. If no further calibration is to be completed, return S1-1 and S1-2 to the down position and remove power from the IAMA. Apply power and check for accurate operation of the newly calibrated range or ranges.

TROUBLESHOOTING

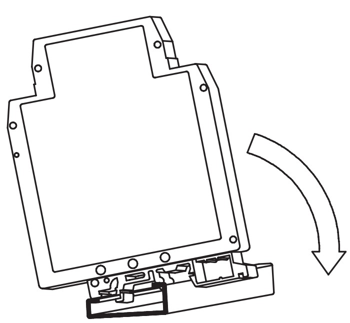
For further technical assistance, contact technical support at the appropriate company numbers listed.

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

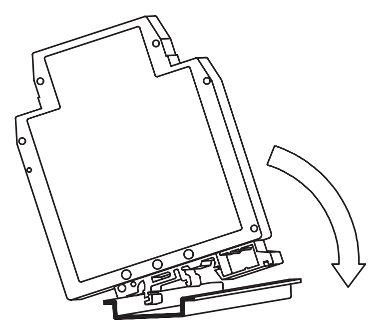
G Rail Installation

To install the IAMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out and away from the rail.



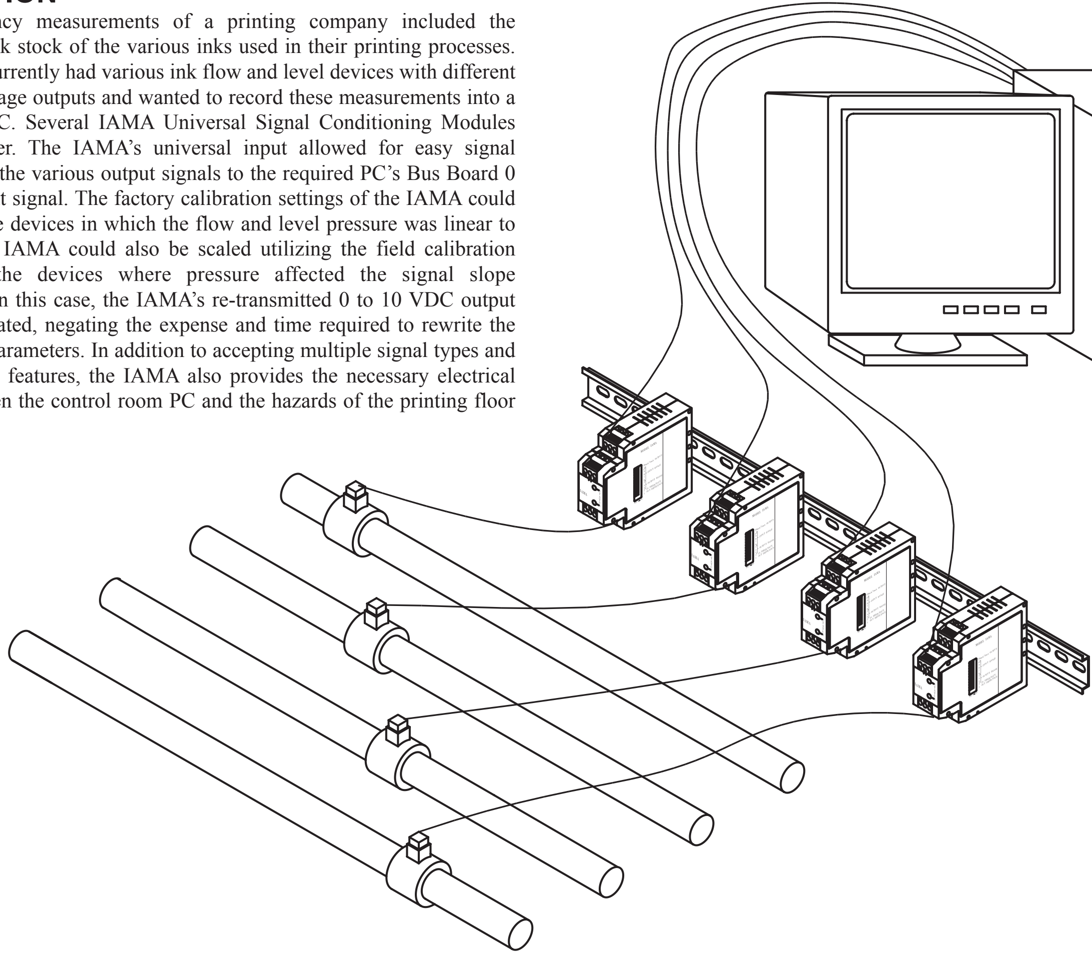
T Rail Installation

To install the IAMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.

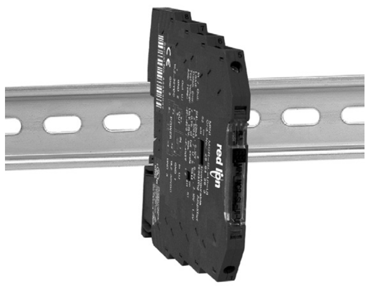


APPLICATION

Cost efficiency measurements of a printing company included the reduction of bulk stock of the various inks used in their printing processes. The company currently had various ink flow and level devices with different current and voltage outputs and wanted to record these measurements into a control room PC. Several IAMA Universal Signal Conditioning Modules were the answer. The IAMA's universal input allowed for easy signal conditioning of the various output signals to the required PC's Bus Board 0 to 10 VDC input signal. The factory calibration settings of the IAMA could be used with the devices in which the flow and level pressure was linear to the signal. The IAMA could also be scaled utilizing the field calibration method with the devices where pressure affected the signal slope specifications. In this case, the IAMA's re-transmitted 0 to 10 VDC output was field calibrated, negating the expense and time required to rewrite the PC's software parameters. In addition to accepting multiple signal types and field calibration features, the IAMA also provides the necessary electrical isolation between the control room PC and the hazards of the printing floor electrical noise.



MODEL IAMA - CONFIGURABLE 3-WAY ISOLATING AMPLIFIER



- *3-WAY ISOLATION OF ANALOG SIGNALS*
- *UNIVERSAL CONVERSION MODULE - INPUTS AND OUTPUTS SELECTED VIA DIP SWITCH SETTINGS*
- *OVER 35 INPUT AND OUTPUT ANALOG CONVERSION COMBINATIONS*
- *ULTRA SLIM DESIGN – ONLY 0.244" WIDE*
- *19 to 30 VDC POWER*

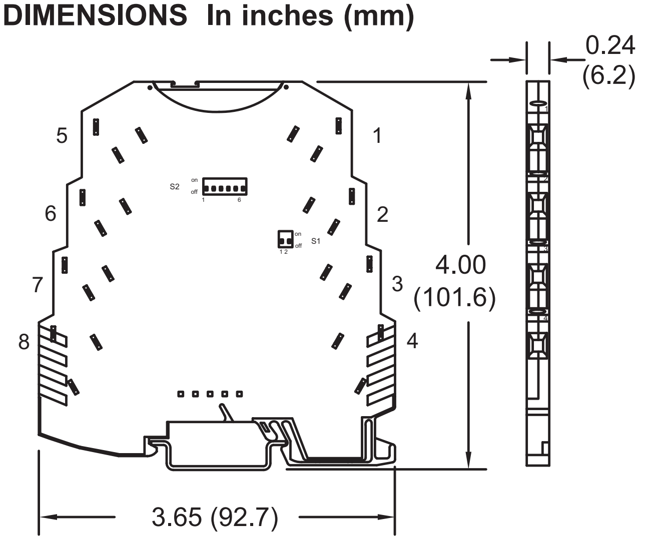
C UL US LISTED

PROCESS CONTROL
EQUIPMENT FOR HAZARDOUS
LOCATIONS 31ZN
CLASS 1, DIV 2
GROUPS A, B, C, D T5

GENERAL DESCRIPTION

The IAMA can isolate and convert over 35 combinations of analog signal ranges. The IAMA converts and transmits signals linearly proportional to the input. DIP switch range selection eliminates the need to order and stock different modules for each input and output signal range, and allows quick and convenient setup for over 35 standard signal conversions. In addition to the conversion capabilities, the IAMA modules feature optically isolated Input/Output signal circuits and isolated Power to Input, Power to Output circuits. The modules' overall full scale accuracy typically exceed 0.04%. DIN rail mounting saves time and panel space. The units are equipped with universal mounting feet for attachment to standard top hat profile rail according to EN50022 - 35x7.5.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
IAMA	Configurable 3-Way Isolating Amplifier	IAMA0006

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **POWER**: 19.2 to 30 V DC, 450 mW max.
2. **INPUT / OUTPUT RANGES**: See table 1
3. **SPAN ADJUSTMENT**: Potentiometer, located below transparent top cover.
4. **MAX INPUT SIGNAL**:
   Current: 50 mA
   Voltage: 30 V
5. **INPUT RESISTANCE**:
   Current: Approx. 50 Ω
   Voltage: Approx. 100 kΩ
6. **OUTPUT**: Self-powered (Active)
7. **MAX OUTPUT SIGNAL**:
   Current: 28 mA/12.5 V
   Voltage: 12.5 V/22 mA
8. **LOAD RESISTANCE**:
   Current: 500 Ω max.
   Voltage: 10 kΩ min
9. **OUTPUT COMPLIANCE**:
   Current: 12.5 V max (500 Ω). Ripple: < 20 mV
   Voltage: 22 mA (10 kΩ). Ripple: < 20 mV
10. **TRANSMISSION ERROR**:
    The transmission error without adjustment is < 0.4%. Using the potentiometer, the error can be adjusted to < 0.1%.
11. **TEMPERATURE COEFFICIENT**:
    Max.: < 0.01%/K
    Typ.: < 0.002%/K
12. **CUT-OFF FREQUENCY**: 100 Hz
13. **STEP RESPONSE (FROM 10 to 90 %)**: 3.5 msec
14. **TEST VOLTAGE (Input/Output/Supply)**: 1.5 kV, 50 Hz, 1 min.
15. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: -20°C to 65°C (-4°F to 149°F)
    Storage Temperature Range: -40°C to +85°C (-40°F to 185°F)

16. **TESTS/APPROVALS**:

CE cULus

PROCESS CONTROL EQUIPMENT FOR HAZARDOUS LOCATIONS
31ZN
Class I Div 2 Groups A, B, C, D T5

A) This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or non- hazardous locations only.
B) Warning - explosion hazard - substitution of components may impair suitability for Class 1, Division 2.
C) Warning - explosion hazard - do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

17. **CERTIFICATIONS AND COMPLIANCES**:

Conformance With EMC Guideline 2004/108/EC And Low Voltage Directive 2006/95/EC

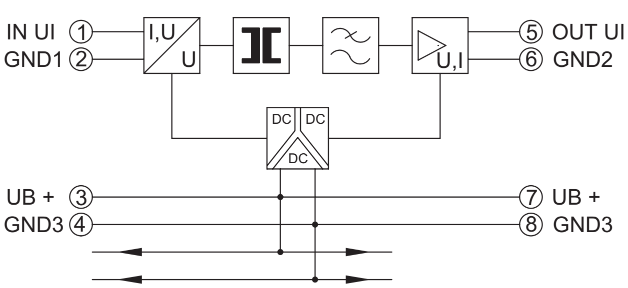
Immunity to Interference According to EN 61000-6-2[1]

Discharge of static electricity (ESD)	EN 61000-4-2	Criterion B[2]
Electromagnetic HF field	EN 61000-4-3	Criterion A[3]
Fast transients (Burst)	EN 61000-4-4	Criterion B[2]
Surge voltage capacities (Surge)	EN 61000-4-5	Criterion B[2]
Conducted disturbance	EN 61000-4-6	Criterion A[3]
Noise Emission According to EN 50081-2		
Noise emission of housing	EN 55011[4]	Class A[5]

[1] EN 61000 corresponds to IEC 1000
[2] Criterion B: Temporary impairment to operational behavior that is corrected by the device itself.
[3] Criterion A: Normal operating behavior within the defined limits.
[4] EN 55011 corresponds to CISPR11
[5] Class A: Area of application industry.

18. **CONNECTIONS**: 12 AWG max., Stripping length: 0.47" (12 mm)
19. **CONSTRUCTION**: Polybutylenterephthalate PBT, black
20. **MOUNTING**: Standard DIN top hat (T) profile rail according to EN50022 - 35x7.5
21. **WEIGHT**: 2 oz. (54 g)

BLOCK DIAGRAM



H

INPUTS

The IAMA accepts a full range of process signal inputs and isolates and converts these signals to common industrial control signals. The input signal combinations are configured by making specific DIP switch selections on the 6 and 2 position DIP switches.

OUTPUTS

As with the input choices, the process signal output of the modules is DIP switch selectable. The maximum output current signal is 28 mA with =500 Ω output resistance and the maximum output voltage signal is 12.5 V with =10 KΩ output resistance. The transmission error without adjustment is < 0.4%. Using the potentiometer, the error can be adjusted to < 0.1%.

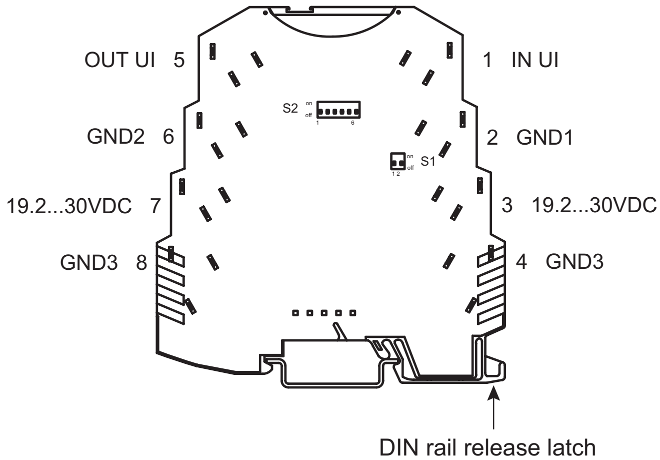
TABLE 1 - CONFIGURATION

RANGES		DIP SWITCHES							
		OUTPUT (S2)						INPUT (S1)	
IN	OUT	1	2	3	4	5	6	1	2
0 –10 V	0 – 20 mA	off	off	off	off	off	off	off	off
	4 - 20 mA	off	off	off	off	off	ON	off	off
	0 – 10 V	ON	off	ON	off	off	off	off	off
	2 – 10 V	ON	off	ON	off	off	ON	off	off
	0 – 5 V	ON	ON	off	off	off	off	off	off
	1 – 5 V	ON	ON	off	off	off	ON	off	off
2 – 10 V	0 – 20 mA	off	off	off	ON	ON	off	off	off
	4 - 20 mA	off	off	off	off	off	off	off	off
	0 – 10 V	ON	off	ON	ON	ON	off	off	off
	2 – 10 V	ON	off	ON	off	off	off	off	off
	0 – 5 V	ON	ON	off	ON	ON	off	off	off
	1 – 5 V	ON	ON	off	off	off	off	off	off
0 – 5 V	0 – 20 mA	off	off	off	off	off	off	ON	off
	4 - 20 mA	off	off	off	off	off	ON	ON	off
	0 – 10 V	ON	off	ON	off	off	off	ON	off
	2 – 10 V	ON	off	ON	off	off	ON	ON	off
	0 – 5 V	ON	ON	off	off	off	off	ON	off
	1 – 5 V	ON	ON	off	off	off	ON	ON	off
1 – 5 V	0 – 20 mA	off	off	off	ON	ON	off	ON	off
	4 - 20 mA	off	off	off	off	off	off	ON	off
	0 – 10 V	ON	off	ON	ON	ON	off	ON	off
	2 – 10 V	ON	off	ON	off	off	off	ON	off
	0 – 5 V	ON	ON	off	ON	ON	off	ON	off
	1 – 5 V	ON	ON	off	off	off	off	ON	off
0 – 20 mA	0 – 20 mA	off	off	off	off	off	off	off	ON
	4 - 20 mA	off	off	off	off	off	ON	off	ON
	0 – 10 V	ON	off	ON	off	off	off	off	ON
	2 – 10 V	ON	off	ON	off	off	ON	off	ON
	0 – 5 V	ON	ON	off	off	off	off	off	ON
	1 – 5 V	ON	ON	off	off	off	ON	off	ON
4 - 20 mA	0 – 20 mA	off	off	off	ON	ON	off	off	ON
	4 - 20 mA	off	off	off	off	off	off	off	ON
	0 – 10 V	ON	off	ON	ON	ON	off	off	ON
	2 – 10 V	ON	off	ON	off	off	off	off	ON
	0 – 5 V	ON	ON	off	ON	ON	off	off	ON
	1 – 5 V	ON	ON	off	off	off	off	off	ON

WIRING CONNECTIONS

Primary power is connected to terminals 7 or 3 (19.2 – 30 VDC) and 8 or 4 (GND 3). For best results, the power should be relatively “clean” and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

The input signal is connected to pins 1 (In U,I) and 2 (GND 1). Connections for the output signal are made on pins 5 (Out U,I) and 6 (GND 2).

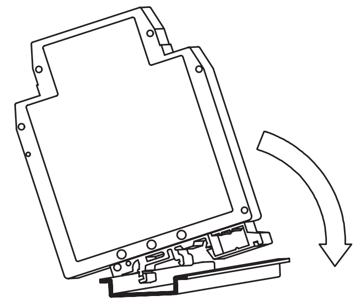


INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

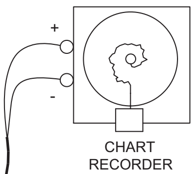
T Rail Installation

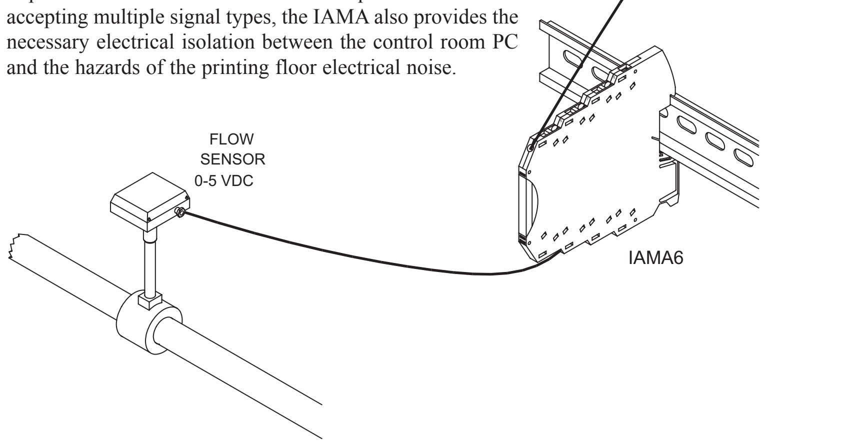
To install the IAMA on a “T” style rail, angle the module so that the top groove of the “foot” is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the “foot”, and pry upwards on the module until it releases from the rail.



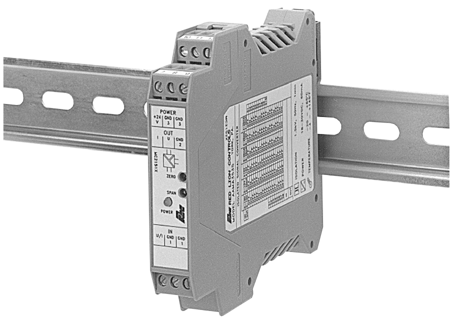
APPLICATION

Cost efficiency measurements of a printing company included the reduction of bulk stock of the various inks used in their printing processes. The company currently had various ink flow and level devices with different current and voltage outputs and wanted to record these measurements into a control room PC. Several IAMA Universal Signal Conditioning Modules were the answer. The IAMA’s universal input allowed for easy signal conditioning of the various output signals to the required PC’s Bus Board 0 to 10 VDC input signal. In this case, the IAMA’s re-transmitted 0 to 10 VDC output was field calibrated, negating the expense and time required to rewrite the PC’s software parameters. In addition to accepting multiple signal types, the IAMA also provides the necessary electrical isolation between the control room PC and the hazards of the printing floor electrical noise.





MODEL AAMA - UNIVERSAL SIGNAL CONDITIONING module



- *3-WAY ISOLATION OF ANALOG SIGNALS*
- *UNIVERSAL CONVERSION MODULE - INPUTS AND OUTPUTS CAN BE SELECTED VIA DIP SWITCH SETTINGS*
- *OVER 100 INPUT AND OUTPUT ANALOG CONVERSION COMBINATIONS*
- *18 to 30 VDC MODULE POWER*

DESCRIPTION

The AAMA3535 Universal Signal Conditioning Module can isolate and convert over 100 combinations of industry standard analog signal ranges. The universal DIP switch selection feature eliminates the need to order and stock different modules for each input and output signal.

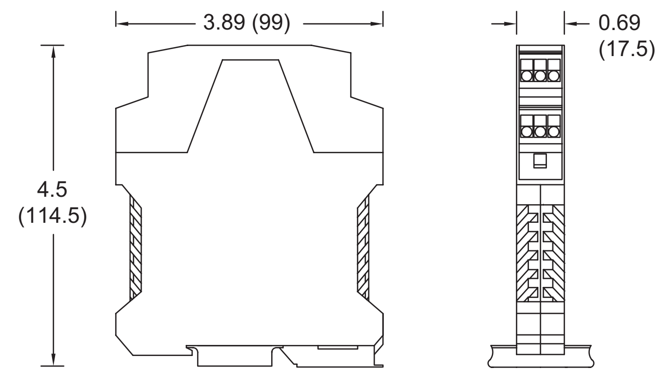
In addition to the conversion capabilities, the AAMA3535 module features an optically isolated Input/Output signal circuit and a transformer (galvanically) isolated Power to Input, Power to Output circuit.

The AAMA3535 module meets the stringent IEC 801 Standard for surge suppression, noise emission and noise immunity. The module is also CE marked for European applications.

The module's overall full scale accuracy can exceed 0.005% depending upon range selection and calibration. A hybrid SMD calibration circuit stores all range and amplification settings. The hybrid circuit maintains a very high accuracy and low drift output signal.

The module's environmental operating temperature range is -20°C to +65°C. The modular high density packaging and mounting saves time and panel space. The modules snap onto standard 35 mm flat DIN rail, and uses removable terminal blocks for easy module wiring.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **POWER SUPPLY VOLTAGE:** 18 to 30 VDC @ 60 mA
2. **INPUT RANGES:**

0 to 60 mV	0 to 100 mV	0 to 200 mV	0 to 300 mV	0 to 500 mV
0 to 1 V	0 to 5 V	0 to 10 V	0 to 20 V	±100 mV
±200 mV	±300 mV	±500 mV	±1 V	±2 V
±5 V	±10 V	±20 V	0 to 5 mA	0 to 20 mA
4 to 20 mA	1 to 5 V			

3. **ZERO/SPAN ADJUSTMENTS:** Range Dependent
4. **MAX. INPUT SIGNAL:**
   Current Input: 50 mA
   Voltage Input: 30 V
5. **INPUT RESISTANCE:**
   Current: 50 Ω
   Voltage: 1 MΩ
6. **INPUT PROTECTION:** Surge suppressor diodes
7. **OUTPUT RANGES:** Self-powered (Active)

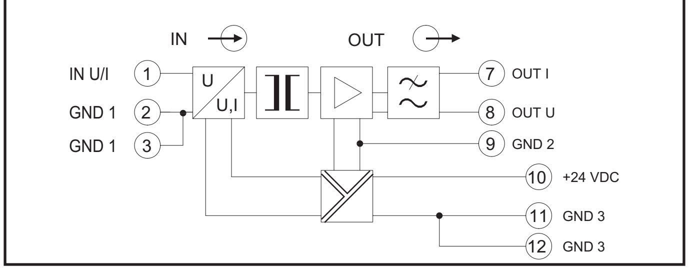
0 to 5 V	±5 V	0 to 10 V	±10 V
0 to 20 mA	4 to 20 mA	1 to 5 V	

8. **MAX. OUTPUT SIGNAL:**
   Current Output: 30 mA
   Voltage Output: 15 V
9. **LOAD RESISTANCE:**
   Current Output: ≤ 500 Ω max.
   Voltage Output: ≥ 5 KΩ
10. **ISOLATION LEVEL INPUT/OUTPUT:** 1.5 kV @ 50 Hz, 1 minute Opto Isolation
11. **POWER TO INPUT/OUTPUT:** 1.0 kV @ 50 Hz, 1 minute Transformer DC/DC
12. **MAX. INPUT FREQUENCY:** 30 Hz
13. **RESPONSE TIME:** 0.034 sec. max.
14. **OVERALL FULL SCALE ACCURACY:** 0.1% to 0.05% Dependent on Calibration Source
15. **OPERATING TEMPERATURE RANGE:** -20 to +65°C (-4 to 145°F)
16. **TEMPERATURE COEFFICIENT:** 100 ppm/K
17. **CONSTRUCTION:** Case body is green, high impact plastic
18. **CONNECTIONS:** 14 AWG wire max.
19. **MOUNTING:** Standard DIN Top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15
20. **WEIGHT:** 3.76 oz (106.59 g)

ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
AAMA	Universal Signal Conditioning	AAMA3535

The AAMA3535 module is ordered nonconfigured, allowing the user the flexibility to select their input and output signals by setting the appropriate DIP switch combination.



BLOCK DIAGRAM

MODULE ISOLATION

AAMA3535 modules feature “3-Way” Signal Isolation. The 3-Way isolation is a combination of optical and transformer isolation. The optical isolation provides common mode voltage (CMV) isolation up to 1.0 kV between the sensor input and the process signal output. The module’s power is isolated from the sensor signal input and the process signal output by a DC/DC transformer isolation circuit.

SURGE AND SHORT CIRCUIT PROTECTION

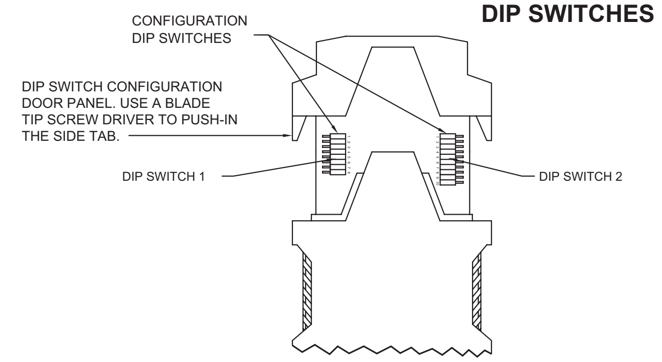
The Signal Conditioning Module is designed for use in industrial environments. Stringent IEC testing has shown that the modules pass the IEC 801.2 (Electrostatic Discharge) and IEC 801.4 (Electrical Fast Transient/Burst) tests. Suppressor diodes protect both input and output circuits from wiring errors.

INPUTS

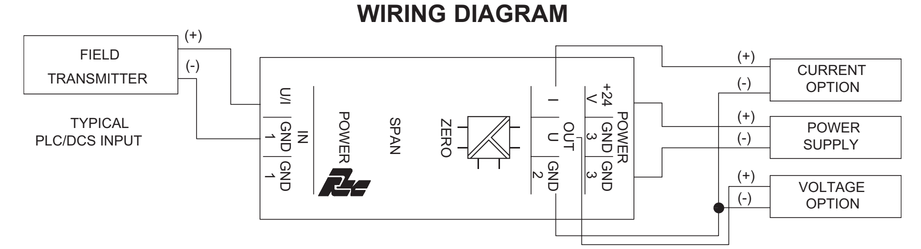
The AAMA3535 module accepts a full range of process signal inputs and will isolate and/or convert these signals to common industrial control signals. The input and output signal combinations are configured by making specific DIP switch selections. The DIP switches can be easily accessed by pushing the side tabs and sliding the module up in the case.

OUTPUTS

As with the input choices, the process signal outputs of the module are DIP switch selectable. The maximum output current signal is 30 mA with ≤500 Ω output resistance and the maximum output voltage signal is 15 V with ≥5 KΩ output resistance.



DIP SWITCHES



WIRING DIAGRAM

ZERO AND SPAN

The AAMA3535 module incorporates two potentiometers for adjusting separate zero and span settings. The module provides a ±5% zero and span fine calibration adjustment. To use this calibration feature, the zero point should be set first, by adjusting the potentiometer labeled ZERO. Adjusting the Zero reference will proportionally offset the output range. After the Zero has been set, adjusting the SPAN potentiometer will change the signal gain.

INPUT/OUTPUT DIP SWITCH SELECTION TABLES

DIP SWITCH SELECTIONS FOR 0-5 VOLT OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV			ON			ON						ON				ON	ON	ON	0-60 mV
0-100 mV			ON			ON						ON					ON		0-100 mV
0-200 mV			ON			ON							ON				ON		0-200 mV
0-300 mV			ON			ON							ON			ON		ON	0-300 mV
0-500 mV			ON			ON						ON				ON			0-500 mV
0-1 V			ON			ON							ON			ON			0-1 V
0-2 V			ON			ON								ON		ON			0-2 V
0-5 V			ON			ON							ON						0-5 V
0-10 V			ON			ON								ON					0-10 V
0-20 V			ON			ON									ON				0-20 V
± 60 mV		ON		ON			ON					ON				ON	ON	ON	± 60 mV
±100 mV		ON		ON			ON					ON					ON		±100 mV
±200 mV		ON		ON			ON						ON				ON		±200 mV
±300 mV		ON		ON			ON						ON			ON		ON	±300 mV
±500 mV		ON		ON			ON					ON				ON			±500 mV
±1 V		ON		ON			ON						ON			ON			±1 V
±2 V		ON		ON			ON							ON		ON			±2 V
±5 V		ON		ON			ON						ON						±5 V
±10 V		ON		ON			ON							ON					±10 V
±20 V		ON		ON			ON								ON				±20 V
0-5 mA			ON			ON					ON			ON		ON	ON	ON	0-5 mA
0-20 mA			ON			ON					ON		ON			ON			0-20 mA
4-20 mA								ON			ON		ON			ON			4-20 mA
1-5 V								ON					ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR 0-10 VOLT OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV			ON		ON	ON						ON				ON	ON	ON	0-60 mV
0-100 mV			ON		ON	ON						ON					ON		0-100 mV
0-200 mV			ON		ON	ON							ON				ON		0-200 mV
0-300 mV			ON		ON	ON							ON			ON		ON	0-300 mV
0-500 mV			ON		ON	ON						ON				ON			0-500 mV
0-1 V			ON		ON	ON							ON			ON			0-1 V
0-2 V			ON		ON	ON								ON		ON			0-2 V
0-5 V			ON		ON	ON							ON						0-5 V
0-10 V			ON		ON	ON								ON					0-10 V
0-20 V			ON		ON	ON									ON				0-20 V
± 60 mV		ON		ON	ON		ON					ON				ON	ON	ON	± 60 mV
±100 mV		ON		ON	ON		ON					ON					ON		±100 mV
±200 mV		ON		ON	ON		ON						ON				ON		±200 mV
±300 mV		ON		ON	ON		ON						ON			ON		ON	±300 mV
±500 mV		ON		ON	ON		ON					ON				ON			±500 mV
±1 V		ON		ON	ON		ON						ON			ON			±1 V
±2 V		ON		ON	ON		ON							ON		ON			±2 V
±5 V		ON		ON	ON		ON						ON						±5 V
±10 V		ON		ON	ON		ON							ON					±10 V
±20 V		ON		ON	ON		ON								ON				±20 V
0-5 mA			ON		ON	ON					ON			ON		ON	ON	ON	0-5 mA
0-20 mA			ON		ON	ON					ON		ON			ON			0-20 mA
4-20 mA					ON			ON			ON		ON			ON			4-20 mA
1-5 V					ON			ON					ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR ±5 VOLT OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV	ON		ON					ON	ON	ON		ON				ON	ON	ON	0-60 mV
0-100 mV	ON		ON					ON	ON	ON		ON					ON		0-100 mV
0-200 mV	ON		ON					ON	ON	ON			ON				ON		0-200 mV
0-300 mV	ON		ON					ON	ON	ON			ON			ON		ON	0-300 mV
0-500 mV	ON		ON					ON	ON	ON		ON				ON			0-500 mV
0-1 V	ON		ON					ON	ON	ON			ON			ON			0-1 V
0-2 V	ON		ON					ON	ON	ON				ON		ON			0-2 V
0-5 V	ON		ON					ON	ON	ON			ON						0-5 V
0-10 V	ON		ON					ON	ON	ON				ON					0-10 V
0-20 V	ON		ON					ON	ON	ON					ON				0-20 V
± 60 mV			ON			ON						ON				ON	ON	ON	± 60 mV
±100 mV			ON			ON						ON					ON		±100 mV
±200 mV			ON			ON							ON				ON		±200 mV
±300 mV			ON			ON							ON			ON		ON	±300 mV
±500 mV			ON			ON						ON				ON			±500 mV
±1 V			ON			ON							ON			ON			±1 V
±2 V			ON			ON								ON		ON			±2 V
±5 V			ON			ON							ON						±5 V
±10 V			ON			ON								ON					±10 V
±20 V			ON			ON									ON				±20 V
0-5 mA	ON		ON					ON	ON	ON	ON			ON		ON	ON	ON	0-5 mA
0-20 mA	ON		ON					ON	ON	ON	ON		ON			ON			0-20 mA
4-20 mA	ON							ON	ON		ON		ON			ON			4-20 mA
1-5 V	ON							ON	ON				ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR 1-5 VOLT OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV	ON			ON								ON				ON	ON	ON	0-60 mV
0-100 mV	ON			ON								ON					ON		0-100 mV
0-200 mV	ON			ON									ON				ON		0-200 mV
0-300 mV	ON			ON									ON			ON		ON	0-300 mV
0-500 mV	ON			ON								ON				ON			0-500 mV
0-1 V	ON			ON									ON			ON			0-1 V
0-2 V	ON			ON										ON		ON			0-2 V
0-5 V	ON			ON									ON						0-5 V
0-10 V	ON			ON										ON					0-10 V
0-20 V	ON			ON											ON				0-20 V
0-5 mA	ON			ON							ON			ON		ON	ON	ON	0-5 mA
0-20 mA	ON			ON							ON		ON			ON			0-20 mA
4-20 mA			ON			ON					ON		ON			ON			4-20 mA
1-5 V			ON			ON							ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR ±10 VOLT OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV	ON		ON		ON			ON	ON	ON		ON				ON	ON	ON	0-60 mV
0-100 mV	ON		ON		ON			ON	ON	ON		ON					ON		0-100 mV
0-200 mV	ON		ON		ON			ON	ON	ON			ON				ON		0-200 mV
0-300 mV	ON		ON		ON			ON	ON	ON			ON			ON		ON	0-300 mV
0-500 mV	ON		ON		ON			ON	ON	ON		ON				ON			0-500 mV
0-1 V	ON		ON		ON			ON	ON	ON			ON			ON			0-1 V
0-2 V	ON		ON		ON			ON	ON	ON				ON		ON			0-2 V
0-5 V	ON		ON		ON			ON	ON	ON			ON						0-5 V
0-10 V	ON		ON		ON			ON	ON	ON				ON					0-10 V
0-20 V	ON		ON		ON			ON	ON	ON					ON				0-20 V
± 60 mV			ON		ON	ON						ON				ON	ON	ON	± 60 mV
±100 mV			ON		ON	ON						ON					ON		±100 mV
±200 mV			ON		ON	ON							ON				ON		±200 mV
±300 mV			ON		ON	ON							ON			ON		ON	±300 mV
±500 mV			ON		ON	ON						ON				ON			±500 mV
±1 V			ON		ON	ON							ON			ON			±1 V
±2 V			ON		ON	ON								ON		ON			±2 V
±5 V			ON		ON	ON							ON						±5 V
±10 V			ON		ON	ON								ON					±10 V
±20 V			ON		ON	ON									ON				±20 V
0-5 mA	ON		ON		ON			ON	ON	ON	ON			ON		ON	ON	ON	0-5 mA
0-20 mA	ON		ON		ON			ON	ON	ON	ON		ON			ON			0-20 mA
4-20 mA	ON				ON			ON	ON		ON		ON			ON			4-20 mA
1-5 V	ON				ON			ON	ON				ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR 0-20 mA OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV			ON		ON	ON						ON				ON	ON	ON	0-60 mV
0-100 mV			ON		ON	ON						ON					ON		0-100 mV
0-200 mV			ON		ON	ON							ON				ON		0-200 mV
0-300 mV			ON		ON	ON							ON			ON		ON	0-300 mV
0-500 mV			ON		ON	ON						ON				ON			0-500 mV
0-1 V			ON		ON	ON							ON			ON			0-1 V
0-2 V			ON		ON	ON								ON		ON			0-2 V
0-5 V			ON		ON	ON							ON						0-5 V
0-10 V			ON		ON	ON								ON					0-10 V
0-20 V			ON		ON	ON									ON				0-20 V
± 60 mV		ON		ON	ON		ON					ON				ON	ON	ON	± 60 mV
±100 mV		ON		ON	ON		ON					ON					ON		±100 mV
±200 mV		ON		ON	ON		ON						ON				ON		±200 mV
±300 mV		ON		ON	ON		ON						ON			ON		ON	±300 mV
±500 mV		ON		ON	ON		ON					ON				ON			±500 mV
±1 V		ON		ON	ON		ON						ON			ON			±1 V
±2 V		ON		ON	ON		ON							ON		ON			±2 V
±5 V		ON		ON	ON		ON						ON						±5 V
±10 V		ON		ON	ON		ON							ON					±10 V
±20 V		ON		ON	ON		ON								ON				±20 V
0-5 mA			ON		ON	ON					ON			ON		ON	ON	ON	0-5 mA
0-20 mA			ON		ON	ON					ON		ON			ON			0-20 mA
4-20 mA					ON			ON			ON		ON			ON			4-20 mA
1-5 V					ON			ON					ON						1-5 V

Note: Blank space = DIP switch OFF.

DIP SWITCH SELECTIONS FOR 4-20 mA OUTPUT

	DIP SWITCH 2										DIP SWITCH 1								
Input	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	**Input**
0-60 mV	ON			ON	ON							ON				ON	ON	ON	0-60 mV
0-100 mV	ON			ON	ON							ON					ON		0-100 mV
0-200 mV	ON			ON	ON								ON				ON		0-200 mV
0-300 mV	ON			ON	ON								ON			ON		ON	0-300 mV
0-500 mV	ON			ON	ON							ON				ON			0-500 mV
0-1 V	ON			ON	ON								ON			ON			0-1 V
0-2 V	ON			ON	ON									ON		ON			0-2 V
0-5 V	ON			ON	ON								ON						0-5 V
0-10 V	ON			ON	ON									ON					0-10 V
0-20 V	ON			ON	ON										ON				0-20 V
0-5 mA	ON			ON	ON						ON			ON		ON	ON	ON	0-5 mA
0-20 mA	ON			ON	ON						ON		ON			ON			0-20 mA
4-20 mA			ON		ON	ON					ON		ON			ON			4-20 mA
1-5 V			ON		ON	ON							ON						1-5 V

Note: Blank space = DIP switch OFF.

CALIBRATION PROCEDURE

Module accuracy is dependent upon your calibration reference. The higher your calibration source accuracy, the lower the overall signal conditioner conversion error.

CALIBRATION OF MODULES WITH 0 to 5 V, 0 to 10 V

Output adjustment of the 0 to 5 V or 0 to 10 V range:

1. Set DIP switches as shown in the DIP switch selection Tables.
2. Apply power, and let the unit stabilize for 5 minutes.
3. Set up output adjustment:
   a. Apply low scale input range value; adjust zero pot for 0 V, ±0.5 mV.
   b. Finally, apply full scale input from calibration source; adjust span pot for full scale ±0.5 mV.

CALIBRATION OF MODULES WITH ±5 V, ±10 V, 1 to 5 V, 4 to 20 mA OR 0 to 20 mA

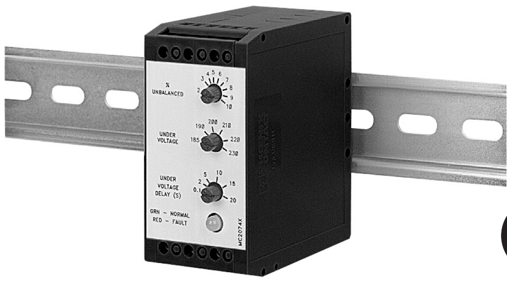
Output adjustment of ±5 V, ±10 V, 1 to 5 V, 4 to 20 mA or 0 to 20 mA ranges:

1. Set DIP switches as shown in the DIP switch selection Tables.
2. Apply power, and let the unit stabilize for 5 minutes.
3. Set up output adjustment:
   a. Apply low scale input range value from calibration source; record output as MV1. (If using 0 to 20 mA output range, apply 2 mA for low scale input value.)
   b. Apply full scale input from calibration source; record output as MV2.
4. With full scale input value still applied:
   a. First calculate the span pot adjustment point “A” using the formula: A= MV2 X constant/ (MV2-MV1). Adjust the span pot for value “A”, plus or minus the adjustment tolerance. (See below table for constant and tolerance.)
   b. Finally, adjust the zero pot for the nominal full scale output value, plus or minus the adjustment tolerance.

The Constants and Adjustment Tolerances are as follows:

INPUT RANGE	CONSTANT	ADJUSTMENT TOLERANCE
±5 V	10 V	±0.5 mV
±10 V	20 V	±0.5 mV
1 to 5 V	4 V	±1 mV
0 to 20 mA	18 mA	±1 μA
4 to 20 mA	16 mA	±1 μA

MODEL APMR - 3 PHASE FAULT DETECTION DIN RAIL MODULE



- *PROTECTS AGAINST PHASE LOSS, UNBALANCE, UNDER VOLTAGE, AND PHASE REVERSAL*
- *AVAILABLE IN 230, 380, OR 480 VAC*
- *LOW COST*
- *DIN RAIL MOUNTABLE*
- *INRUSH UNDER VOLTAGE DELAY*

UL Recognized Component, File # E137808

DESCRIPTION

The APMR protects three phase equipment, mostly motors, from destructive line conditions. Specifically it detects Phase Reversal, Phase Loss, Phase Unbalance and Low Voltage. All of these conditions, except for Phase Reversal, produce excessive heating of motor windings, causing immediate or cumulative damage to the motor. Phase Reversal will cause a motor to operate in the reverse intended direction, possibly damaging machinery.

There are three models available; 230 VAC, 380 VAC, and 480 VAC. The 230 VAC model is used with 208, 220, 230, and 240 VAC rated equipment. The 380 VAC model is used with 380 and 415 VAC (European) equipment. The 480 VAC model is used with 440, 460, and 480 VAC rated equipment. The electrical connection is three wire Delta or WYE configurations (no neutral connection required).

The output is SPDT relay and LED. The relay is typically connected in series with a motor contactor coil to inhibit motor start or to disconnect the motor in the presence of a fault condition. The relay automatically resets when the fault clears. The relay is typically used in a latching configuration so the motor has to be restarted after the fault is cleared. The LED illuminates green when all conditions are normal - no fault. When the LED is green, the relay is energized. When a fault occurs, the LED turns red and the relay is de-energized. If phase loss occurs on L1 or L3 the LED turns-off and the relay is de-energized.

SAFETY SUMMARY

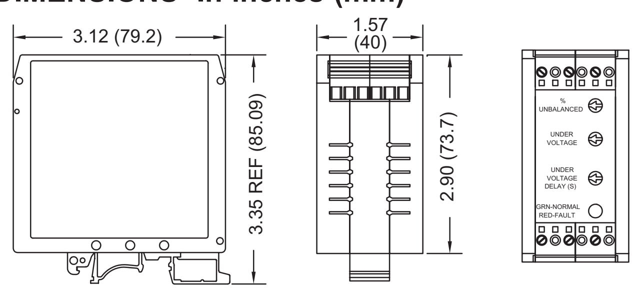
All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

WARNING: 3 Phase Fault Detection Modules must never be used as "Primary" protection against hazardous operating conditions. Machinery must first be made safe by inherent design or the installation of guards, shields, or other devices to protect personnel in the event of a hazardous machine condition.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **POWER:**
   230 VAC: 185 min to 264 max, 3 VA (Typ)⇒Nominal is 185 to 240, 48 to 62 Hz.
   380 VAC: 320 min to 457 max, 3 VA (Typ)⇒Nominal is 320 to 415, 48 to 62 Hz.
   480 VAC: 380 min to 528 max, 3 VA (Typ)⇒Nominal is 380 to 480, 48 to 62 Hz.
2. **OUTPUT:** SPDT 10 A @ 240 VAC (resistive load); 1/2 HP @ 240 VAC
   Response Time:
   Phase Reversal: Not greater than 120 msec
   Low Voltage: 0.1 to 20 sec, user adjustable
   Phase Loss and Unbalance: Not greater than 100 ms
3. **TEMPERATURE COEFFICIENTS:**
   Unbalance: ±0.5% Over temperature range
   Undervoltage: ±200 PPM/°C
4. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature: 0 to 55°C
   Storage Temperature: -40 to 80°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C.
   Altitude: Up to 2000 meters
5. **ISOLATION BREAKDOWN RATING:** 3000 V
6. **CERTIFICATIONS AND COMPLIANCES:**
   SAFETY
   UL Recognized Component, File # E137808, UL 508, CSA C22.2 No. 14
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Simulation of cordless telephone	ENV 50204	Level 3; 10 V/m
		900 MHz ± 5 MHz
		200 Hz, 50% duty cycle
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A

   Refer to EMC Installation Guidelines for additional information.
7. **MOUNTING:** Universal mounting foot for attachment to standard DIN style mounting rails, including top hat (T) profile rail according to EN50022 - 35 X 7.5 and 35 X 15, and G profile rail according to EN50035 - G32.
8. **CONNECTION:** Compression type terminal block
9. **CONSTRUCTION:** High impact black plastic case. Installation Category II, Pollution Degree 2.
10. **WEIGHT:** 7.0 oz. (0.20 Kg)

FUNCTION DESCRIPTIONS

PHASE UNBALANCE

Unbalance occurs in 3 phase systems when single phase loads are added without regard to voltage effects on the remaining phases. This unbalance in phase voltage causes excessive motor current producing temperatures in excess of specifications. The relationship between voltage unbalance and percentage of temperature rise is approximately the square of the percent voltage unbalance times two. ie., - % temperature rise = (% unbalance ^{2} X 2).

Therefore, a 4% voltage unbalance will result in approximately a 32% increase in winding temperature. The effect of temperature rise is immediate failure of winding insulation if unbalance is severe as with single phasing. If unbalance is slight, gradual winding degradation will result in premature insulation failure. The APMR will detect slight unbalances that thermal and magnetic devices usually miss.

PHASE LOSS

Phase Loss is an extreme case of unbalance known as “single phasing” where a total loss of one of the phases occurs. During this condition the motor will continue to run and the full current is drawn from the remaining phases. Unless the motor is lightly loaded motor failure will occur. The APMR will detect Phase Loss even with regenerated voltages present.

PHASE REVERSAL

Reversing any two of the three phases will cause a motor to rotate opposite the intended direction causing damage to machinery. Reversal can occur during maintenance of distribution systems. The APMR will detect Phase Reversal regardless of load conditions.

UNDERVOLTAGE

Undervoltage can occur during Brownouts, excessive system loading and motor startups. An undervoltage **Time Delay** is provided with the undervoltage detection to eliminate false tripping during startups when a motor draws many times its operating current.

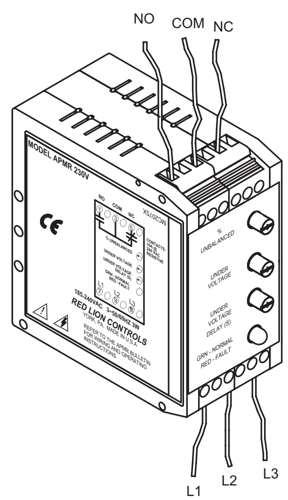
EMC INSTALLATION GUIDELINES

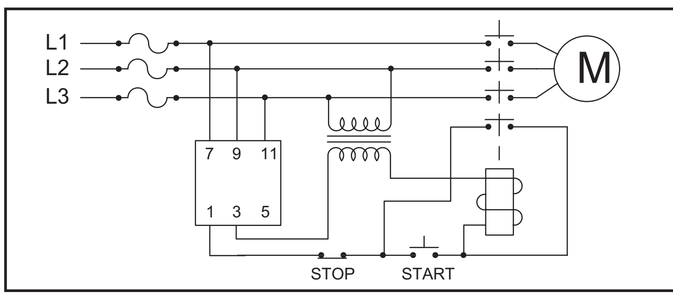
Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The unit should be mounted in a metal enclosure, that is properly connected to protective earth.
   a. If the bezel is exposed to high Electro-Static Discharge (ESD) levels, above 4 Kv, it should be connected to protective earth. This can be done by making sure the metal bezel makes proper contact to the panel cut-out or connecting the bezel screw with a spade terminal and wire to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VB3
      Corcom #1VR3
   Note: *Reference manufacturer’s instructions when installing a line filter.*
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

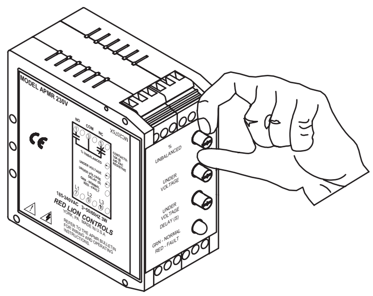
All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the number on the label to identify the position number with the proper function. Strip wire, leaving approximately 1/4" (6mm) of bare wire exposed. Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.





SETUP

1. Adjust the dials on the APMR to the following settings:
   a. Under Voltage to minimum (CCW)
   b. Under Voltage Delay to minimum (CCW)
   c. % Unbalanced to maximum (CW)



2. Connect input wire from the fused 3 phase line voltage to Terminals 7 (L1), 9 (L2), and 11 (L3). In Wye systems, connection to neutral wire is not required. Do not wire output contacts until Step 9.
3. TURN POWER ON. When the internal relay energizes, and the Red LED glows green, the phase sequence is correct and the voltages on all three phases are above the minimum under voltage setting.
   a. If the internal output relay does not energize, and the LED stays red, TURN POWER OFF and swap any two (2) of the three (3) input wires. This corrects the phase sequence if the monitor was connected in reverse rotation. *Note: Insure that the motor is wired for correct rotation.*
4. Select the proper under voltage trip point. (This is the dial marked Under Voltage.) The under voltage setting should be the same as the minimum operating voltage for the equipment to be protected.
   Note: If the recommended setting is not known, turn the Undervoltage adjustment knob CW until the relay de-energizes and the LED glows red. Turn the knob CCW until the relay energizes and the LED glows green. This procedure assumes that the line voltages are at an acceptable level when the adjustments are made.
5. Set the **Under Voltage Delay** to the desired value. This is the maximum time period that an under voltage condition can exist before de-energizing the internal relay. The exact value of the delay depends on the type of equipment being protected and the quality of the available three phase power. A setting too low, will cause unnecessary interruptions due to momentary dips in the line voltage. On the other hand, if the time delay is too long, damage to the equipment can occur before a legitimate under voltage condition is detected. Three phase motors have a starting current that is many times higher than the normal full load current but lasts for only a few seconds. Setting the delay slightly longer than the duration of this inrush period will prevent the APMR from being tripped due to a low voltage condition caused by the starting current.
   Note: The under voltage delay applies only to under voltage conditions. Exceeding the phase unbalance trip setting or a phase loss will de-energize the relay instantly regardless of the delay setting.
6. Phase **Unbalance** setting. Maximum permissible unbalance and phase voltages that most three phase powered equipment can tolerate are very seldom specified. In most locations, three phase voltages typically are not perfectly balanced. Use your own discretion when setting this value. Too low of a setting (CCW) can cause unnecessary tripping. Too high of a setting (CW) does not provide adequate protection.
   An alternative procedure is to turn the Unbalance adjustment CCW until the relay de-energizes and the LED turns red. Turn the knob CW until the relay energizes and the LED turns green.
   Note: This procedure assumes that the line voltages are sufficiently balanced when the adjustments are made. % Voltage Unbalance is defined by NEMA as: [(Maximum Deviation From Average Voltage/Average Voltage) X 100] where Average Voltage = (L1 + L2 + L3)/3.
   Note: NEMA recommends not to operate motors with a phase unbalance greater than 5%.
7. When the phase sequence is correct and the line voltages are within preset limits, the internal relay of the APMR will energize. The LED indicator glows green to show a normal condition.
8. TURN POWER OFF. Refer to the wiring diagram for proper output contact connections.
9. After proper connections are made, TURN POWER ON. The internal relay energizes allowing the monitored load to become active.

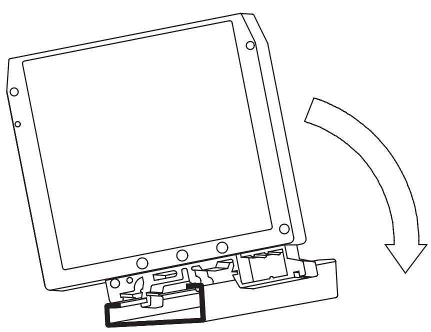
INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15.

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

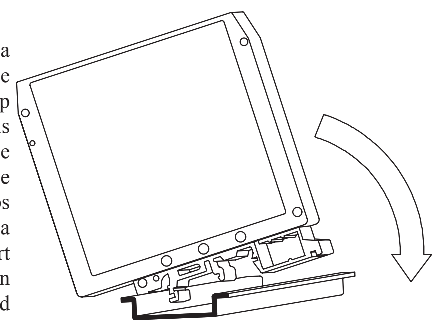
G Rail Installation

To install the APMR on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.

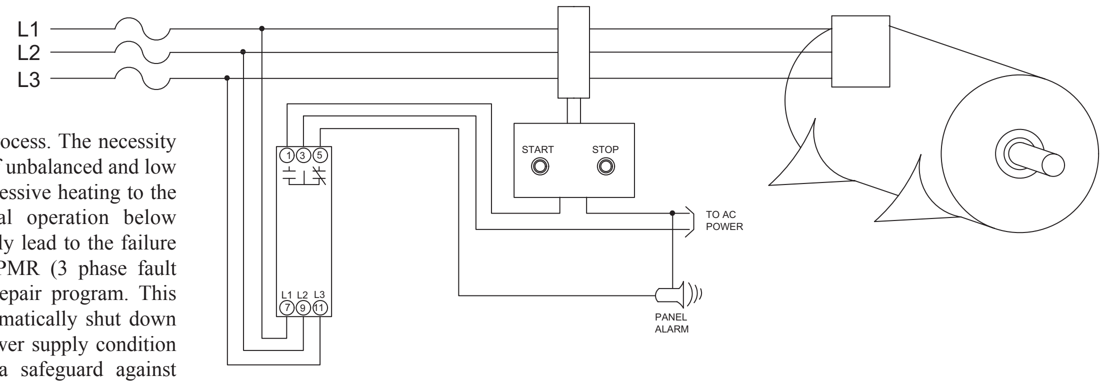


T Rail Installation

To install the APMR on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.



APPLICATION



A waste water treatment plant had just completed a costly repair program, reconditioning several motors used in their pumping process. The necessity to rebuild was the direct result of unbalanced and low voltage supply lines causing excessive heating to the motor windings. The continual operation below acceptable levels of power supply lead to the failure of the motor windings. The APMR (3 phase fault detector) was included in the repair program. This upgrade to the system will automatically shut down the motors if an undesirable power supply condition is detected. Not only is this a safeguard against unbalance or low voltage, it will also detect phase loss or reversal. An alarm will also trigger in the control room, alerting the operators of the shut down action.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES		
		480 VAC	380 VAC	230 VAC
APMR	3 Phase Fault Detection Module	APMR0096	APMR0086	APMR0016
For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.				

MODEL IRMA - INTELLIGENT RTD MODULE WITH ANALOG OUTPUT

- *USER PROGRAMMABLE INPUT (RTD alpha=0.00385 (DIN 43760), alpha=0.00392, or resistance)*
- *12 to 42 VDC LOOP POWERED (4 to 20 mA Output)*
- *MICROPROCESSOR CONTROLLED*
- *SIMPLE ADJUSTABLE RANGE SETTING (Using Input Signal)*
- *RTD BREAK DETECTION*
- *MOUNTS ON "T" AND "G" STYLE DIN RAILS*
- *2-WAY ELECTRICAL ISOLATION (INPUT/OUTPUT & POWER)*
- *HIGH-DENSITY PACKAGING (22.5 mm wide)*
- *WIDE OPERATING TEMPERATURE RANGE*

DESCRIPTION

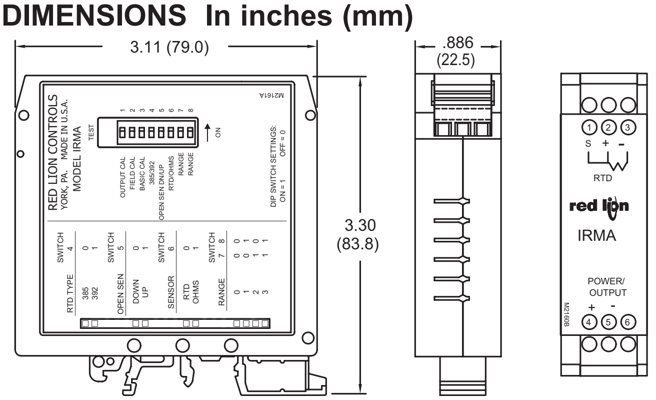
The IRMA accepts a 2, 3, or 4 wire RTD or resistance input and converts it into a 4 to 20 mA current output. The 4 to 20 mA output is linearly proportional to the temperature or the resistance input. This output is ideal for interfacing to indicators, chart recorders, controllers, or other instrumentation equipment.

The IRMA is loop-powered which means that the same two wires are carrying both the power and the output signal. The unit controls the output current draw from 4 to 20 mA in direct proportion to the input while consuming less than 4 mA for operation. The conversion to a current output signal makes the IRMA less susceptible to noise interference and allows accurate transmission over long distances. Two-Way isolation allows the use of grounded RTD's which can provide additional noise reduction benefits.

The IRMA uses an eight position DIP switch to accomplish the input sensor configuration, range selection, and unit calibration. A simple range setting technique (Field Calibration) is used so the actual input signal adjusts the output current for scaling. This technique eliminates the need for potentiometers which are vulnerable to changes due to vibration.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat rail (T) according to EN 50 022 - 35 X 7.5 and 35 X 15, and G profile according to EN 50 035 - G 32.

DIMENSIONS In inches (mm)



CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
IRMA	Intelligent RTD Module	IRMA2003

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

SPECIFICATIONS

1. **POWER**: 12 to 42 VDC *(Loop powered). The power supply must have a 30 mA min. capacity.
   [* Min. voltage must be increased to include the drop across any current display indicator]
2. **INPUT**: RTD 2, 3, or 4 wire, 100 ohm platinum, alpha=0.00385 (DIN 43760), alpha=0.00392, or resistance [selectable via DIP switch]
   Excitation: 0.170 mA nominal
   Lead resistance: Less than 0.5°C with 15 ohms max. per lead
   Note: There is no lead compensation for 2 wire input. Field calibration should be accomplished with equivalent series resistance.
3. **OUTPUT**: 4 to 20 mA Linear output with Temperature or resistance input.
   Ripple: Less than 15 mV peak-to-peak max., across 250Ω load resistor (up to 120 Hz frequencies).
4. **RANGE & ACCURACY**: (12 Bit resolution)
   Accuracy: ± (0.075% Range + 0.1°C [Conformity]) at 23°C after 20 min. warm-up, conforming to ITS-90.
   Note: RTD conformity does not apply to resistance input.
   Relative Humidity: Less than 85% RH (non-condensing)
   Span: The input span can be set to a min. of 1/8 of the full scale range, anywhere within that range.
   Range Accuracy:

INPUT	RANGE	DIP SWITCH TYPE RANGE 4 6 7 8	TEMPERATURE & OHMS RANGE	RANGE ACCURACY
RTD alpha = 0.00385	0	0 0 0 0	-160 to 654°C	± 0.61°C
	1	0 0 0 1	-108 to 207°C	± 0.24°C
	2	0 0 1 0	-5 to 414°C	± 0.31°C
	3	0 0 1 1	194 to 608°C	± 0.31°C
RTD alpha = 0.00392	0	1 0 0 0	-157 to 640°C	± 0.60°C
	1	1 0 0 1	-106 to 203°C	± 0.23°C
	2	1 0 1 0	-5 to 406°C	± 0.31°C
	3	1 0 1 1	190 to 596°C	± 0.30°C
OHMS	0	0 1 0 0	35.5 to 331.0 Ω	± 0.222 Ω
	1	0 1 0 1	57.0 to 178.5 Ω	± 0.091 Ω
	2	0 1 1 0	98.0 to 252.0 Ω	± 0.116 Ω
	3	0 1 1 1	173.5 to 316.5 Ω	± 0.107 Ω

Note: DIP switch settings ON = 1 OFF = 0

SPECIFICATIONS (Cont'd)

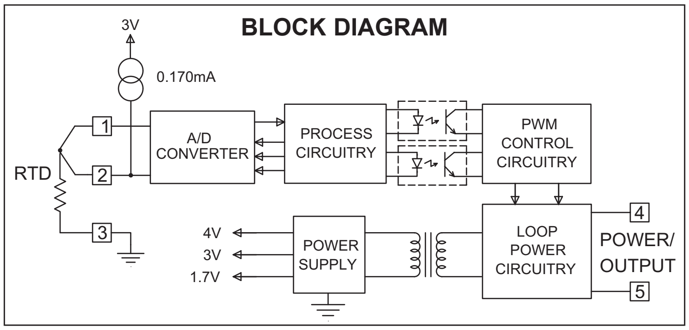
5. **SENSOR BREAK DETECTION**: Upscale to 22.5 mA (nominal) or Downscale to 3.6 mA (nominal) [selectable via DIP switch]
6. **RESPONSE TIME**: 400 msec (to within 99% of final value w/step input; typically, response is limited to response time of probe.)
7. **DIELECTRIC WITHSTAND VOLTAGE:** 1500 VAC for 1 minute
   Working Voltage: 50 VAC from input to output.
8. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact [1]
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3: 10 V/m [2] 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Emissions to EN 50081-2		
RF interference	EN 55011	Enclosure class A

Notes:
1. This device was designed for installation in an enclosure. To avoid electrostatic discharge, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure, (ex. making adjustments, setting switches etc.) typical anti-static precautions should be observed before touching the device.
2. Self-recoverable loss of performance during EMI disturbance at 10 V/m: Analog output signal may deviate during EMI disturbance.

For operation without loss of performance:
Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent).
I/O and power cables are routed in metal conduit connected to earth ground.

9. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature Range: -25°C to 75°C (-13°F to 167°F)
   Storage Temperature Range: -40°C to 85°C (-40°F to 185°F)
   Vibration according to IEC 68-2-6: Operational 5 to 150 Hz in X, Y, Z direction for 1.5 hours, 2 g's.
   Shock according to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions
   Temperature Coefficient: ± 0.01% of input range per °C
   Altitude: Up to 2000 meters.
10. **MOUNTING:** Universal mounting foot for attachment to standard DIN style mounting rails, including top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15, and G profile rail according to EN50035 - G32.
11. **CONNECTION:** Compression type terminal block
12. **CONSTRUCTION:** High impact green plastic case
13. **WEIGHT:** 2.7 oz (76.54 g)



FUNCTION DESCRIPTIONS

Open Sensor Detection

The output can be set to go Upscale or Downscale for the detection of an open sensor. The Upscale setting makes the output go to 22.5 mA (nominal). The Downscale setting makes the output go to 3.5 mA (nominal). This setting is always active, so changes in the setting are effective immediately.

Calibration Malfunction

If the unit has scaling problems (current remains at 3.5 mA nominal), check the voltage between the RTD- Input (-) and TEST pad (+) [located next to the DIP switches on the side of the unit]. For normal operation the voltage is 0 V (nominal). If the voltage is +3 V(nominal), a problem occurred storing information in the E^2PROM. When this happens, perform a Basic Calibration and then a Field Calibration. Turn off power for 5 seconds. Turn on power and check the voltage between the TEST pad (+) and RTD- Input (-). If the voltage is still +3 V(nominal), contact the factory.

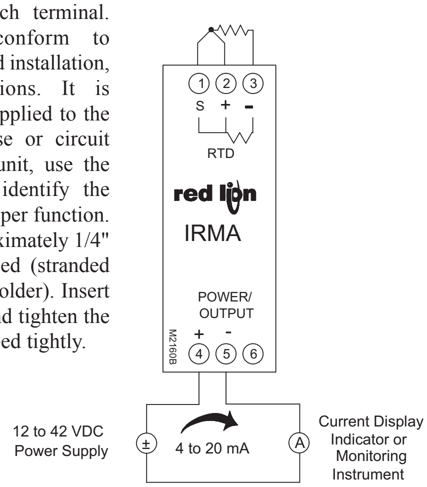
EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of electrical noise, source or coupling method into the unit may be different for various installations. In extremely high EMI environments, additional measures may be needed. For the purpose of EMC testing, both input and output lines on the unit were connected with 25 feet (8 m) of cable. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

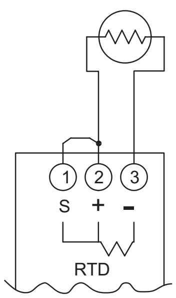
All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" (6 mm) of bare wire exposed (stranded wire should be tinned with solder). Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.



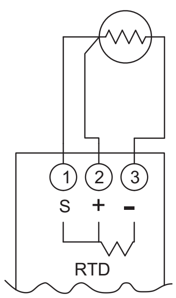
INPUT AND POWER/OUTPUT CONNECTIONS

INPUT

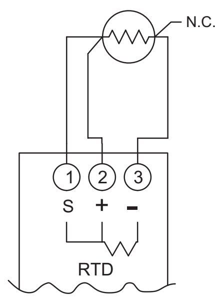
When connecting the RTD or resistance device, be certain that the connections are clean and tight. Attach the device to terminals #2 and #3. Install a copper sense lead of the same gauge as those used to connect the device. Attach one end of the wire at the probe where the lead connected to terminal #2 is attached and the other end to terminal #1. This configuration will provide complete lead wire compensation. If a sense wire is not utilized, then Terminal #1 should be shorted to terminal #2. To avoid errors due to lead wire resistance, field calibration should be performed with a series resistance equal to the total lead resistance in the system. Always refer to the probe manufacturer's recommendations for mounting, temperature range, shielding, etc.



2-WIRE RTD



3-WIRE RTD



4-WIRE RTD

POWER/OUTPUT

The unit has the power and current output sharing the same two wires (loop-powered). Connect DC power to terminals #4 and #5, observing the correct polarity, with a current meter/indicator connected in between so that the output current can be monitored. Be certain that the DC power is relatively "clean" and within the 12 to 42 VDC range at the terminals. The current meter voltage drop must be included in the power supply considerations.

DIP SWITCH SETTING DESCRIPTIONS

SWITCH	DESCRIPTION	
1	OUTPUT CAL	Output Calibration
2	FIELD CAL	Field Calibration
3	BASIC CAL	Basic Calibration
4	385/392	Select RTD alpha - 0.00392 (ON) / 0.00385 (OFF)
5	OPEN SEN DN/UP	Open Sensor Detection - Upscale (ON) / Downscale (OFF)
6	RTD/OHMS	Select Input Type - Ohms (ON) / RTD (OFF)
7	RANGE	Sensor Range - 2 switch combination setting
8		

Range switch settings (ON = 1 OFF = 0)

RANGE	DIP SWITCH	
	7	8
0	0	0
1	0	1
2	1	0
3	1	1

FACTORY SETTINGS

The unit is shipped from the factory calibrated for a 4 to 20 mA output using a type 385 RTD in range 0. The IRMA should be calibrated by the operator for the application environment it will be used in. If the unit is not recalibrated by the operator, the following table lists the temperature ranges for each RTD type.

TYPE	RANGE	TEMPERATURE RANGE
385	0	150°C to 606°C
392	0	150°C to 595°C

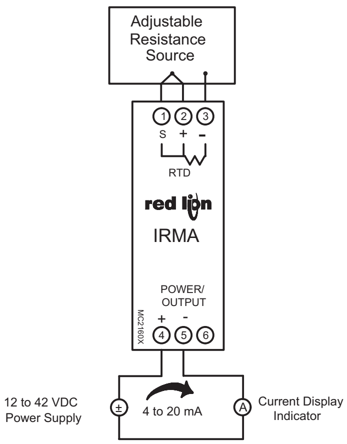
1.0 Field Calibration

Allow a 30 minute warm-up period before starting Field Calibration. Field Calibration scales the 4 to 20 mA output to a temperature or resistance input. This procedure assigns an input value to 4 mA and an input value to 20 mA. The microprocessor handles configuring the output so it is linear to the temperature or resistance input. The Field Calibration procedure is described below.

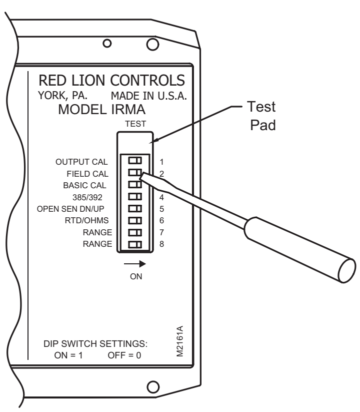
Note: The unit needs to have the Field Calibration completed by the operator before normal operation. To abort this calibration and reset to the previous settings, set the FIELD CAL switch OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 1.11) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

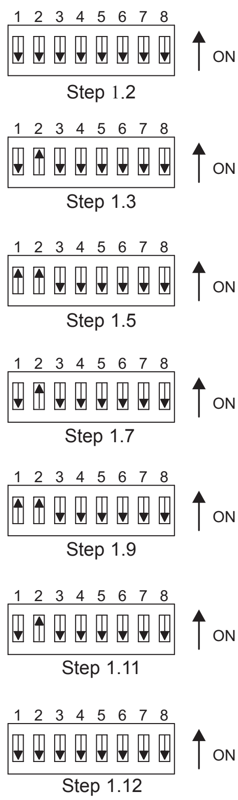
RTD temperature to resistance conversion table

Temperature °C	alpha 0.00385 ohms	alpha 0.00392 ohms	Temperature °C	alpha 0.00385 ohms	alpha 0.00392 ohms
-160	35.53	34.38	300	212.03	214.08
-150	39.71	38.64	350	229.69	232.07
-100	60.25	59.55	400	247.05	249.77
-50	80.30	79.96	410	250.49	253.28
0	100.00	100.00	450	264.13	267.18
50	119.40	119.75	500	280.92	284.30
100	138.5	139.20	550	297.42	301.13
150	157.33	158.36	590	310.41	314.38
190	172.17	173.48	600	313.63	317.66
200	175.85	177.23	640	326.38	330.68
250	194.09	195.80	650	329.54	333.90



Field Calibration Wiring





Field Calibration with an Accurate Adjustable Resistance Source

1.1 Connect an Adjustable Resistance Source with an accuracy of 0.03% to the RTD input terminals using a third sense wire.
For 2 wire sensors short terminal #1 to terminal #2.

1.2 Set the Type and Range for the RTD or resistance used in your application (DIP switches #4, #6, #7 and #8). (RTD alpha=0.00385, Range 0 shown)

1.3 Set the FIELD CAL switch (#2) ON. [Current goes to 3.6 mA (nominal)]

1.4 Set the resistance source to the desired resistance for the 4 mA output. For 2 wire sensors add the system lead resistance to the desired value.

1.5 Set the OUTPUT CAL switch (#1) ON. [Current stays at 3.6 mA (nominal)]

1.6 Adjust the input resistance up until the output equals 4 mA.

1.7 Set the OUTPUT CAL switch (#1) OFF. [Current increases to 22.3 mA (nominal)]

1.8 Set the resistance source to the desired resistance for the 20 mA output. For 2 wire sensors add the system lead resistance to the desired value.

1.9 Set the OUTPUT CAL switch (#1) ON. [Current decreases to 20.5 mA (nominal)]

1.10 Adjust the input resistance down until the output equals 20 mA.

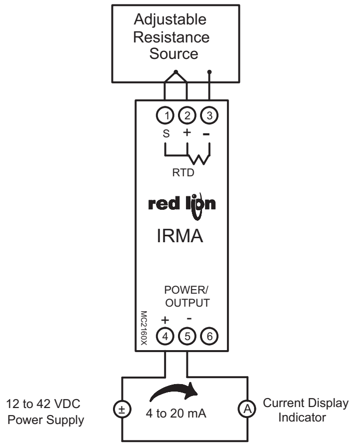
1.11 Set the OUTPUT CAL switch (#1) OFF.

1.12 Set the FIELD CAL switch (#2) OFF.

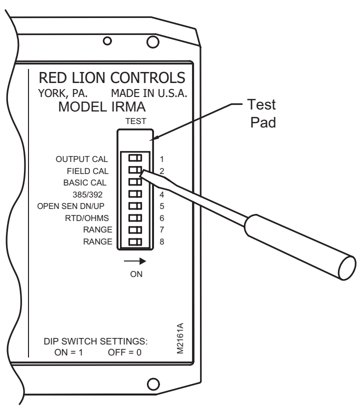
1.13 Disconnect the resistance source from the IRMA and connect the actual sensor to be used in the application.

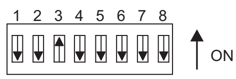
H

2.0 Basic Calibration (Factory Calibration)

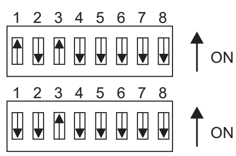


Basic Calibration Wiring

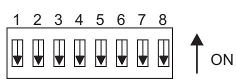




Step 2.1



Steps 2.3 to 2.15



Step 2.16

The Basic Calibration should only be performed with an ambient temperature between 21°C and 29°C. The Basic Calibration was performed on the unit at the factory and generally does not need to be done again. This procedure initializes the unit by calibrating the input circuitry. The Basic Calibration should be performed only if a condition exists as described in the "Calibration Malfunction" section. After completion of this calibration, the unit needs to be scaled in Field Calibration. The Basic Calibration procedure is described below.

Note: To abort this calibration and reset to the previous settings, set the BASIC CAL switch OFF prior to the final setting of the OUTPUT CAL switch (Step 2.15) and turn off power for 5 seconds. Then turn on power and the previous settings will be loaded.

2.1 Connect an Adjustable Resistance Source with an accuracy of 0.03% to the RTD input terminals using a third sense wire. Set the RANGE (#7&#8), TYPE (#4), OUTPUT CAL (#1), and FIELD CAL (#2) switches OFF. Set the BASIC CAL switch (#3) ON.
2.2 Apply power and allow a 30 minute warm-up period. [Current goes to 3.5 mA (nominal)]

2.3 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.4 Set the resistance source to 40 ohms and wait 5 seconds.
2.5 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.6 Set the resistance source to 60 ohms and wait 5 seconds.
2.7 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.8 Set the resistance source to 100 ohms wait 5 seconds.
2.9 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.10 Set the resistance source to 175 ohms and wait 5 seconds.
2.11 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.12 Set the resistance source to 250 ohms and wait 5 seconds.
2.13 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.14 Set the resistance source to 315 ohms and wait 5 seconds.
2.15 Set the OUTPUT CAL switch (#1) ON and then OFF.

2.16 Set the BASIC CAL switch (#3) OFF. [Current increases to 3.6 mA (nominal) or more]
2.17 Perform a Field Calibration. (See Section 1.0)

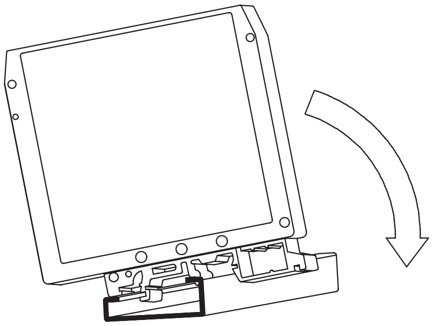
H

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

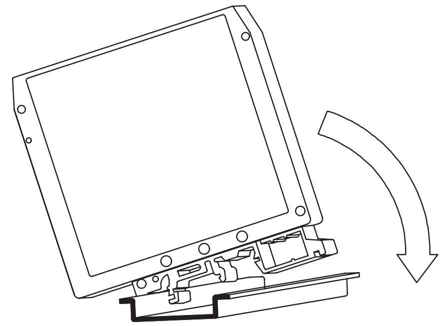
G Rail Installation

To install the IRMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



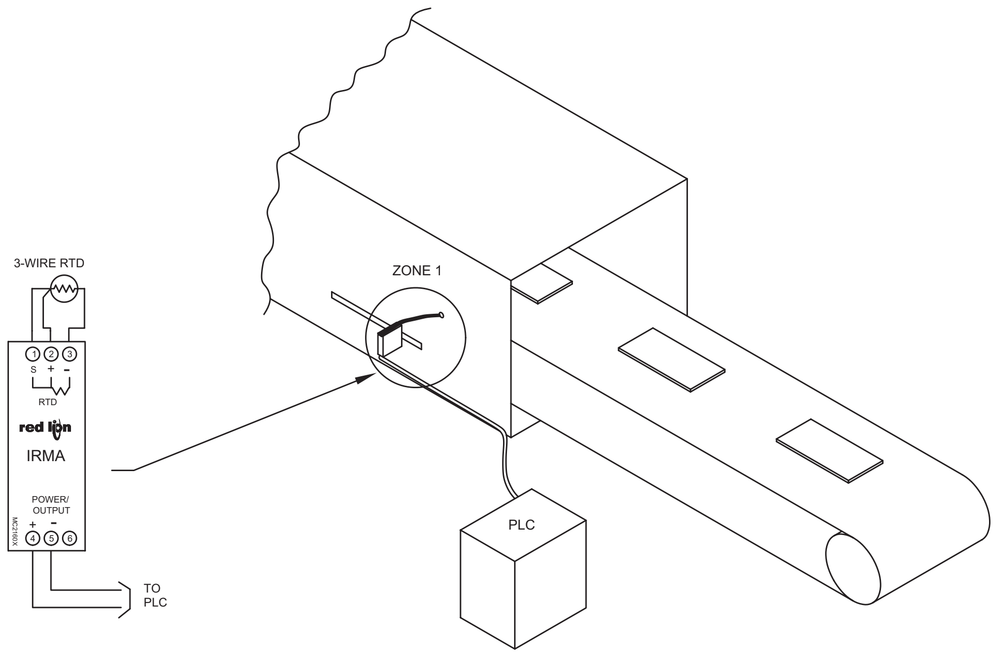
T Rail Installation

To install the IRMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.



APPLICATION

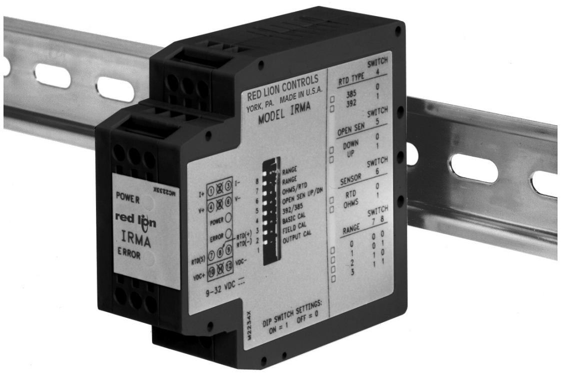
An aluminum manufacturer had the requirement to heat soak aluminum ingots before they were to advance into their hot roll mill. The system is being controlled by a PLC that allows the material to move to the next of twelve zones as soon as the aluminum ingot reaches the soak temperature. An IRMA, RTD Loop powered signal conditioner was used to transmit each zone temperature, measured by an RTD sensor, to the PLC. Because the heat soak procedure was accomplished in an eighty foot furnace tunnel, a relatively long wire run was required to connect each RTD with the PLC. The IRMA transmitter converts and linearizes the RTD signal into a 4 to 20 mA signal that can be run long distances to connect to the PLC.



TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL IRMA DC - INTELLIGENT RTD MODULE WITH ANALOG OUTPUT



- USER PROGRAMMABLE INPUT (RTD alpha = 0.00385 (DIN 43760), alpha = 0.00392, or resistance)
- MICROPROCESSOR CONTROLLED
- SIMPLE ADJUSTABLE RANGE SETTING (Using Input Signal)
- RTD BREAK DETECTION
- MOUNTS ON "T" AND "G" STYLE DIN RAILS
- 3-WAY ELECTRICAL ISOLATION (POWER/INPUT/OUTPUT)
- MULTIPLE ANALOG OUTPUTS (0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC)
- WIDE OPERATING TEMPERATURE RANGE (-25°C to 75°C)
- LED INDICATION (POWER & MEMORY ERROR)
- 9 to 32 VDC POWERED

DESCRIPTION

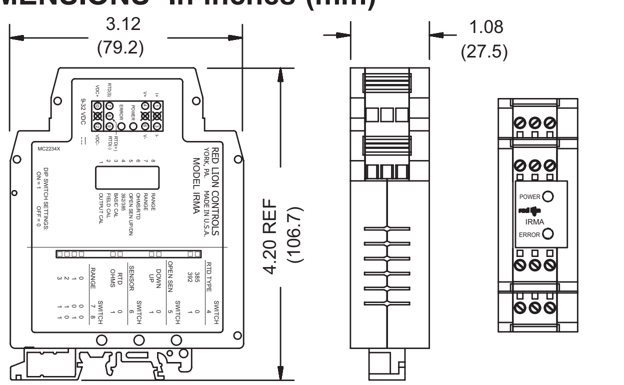
The IRMA accepts an RTD or resistance input and converts it into a voltage or current output. The output is linearly proportional to the temperature or resistance input. This output is ideal for interfacing to indicators, chart recorders, controllers, or other instrumentation equipment.

The IRMA is DC powered. The DC power input is isolated from the signal input and analog output. The unit scales the analog output proportionally to the RTD or resistance input signal. The analog output may be configured for one of the following: 0 to 20 mA, 4 to 20 mA, or 0 to 10 VDC. Making the signal conversion with the IRMA to a current output signal, makes the signal less susceptible to noise interference and allows accurate transmission over long distances. The 3-Way isolation allows the use of grounded RTD's which can provide additional noise reduction benefits.

The IRMA uses an eight position DIP switch to accomplish the input sensor configuration, range selection, and unit calibration. A simple range setting technique (Field Calibration) is used so the actual input signal adjusts the output for scaling. This technique eliminates the need for potentiometers which are vulnerable to changes due to vibration.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat rail (T) according to EN 50 022 - 35 × 7.5 and 35 × 15, and (G) profile according to EN 50 035 - G 32.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
IRMA	Intelligent RTD Module	IRMA3035

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **POWER**: 9 to 32 VDC; 1.75 W. 200 mA max. current. The power supply must have 400 mA for 200 msec. surge capacity.
2. **INPUT**: RTD 2, 3, or 4 wire, 100 ohm platinum, alpha = 0.00385 (DIN 43760), alpha = 0.00392, or resistance [selectable via DIP switches].
   Excitation: 0.170 mA nominal
   Lead resistance: Less than 0.5°C with 15 ohms max. per lead
   Note: There is no lead compensation for 2 wire input. Field calibration should be performed with equivalent series resistance.
3. **OUTPUT**: All output signals scaled linearly using temperature or resistance input. Unit is shipped set for the 4 to 20 mA output. 4 to 20 mA or 0 to 20 mA selected via internal jumper.
   Voltage Output Compliance:
   0 to 10 VDC across min. 1 KΩ load (10 mA)
   20 mV peak to peak max. ripple (for frequencies up to 120 Hz)
   Current Output Compliance:
   0 to 20 mA through max. 600Ω load (12 VDC)
   4 to 20 mA through max. 600Ω load (12 VDC)
   15 mV peak to peak max. ripple across 600Ω load (for frequencies up to 120 Hz)
4. **RTD BREAK DETECTION**: Nominal values shown in the following order: (0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC).
   Upscale: 22.9 mA, 22.5 mA, and 11.5 VDC
   Downscale: -0.5 mA, 3.5 mA, and -0.4 VDC
5. **RESPONSE TIME**: 400 msec. (to within 99% of final value w/step input; typically, response is limited to response time of probe.)
6. **TEMPERATURE EFFECTS**:
   Temperature Coefficient: ± 0.025% of input range per °C
7. **DIELECTRIC WITHSTAND VOLTAGE**: 1500 VAC for 1 minute
   Working Voltage: 50 VAC
   Power input to Signal input, Power input to Signal output, & Signal input to Signal output.

8. **RANGE & ACCURACY**: (12 Bit resolution)
   Accuracy: ± (0.075% Range + 0.1°C [Conformity]) at 23°C after 45 min. warm-up, conforming to ITS-90.
   Note*: RTD Conformity does not apply to resistance input. For best accuracy, calibration should be performed under operating conditions.*
   Relative Humidity: Less than 85% RH (non-condensing)
   Span: The input span can be set to a min. of 1/8 of the full scale range, anywhere within that range.

Range Accuracy

INPUT	RANGE	DIP SWITCH TYPE RANGE 4 6 7 8	TEMPERATURE & OHMS RANGE	RANGE ACCURACY
RTD alpha = 0.00385	0	0 0 0 0	-160 to 654°C	± 0.61°C
	1	0 0 0 1	-108 to 207°C	± 0.24°C
	2	0 0 1 0	-5 to 414°C	± 0.31°C
	3	0 0 1 1	194 to 608°C	± 0.31°C
RTD alpha = 0.00392	0	1 0 0 0	-157 to 640°C	± 0.60°C
	1	1 0 0 1	-106 to 203°C	± 0.23°C
	2	1 0 1 0	-5 to 406°C	± 0.31°C
	3	1 0 1 1	190 to 596°C	± 0.30°C
OHMS	0	0 1 0 0	35.5 to 331.0 Ω	± 0.222 Ω
	1	0 1 0 1	57.0 to 178.5 Ω	± 0.091 Ω
	2	0 1 1 0	98.0 to 252.0 Ω	± 0.116 Ω
	3	0 1 1 1	173.5 to 316.5 Ω	± 0.107 Ω

Note: DIP switch settings ON = 1 OFF = 0

Accuracy Example:
RTD 385 Range "0"
-160°C to 654°C

Range		Conformity		Total Error
(±0.61°C	+	±0.1°C)	=	±0.71°C

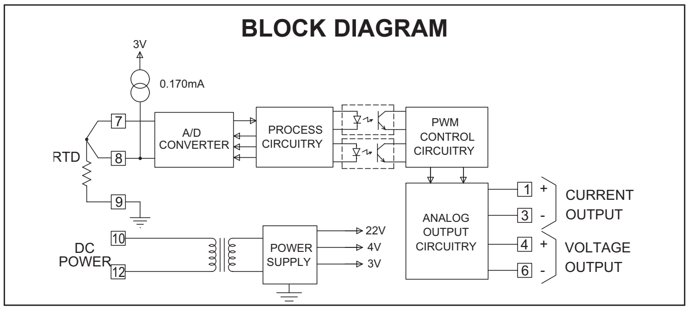
9. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2

Electrostatic discharge	EN 61000-4-2	Level 2; 4 kV contact[1]
		Level 3; 8 kV air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m[2]
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 kV I/O
		Level 3; 2 kV power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz – 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Emission to EN 50081-2		
RF interference	EN 55011	Enclosure class B

Notes:
1. This device was designed for installation in an enclosure. To avoid electrostatic discharge, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure (ex. making adjustments, setting switches etc.) typical anti-static precautions should be observed before touching the unit.
2. Self-recoverable loss of performance during EMI disturbance at 10 V/m:
Analog output signal may deviate during EMI disturbance.
For operation without loss of performance:
Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent)
I/O and power cables are routed in metal conduit connected to earth ground.
Refer to the EMC Installation Guidelines section of this bulletin for additional information.

10. **ENVIRONMENTAL CONDITIONS**:
    Operating Temperature Range: -25°C to 75°C (-13°F to 167°F)
    Storage Temperature Range: -40 to 85°C (-40°F to 185°F)
    Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from -25°C to 75°C.
    Altitude: Up to 2000 meters
11. **MOUNTING**: Universal mounting foot for attachment to standard DIN style mounting rails, including top hat (T) profile rail according to EN50022 - 35 × 7.5 and 35 × 15, and G profile rail according to EN50035 - G32.
12. **CONNECTION**: Compression type terminal block
13. **CONSTRUCTION**: High impact black plastic case, Installation Category I, Pollution Degree 2.
14. **WEIGHT**: 4.02 oz. (114.0 g)



FUNCTION DESCRIPTIONS

Open Sensor Detection

The output can be set to go Upscale or Downscale for the detection of an open sensor. The nominal values for each output range are listed under RTD Break Detection in the Specifications section. This setting is always active, so changes to the setting are effective immediately.

Unit Malfunction

If the unit has scaling problems (output remains at -0.5 mA, 3.5 mA, or -0.5 VDC nominal), check the ERROR LED on the front of the unit. An E^2PROM problem is indicated when the ERROR LED is on. If the ERROR LED is on, perform a Basic Calibration followed by a Field Calibration. Turn the power off for 5 seconds. Turn power on and check if the ERROR LED is on. If the LED is on, contact the factory.

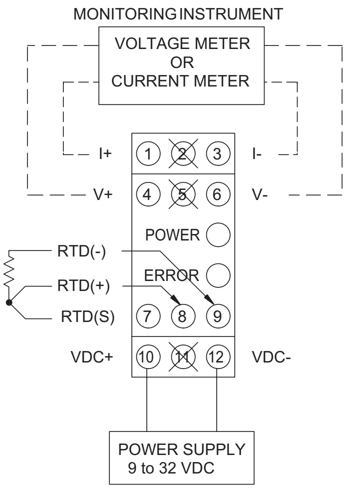
EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite # 0443167251 (RLC #FCOR0000)
      TDK # ZCAT3035-1330A
      Steward #28B2029-0A0
   Line Filters for input power cables:
      Schaffner # FN610-1/07 (RLC #LFIL0000)
      Schaffner # FN670-1.8/07
      Corcom #1VR3
   Note: *Reference manufacturer's instructions when installing a line filter.*
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

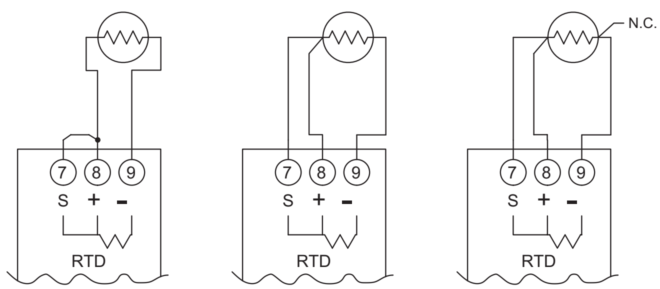
All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" (6 mm) of bare wire exposed (stranded wire should be tinned with solder). Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.



INPUT AND POWER/OUTPUT CONNECTIONS

INPUT

When connecting the RTD or resistance device, be certain that the connections are clean and tight. Attach the device to terminals #8 and #9. Install a copper sense lead of the same gauge as those used to connect the device. Attach one end of the wire at the probe where the lead connected to terminal #8 is attached and the other end to terminal #7. This configuration will provide complete lead wire compensation. If a sense wire is not utilized, then Terminal #7 should be shorted to terminal #8. To avoid errors due to lead wire resistance, field calibration should be performed with a series resistance equal to the total lead resistance in the system. Always refer to the probe manufacturer's recommendations for mounting, temperature range, shielding, etc.

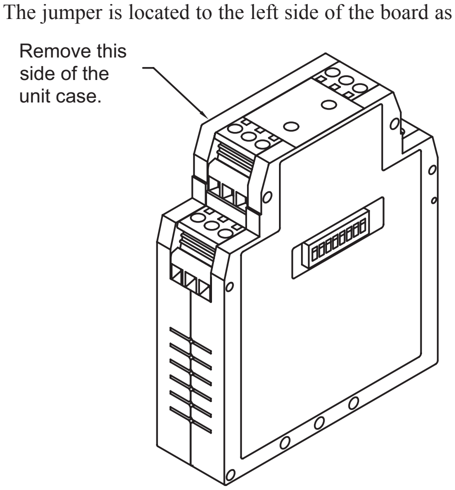


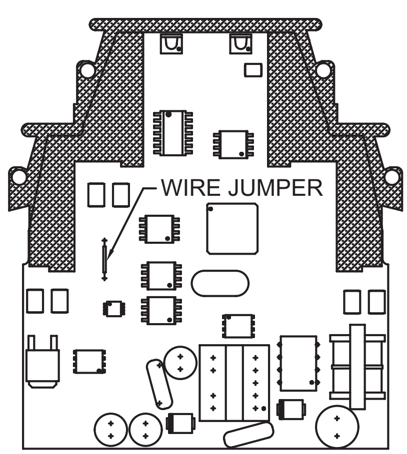
2-WIRE RTD 3-WIRE RTD 4-WIRE RTD

OUTPUT

Connect the output signal wires to the desired output terminals. For voltage output, use terminals #4 and #6; for current output, use terminals #1 and #3 observing proper polarity. Only one output may be used at a time. The unit is factory set for a 4 to 20 mA output. The voltage output will track the current output linearly within ±2.5% deviation of range endpoints.

To select 0 to 20 mA, output you must open the case and cut the wire jumper. The jumper is located to the left side of the board as shown in the drawing.





POWER

Connect DC power to terminals #10 and #12 observing proper polarity. Be certain DC power is within the 9 to 32 VDC specifications.

POWER LED

The IRMA has a green LED located on the front to indicate that power is applied to the unit.

DIP SWITCH SETTING DESCRIPTIONS

SWITCH	LABEL	DESCRIPTION
1	OUTPUT CAL	Output Calibration
2	FIELD CAL	Field Calibration
3	BASIC CAL	Basic Calibration
4	385/392	RTD Type
5	OPEN SEN UP/DN	Open Sensor Detection - Upscale (ON) / Downscale (OFF)
6	RTD/OHMS	Select Input Type - Ohms (ON) / RTD (OFF)
7	RANGE	Sensor Range - 2 switch combination setting
8		

Range switch settings (ON = 1 OFF = 0)

RANGE	DIP SWITCH	
	7	8
0	0	0
1	0	1
2	1	0
3	1	1

FACTORY SETTINGS

The unit is shipped from the factory calibrated for a 4 to 20 mA output using a type 385 RTD in range 0. The IRMA should be Field calibrated by the operator for the application environment it will be used in. If the unit is not recalibrated by the operator, the following table lists the temperature ranges for each RTD type.

NOMINAL FACTORY FIELD CALIBRATION		
TYPE	RANGE	TEMPERATURE RANGE
385	0	150°C to 606°C
392	0	150°C to 595°C

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

CALIBRATION PROCEDURES

1.0 Field Calibration

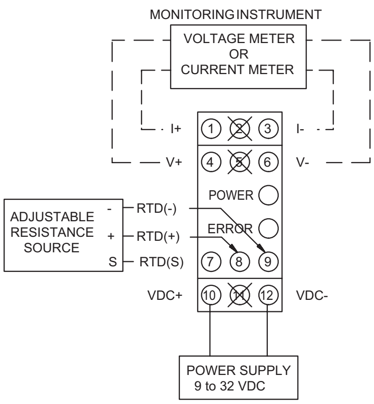
Field Calibration scales the selected output to a temperature or resistance input. This procedure assigns an input value to the low end and an input value to the high end. The microprocessor handles configuring the output so it is linear to the temperature or resistance input. The Field Calibration procedure is described below.

Note: The unit needs to have the Field Calibration completed by the operator before normal operation. To abort this calibration and reset to the previous settings, set the FIELD CAL switch OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 1.11) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

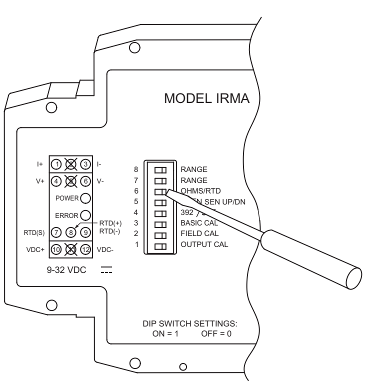
RTD temperature to resistance conversion table

Temperature °C	alpha 0.00385	alpha 0.00392
-160	35.53	34.38
-150	39.71	38.64
-100	60.25	59.55
-50	80.30	79.96
0	100.00	100.00
50	119.40	119.75
100	138.5	139.20
150	157.33	158.36
190	172.17	173.48
200	175.85	177.23
250	194.09	195.80

Temperature °C	alpha 0.00385	alpha 0.00392
300	212.03	214.08
350	229.69	232.07
400	247.05	249.77
410	250.49	253.28
450	264.13	267.18
500	280.92	284.30
550	297.42	301.13
590	310.41	314.38
600	313.63	317.66
640	326.38	330.68
650	329.54	333.90



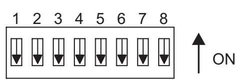
Field Calibration Wiring



Field Calibration with an Accurate Adjustable Resistance Source

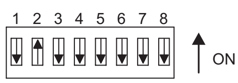
Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)

1.1 Connect resistance source to the RTD input terminals using a third sense wire. (For 2 wire sensors, short terminal #7 to terminal #8.)



Step 1.2

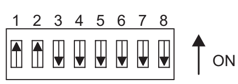
1.2 Set the type and Range for the RTD or resistance used in your application. (DIP switches #4, #6, #7 & #8). (RTD alpha = 0.00385, Range 0 shown). APPLY OPERATING VOLTAGE and allow 45 minute warm-up period.



Step 1.3

1.3 Set the FIELD CAL switch (#2) ON. [Output goes to -0.8 mA, 3.5 mA, or -0.4 V nominal]

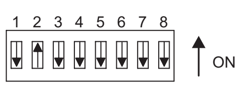
1.4 Set the input resistance to the value intended to generate the analog low endpoint (For 2 wire sensors, add the system lead resistance to the desired value.)



Step 1.5

1.5 Set the OUTPUT CAL switch (#1) ON. [Output stays at -0.8 mA, 3.5 mA, or -0.4 V nominal]

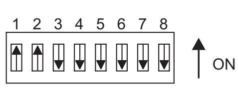
1.6 Adjust the input signal up until the analog output equals desired low value.[0 mA, 4 mA, or 0 V]



Step 1.7

1.7 Set the OUTPUT CAL switch (#1) OFF. [Output increases to 22.9 mA, 22.5 mA, or 11.5 V nominal]

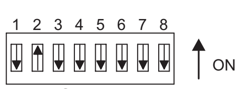
1.8 Set the input resistance to the value intended to generate the analog high endpoint. (For 2 wire sensors, add the system lead resistance to the desired value.)



Step 1.9

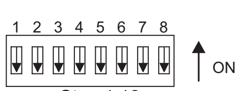
1.9 Set the OUTPUT CAL switch (#1) ON. [Output decreases to 21.1 mA, 20.7 mA, or 10.6 V nominal]

1.10 Adjust the input signal down until the output equals desired high value. [20 mA, 20 mA, or 10 V]



Step 1.11

1.11 Set the OUTPUT CAL switch (#1) OFF.



Step 1.12

1.12 Set the FIELD CAL switch (#2) OFF.

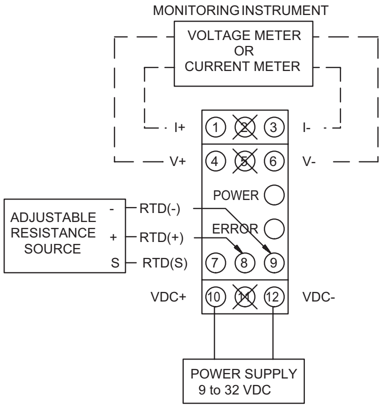
1.13 Disconnect the resistance source from the IRMA and connect the actual sensor to be used in the application.

2.0 Basic Calibration

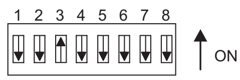
The Basic Calibration should only be performed with an ambient temperature between 21°C and 29°C. The Basic Calibration was performed on the unit at the factory and generally does not need to be done again. This procedure initializes the unit by calibrating the input. The Basic Calibration should be performed only if a condition exists as described in the "Unit Malfunction" section. After completion of this calibration, the unit needs to be scaled in Field Calibration. The Basic Calibration procedure is described below.

Note: To abort this calibration and reset to the previous settings, set the BASIC CAL switch(#3) OFF prior to the final setting of the OUTPUT CAL switch (#1) (Step 4.17) and turn off power for 5 seconds. Then turn on power and the previous settings will be loaded.

Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)



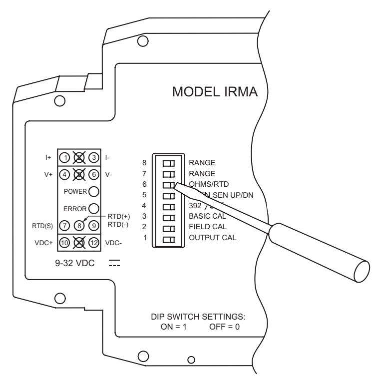
Basic Calibration Wiring

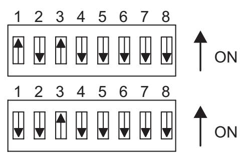


Step 2.1

2.1 Connect an adjustable resistance source with an accuracy of 0.03% to the RTD input terminals using a third sense wire. Set the RANGE (#7& #8), TYPE (#4), OUTPUT CAL (#1), and FIELD CAL (#2) switches OFF. Set the BASIC CAL switch (#3) ON.

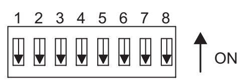
2.2 Apply operating power and allow a 45 minute warm-up period. [Current goes to -0.9 mA, 3.4 mA, or -0.5 V(nominal)]





Steps 2.3 to 2.15

2.3 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.4 Set the resistance source to 40 ohms and wait 5 seconds.
2.5 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.6 Set the resistance source to 60 ohms and wait 5 seconds.
2.7 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.8 Set the resistance source to 100 ohms wait 5 seconds.
2.9 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.10 Set the resistance source to 175 ohms and wait 5 seconds.
2.11 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.12 Set the resistance source to 250 ohms and wait 5 seconds.
2.13 Set the OUTPUT CAL switch (#1) ON and then OFF.
2.14 Set the resistance source to 315 ohms and wait 5 seconds.
2.15 Set the OUTPUT CAL switch (#1) ON and then OFF.



Step 2.16

2.16 Set the BASIC CAL switch (#3) OFF. [Current increases to 3.6 mA (nominal) or more]

2.17 Perform a Field Calibration. (See Section 1.0)

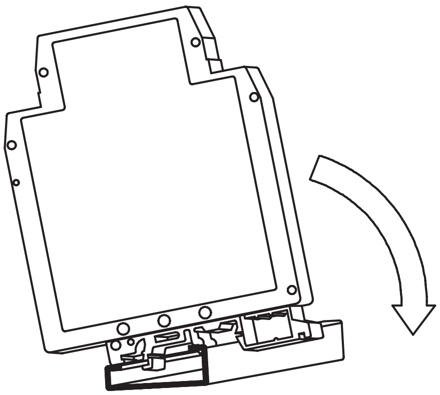
H

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

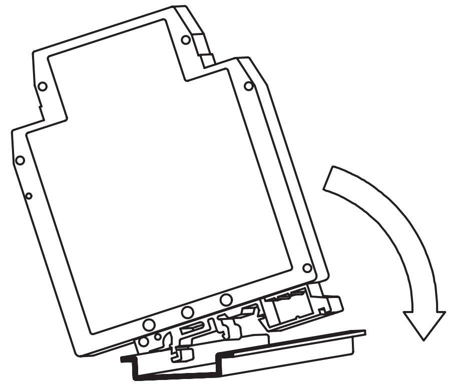
G Rail Installation

To install the IRMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



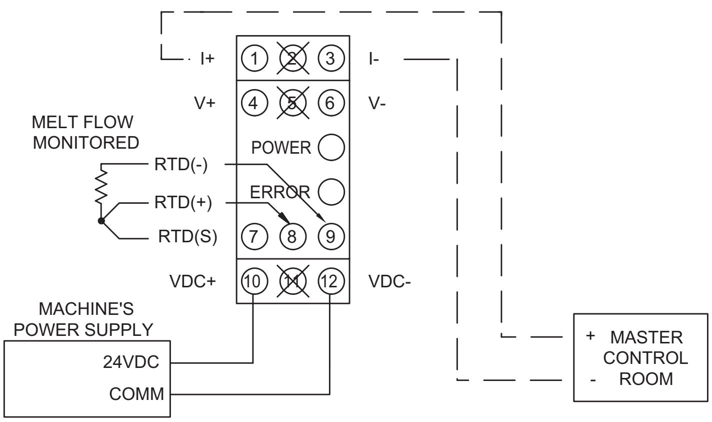
T Rail Installation

To install the IRMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.

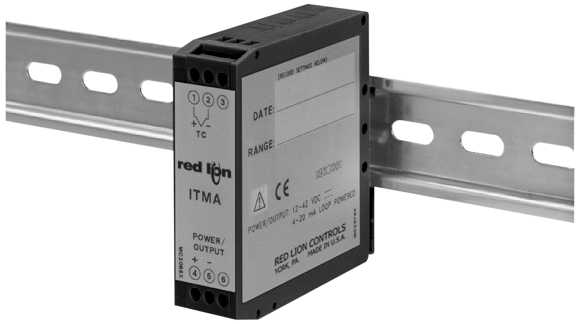


APPLICATION

The temperature of certain industrial plastics is critical for melt flow of an injection molding process. Different plastic grades and the complexity of the mold determine required temperatures for efficient material flow. The master control room monitors the temperature of the melt flow of each injection mold machine. They will determine whether the operator may start the process on his machine or override the injection molding process. The injection molding machines are located throughout the plant, posing an RTD signal loss problem from long cable runs. The IRMA DC powered unit is mounted at the machine and uses the local 24 VDC for power. The signal loss problem is solved using the 4 to 20 mA analog output for the long cable run to the master control room.



MODEL ITMA - INTELLIGENT THERMOCOUPLE MODULE WITH ANALOG OUTPUT



USER PROGRAMMABLE INPUT
(Thermocouple types J, K, T, & E, or millivolt)

12 to 42 VDC LOOP POWERED (4 to 20 mA Output)

MICROPROCESSOR CONTROLLED

SIMPLE ADJUSTABLE RANGE SETTING (Using Input Signal)

THERMOCOUPLE BREAK DETECTION

MOUNTS ON "T" AND "G" STYLE DIN RAILS

2-WAY ELECTRICAL ISOLATION (INPUT/OUTPUT & POWER)

HIGH-DENSITY PACKAGING (22.5 mm wide)

WIDE OPERATING TEMPERATURE RANGE

DESCRIPTION

The ITMA accepts a thermocouple or millivolt input and converts it into a 4 to 20 mA current output. The 4 to 20 mA output is linearly proportional to the temperature or the millivolt input. This output is ideal for interfacing to indicators, chart recorders, controllers, or other instrumentation equipment.

The ITMA is loop-powered which means that the same two wires are carrying both the power and the output signal. The unit controls the output current draw from 4 to 20 mA in direct proportion to the input change while consuming less than 4 mA for power. The conversion to a current output signal makes the ITMA less susceptible to noise interference and allows accurate transmission over long distances. The 2-Way isolation allows the use of grounded thermocouples which can provide additional noise reduction benefits.

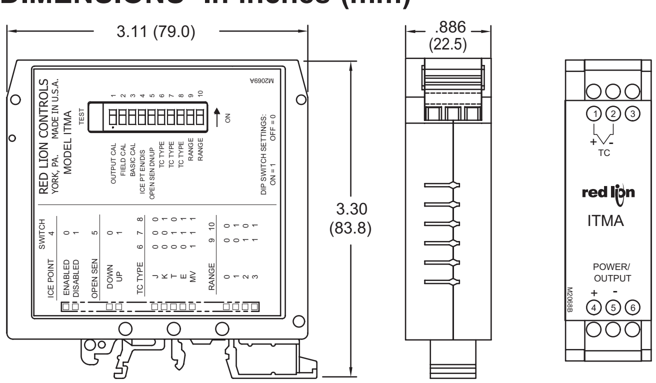
The ITMA uses a ten position DIP switch to accomplish the input sensor configuration, range selection, and unit calibration. A simple range setting technique (Field Calibration) is used so the actual input signal adjusts the output current for scaling. This technique eliminates the need for potentiometers which are vulnerable to changes due to vibration.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat rail (T) according to EN 50 022 - 35 × 7.5 and 35 × 15, and G profile according to EN 50 035 - G 32.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ITMA	Intelligent Thermocouple Module	ITMA2003

CAUTION: Read complete Instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **POWER:** 12 to 42 VDC *(Loop powered). The power supply must have a 30 mA min. capacity.
   [* Min. voltage must be increased to include the drop across any current display indicator]
2. **INPUT:** J, K, T, E, mV [selectable via DIP switch]
3. **OUTPUT:** Loop powered (passive), 4 to 20 mA Linear output
   Ripple: Less than 15 mV peak-to-peak max., across 250Ω load resistor (up to 120 Hz frequencies).
4. **RANGE & ACCURACY:** (12 Bit resolution)
   Accuracy: ± (0.075% Range + 0.25°C [Conformity] + 0.50°C [Ice Point]) at 23°C after 20 min. warm-up, conforming to ITS-90.
   Note: TC Conformity and Ice Point do not apply to mV input.
   Relative Humidity: Less than 85% RH (non-condensing)
   Span: The input span can be set to a min. of 1/8 of the full scale range, anywhere within that range.

Thermocouple Accuracy for each type and the corresponding ranges:

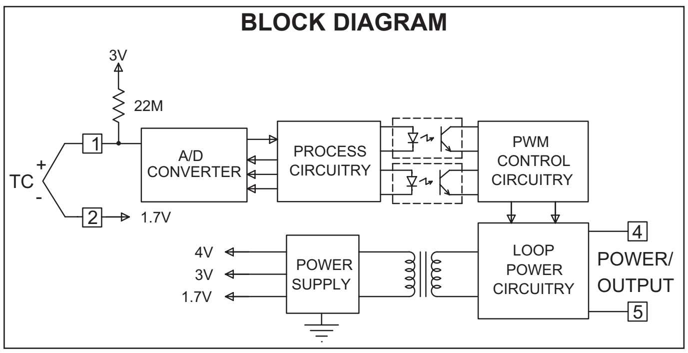
TC (INPUT)	RANGE	DIP SWITCH TYPE RANGE 6 7 8 9 10	TEMPERATURE & mV RANGE	RANGE ACCURACY	WIRE COLOR ANSI	WIRE COLOR BS1843
J	0	0 0 0 0 0	-136 to 111°C	± 0.19°C	White (+) Red (-)	Yellow (+) Blue (-)
	1	0 0 0 0 1	69 to 575°C	± 0.38°C		
	2	0 0 0 1 0	338 to 800°C	± 0.35°C		
	3	0 0 0 1 1	-149 to 862°C	± 0.76°C		
K	0	0 0 1 0 0	-200 to 541°C	± 0.56°C	Yellow (+) Red (-)	Brown (+) Blue (-)
	1	0 0 1 0 1	427 to 1132°C	± 0.53°C		
	2	0 0 1 1 0	648 to 1372°C	± 0.54°C		
	3	0 0 1 1 1	-192 to 1372°C	± 1.17°C		
T	0	0 1 0 0 0	-225 to 149°C	± 0.28°C	Blue (+) Red (-)	White (+) Blue (-)
	1	0 1 0 0 1	74 to 326°C	± 0.19°C		
	2	0 1 0 1 0	68 to 400°C	± 0.25°C		
	3	0 1 0 1 1	-200 to 400°C	± 0.45°C		
E	0	0 1 1 0 0	-111 to 311°C	± 0.32°C	Violet (+) Red (-)	Brown (+) Blue (-)
	1	0 1 1 0 1	276 to 609°C	± 0.25°C		
	2	0 1 1 1 0	377 to 1000°C	± 0.47°C		
	3	0 1 1 1 1	-114 to 1000°C	± 0.84°C		
mV	0	1 1 1 0 0	-9 to 6 mV	± 0.0113 mV	N/A	N/A
	1	1 1 1 0 1	-9 to 22 mV	± 0.0233 mV		
	2	1 1 1 1 0	-9 to 63 mV	± 0.0540 mV		
	3	1 1 1 1 1	-9 to 77 mV	± 0.0645 mV		

Note: DIP switch settings ON = 1 OFF = 0

Accuracy Example:
Type "J" Range "0"
-136°C to 111°C

Range		Conformity		Ice Point		Total Error
(±0.19°C	+	±0.25°C	+	±0.50°C)	=	±0.94°C

5. **TC BREAK DETECTION:** Upscale to 22.5 mA (nominal) or Downscale to 3.6 mA (nominal) [selectable via DIP switch]
6. **RESPONSE TIME:** 400 msec (to within 99% of final value w/step input; typically, response is limited to response time of probe.)
7. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature Range: -25°C to 75°C (-13°F to 167°F)
   Storage Temperature Range: -40°C to 85°C (-40°F to 185°F)
   Operating and Storage Humidity: 85% max. (non-condensing) from -25°C to 75°C.
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 30 g
   Temperature Coefficient: ± 0.01% of input range per °C
   Ice Point Compensation: ± 0.75°C for a 50°C change in temperature
   Altitude: Up to 2000 meters.
8. **DIELECTRIC WITHSTAND VOLTAGE:** 1500 VAC for 1 minute, at 50 VAC working volts, from Input to Output
9. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
   EN 61326-1 Immunity to Industrial Locations
   Emission CISPR 11 Class A
   IEC/EN 61010-1
   Refer to the EMC Installation Guidelines section of this bulletin for additional information.
10. **MOUNTING:** Universal mounting foot for attachment to standard DIN style mounting rails, including top hat (T) profile rail according to EN50022 - 35 × 7.5 and 35 × 15, and G profile rail according to EN50035 - G32.
11. **CONNECTION:** Compression type terminal block
12. **CONSTRUCTION:** High impact black plastic case. Installation Category I, Pollution Degree 2.
13. **WEIGHT:** 2.7 oz (76.54 g)



FUNCTION DESCRIPTIONS

Open Sensor Detection

The output can be set to go Upscale or Downscale for the detection of an open sensor. The Upscale setting makes the output go to 22.5 mA (nominal). The Downscale setting makes the output go to 3.5 mA (nominal). This setting is always active, so changes in the setting are effective immediately.

Ice Point Compensation

The Ice Point Compensation for the thermocouple sensors can be enabled (DIP Switch OFF) or disabled (DIP Switch ON). The mV sensor input is not affected by this setting. Generally, the Ice Point Compensation is always enabled.

Calibration Malfunction

If the unit has scaling problems (current remains at 3.5 mA nominal), check the voltage between the TC- Input (-) and TEST pad (+) [located next to the DIP switches on the side of the unit]. For normal operation the voltage is -1.77 V (nominal). If the voltage is +1.23 V(nominal), a problem occurred storing information in the E^2PROM. When this happens, perform a Basic Calibration and then a Field Calibration. Turn off power for 5 seconds. Turn on power and check the voltage between the TEST pad (+) and TC- Input (-). If the voltage is still +1.23 V(nominal), contact the factory.

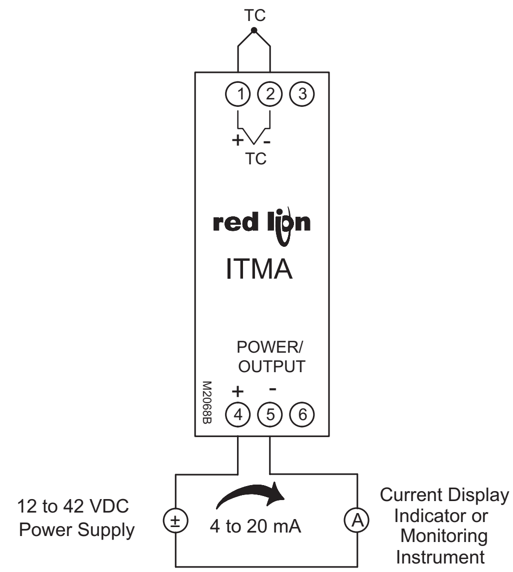
FACTORY SETTINGS

The unit is shipped from the factory calibrated for a 4 to 20 mA output using a type J thermocouple in range 3. The ITMA should be Field calibrated by the operator for the application environment it will be used in. If the unit is not recalibrated by the operator, the following table lists the temperature ranges for the given thermocouple types.

TYPE	RANGE	TEMPERATURE RANGE
J	3	-50°C to 500°C
K	3	-85°C to 790°C
T	3	-195°C to 162°C
E	3	3°C to 602°C

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" (6 mm) of bare wire exposed (stranded wire should be tinned with solder). Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.



EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.

5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

INPUT AND POWER/OUTPUT CONNECTIONS

Input

When connecting the thermocouple, be certain that the connections are clean and tight. The negative thermocouple lead is connected to Terminal #2 (TC-) and the positive lead is connected to Terminal #1 (TC+). If the thermocouple probe cannot be connected directly to the module, thermocouple wire or thermocouple extension-grade wire must be used to extend the connection points (copper wire does not work). Always refer to the thermocouple manufacturer's recommendations for mounting, temperature range, shielding, etc.

Power/Output

The unit has the power and current output sharing the same two wires (loop-powered). Connect DC power to terminals #4 and #5, observing the correct polarity, with a current meter/indicator connected in between so that the output current can be monitored. Be certain that the DC power is relatively "clean" and within the 12 to 42 VDC range at the terminals. The current meter voltage drop must be included in power supply considerations.

DIP SWITCH SETTING DESCRIPTIONS

SWITCH	DESCRIPTION	
1	OUTPUT CAL	Output Calibration
2	FIELD CAL	Field Calibration
3	BASIC CAL	Basic Calibration
4	ICE PT EN/DIS	Ice Point Compensation - Disabled (ON) / Enabled (OFF)
5	OPEN SEN DN/UP	Open Sensor Detection - Upscale (ON) / Downscale (OFF)
6	TC TYPE	Thermocouple Type - 3 switch combination setting
7		
8		
9	RANGE	Sensor Range - 2 switch combination setting
10		

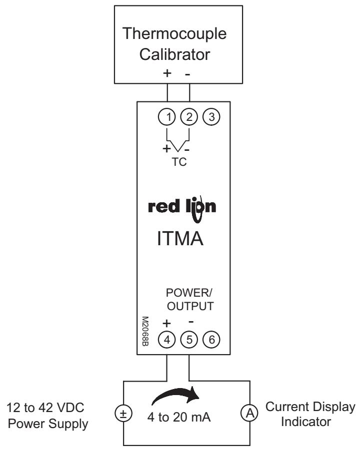
TC Type and Range switch settings (ON = 1 OFF = 0)

TC TYPE	DIP SWITCH		
	6	7	8
J	0	0	0
K	0	0	1
T	0	1	0
E	0	1	1
mV	1	1	1

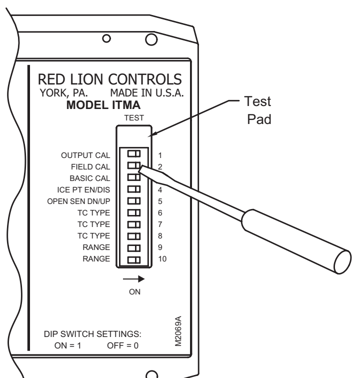
RANGE	DIP SWITCH	
	9	10
0	0	0
1	0	1
2	1	0
3	1	1

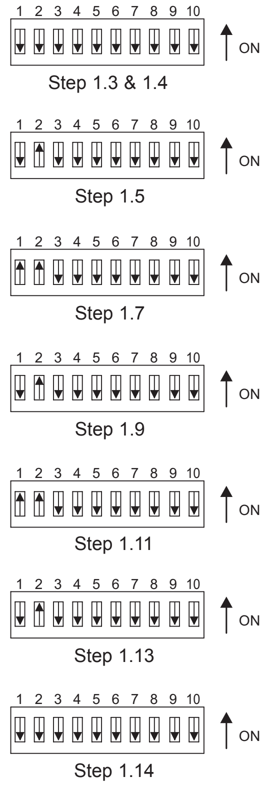
CALIBRATION PROCEDURES

1.0 Field Calibration



Field Calibration Wiring





Field Calibration scales the 4 to 20 mA output to a temperature or mV input. This procedure assigns an input value to 4 mA and an input value to 20 mA. The microprocessor handles configuring the output so it is linear to the temperature or mV input. The Field Calibration procedure is described below.

Note: Allow a 30 minute warm-up period before calibrating. The unit needs to have the Field Calibration completed by the operator before normal operation. To abort this calibration and reset to the previous settings, set the FIELD CAL switch OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 1.13) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

Field Calibration with a Thermocouple Calibrator

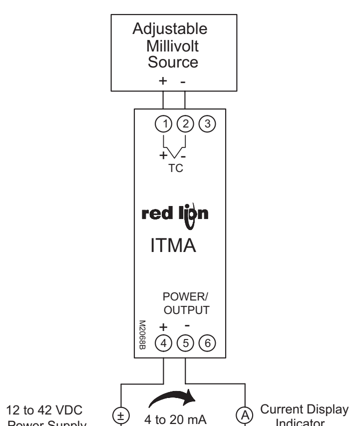
1.1 Enable the Ice Point Compensation on the Thermocouple Calibrator and set it to the Thermocouple type being used in your application.
1.2 Connect the thermocouple wire as selected in step 1 to the TC input terminals of the ITMA and the thermocouple calibrator.
1.3 Set the ICE PT EN/DIS switch (#4) OFF to enable Ice Point Compensation.
1.4 Set the Type and Range for the thermocouple or mV used in your application (DIP switches #6 through #10). (TC type "J", Range 0 shown)
1.5 Set the FIELD CAL switch (#2) ON. [Current goes to 3.6 mA (nominal)]
1.6 Apply the input signal for the 4 mA output.
1.7 Set the OUTPUT CAL switch (#1) ON. [Current stays at 3.6 mA (nominal)]

1.8 Adjust the input signal up until the output equals 4 mA.
1.9 Set the OUTPUT CAL switch (#1) OFF. [Current increases to 22.3 mA (nominal)]
1.10 Apply the input signal for the 20 mA output.

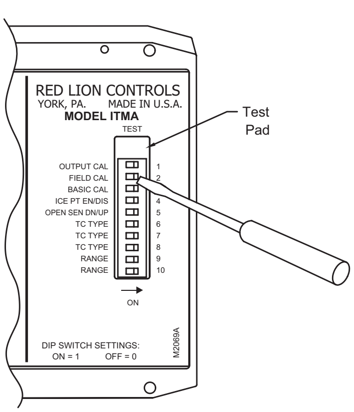
1.11 Set the OUTPUT CAL switch (#1) ON. [Current decreases to 20.5 mA (nominal)]
1.12 Adjust the input signal down until the output equals 20 mA.

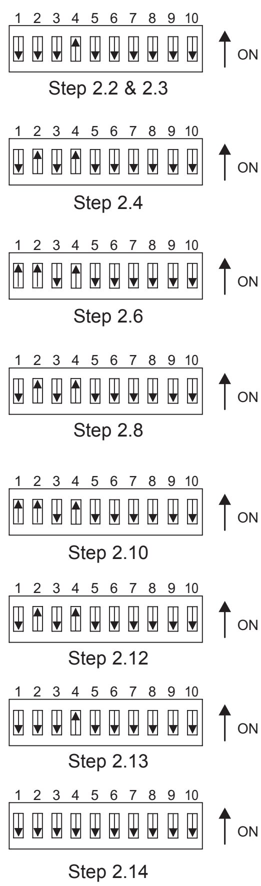
1.13 Set the OUTPUT CAL switch (#1) OFF.
1.14 Set the FIELD CAL switch (#2) OFF.
1.15 Disconnect the thermocouple calibrator from the ITMA and connect the actual sensor to be used in the application.

2.0 Field Calibration With an Accurate Adjustable Millivolt Source: (Alternate Method)



Field Calibration Wiring





This calibration procedure can be used to assign the high and low input values if a thermocouple calibrator is not available.

Note: To abort this calibration and reset to the previous settings, set the FIELD CAL switch OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 2.12) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

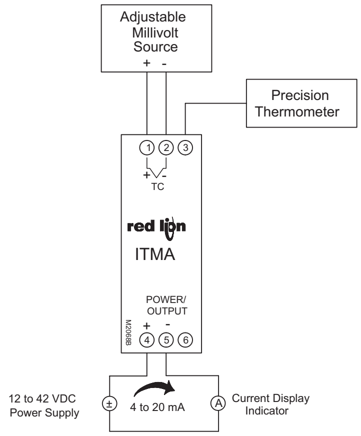
2.1 Connect the accurate Adjustable Millivolt Source to the TC input terminals.
2.2 Set the ICE PT EN/DIS switch (#4) ON to disable Ice Point Compensation.
2.3 Set the Type and Range for the thermocouple or mV used in your application (DIP switches #6 through #10).(TC type "J", Range 0 shown)
2.4 Set the FIELD CAL switch (#2) ON.[Current goes to 3.6 mA (nominal)]
2.5 Apply the input signal (mV equivalent for the thermocouple temperature) for the 4 mA output.
2.6 Set the OUTPUT CAL switch (#1) ON. [Current stays at 3.6 mA (nominal)]
2.7 Adjust the input signal up until the output equals 4 mA.

2.8 Set the OUTPUT CAL switch (#1) OFF. [Current increases to 22.3 mA (nominal)]
2.9 Apply the input signal (millivolt equivalent for the thermocouple temperature) for the 20 mA output.

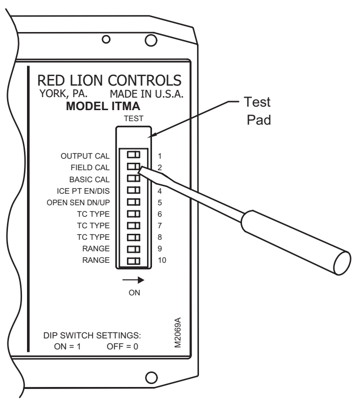
2.10 Set the OUTPUT CAL switch (#1) ON. [Current decreases to 20.5 mA (nominal)]
2.11 Adjust the input signal down until the output equals 20 mA.

2.12 Set the OUTPUT CAL switch (#1) OFF.
2.13 Set the FIELD CAL switch (#2) OFF.
2.14 Set the ICE PT EN/DIS switch (#4) OFF to enable Ice Point Compensation.
2.15 Disconnect millivolt source from the ITMA and connect the actual sensor to be used in the application.

3.0 Ice Point Calibration

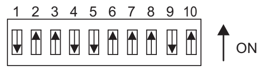


Ice Point Calibration Wiring



The Ice Point Calibration should only be performed with an ambient temperature between 21°C and 29°C. This Calibration was performed on the unit at the factory during the Basic Calibration and generally does not need to be done again. The Ice Point Compensation can be adjusted through this calibration. The Ice Point Calibration procedure is described below.

Note: Calibration can be aborted by setting the BASIC CAL switch OFF prior to the setting of the OUTPUT CAL switch OFF. (Step 3.6)



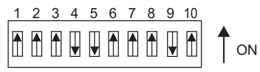
Step 3.1

3.1 Connect a precision mV source with an accuracy of 0.02% to Terminal #1 TC+ Input and Terminal #2 TC- Input. Set the OUTPUT CAL switch (#1) and ICE PT EN/DIS switch (#4) OFF. Set the BASIC CAL (#3) and FIELD CAL (#2) switches ON. The positions of switches #5 thru #10 are not relevant for this calibration procedure.

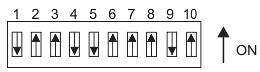
3.2 Connect a precision thermometer (accuracy of 0.1°C) to the unused terminal (#3) beside the TC Input terminals.

3.3 Apply power and allow a 30 minute warm-up period. [Current goes to 3.5 mA (nominal)]

3.4 Using the temperature indicated by the precision thermometer, input an equivalent 1 mV/°C signal to the TC Input terminals and wait 5 seconds.

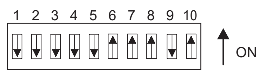


Step 3.5



Step 3.5

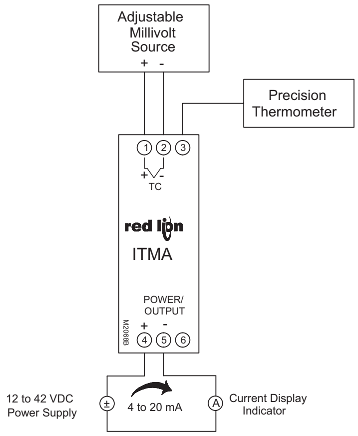
3.5 Set the OUTPUT CAL switch (#1) ON and then OFF.



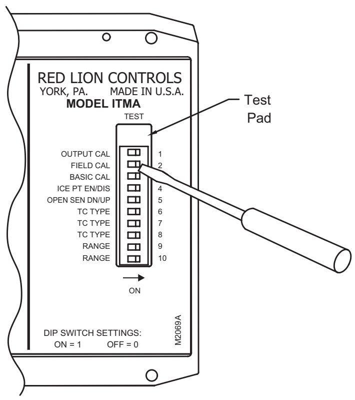
Step 3.6

3.6 Set the BASIC CAL switch (#3) and FIELD CAL switch (#2) OFF. [Current increases to 3.6 mA (nominal) or more]

4.0 Basic Calibration

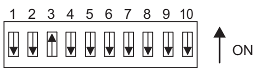


Basic Calibration Wiring



The Basic Calibration should only be performed with an ambient temperature between 21°C and 29°C. The Basic Calibration was performed on the unit at the factory and generally does not need to be done again. This procedure initializes the unit by calibrating the input, and the Ice Point Compensation. The Basic Calibration should be performed only if a condition exists as described in the "Calibration Malfunction" section. After completion of this calibration, the unit needs to be scaled in Field Calibration. The Basic Calibration procedure is described below.

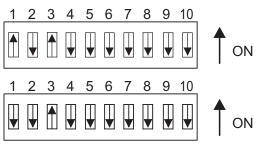
Note: To abort this calibration and reset to the previous settings, set the BASIC CAL switch OFF prior to the final setting of the OUTPUT CAL switch (Step 4.17) and turn off power for 5 seconds. Then turn on power and the previous settings will be loaded.



Step 4.1

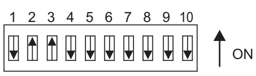
4.1 Connect a precision mV source with an accuracy of 0.02% to Terminal #1 (TC+ Input) and Terminal #2 (TC- Input). Set the ICE PT EN/DIS switch (#4), RANGE (#9&#10), TYPE (#6, #7, and #8), OUTPUT CAL (#1), and FIELD CAL (#2) switches OFF. Set the BASIC CAL switch (#3) ON.

4.2 Apply power and allow a 30 minute warm-up period. [Current goes to 3.5 mA (nominal)]



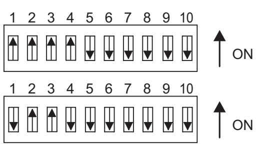
Steps 4.3 to 4.15

4.3 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.4 Input -9 mV and wait 5 seconds.
4.5 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.6 Input 6 mV and wait 5 seconds.
4.7 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.8 Input 22 mV and wait 5 seconds.
4.9 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.10 Input 41mV and wait 5 seconds.
4.11 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.12 Input 63 mV and wait 5 seconds.
4.13 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.14 Input 77 mV and wait 5 seconds.
4.15 Set the OUTPUT CAL switch (#1) ON and then OFF.



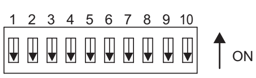
Step 4.16

4.16 Ice Point Calibration.
  a. If ice point calibration is not desired, go to step 4.17.
  b. To Enable ice point calibration, set the FIELD CAL switch (#2) ON.
    1. Connect a precision thermometer (accuracy of 0.1°C) to the unused terminal beside the TC Input terminals.
    2. Allow 5 minutes for the temperature to equalize.
    3. Using the temperature indicated by the precision thermometer, input an equivalent 1 mV/°C signal to the TC Input terminals.



Step 4.17

4.17 Set the OUTPUT CAL switch (#1) ON and then OFF.



Step 4.18

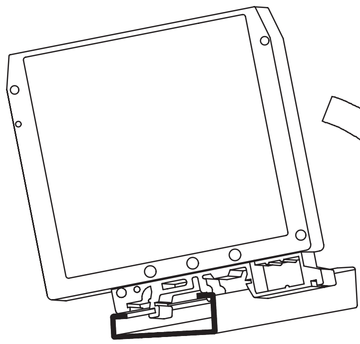
4.18 Set the BASIC CAL switch (#3) and FIELD CAL switch (#2) OFF. [Current increases to 3.6 mA (nominal) or more]
4.19 Perform a Field Calibration. (See Section 1.0)

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

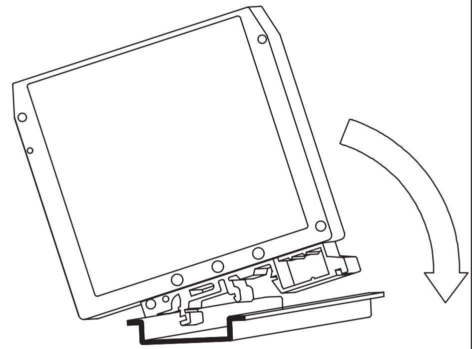
G Rail Installation

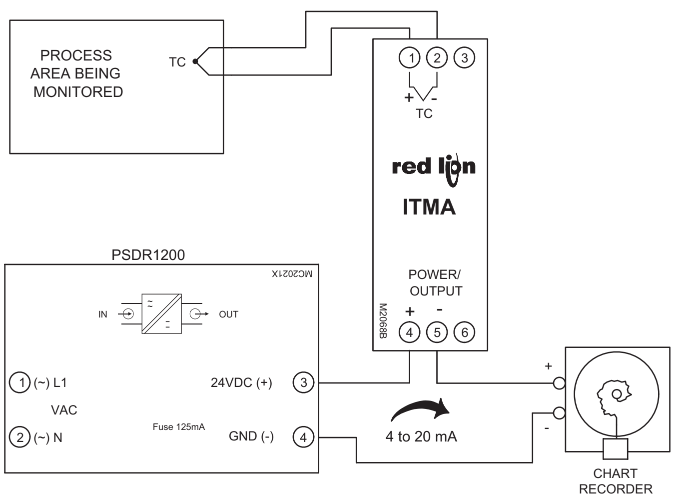
To install the ITMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



T Rail Installation

To install the ITMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.





APPLICATION

A meat processing plant needs to keep daily records of the process area temperature. FDA regulations require the temperature to be 22°C at all times. The ITMA can be used for this application, with the added benefit of being DIN rail mounted to save space.

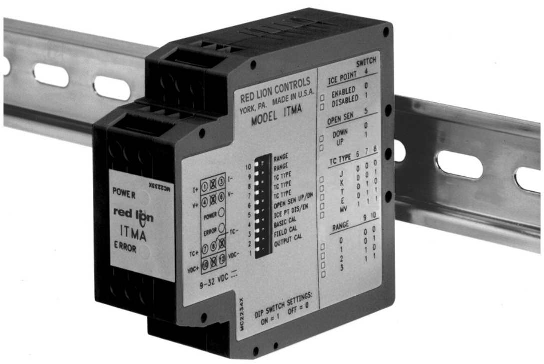
The ITMA will sense the process area temperature, and transmit a 4 to 20 mA output to a chart recorder. The processing plant uses a "J" type thermocouple with a range of -136°C to 111°C. The ITMA is field calibrated to output 4 mA at 0°C and 20 mA at 44°C. See Section 1.0 for the Field Calibration procedure.

The ITMA output receives its power from a PSDR1200 Signal Conditioning Power Supply with a +24 VDC output.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL ITMA DC - INTELLIGENT THERMOCOUPLE MODULE WITH ANALOG OUTPUT



- *USER PROGRAMMABLE INPUT (Thermocouple types J, K, T, & E, or millivolt)*
- *MICROPROCESSOR CONTROLLED*
- *SIMPLE ADJUSTABLE RANGE SETTING (Using Input Signal)*
- *THERMOCOUPLE BREAK DETECTION*
- *MOUNTS ON "T" AND "G" STYLE DIN RAILS*
- *3-WAY ELECTRICAL ISOLATION (POWER/INPUT/OUTPUT)*
- *MULTIPLE ANALOG OUTPUTS (0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC)*
- *WIDE OPERATING TEMPERATURE RANGE (-25°C to 75°C)*
- *POWER & MEMORY ERROR INDICATION*
- *9 to 32 VDC POWERED*

DESCRIPTION

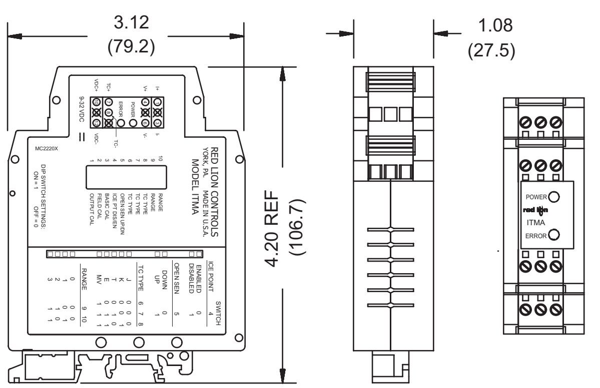
The ITMA accepts a thermocouple or millivolt input and converts it into a voltage or current output. The voltage or current output is linearly proportional to the temperature or millivolt input. This output is ideal for interfacing to indicators, chart recorders, controllers, or other instrumentation equipment.

The ITMA is DC powered. The DC power input is isolated from the signal input and analog output. The unit scales the analog output proportionally to the thermocouple or millivolt input signal. The analog output may be configured for one of the following: 0 to 20 mA, 4 to 20 mA, or 0 to 10 VDC. Making the signal conversion with the ITMA to a current output signal, makes the signal less susceptible to noise interference and allows accurate transmission over long distances. The 3-Way isolation allows the use of grounded thermocouples which can provide additional noise reduction benefits.

The ITMA uses a ten position DIP switch to accomplish the input sensor configuration, range selection, and unit calibration. A simple range setting technique (Field Calibration) is used so the actual input signal adjusts the output for scaling. This technique eliminates the need for potentiometers which are vulnerable to changes due to vibration.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat rail (T) according to EN 50 022 - 35 × 7.5 and 35 × 15, and (G) profile according to EN 50 035 - G 32.

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **POWER**: 9 to 32 VDC; 1.75 W The power supply must have 300 mA for 200 msec. surge capacity.
2. **INPUT**: J, K, T, E, mV [selectable via DIP switch]
3. **OUTPUT**: Self-powered (active); All output signals scaled linearly using temperature or mV input. Unit is shipped set for 4 to 20 mA output. 4 to 20 mA or 0 to 20 mA selected via internal jumper.
   Voltage Output Compliance:
   0 to 10 VDC across min 1 KΩ load (10 mA)
   20 mV peak to peak max. ripple (for frequencies up to 120 Hz)
   Current Output Compliance:
   0 to 20 mA through max. 600Ω load (12 VDC)
   4 to 20 mA through max. 600Ω load (12 VDC)
   15 mV peak to peak max. ripple across 600Ω load (for freq. up to 120 Hz)
4. **TC BREAK DETECTION**: Nominal values shown in the following order: (0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC).
   Upscale: 22.9 mA, 22.5 mA, and 11.5 VDC
   Downscale: -0.5 mA, 3.5 mA, and -0.4 VDC
5. **RESPONSE TIME**: 400 msec (to within 99% of final value w/step input; typically, response is limited to response time of probe.)
6. **TEMPERATURE EFFECTS**:
   Temperature Coefficient: ± 0.025% of input range per °C
   Ice Point Compensation: ± 0.75°C for a 50°C change in temperature
7. **DIELECTRIC WITHSTAND VOLTAGE**: 1500 VAC for 1 minute
   Working Voltage: 50 VAC
   Power input to Signal input, Power input to Signal output, & Signal input to Signal output.
8. **RANGE & ACCURACY**: (12 Bit resolution)
   Accuracy: ± (0.075% Range + 0.25°C [Conformity] + 0.50°C [Ice Point]) at 23°C after 20 min. warm-up, conforming to ITS-90.
   Note: TC Conformity and Ice Point do not apply to mV input

Relative Humidity: Less than 85% RH (non-condensing)
Span: The input span can be set to a min. of 1/8 of the full scale range, anywhere within that range.

Thermocouple Accuracy for each type and the corresponding ranges:

TC (INPUT)	RANGE	DIP SWITCH TYPE RANGE 6 7 8 9 10	TEMPERATURE & mV RANGE	RANGE ACCURACY	WIRE COLOR ANSI	WIRE COLOR BS1843
J	0	0 0 0 0 0	-136 to 111°C	± 0.19°C	White (+) Red (-)	Yellow (+) Blue (-)
	1	0 0 0 0 1	69 to 575°C	± 0.38°C		
	2	0 0 0 1 0	338 to 800°C	± 0.35°C		
	3	0 0 0 1 1	-149 to 862°C	± 0.76°C		
K	0	0 0 1 0 0	-200 to 541°C	± 0.56°C	Yellow (+) Red (-)	Brown (+) Blue (-)
	1	0 0 1 0 1	427 to 1132°C	± 0.53°C		
	2	0 0 1 1 0	648 to 1372°C	± 0.54°C		
	3	0 0 1 1 1	-192 to 1372°C	± 1.17°C		
T	0	0 1 0 0 0	-225 to 149°C	± 0.28°C	Blue (+) Red (-)	White (+) Blue (-)
	1	0 1 0 0 1	74 to 326°C	± 0.19°C		
	2	0 1 0 1 0	68 to 400°C	± 0.25°C		
	3	0 1 0 1 1	-200 to 400°C	± 0.45°C		
E	0	0 1 1 0 0	-111 to 311°C	± 0.32°C	Violet (+) Red (-)	Brown (+) Blue (-)
	1	0 1 1 0 1	276 to 609°C	± 0.25°C		
	2	0 1 1 1 0	377 to 1000°C	± 0.47°C		
	3	0 1 1 1 1	-114 to 1000°C	± 0.84°C		
mV	0	1 1 1 0 0	-9 to 6 mV	± 0.0113 mV	N/A	N/A
	1	1 1 1 0 1	-9 to 22 mV	± 0.0233 mV		
	2	1 1 1 1 0	-9 to 63 mV	± 0.0540 mV		
	3	1 1 1 1 1	-9 to 77 mV	± 0.0645 mV		

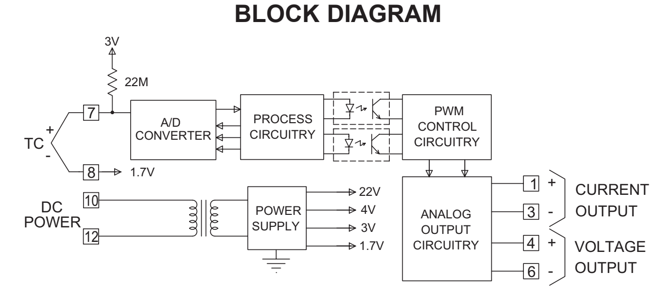
Note: DIP switch settings ON = 1 OFF = 0

Accuracy Example:
Type “J” Range “0”
-136°C to 111°C

Range		Conformity		Ice Point		Total Error
(±0.19°C	+	±0.25°C	+	±0.50°C)	=	±0.94°C

9. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: -25°C to 75°C (-13°F to 167°F)
Storage Temperature Range: -40 to 85°C (-40°F to 185°F)
Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from -25°C to 75°C.
Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
Shock to IEC 68-2-27: Operational 30 g
Altitude: Up to 2000 meters
10. **MOUNTING**: Universal mounting foot for attachment to standard DIN style mounting rails, including top hat (T) profile rail according to EN50022 -35 × 7.5 and -35 × 15, and G profile rail according to EN50035 - G32.
11. **CONNECTION**: Compression type terminal block
12. **CONSTRUCTION**: High impact black plastic case
13. **CERTIFICATIONS AND COMPLIANCES**:
CE Approved
EN 61326-1 Immunity to Industrial Locations
Emission CISPR 11 Class B
IEC/EN 61010-1
RoHS Compliant
Refer to the EMC Installation Guidelines section of this bulletin for additional information.
14. **WEIGHT**: 4.02 oz. (114.0 g)

BLOCK DIAGRAM



FUNCTION DESCRIPTIONS

Open Sensor Detection

The output can be set to go Upscale or Downscale for the detection of an open sensor. The nominal values for each output range are listed under TC Break Detection in the Specifications section. This setting is always active, so changes to the setting are effective immediately.

Ice Point Compensation

The Ice Point Compensation for the thermocouple sensors can be enabled (DIP Switch OFF) or disabled (DIP Switch ON). The mV sensor input is not affected by this setting. Generally, the Ice Point Compensation is always enabled.

Unit Malfunction

If the unit has scaling problems (output remains at -0.5 mA, 3.5 mA, or -0.5 VDC nominal), check the ERROR LED on the front of the unit. An E^2PROM problem is indicated when the ERROR LED is on. If the ERROR LED is on, perform a Basic Calibration followed by a Field Calibration. Turn the power off for 5 seconds. Turn power on and check if the ERROR LED is on. If the LED is on, contact the factory.

EMC INSTALLATION GUIDELINES

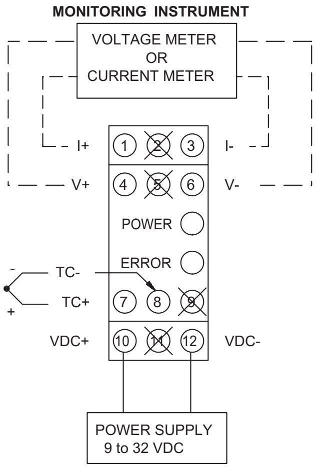
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument’s operation.

Visit RLC’s web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

WIRING CONNECTIONS

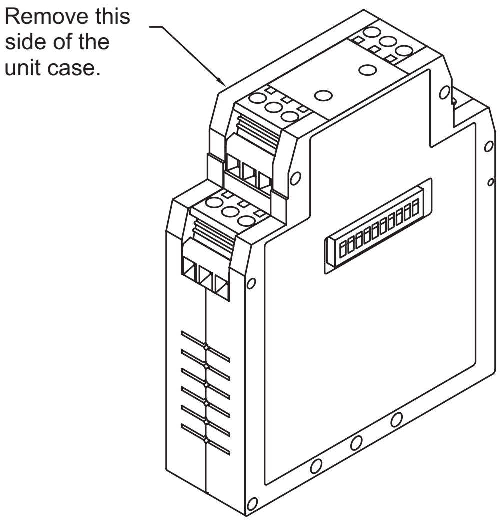
All conductors should meet voltage and current ratings for each terminal. Also, cabling should conform to applicable standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. When wiring the unit, use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" (6 mm) of bare wire exposed (stranded wire should be tinned with solder). Insert the wire into the terminal, and tighten the screw until the wire is clamped tightly.

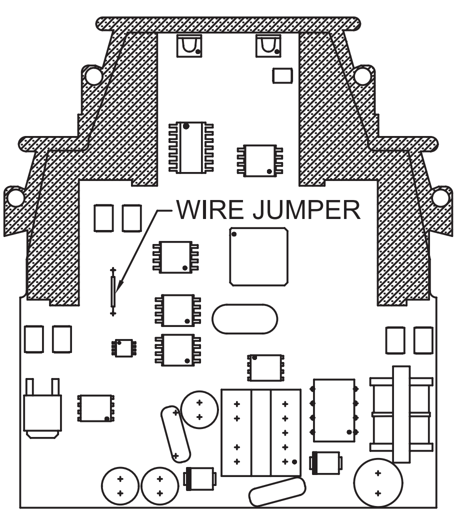


INPUT, OUTPUT, AND POWER CONNECTIONS

INPUT

Ensure thermocouple wire ends are stripped and clean. Connect positive thermocouple lead to terminal #7 (TC+). Connect negative thermocouple lead to terminal #8 (TC-). If the thermocouple probe cannot be connected directly to the module, thermocouple wire or thermocouple extension-grade wire must be used to extend the connection (copper wire does not work). Always refer to the thermocouple manufacturer's recommendations for: mounting, temperature range, shielding, etc.





OUTPUT

Connect the output signal wires to the desired output terminals. For voltage output, use terminals #4 and #6; for current output, use terminals #1 and #3 observing proper polarity. Only one output may be used at a time. The unit is factory set for a 4 to 20 mA output. The voltage output will track the current output nominally within a ±2.5% deviation range.

To select 0 to 20 mA, output you must open the case and cut the wire jumper. The jumper is located to the left side of the board as shown in the drawing.

POWER

Connect DC power to terminals #10 and #12 observing proper polarity. Be certain DC power is within the 9 to 32 VDC specifications.

POWER LED

The ITMA has a green LED located on the front to indicate that power is applied to the unit.

DIP SWITCH SETTING DESCRIPTIONS

SWITCH	LABEL	DESCRIPTION
1	OUTPUT CAL	Output Calibration
2	FIELD CAL	Field Calibration
3	BASIC CAL	Basic Calibration
4	ICE PT DIS/EN	Ice Point Compensation - Disabled (ON) / Enabled (OFF)
5	OPEN SEN UP/DN	Open Sensor Detection - Upscale (ON) / Downscale (OFF)
6	TC TYPE	Thermocouple Type - 3 switch combination setting
7		
8		
9	RANGE	Sensor Range - 2 switch combination setting
10		

TC Type and Range switch settings (ON = 1 OFF = 0)

TC TYPE	DIP SWITCH 6	7	8
J	0	0	0
K	0	0	1
T	0	1	0
E	0	1	1
mV	1	1	1

RANGE	DIP SWITCH 9	10
0	0	0
1	0	1
2	1	0
3	1	1

FACTORY SETTINGS

The unit is shipped from the factory calibrated for a 4 to 20 mA output using a type J thermocouple in range 3. The ITMA should be Field calibrated by the operator for the application environment it will be used in. If the unit is not recalibrated by the operator, the following table lists the temperature ranges for the given thermocouple types.

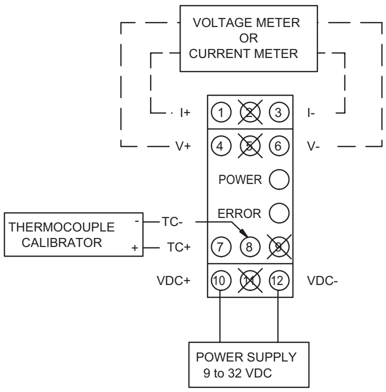
NOMINAL FACTORY FIELD CALIBRATION		
TYPE	RANGE	TEMPERATURE RANGE
J	3	-50°C to 500°C
K	3	-85°C to 790°C
T	3	-195°C to 162°C
E	3	3°C to 602°C

TROUBLESHOOTING

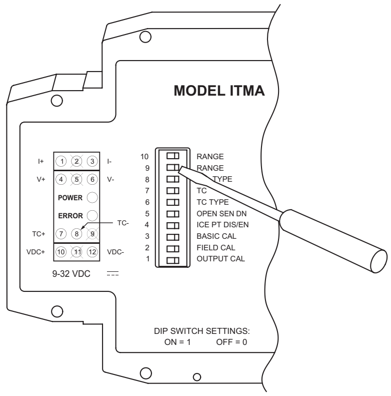
For further technical assistance, contact technical support at the appropriate company numbers listed.

CALIBRATION PROCEDURES

1.0 Field Calibration

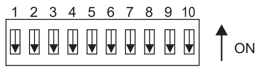


Field Calibration Wiring

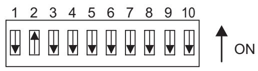


Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)

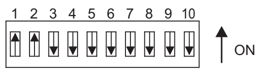
Allow a 30 minute warm-up period before starting Field Calibration. Field Calibration scales the voltage or current output to a temperature or mV input. This procedure assigns an input value to analog output low and an input value to analog output high. The microprocessor handles configuring the output so it is linear to the temperature or mV input. The Field Calibration procedure is described below.



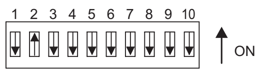
Step 1.3 & 1.4



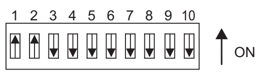
Step 1.5



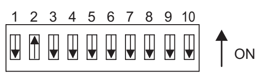
Step 1.7



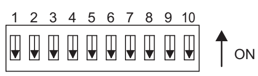
Step 1.9



Step 1.11



Step 1.13



Step 1.14

Note: The unit needs to have the Field Calibration completed by the operator before normal operation. To abort this calibration and reset to the previous settings, set the FIELD CAL switch(#2) OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 1.13) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

Field Calibration with a Thermocouple Calibrator

1.1 Enable the Ice Point Compensation on the Thermocouple Calibrator and set it to the Thermocouple type being used in your application.

1.2 Connect the thermocouple wire as selected in step 1 to the TC input terminals of the ITMA and the thermocouple calibrator.

1.3 Set the ICE PT EN/DIS switch (#4) OFF to enable Ice Point Compensation.

1.4 Set the Type and Range for the thermocouple or mV used in your application (DIP switches #6 through #10). (TC type “J”, Range 0 shown)

1.5 Set the FIELD CAL switch (#2) ON. [Output goes to -0.8 mA, 3.5 mA, or -0.4 V nominal]

1.6 Apply the input signal for the analog output low value.

1.7 Set the OUTPUT CAL switch (#1) ON. [Output stays at -0.8 mA, 3.5 mA, or -0.4 V nominal]

1.8 Adjust the input signal up until the output equals desired low value.

1.9 Set the OUTPUT CAL switch (#1) OFF. [Output increases to 22.9 mA, 22.5 mA, or 11.5 V nominal]

1.10 Apply the input signal for the analog output high value.

1.11 Set the OUTPUT CAL switch (#1) ON. [Output decreases to 21.1 mA, 20.7 mA, or 10.6 V nominal]

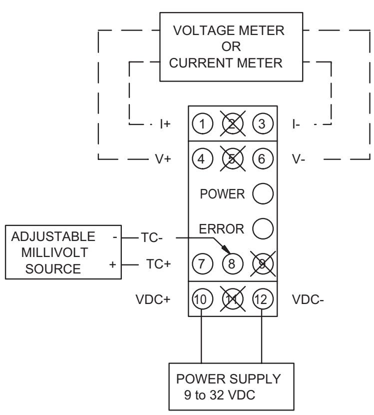
1.12 Adjust the input signal down until the output equals desired high value.

1.13 Set the OUTPUT CAL switch (#1) OFF.

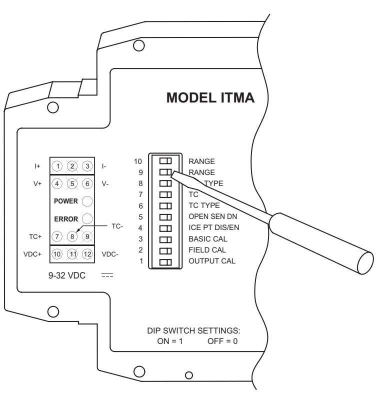
1.14 Set the FIELD CAL switch (#2) OFF.

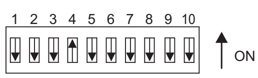
1.15 Disconnect the thermocouple calibrator from the ITMA and connect the actual sensor to be used in the application.

2.0 Field Calibration With an Accurate Adjustable Millivolt Source: (Alternate Method)

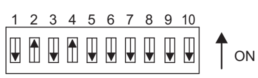


Field Calibration Wiring

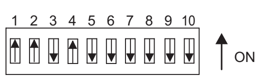




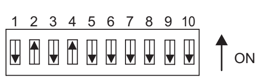
Step 2.2 & 2.3



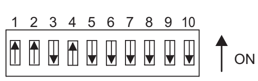
Step 2.4



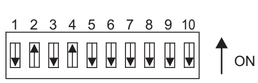
Step 2.6



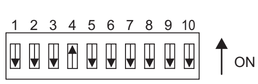
Step 2.8



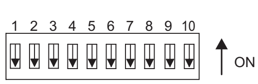
Step 2.10



Step 2.12



Step 2.13



Step 2.14

Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)

This calibration procedure can be used to assign the high and low input values if a thermocouple calibrator is not available.

Note: To abort this calibration and reset to the previous settings, set the FIELD CAL switch(#2) OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 2.12) and turn off power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

2.1 Connect the accurate Adjustable Millivolt Source to the TC input terminals.

2.2 Set the ICE PT EN/DIS switch (#4) ON to disable Ice Point Compensation.

2.3 Set the Type and Range for the thermocouple or mV used in your application (DIP switches #6 through #10).(TC type “J”, Range 0 shown)

2.4 Set the FIELD CAL switch (#2) ON.[Output goes to -0.8 mA, 3.5 mA, or -0.4 V nominal]

2.5 Apply the input signal (mV equivalent for the thermocouple temperature) for the analog output low value.

2.6 Set the OUTPUT CAL switch (#1) ON. [Output stays at -0.8 mA, 3.5 mA, or -0.4 V nominal]

2.7 Adjust the input signal up until the output equals desired low value.

2.8 Set the OUTPUT CAL switch (#1) OFF. [Output increases to 22.9 mA, 22.5 mA, or 11.5 V nominal]

2.9 Apply the input signal (millivolt equivalent for the thermocouple temperature) for the analog output high value.

2.10 Set the OUTPUT CAL switch (#1) ON. [Output decreases to 21.1 mA, 20.7 mA, or 10.6 V nominal]

2.11 Adjust the input signal down until the output equals desired high value.

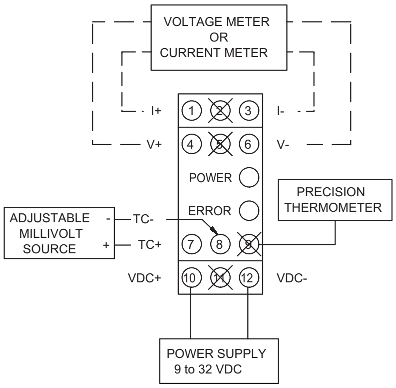
2.12 Set the OUTPUT CAL switch (#1) OFF.

2.13 Set the FIELD CAL switch (#2) OFF.

2.14 Set the ICE PT EN/DIS switch (#4) OFF to enable Ice Point Compensation.

2.15 Disconnect millivolt source from the ITMA and connect the actual sensor to be used in the application.

3.0 Ice Point Calibration

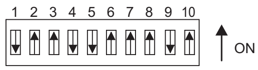


Ice Point Calibration Wiring

Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)

The Ice Point Calibration should only be performed with an ambient temperature between 21°C and 29°C. This Calibration was performed on the unit at the factory during the Basic Calibration and generally does not need to be done again. The Ice Point Compensation can be adjusted through this calibration. The Ice Point Calibration procedure is described below.

Note: Calibration can be aborted by setting the BASIC CAL switch(#3) OFF prior to the setting of the OUTPUT CAL switch OFF. (Step 3.6)



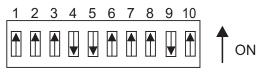
Step 3.1

3.1 Connect a precision mV source with an accuracy of 0.02% to Terminal #7 TC+ Input and Terminal #8 TC- Input. Set the OUTPUT CAL switch (#1) and ICE PT EN/DIS switch (#4) OFF. Set the BASIC CAL (#3) and FIELD CAL (#2) switches ON. The positions of switches #5 thru #10 are not relevant for this calibration procedure.

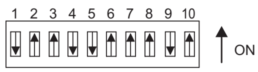
3.2 Connect a precision thermometer (accuracy of 0.1°C) to the unused terminal (#9) beside the TC Input terminals.

3.3 Apply power and allow a 30 minute warm-up period. [Output goes to -0.9 mA, 3.4 mA, or -0.5V nominal]

3.4 Using the temperature indicated by the precision thermometer, input an equivalent 1 mV/°C signal to the TC Input terminals and wait 5 seconds.

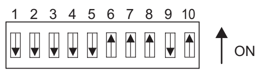


Step 3.5



Step 3.5

3.5 Set the OUTPUT CAL switch (#1) ON and then OFF.



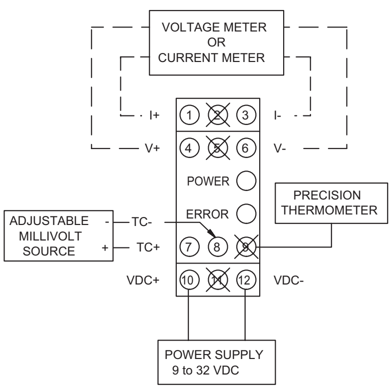
Step 3.6

3.6 Set the BASIC CAL switch (#3) and FIELD CAL switch (#2) OFF. [Output increases to -0.8 mA, 3.5 mA, or -0.38 V nominal, or more]

4.0 Basic Calibration

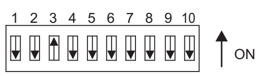
Note: The nominal output value for the various output ranges are designated in the following order: (0 to 20 mA, 4 to 20 mA, 0 to 10 VDC)

The Basic Calibration should only be performed with an ambient temperature between 21°C and 29°C. The Basic Calibration was performed on the unit at the factory and generally does not need to be done again. This procedure initializes the unit by calibrating the input, and the Ice Point Compensation. The Basic Calibration should be performed only if a condition exists as described in the "Unit Malfunction" section. After completion of this calibration, the unit needs to be scaled in Field Calibration. The Basic Calibration procedure is described below.



Basic Calibration Wiring

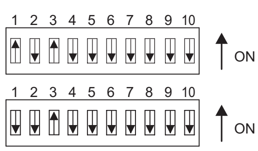
Note: To abort this calibration and reset to the previous settings, set the BASIC CAL switch(#3) OFF prior to the final setting of the OUTPUT CAL switch (Step 4.17) and turn off power for 5 seconds. Then turn on power and the previous settings will be loaded.



Step 4.1

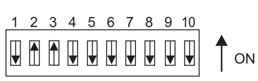
4.1 Connect a precision mV source with an accuracy of 0.02% to Terminal #7 (TC+ Input) and Terminal #8 (TC- Input). Set the ICE PT EN/DIS switch (#4), RANGE (#9&#10), TYPE (#6, #7, and #8), OUTPUT CAL (#1), and FIELD CAL (#2) switches OFF. Set the BASIC CAL switch (#3) ON.

4.2 Apply power and allow a 30 minute warm-up period. [Output goes to -0.9 mA, 3.4 mA, or -0.5 V nominal]

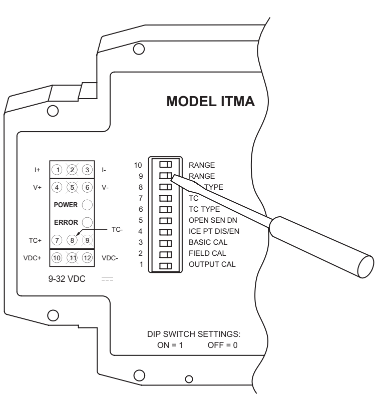


Steps 4.3 to 4.15

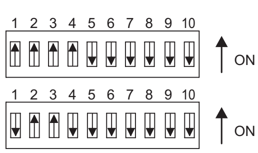
4.3 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.4 Input -9 mV and wait 5 seconds.
4.5 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.6 Input 6 mV and wait 5 seconds.
4.7 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.8 Input 22 mV and wait 5 seconds.
4.9 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.10 Input 41mV and wait 5 seconds.
4.11 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.12 Input 63 mV and wait 5 seconds.
4.13 Set the OUTPUT CAL switch (#1) ON and then OFF.
4.14 Input 77 mV and wait 5 seconds.
4.15 Set the OUTPUT CAL switch (#1) ON and then OFF.



Step 4.16

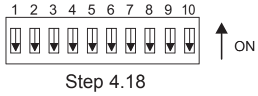


4.16 Ice Point Calibration.
   a. If ice point calibration is not desired, go to step 4.17.
   b. To Enable ice point calibration, set the FIELD CAL switch (#2) ON.
      1. Connect a precision thermometer (accuracy of 0.1°C) to the unused terminal beside the TC Input terminals.
      2. Allow 5 minutes for the temperature to equalize.
      3. Using the temperature indicated by the precision thermometer, input an equivalent 1 mV/°C signal to the TC Input terminals.



Step 4.17

4.17 Set the OUTPUT CAL switch (#1) ON and then OFF.



Step 4.18

4.18 Set the BASIC CAL switch (#3) and FIELD CAL switch (#2) OFF. [Output increases to -0.8 mA, 3.5 mA, or -0.4 V nominal, or more]

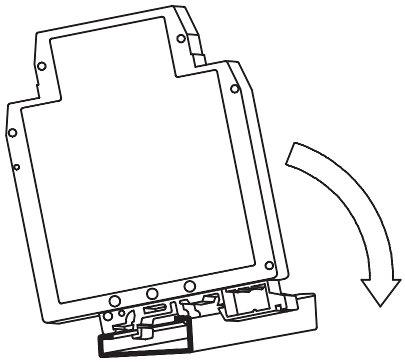
4.19 Perform a Field Calibration. (See Section 1.0)

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

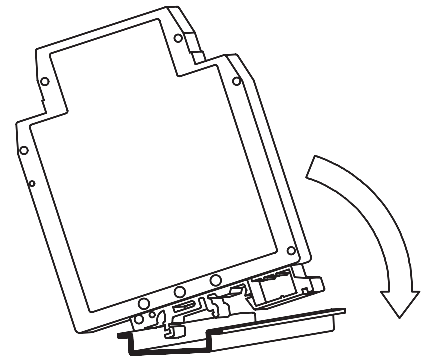
G Rail Installation

To install the ITMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



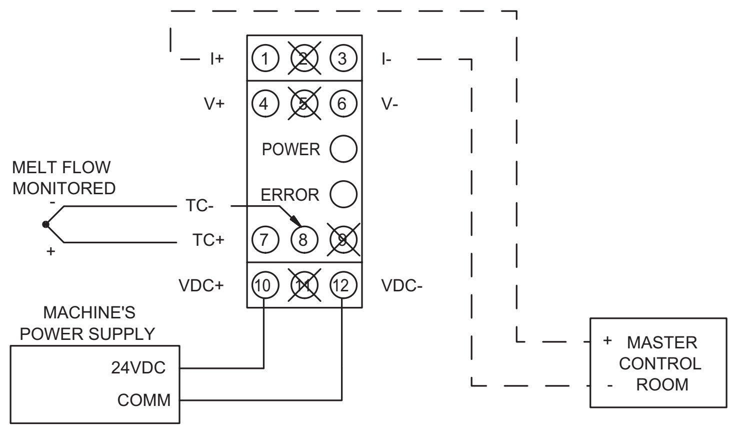
T Rail Installation

To install the ITMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.



APPLICATION

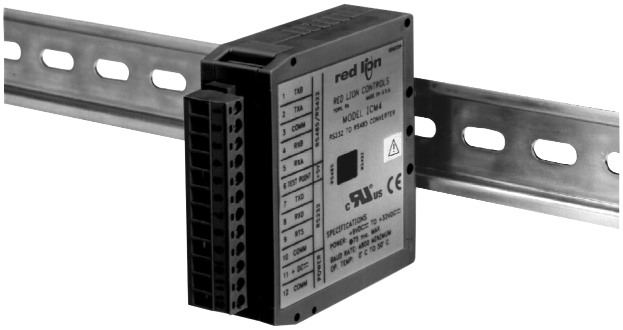
The temperature of certain industrial plastics is critical for melt flow of an injection molding process. Different plastic grades and the complexity of the mold determine required temperatures for efficient material flow. The master control room monitors the temperature of the melt flow of each injection mold machine. They will determine whether the operator may start the process on his machine or override the injection molding process. The injection molding machines are located throughout the plant, posing a thermocouple signal loss problem from long cable runs. The ITMA DC powered unit is mounted at the machine and uses the local 24 VDC for power. The signal loss problem is solved using the 4 to 20 mA analog output for the long cable run to the master control room.



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ITMA	Intelligent Thermocouple Module	ITMA3035

MODEL ICM4 - SERIAL CONVERTER MODULE (RS-232C/RS-485)



- *ALLOWS COMMUNICATIONS BETWEEN RS-232 CONTROL EQUIPMENT AND PRODUCTS WITH RS-485 SERIAL COMMUNICATIONS*
- *WIDE DC INPUT POWER RANGE (+9 to 32 VDC)*
- *HALF DUPLEX (RS-485) AND FULL DUPLEX (RS-422)*
- *LED INDICATION FOR RXD, TXD, and POWER*
- *UNIVERSAL MOUNTING FOOT FOR DIN RAIL INSTALLATION*

UL Recognized Component, File # E179259

DESCRIPTION

The ICM4 Serial Converter Module provides the capability of interfacing equipment with RS-485 serial communications to equipment with RS-232 communications. Data format of the RS-232 and RS-485 equipment must be the same.

For full duplex (RS-422), the DIP switch on the side of the module must be in the RS-422 position. For half duplex (RS-485), the DIP switch must be in the RS-485 position. In half duplex mode, the RS-485 driver is enabled using the leading edge of the first character transmitted (RXD input). After the last character transmits, the converter waits one character time (at 9600 baud) to disable the RS-485 driver.

There are 3 LED's that can be viewed from the front of the converter module. A green power LED indicates power is on, a red RS-232 TXD LED flashes when the module is transmitting, and a green RS-232 RXD LED flashes when the module is receiving.

An external DC power source (+9 to 32 VDC) is required to power the ICM4. The external power source and serial communications connections are made via a 12 position removable terminal block located on the front of the module.

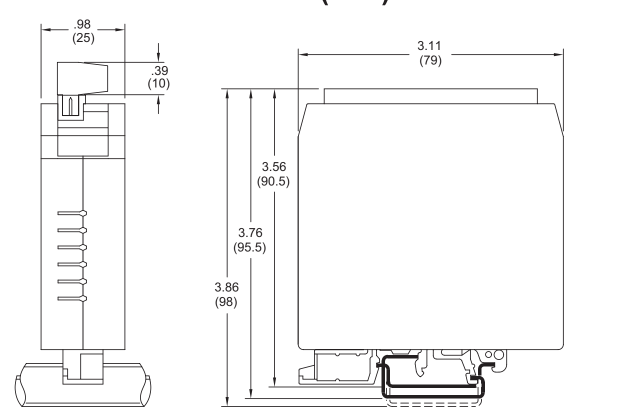
The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat profile rail according to EN50022 - 35 x 7.5 and 35 x 15, and G profile rail according to EN50035 - G32.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **POWER**: +9 to 32 VDC @ 75 mA maximum. Above 26 VDC, derate max. operating temperature to 40 °C. Power supply must be Class 2 or SELV rated.
2. **RS232 VOLTAGES**:
   Receive Data Pin: ± 30 VDC max.
   Mark Condition: ≤ 0.8 VDC
   Space Condition: ≥ 2.4 VDC
   Transmit Data Pin:
   Mark Condition: −8 VDC (typ.)
   Space Condition: +8 VDC (typ.)
3. **RS485 VOLTAGES**:
   Differential Output Voltage: ± 5 VDC max. under no load
   Differential Input Voltage: ± 5 VDC max.
   Mark Condition: ≤ −0.2 VDC
   Space Condition: ≥ +0.2 VDC
   RS485 Drive Capability: Up to 32 RS-485 receivers connected in parallel.
   RS485 Drive Disable Time: 4 msec. max.
4. **MAXIMUM CABLE LENGTH**:
   RS232: 50 feet
   RS485: 4000 feet
5. **BAUD RATE**: 9600 min., 19200 max.
6. **CERTIFICATIONS AND COMPLIANCES**:
   SAFETY
   UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 1010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   IECEE CB Scheme Test Certificate # US/5141B/UL,
   CB Scheme Test Report # 01ME11540-0702001
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1.
   ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact
		Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m
		80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O
		Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms
		150 KHz - 80 MHz
Simulation of cordless telephone	ENV 50204	Level 3; 10 V/m
		900 MHz ± 5 MHz
		200 Hz, 50% duty cycle
Emissions to EN 50081-1		
RF interference	EN 55022	Enclosure class B

Refer to EMC Installation Guidelines for additional information.

SPECIFICATIONS (Cont'd)

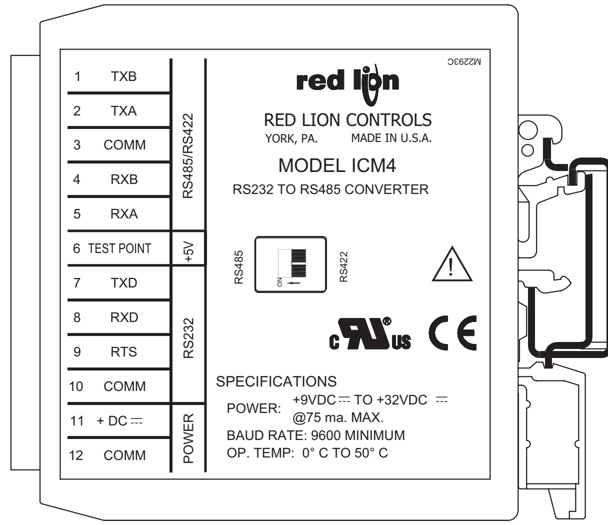
7. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50 °C. Derate max. operating temperature to 40 °C above 26 VDC.
   Storage Temperature: -40 to + 75 °C
   Operating and Storage Humidity: 85% max.relative humidity (non-condensing) from 0 to 50 °C
   Vibration according to IEC 68-2-6: Operational 5 to 150 Hz in X, Y, Z direction for 1.5 hours, 2 g's.
   Shock according to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions
   Altitude: Up to 2000 meters
8. **CONSTRUCTION**: Case body is black, high impact plastic. Installation Category I, Pollution Degree 2.
9. **MOUNTING**: Standard DIN rail top hat (T) profile rail according to EN50022- 35 X 7.5 and 35 X 15
10. **WEIGHT**: 3.2 oz. (90.7 g)

EMC INSTALLATION GUIDELINES

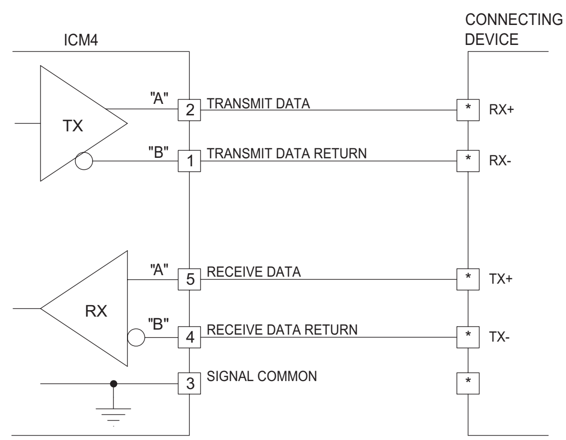
Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of electrical noise, source or coupling method into the unit may be different for various installations. In extremely high EMI environments, additional measures may be needed. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. DC power to the unit should be relatively clean and within the specified limits. Connecting power to the unit from circuits that power inductive loads that cycle on and off, such as contactors, relays, motors, etc., should be avoided. This will reduce the chance of noise spikes entering the DC power connection and affecting the unit.
2. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the unit to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection.
   Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: *Reference manufacturer's instructions when installing a line filter.*
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

SIDE VIEW OF ICM4

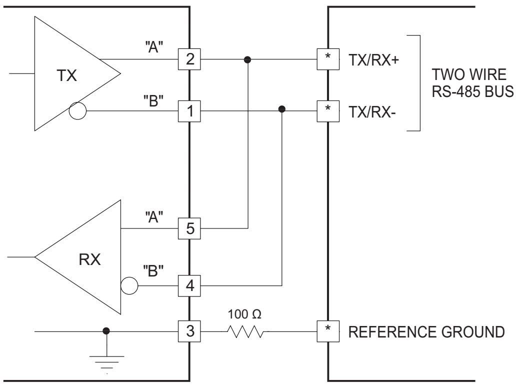


TYPICAL RS-422 CONNECTIONS



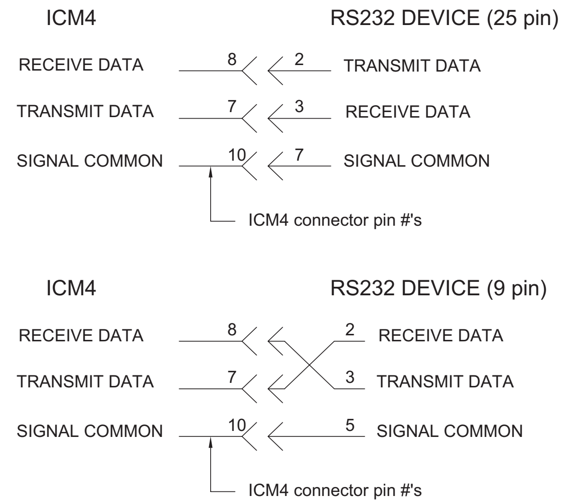
Notes:
1. Connect shield drain wire to earth ground.
2. Place DIP switch on the side of the ICM4 in the 422 position.
3. RS-422 polarity: Terminal "A" is negative with respect to Terminal "B" in the mark (logic 1) condition.

TYPICAL RS-485 CONNECTIONS

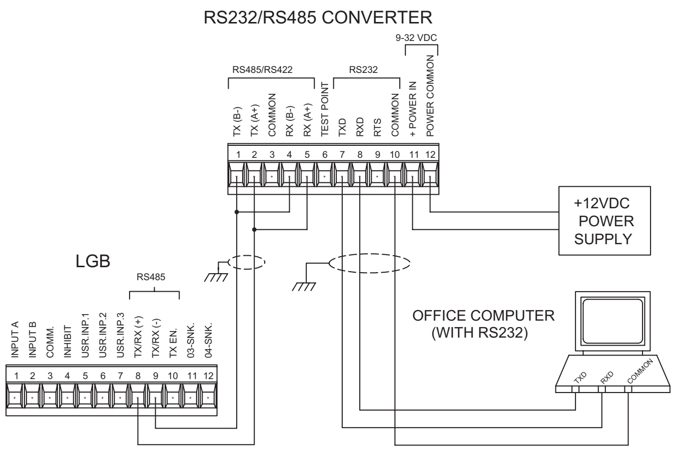


Notes:
1. Connect shield drain wire to earth ground.
2. Place DIP switch on the side of the ICM4 in the 485 position.
3. The transmit and receive data lines of the ICM4 should be wired together.

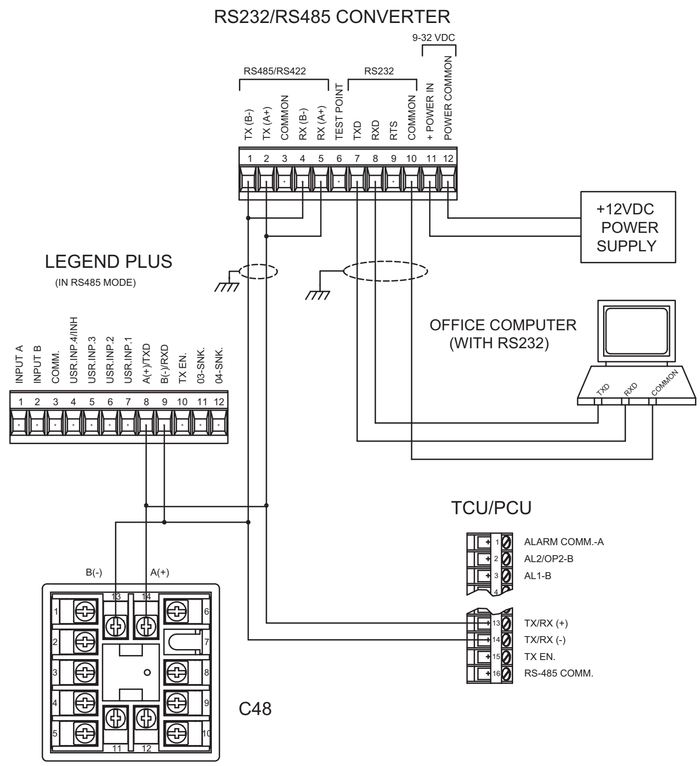
TYPICAL RS-232 CONNECTIONS



TYPICAL CONNECTION FOR SINGLE UNIT



TYPICAL CONNECTION FOR MULTIPLE UNITS

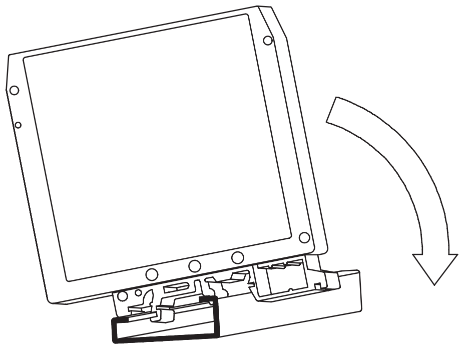


INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

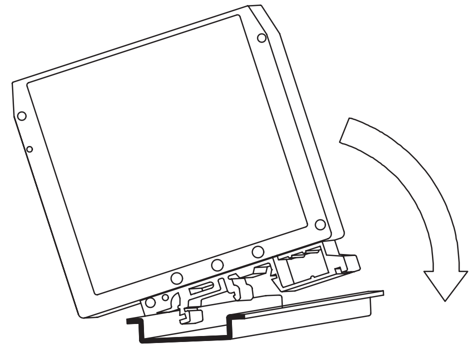
G Rail Installation

To install the ICM4 on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



T Rail Installation

To install the ICM4 on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ICM4	RS-232/RS-485 Converter Module	ICM40030

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL ICM5 – THREE WAY ISOLATED SERIAL CONVERTER MODULE (RS-232C/RS-485)

- *ALLOWS COMMUNICATIONS BETWEEN RS-232 CONTROL EQUIPMENT AND PRODUCTS WITH RS-422/RS-485 SERIAL COMMUNICATIONS*
- *THREE WAY ISOLATION PROTECTS SERIAL EQUIPMENT FROM GROUND LOOPS (1000 VDC)*
- *AUTOMATIC RS-485 DRIVER CONTROL*
- *DIP SWITCH SELECTABLE BAUD RATES 9600, 19200, 38400, 57600, 115200*
- *WIDE DC INPUT POWER RANGE (+9 to 26 VDC)*
- *HALF DUPLEX (RS-485) AND FULL DUPLEX (RS-422)*
- *LED INDICATION FOR RXD, TXD, and POWER*
- *UNIVERSAL MOUNTING FOOT FOR DIN RAIL INSTALLATION*
- *SELECTABLE DTE & DCE OPERATION WORKS WITH ANY RS-232 CABLE*
- *9 PIN D-SUB CONNECTOR FOR RS-232 CONNECTION*
- *SWITCHABLE TERMINATION AND BIASING RESISTORS*
- *MODULAR RJ JACK OR SCREW TERMINAL FOR RS-485 CONNECTION*

UL Recognized Component, File # E179259

DESCRIPTION

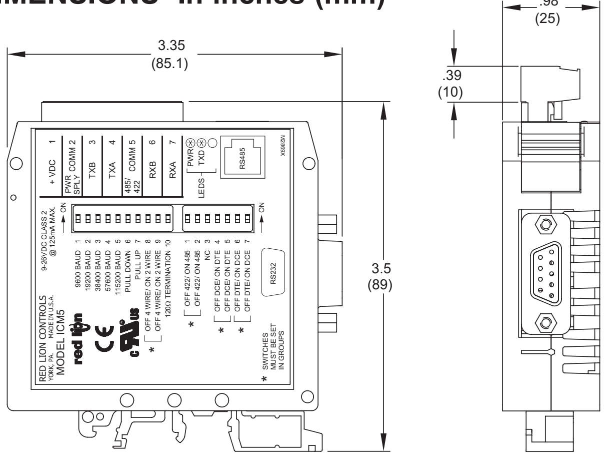
The ICM5 Serial Converter Module provides the capability of interfacing equipment with RS-485 serial communications to equipment with RS-232 communications while providing three way isolation. Data format of the RS-232 and RS-485 equipment must be the same.

The unit can be configured for full duplex (RS-422), or half duplex (RS-485) operation. In half duplex mode, the RS-485 driver is automatically enabled using the leading edge of the first character that is received on the RS-232 side. After the last character is received, the converter waits one character time (at the selected baud rate) to disable the RS-485 driver.

An external DC power source (+9 to 26 VDC) is required to power the ICM5. The external power source and RS-485 communications connections are made via a 7-position removable terminal block located on the front of the module. A modular RS-485 connector is also provided for fast and efficient connection to other Red Lion devices that use a modular connector. The RS-232 connection is provided via a standard D-SUB 9-pin male connector. The ICM5 can be configured for DTE or DCE operation, allowing the use of modem or null-modem cables.

There are 3 LEDs that can be viewed from the front of the converter module. A green power LED indicates power is on, a red RS-232 TXD LED flashes when the module is transmitting, and a green RS-232 RXD LED flashes when the module is receiving.

DIMENSIONS In inches (mm)



The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat profile rail according to EN 50 022 - 35x7.5 and 35x15, and G profile rail according to EN 50 035 - G32.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION:
Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **POWER**: +9 to 26 VDC @ 125 mA maximum. 85 mA typical
   Power Supply must be Class 2 or SELV rated.
2. **RS-232 VOLTAGES**:
   Receive Data Pin: ± 30 VDC max.
   Mark Condition: ≤ 0.8 VDC
   Space Condition: ≥ 2.4 VDC
   Transmit Data Pin:
   Mark Condition: -8 VDC (typ.)
   Space Condition: +8 VDC (typ.)
3. **RS-485 VOLTAGES**:
   Differential Output Voltage: ± 5 VDC max. under no load
   Differential Input Voltage: ± 5 VDC max.
   Mark Condition: ≤ -0.2 VDC
   Space Condition: ≥ +0.2 VDC
   RS-485 Drive Capability: Up to 32 RS-485 receivers connected in parallel
   RS-485 Drive Disable Time: one character time (at the set baud rate)
4. **MAXIMUM CABLE LENGTH**:
   RS-232: 50 feet (15.24 m)
   RS-485: 4000 feet (1219.2 m)
5. **BAUD RATE**: 9600 min., 115200 max.
6. **ISOLATION**: 1000 VDC
7. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50°C.
   Storage Temperature: -40 to + 75°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0 to 50°C

Vibration according to IEC 68-2-6: Operational 5 to 150 Hz in X, Y, Z direction for 1.5 hours, 2 g's.
Shock according to IEC 68-2-27: Operational 30 g's, 11 msec in 3 directions.
Altitude: Up to 2000 meters

8. **CERTIFICATIONS AND COMPLIANCES**:

SAFETY

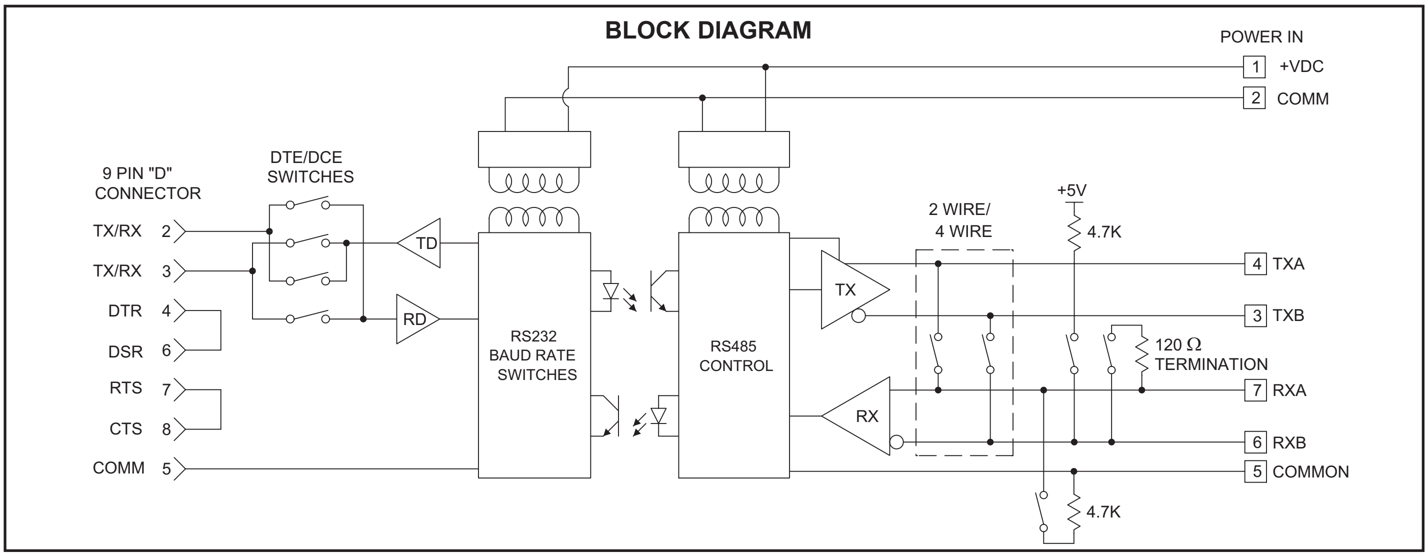
UL Recognized Component, File #E179259, UL3101-1, CSA 22.2 No. 1010-1
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
IECEE CB Scheme Test Report #01ME11540-0702001
Issued by Underwriters Laboratories, Inc.
IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2		
Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact[1] Level 3; 8 Kv air[1]
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms 150 KHz - 80 MHz
Emissions to EN 50081-1		
RF interference	EN 55022	Enclosure class B Power mains class B

Note:
1. This device was designed for installation in an enclosure. To avoid electrostatic discharge to the unit in environments with static levels above 4 Kv, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure, (ex. making adjustments, setting switches etc.) typical anti-static precautions should be observed before touching the unit.
Refer to EMC Installation Guidelines for additional information.

9. **CONSTRUCTION**: Case body is black, high impact plastic. Installation Category I, Pollution Degree 2.
10. **MOUNTING**: Standard DIN rail top hat (T) profile rail according to EN50022- 35 X 7.5 and 35 X 15
11. **WEIGHT**: 3.3 oz. (93.6 g)

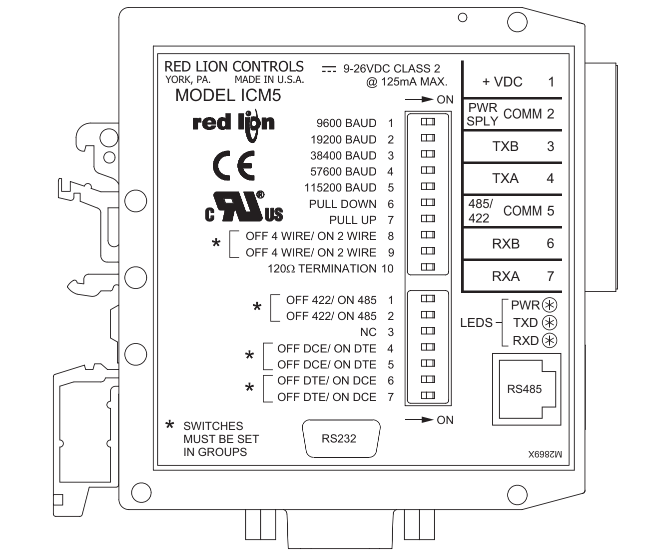


EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of electrical noise, source or coupling method into the unit may be different for various installations. In extremely high EMI environments, additional measures may be needed. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

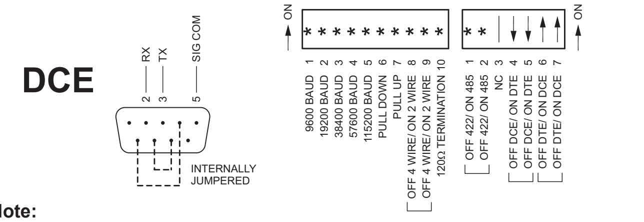
1. DC power to the unit should be relatively clean and within the specified limits. Connecting power to the unit from circuits that power inductive loads that cycle on and off, such as contactors, relays, motors, etc., should be avoided. This will reduce the chance of noise spikes entering the DC power connection and affecting the unit.
2. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the unit to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection.
   Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3
   Note: *Reference manufacturer's instructions when installing a line filter.*
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

SIDE VIEW OF ICM5



TYPICAL RS-232 CONNECTIONS

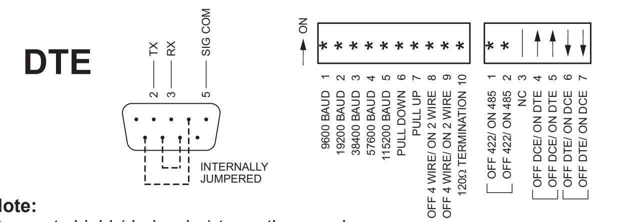
DCE



Note:
Connect shield (drain wire) to earth ground.

* - Application Dependent

DTE



Note:
Connect shield (drain wire) to earth ground.

* - Application Dependent

DIP SWITCH SETTINGS

Top Bank of 10 Switches

DEFAULT SETTINGS
BAUD RATE 9600
DCE
2 WIRE \ RS-485
NO TERMINATION
NO PULL-UP OR PULL DOWN

Switches 1-5 - BAUD

Select the appropriate baud rate. This adjusts the time delay for the automatic RS-485 driver controller. Only one of the baud switches should be in the ON position.

Switches 6-7 - PULL UP / PULL DOWN

These switches connect 4.7 KΩ biasing resistors to the A and B lines of the 485 receiver. To minimize loading of the network, these should only be used if no other device in the system provides biasing.

Switches 8-9 - OFF 4 WIRE / ON 2 WIRE

These switches can be used to internally jumper the A and B lines of the RS-485 driver and receiver together. This allows 2-wire operation without the use of external jumper wires. To use the RJ-11 connector, the ICM5 must be in 2-wire mode. Both switches should be in the same position.

Switch 10 - 120 Ω TERMINATION

This switch connects a 120 Ω resistor across the A and B lines of the RS-485 receiver. The use of the resistor prevents signal reflection, or echoing, at high baud rates, over long distances. This should only be turned on if the ICM5 is the first, or last, device in a multi-drop network that is experiencing reflection due to long cable distances.

Bottom Bank of 7 Switches

Switches 1-2 - OFF 422 / ON 485

These switches enable and disable the automatic RS-485 driver control. In the 422 position, the driver is always enabled, allowing 4-wire full duplex operation. In the 485 position, the driver is enabled as soon as characters are received on the RS-232 side. When the RS-485 driver has transmitted the last character, it waits one character time (at the selected baud rate), and then enters a high-impedance state. The receiver is also enabled and disabled in a similar fashion to prevent transmitted characters from being echoed back. This allows 2-wire, half-duplex operation, without the use of handshake lines. Both switches should be in the same position.

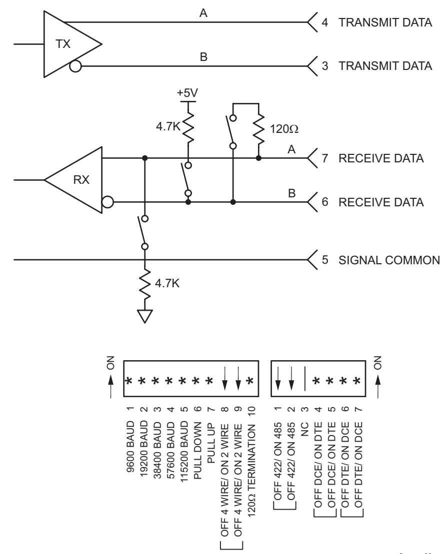
Switch 3 - N/C

No Connection

Switches 4-7 - OFF DCE / ON DTE

These switches configure the RS-232 port to act as a DCE or DTE device. With all of the switches in the DCE position, pin 2 of the DB-9 connector is the RS-232 receiver, and pin 3 is the RS-232 transmitter. DTE configures pin 2 as the transmitter, and pin 3 as the receiver. These switches allow the use of modem or null-modem cables. All of these switches should be in the DCE or DTE position. No other combinations are valid.

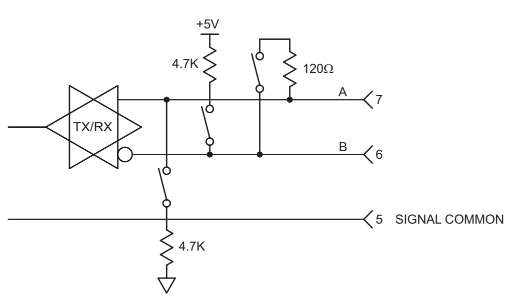
TYPICAL RS-422 CONNECTIONS

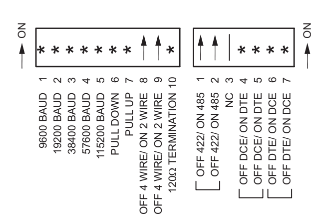


* - Application Dependent

Notes:
1. Connect shield (drain wire) to earth ground.
2. RS-422 polarity: Terminal “A” is negative with respect to Terminal “B” in the mark (logic 1) condition.

TYPICAL RS-485 CONNECTIONS

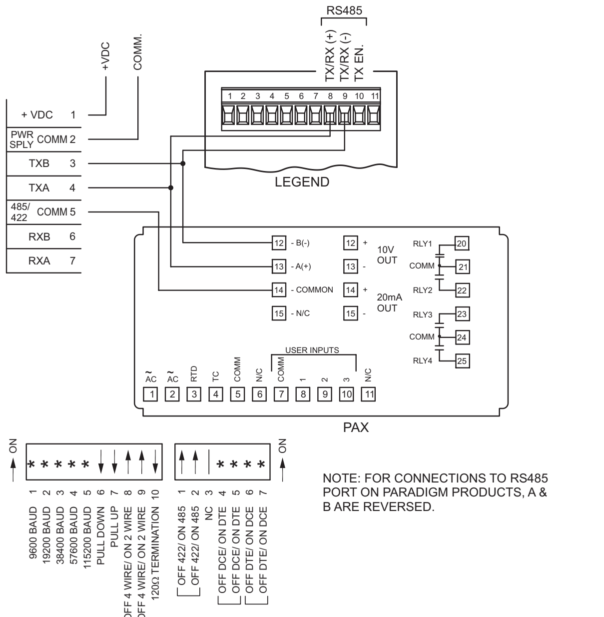




Note:
Connect shield (drain wire) to earth ground.

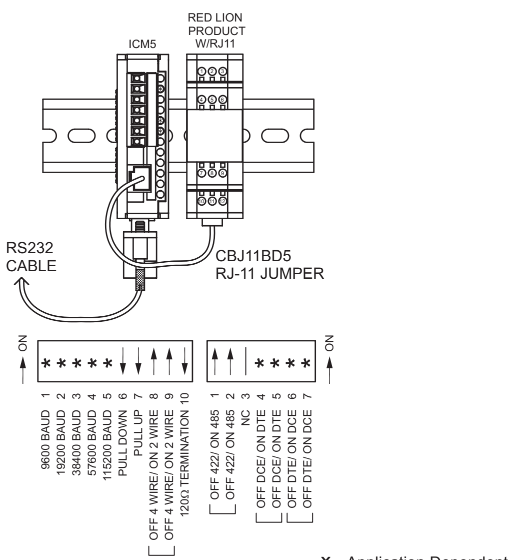
* - Application Dependent

TYPICAL CONNECTION FOR RS-485 DEVICES



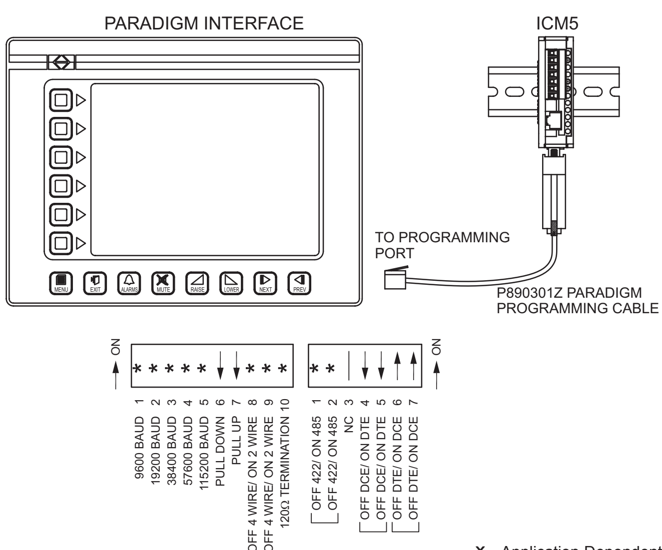
* - Application Dependent

TYPICAL RS-485 CONNECTIONS USING RJ-11



* - Application Dependent

CONNECTING TO PARADIGM INTERFACE



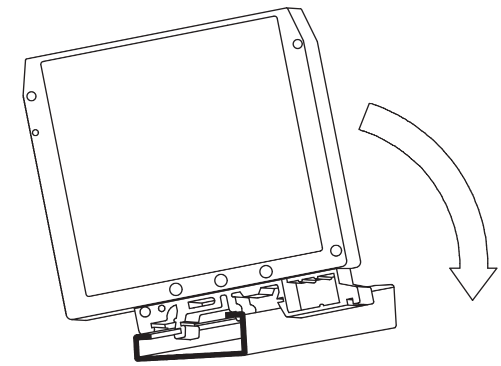
* - Application Dependent

INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

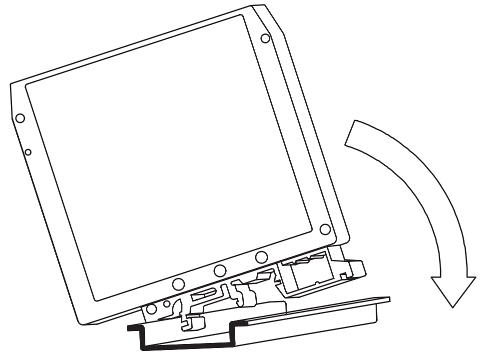
G Rail Installation

To install the ICM5 on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out away from the rail.



T Rail Installation

To install the ICM5 on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ICM5	RS-232/RS-485 Converter Module	ICM50000
CBJ	6" RJ-11 Jumper Cable	CBJ11BD5

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

MODEL ICM8 – ETHERNET GATEWAY

- *ETHERNET GATEWAY FOR RED LION PANEL METERS*
- *PROGRAMMABLE VIA CRIMSON SOFTWARE*
- *USB PROGRAMMING PORT*
- *EXTENSIVE ETHERNET DRIVER LIST ALLOWS EASY DATA MAPPING TO PLCs, PCs, AND SCADA SYSTEMS*
- *10 BASE-T/100 BASE-TX ETHERNET*

GENERAL DESCRIPTION

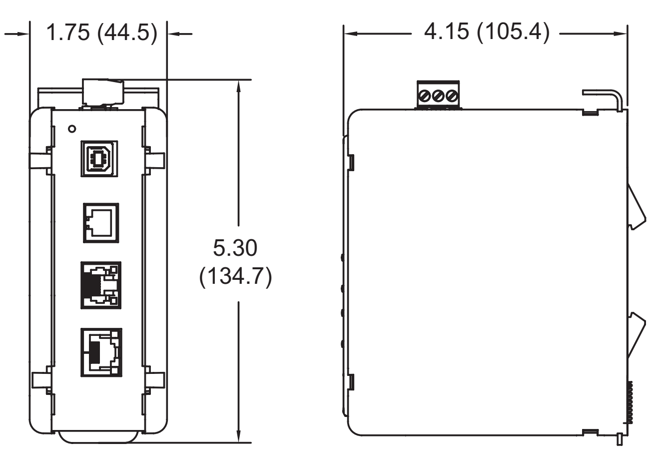
The ICM8 is designed to act as an ethernet gateway offering multiple protocol conversion for Red Lion panel meters. With two serial ports (one RS232 and one RS485) and a 10 Base-T/100 Ethernet Port, the unit performs protocol conversion, allowing Red Lion panel meters to communicate seamlessly to the ethernet network. Programming the unit can be accomplished via the RS232 or the USB Port using Crimson Software. It is important to note that this device is designed to function with Red Lion panel meters and will not offer protocol conversion if a Red Lion Product is not connected to at least one of the serial ports.

The ICM8'S DIN rail mounting saves time and panel space and snaps easily onto standard top hat (T) profile DIN rail.

SOFTWARE

The ICM8 is programmed with Windows® compatible Crimson software. The software is an easy to use graphical interface which can be purchased as part of a kit that includes a manual and cables, or downloaded free of charge from www.redlion.net.

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

SPECIFICATIONS

1. **POWER**: 24 VDC ± 10% 200 mA max. Must use a Class 2 or SELV rated power supply.
2. **COMMUNICATIONS**:
   USB/PG Port: Adheres to USB specification 1.1. Device only using Type B connection.
   Serial Ports: Format and Baud Rates for each port are individually software programmable up to 115,200 baud.
   RS232/PG Port: RS232 port via RJ12
   COMMS Ports: RS485 port via RJ11
   Ethernet Port: 10 BASE-T / 100 BASE-TX
3. **LEDs**:
   STS – Status LED indicates condition of ICM8.
   TX/RX – Transmit/Receive LEDs show serial activity.
   Ethernet – Link and activity LEDs.
4. **MEMORY**:
   On-board User Memory: 4 Mbytes of non-volatile Flash memory.
   On-board SDRAM: 2 Mbytes

5. **CERTIFICATIONS AND COMPLIANCES**:
SAFETY
IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion B [3] 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion B 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion A 1kV L-L,2 kV L&N-E power
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Emissions:		
Emissions	EN 55011	Class A

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.
3. This device was designed for installation in an enclosure. To avoid electrostatic discharge to the unit in environments with static levels above 4 kV precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure (ex. making adjustments, setting switches etc.) typical anti-static precautions should be observed before touching the unit.

6. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature Range: 0 to 50°C
Storage Temperature Range: -30 to +70°C
Operating and Storage Humidity: 80% max relative humidity, non-condensing, from 0 to 50°C
Altitude: Up to 2000 meters
7. **CONSTRUCTION**: Case body is black high impact plastic and stainless steel. Installation Category I, Pollution Degree 2.
8. **POWER CONNECTION**: Removable wire clamp screw terminal block.
Wire Gage Capacity: 24 AWG to 12 AWG
Torque: 4.45 to 5.34 in/lb (0.5 to 0.6 N-m)
9. **MOUNTING**: Snaps onto standard DIN style top hat (T) profile mounting rails according to EN50022 -35 x 7.5 and -35 x 15.
10. **WEIGHT**: 12.3 oz (348g)

HARDWARE

INSTALLATION

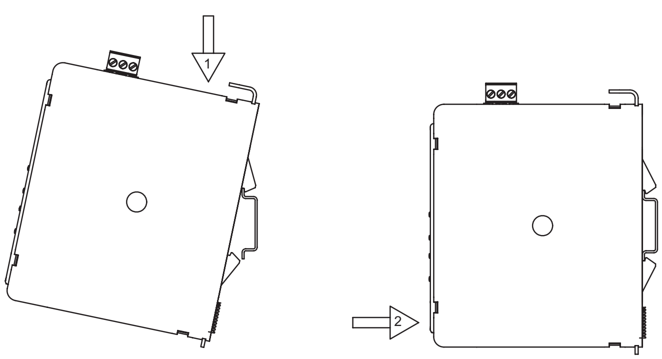


Figure 1 - Attach ICM8 To DIN Rail

POWER SUPPLY REQUIREMENTS

It is very important that the power supply is mounted correctly if the unit is to operate reliably. Please take care to observe the following points:

– The power supply must be mounted close to the unit, with usually not more than 6 feet (1.8 m) of cable between the supply and the ICM8. Ideally, the shortest length possible should be used.
– The wire used to connect the ICM8's power supply should be at least 22-gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, inverters, and other devices which may generate significant electrical noise.
– A power supply with a Class 2 or SELV rating is to be used. A Class 2 or SELV power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low voltage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.

EMC INSTALLATION GUIDELINES

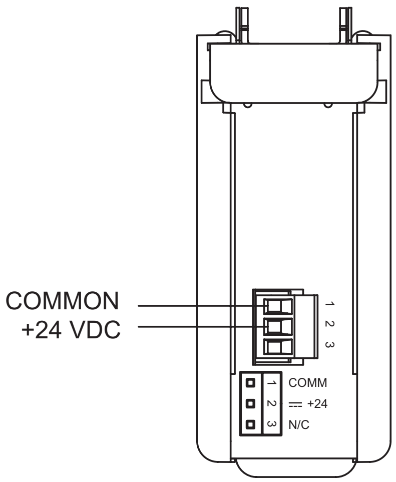
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. To reduce the chance of noise spikes entering the unit via the power lines, connections should be made to a clean source. Connecting to circuits that also power loads such as contactors, relays, motors, solenoids etc. should be avoided.
2. The unit should be mounted in a metal enclosure, which is properly connected to protective earth.
3. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
   c. Connect the shield to common of the Data Station and leave the other end of the shield unconnected and insulated from earth ground.
4. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. In extremely high EMI environments, the use of external EMI suppression devices is effective. The following EMI suppression devices (or equivalent) are recommended:
   Ferrite Suppression Cores for signal and control cables:
      Fair-Rite part number 0443167251 (RLC part number FCOR0000)
      TDK part number ZCAT3035-1330A
      Steward part number 28B2029-0A0
   Line Filters for input power cables:
      Schaffner part number FN2010-1/07 (RLC part number LFIL0000)
      Schaffner part number FN670-1.8/07
      Corcom part number 1 VR3

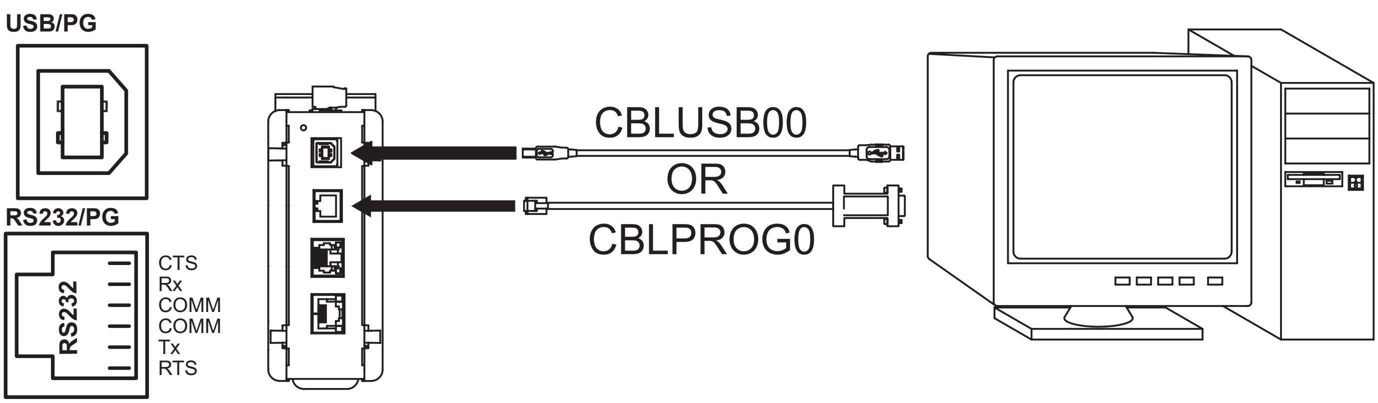
Visit RLC's web site at www.redlion.net for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

WIRING

POWER CONNECTION

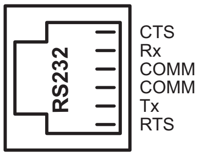


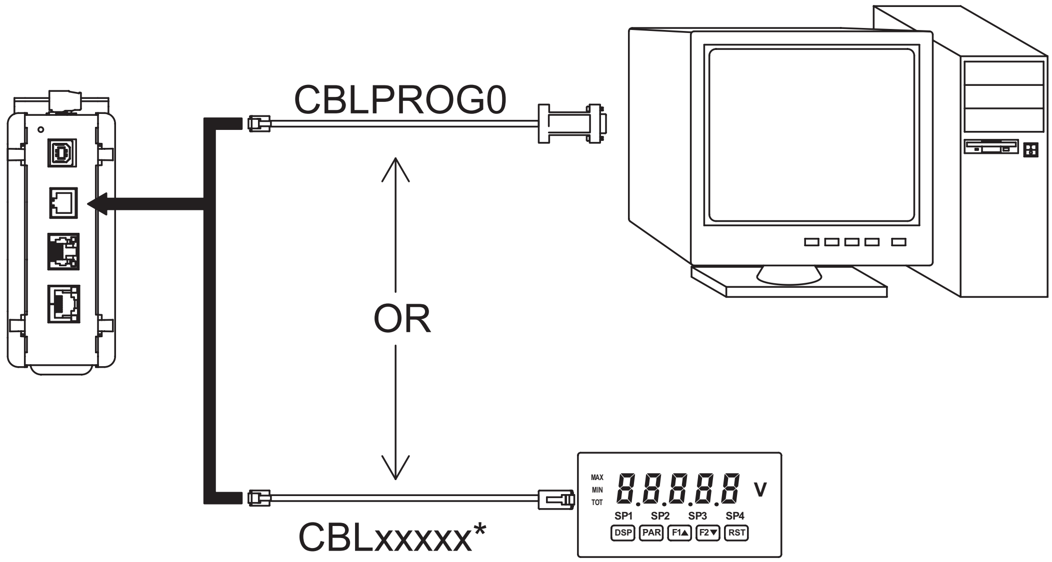
PROGRAMMING PORTS



COMMUNICATION PORTS

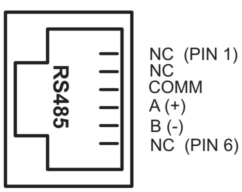
RS232/PG

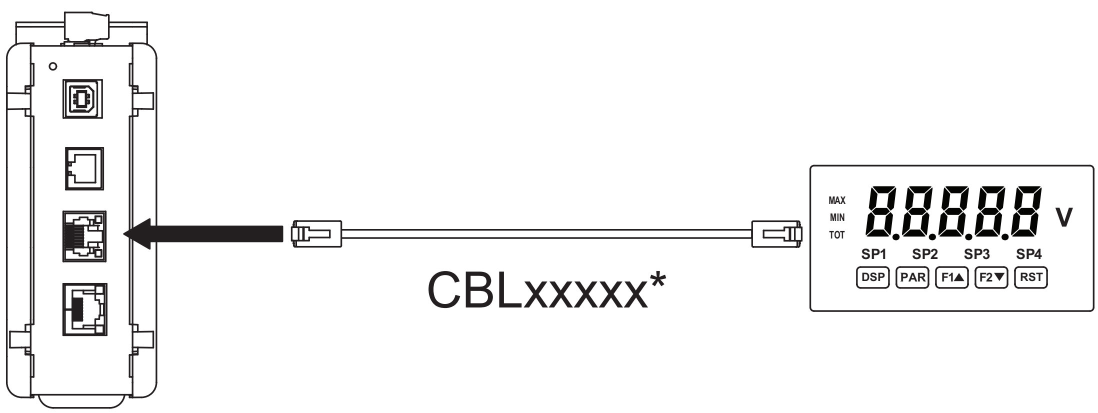




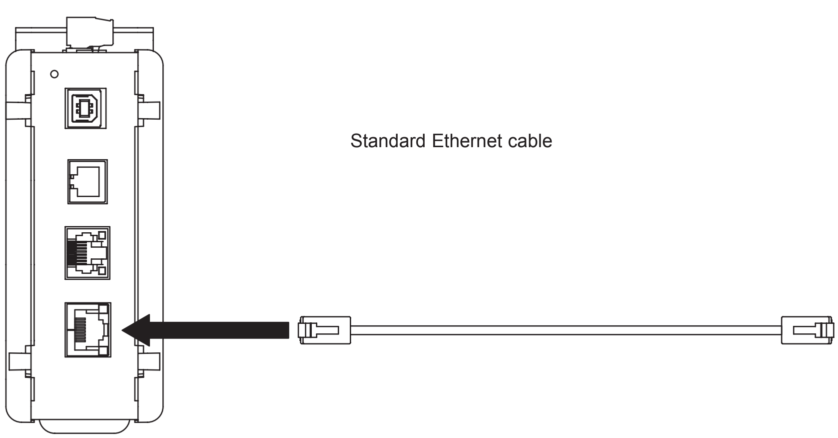
* Use appropriate communications cable. See Ordering Information for descriptions of the available cables.

RS485

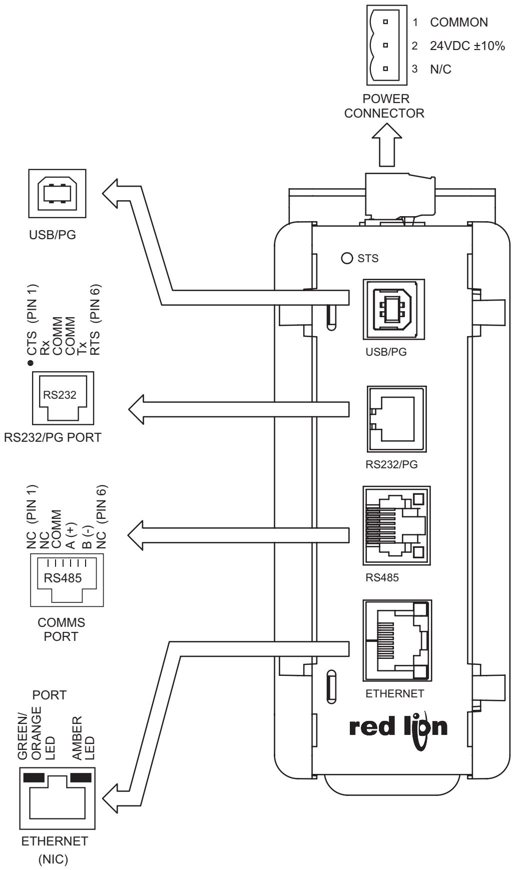




PORT 3 - ETHERNET CONNECTION



ICM8 PORT PIN OUTS



TROUBLESHOOTING

1. This module is designed to operate with Red Lion panel meters only. Please make sure a Red Lion product is connected to either one of the two serial ports for the gateway to be active.
2. The Ethernet port is equipped with data LEDs. If they are blinking, the converter is active and the data is available at the port. Please verify the receiving equipment is properly programmed.
3. If for any reason you have trouble operating, connecting, or simply have questions concerning your new ICM8, contact Red Lion's technical support. For contact information, refer to the back page of this bulletin for phone and fax numbers.

EMAIL: techsupport@redlion.net
Web Site: http://www.redlion.net

COMMUNICATING WITH THE ICM8

CONFIGURING THE ICM8

The ICM8 is configured using Crimson software. Crimson is available as a free download from Red Lion's website, or it can be ordered on CD. Updates to Crimson for new features and drivers are posted on the website as they become available. Crimson software can configure the ICM8 through the RS232/PG port or USB/PG port. The USB/PG port is connected using a standard USB cable with a Type B connector.

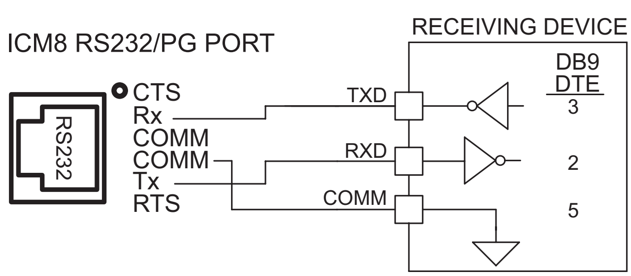
The driver needed to use the USB port will be installed with Crimson. The RS232/PG port uses a programming cable made by Red Lion to connect to the DB9 COM port of your computer. If making your own cable, refer to the "ICM8 Port Pin Outs" for wiring information.

ETHERNET COMMUNICATIONS

Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. The Crimson manual contains additional information on Ethernet communications.

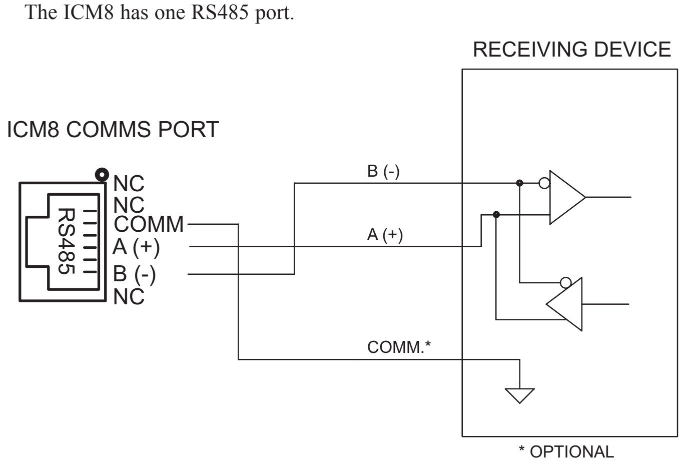
RS232 PORTS

The ICM8 has one RS232 port. The port can be used for programming or communications.



RS485 PORT

The ICM8 has one RS485 port.



Note: All Red Lion devices connect A to A and B to B.

H

LEDs

STS – STATUS LED

The green Status LED provides information regarding the state of the ICM8. This includes indication of the various stages of the start-up routine (power-up), and any errors that may occur.

Startup Routing

	INDICATION
Rapidly Flashing	ICM8 is currently running the boot loader and/or being flash upgraded by Crimson
Steady	ICM8 is operating properly

USER COMMUNICATION PORTS - TX/RX LEDS

LED	INDICATION
GREEN	Transmitting
RED	Receiving

ETHERNET LEDS

LED	INDICATION
YELLOW (Solid)	Link Established
YELLOW (Flashing)	Network Activity
GREEN	10 BASE-T Communications
AMBER	100 BASE-T Communications

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ICM8	Communication Gateway	ICM80000
PSDR	DIN Rail Power Supply	PSDRxxxx
SFCRM2	Crimson 2.0 [2], Manual and Download Cable	SFCRM200
CBL	RS-232 Programming Cable	CBLPROG0
	USB Cable	CBLUSB00
	Communications Cables [1]	CBLxxxxx
DR	DIN Rail Mountable Adapter Products [3]	DRxxxxxx

[1] Contact your Red Lion distributor or visit our website for complete selection.
[2] Use this part number to purchase Crimson on CD with a printed manual, USB cable, and RS-232 cable. Otherwise, download free of charge from www.redlion.net.
[3] Red Lion offers RJ modular jack adapters. Refer to the DR literature for complete details.

SENSORS

I

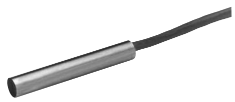
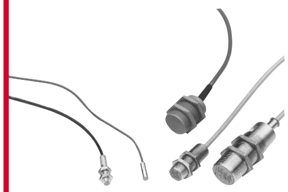
The Trusted Source for

Innovative Control Solutions

QUICK Specs

Sensors

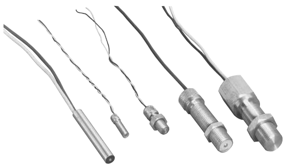
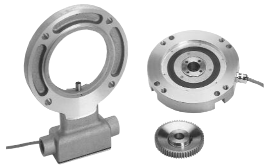
PROXIMITY SENSORS

	HESS	PSA SERIES	PSAC	PSAFP SERIES
				
Description	Round Proximity	Round Threaded Proximity	Round Amplified Proximity	Space Saving Flat Pack Proximity
Dimensions (Height) x (Width)	64 mm (H) x 10 mm (W)	Model Dependent	114 mm (H) x 19 mm (W)	Model Dependent
Recommended Installation	Counters/Rate Meters	Counters/Rate Meters	Counters/Rate Meters	Counters/Rate Meters
Max. Operating Frequency	5 KHz	Model Dependent	5 KHz	Model Dependent
Output	NPN O. C.	NPN Loaded Collector, 1 mA to 3 mA Swing	NPN O. C.	NPN O. C.
Max. Sensing Distance	.040" (1 mm)	.059" (1.5 mm) to .394" (10 mm) Model Dependent	.040" (1 mm)	.078" (2 mm) .393" (10 mm)
Operating Power	8 to 30 VDC	Model Dependent	10 to 30 VDC	10 to 30 VDC
Options	N/A	Mounting Brackets	Mounting Brackets, Quick Disconnect Cables	Mounting Bracket and Spacer
Construction	Stainless Steel Case with 10 Foot Cable	Model Dependent	Stainless Steel Case	High Impact Plastic Case
Page Number	Page 851	Page 852	Page 856	Page 858

QUICK Specs

Sensors

MAGNETIC PICK-UPS

	MP SERIES	LMP SERIES	ARC RINGS
			
Description	Threaded Magnetic Pick-ups	Amplified Magnetic Pick-ups	"C" Face-Mounted Motor Adapter Kits
Dimensions (Height)x(Width)	Model Dependent	102 mm (H) x 19 mm (W)	Refer to Drawing
Recommended Installation	Rate Meters, 100 RPM Min.	Rate Meters, 25 RPM Min.	Magnetic: Rate Meters Proximity: Counters/Rate Meters
Max. Operating Frequency	Greater than 50 KHz Typical	10 KHz	Magnetic: Greater than 50 KHz Typical Proximity: 5 KHz
Output	AC Voltage Signal	NPN OC (LMPC) 5 VDC Signal (LMPEC)	Magnetic: A/C Voltage Signal Proximity: NPN O. C.
Max. Sensing Distance	Model Dependent	0.125" w/24 DP Gear	Sensor Pregapped in Ring Kits
Operating Power	Self Powered Two Wires	9 to 30 VDC	Magnetic: Self Powered Proximity: 8 to 10 VDC
Options	In-Line Amplifier (ASTC) Explosion-Proof Version (MP75TX)	Mounting Brackets, Quick Disconnect Cables	N/A
Construction	Threaded Stainless Steel Case	Stainless Steel Case	Cast Aluminum w/ Junction Box
Page Number	Page 861	Page 863	Page 865

QUICK Specs

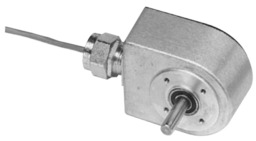
I

	Sensors			
	MOTOR FEEDBACK		ROTARY PULSE GENERATORS	
	MOTOR MOUNT	MOTOR MOUNT	LOW PROFILE	LOW PROFILE
				
Description	Motor Mount Configurations	C-Face Encoders	Small Thru-Bore and Shaft Encoders	Large Thru-Bore Encoders
Dimensions (Height) x (Width)	Refer to Drawing	Refer to Drawing	Refer to Drawing	Refer to Drawing
Recommended Installation	Motor Feedback Systems	Motor Feedback Systems	Counters/Rate Meters	Counters/Rate Meters
Max. Operating Frequency	250 KHz	200 KHz	200 KHz	200 KHz
Output	Line Driver	Line Driver	Standard: Quadrature Open Collector, Others Include Line Driver, Push Pull	Standard: Quadrature Open Collector, Others Include Line Driver, Push Pull
Max. Sensing Distance	N/A	N/A	N/A	N/A
Operating Power	5 to 28 VDC	5 to 28 VDC	5 to 28 VDC	5 to 28 VDC
Options	Protective Cover Kit, Various Bore Sleeves	N/A	Precision Shaft Couplings	Flex Mount Kits, Bore Insert Kits, Magnetic Coupling Kit
Construction	Nylon Composite	Metal	Aluminum	Aluminum
Page Number	Page 871	Page 867	Page 875	Page 876

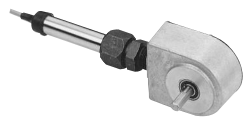
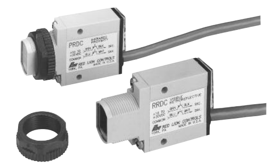
QUICK Specs

Sensors

ROTARY PULSE GENERATORS

	INDUSTRIAL DUTY	INDUSTRIAL DUTY	INDUSTRIAL AND HEAVY DUTY	HEAVY DUTY ENCODER
				
Description	Shaft Encoders	Large Thru-Bore Encoders	Industrial and Heavy Duty Encoder	Size 20 and 25 Flange Encoders
Dimensions (Height)x(Width)	Refer to Drawing	Refer to Drawing	Refer to Drawing	Refer to Drawing
Recommended Installation	Counters/Rate Meters	Counters/Rate Meters	Counters/Rate Meters	Counters/Rate Meters
Max. Operating Frequency	10 KHz	1 MHz	20 KHz	1 MHz
Output	Single Channel or Quadrature, NPN O.C.	Standard: Quadrature Open Collector, Others Include Line Driver, Push Pull	Single Channel or Quadrature, Current Sinking.	Standard: Quadrature Open Collector, Others Include Line Driver, Push Pull
Max. Sensing Distance	N/A	N/A	N/A	N/A
Operating Power	8 to 35 VDC (ZCG) 8 to 28 VDC (ZCH)	5 to 28 VDC	5 to 28 VDC	5 to 28 VDC
Options	Precision Shaft Couplings	Tether Arm Kits, Bore Insert Kits, Magnetic Coupling Kit	Precision Shaft Couplings	Precision Shaft Couplings
Construction	Cast Aluminum	Nylon Composite	Aluminum	Aluminum
Page Number	Page 877	Page 885	Page 889	Page 897

Sensors

	LENGTH SENSORS		LINEAR	PHOTO EYE
	MINIATURE LENGTH SENSORS	LENGTH SENSORS	LINEAR ENCODER	PHOTO EYES
				
Description	Length Measurement Sensor	Length Measurement Sensor	Length Measurement Sensor	Photo Electric Sensors
Dimensions (Height) x (Width)	Refer to Drawing	Refer to Drawing	Refer to Drawing	Model Dependent
Recommended Installation	Counters/Rate Meters	Counters/Rate Meters	Counters/Rate Meters	Counters/Timers
Max. Operating Frequency	200 KHz	10 KHz	125 KHz	1 KHz
Output	Quadrature Open Collector	Single Channel or Quadrature, Current Sinking.	Quadrature, Open Collector	NPN O. C., PNP O. C.
Max. Sensing Distance	N/A	N/A	N/A	15 Foot (Reflective) 12 Inch (Proximity) 10 Foot (Opposed Beam)
Operating Power	5 to 28 VDC	8 to 35 VDC (ZFG) 8 to 28 VDC (ZFH)	5 to 28 VDC	10 to 30 VDC
Options	Mounting Bracket, Various Measuring Wheels	Single or Dual Shaft, Mounting Bracket, Various Measuring Wheels	Mounting Bracket	Mounting Brackets, Reflectors
Construction	Nylon Composite	Cast Aluminum	Aluminum	Plastic
Page Number	Page 899	Page 877	Page 901	Page 903

QUICK Specs

	Sensors			
	PRESSURE	TEMPERATURE SENSORS		CURRENT TRANSDUCERS
	PT SERIES	THERMOCOUPLES	RTDS	CURRENT TRANSFORMERS
				
Description	Pressure Sensors	Various Thermocouple Sensors	Various RTD Sensors	Current Transformers
Dimensions (Height)x(Width)	68 mm (H) x 23 mm (W)	Model Dependent	Model Dependent	Model Dependent
Recommended Installation	Digital Panel Meters/Process Meters	Temperature Meters/Controllers	Temperature Meters/Controllers	Digital Panel Meters/Process Meters
Max. Operating Frequency	N/A	N/A	N/A	Model Dependent
Output	4 to 20 mA	mV	mV	0.1, 1, and 5 Amp
Max. Sensing Distance	N/A	N/A	N/A	N/A
Operating Power	8 to 33 VDC	Model Dependent	Model Dependent	N/A
Options	Adapter Fittings	Field Cuttable, Quick Disconnects, Handheld, Compression, Surface, Pipe Plug	Field Cuttable, Quick Disconnects, Handheld, Compression, Surface, Pipe Plug	N/A
Construction	Stainless Steel Case	Model Dependent	Model Dependent	Plastic
Page Number	Page 910	Page 911	Page 920	Page 925

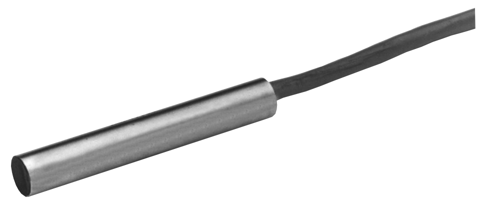
QUICK Specs

Sensors

CURRENT TRANSDUCERS

	CURRENT TRANSDUCERS	CURRENT SWITCH
		
Description	Current Transducers	Current Switch
Dimensions (Height) x (Width)	Model Dependent	Model Dependent
Recommended Installation	Digital Panel Meters/Process Meters	Stand Alone
Max. Operating Frequency	Model Dependent	60 to 100 Hz
Output	4 to 20 mA or 0 to 10 VDC Model Dependent	Solid State Switch
Max. Sensing Distance	N/A	N/A
Operating Power	N/A	Self Powered
Options	Fixed or Split Core, Model Dependent	Fixed or Split Core, Model Dependent
Construction	Thermoplastic	Thermoplastic
Page Number	Page 928	Page 934

MODEL HESS - HALL EFFECT SPEED SENSOR



DETECTS STEEL SENSING GEARS OR OTHER FERROUS TARGETS

NPN OPEN COLLECTOR OUTPUT

OPERATES FROM 0 TO 10 KHz

3/8" DIAMETER STAINLESS STEEL CASE

EPOXY ENCAPSULATED FOR OIL, DIRT & MOISTURE RESISTANCE

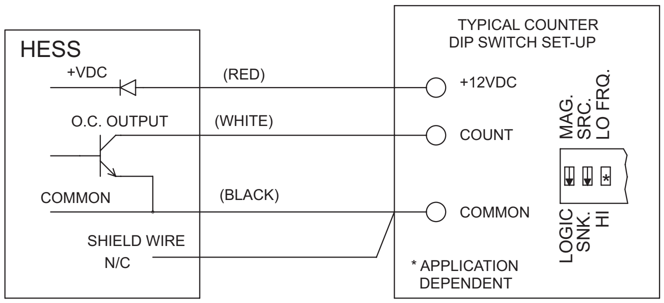
IDEAL FOR TACHOMETRIC INPUTS

DESCRIPTION

The Hall Effect speed sensor (HESS) is ideal for sensing steel gears or other ferrous targets from 0 to 10 KHz. This sensor does not have a minimum threshold speed as does a magnetic pickup sensor. However, when the sensor is first powered up, the output state is indeterminate *(Hi or Lo)* when the sensor is not detecting metal. The unit operates from a +8 to +30 VDC power supply and is reverse polarity protected. The sensor face can be mounted flush into metal panels. The case is stainless steel and is supplied with 10 feet (3 M) of cable. The stranded shield wire is not connected to the sensor circuit or case.

SPECIFICATIONS

1. **POWER SUPPLY:** +8 to +30 VDC @ 30 mA max.; reverse polarity protected.
2. **MAXIMUM SENSING DISTANCE:** 0.040" (1 mm).
3. **OUTPUT:** NPN O.C. transistor; V_{MAX} = 30 VDC; V_{SAT} = 1 V_{MAX} @ 30 mA max. load.
4. **OPERATING TEMPERATURE RANGE:** -25°C to 70°C (-14°F to 158°F).
5. **CABLE LENGTH:** 10 feet (3.05 M).
6. **OPERATING FREQUENCY:** 0 to 10 KHz.
7. **WIRE:** 3 wire, 22 AWG with stranded shield wire and 100% foil coverage; grey PVC jacket.
   Color Code: Red (+VDC), Black (Comm.), White (Output).
8. **CABLE STRAIN RELIEF:** 10 lbs. (4.5 Kg.) for 1 minute.
   Note: DO NOT adjust sensor air gap while target (gear) is moving.



TARGET SIZE

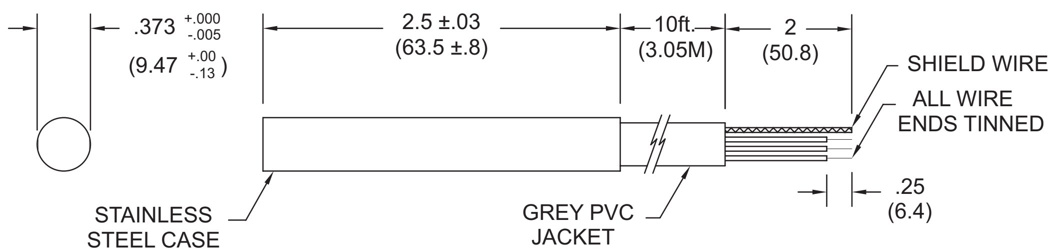
The HESS can detect gears as small as 24 D.P. or other ferrous targets with equal or greater dimensions. The sensor is compatible with all Red Lion Controls Sensing Gears.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
HESS	NPN O.C. Hall Effect Speed Sensor	HESS0000

Do not dispose of unit in trash - Recycle

DIMENSIONS In inches (mm)



MODEL PSAH - HALL EFFECT SPEED SENSOR

I

- DETECTS STEEL SENSING GEARS OR OTHER FERROUS TARGETS
- NPN OPEN COLLECTOR OUTPUT
- OPERATES FROM 0 TO 10 KHz
- IDEAL FOR RATE APPLICATIONS

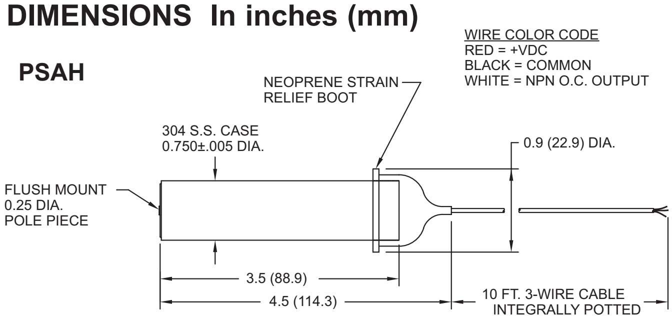
DESCRIPTION

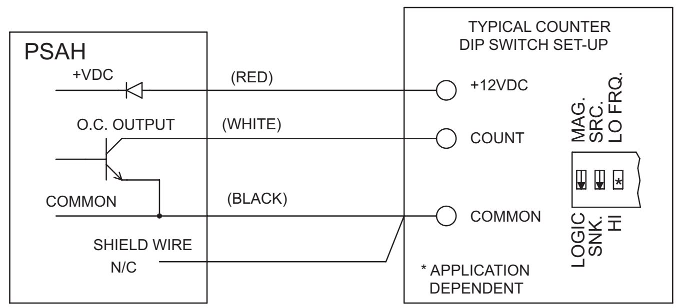
The Hall Effect speed sensor (PSAH) is ideal for sensing steel gears or other ferrous targets from 0 to 10 KHz. This sensor does not have a minimum threshold speed as does a magnetic pickup sensor. However, when the sensor is first powered up, the output state is indeterminate *(Hi or Lo)* when the sensor is not detecting metal. The unit operates from a +8 to +30 VDC power supply and is reverse polarity protected. The sensor face can be mounted flush into metal panels. The case is stainless steel and is supplied with 10 feet (3 M) of cable. The stranded shield wire is not connected to the sensor circuit or case.

SPECIFICATIONS

1. **POWER SUPPLY:** +8 to +30 VDC @ 30 mA max.; reverse polarity protected.
2. **MAXIMUM SENSING DISTANCE:** 0.040" (1 mm).
3. **OUTPUT:** NPN O.C. transistor; V_{MAX} = 30 VDC; V_{SAT} = 1 V_{MAX} @ 30 mA max. load.
4. **OPERATING FREQUENCY:** 0 to 10 KHz.
5. **OPERATING TEMPERATURE RANGE:** -25°C to 70°C (-14 °F to 158 °F).
6. **OUTPUT CABLE:** Integrally potted 10 ft PVC jacketed, 3 wire, 22 AWG conductors, with stranded shield wire and 100% foil coverage; grey PVC jacket.
   Color Code: Red (+VDC), Black (Comm.), White (NPN OC Output).
7. **CONSTRUCTION**: Epoxy encapsulated 0.297 sensor in 0.75" ±0.005" dia. #304 stainless steel case.

DIMENSIONS In inches (mm)





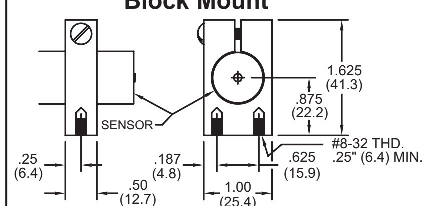
TARGET SIZE

The PSAH can detect gears as small as 24 D.P. or other ferrous targets with equal or greater dimensions. The sensor is compatible with all Red Lion Controls Sensing Gears.

3/4" DIAMETER CYLINDRICAL SENSOR MOUNTING

The PSAH and other Red Lion Controls 3/4" dia. cylindrical pickups may be easily mounted using Model 5400100 **Block Mount** *(see diagram below)*. This machined block of solid aluminum provides for rigid mounting using the two included #8-32 x 1/2" screws. The single screw split-clamp design allows for easy adjustment of the airgap and locks the unit securely without deforming the case.

Block Mount



For 3/4" cylindrical sensors
Qty. 2 #8-32 x 1/2" Mounting screws included
P/N 5400100

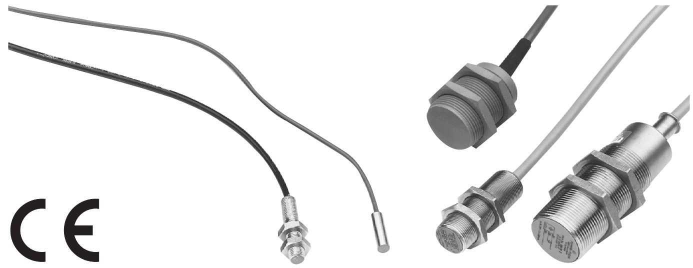
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PSAH	NPN O.C. Hall Effect Sensor	PSAH0000
BM	Block Mount	5400100

Do not dispose of unit in trash - Recycle

INDUCTIVE PROXIMITY SENSORS

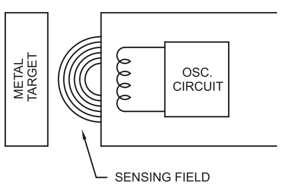
- *SENSE FERROUS & NON-FERROUS METAL OBJECTS TO "ZERO SPEED"*
- *2-WIRE CURRENT SOURCE (NAMUR) & 3-WIRE NPN TRUE OPEN COLLECTOR OUTPUTS*
- *5 SIZES & 3 SENSING DISTANCES FOR APPLICATION VERSATILITY*
- *L.E.D. TARGET INDICATOR (PSA 2B, 6B, 7B, & 8B)*



DESCRIPTION & OPERATION

Inductive Proximity Sensors detect the presence of metal objects which come within range of their oscillating field and provide target detection to *"zero speed"*. Internally, an oscillator creates a high frequency electromagnetic field (RF) which is radiated from the coil and out from the sensor face *(See Figure 1)*. When a metal object enters this field, eddy currents are induced into the object.

As the metal moves closer to the sensor, these eddy currents increase and result in an absorption of energy from the coil which dampens the oscillator amplitude until it finally stops.



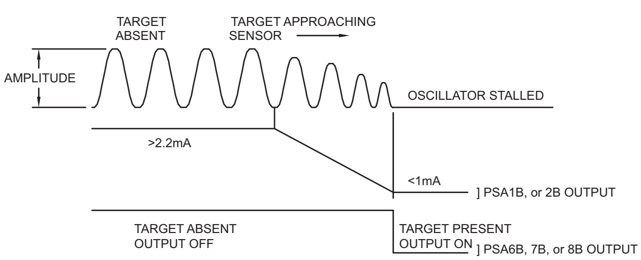


Figure 1

MODELS PSA-1B & 2B

The 2-wire Models PSA-1B and 2B contain only the coil and oscillator circuit *(See Figure 2)*. With no metal object being sensed, the circuit oscillates and draws greater than 2.2 mA of supply current. As a metal object of sufficient size is brought into the sensing field, the oscillator amplitude dampens and finally stops, resulting in less than 1 mA of circuit current being drawn. This greater than 2.2 mA to less than 1 mA change in circuit current between oscillating and non-oscillating conditions is converted into a usable voltage signal (V_S) by placing a resistor (R_S) in series with the sensor leads.

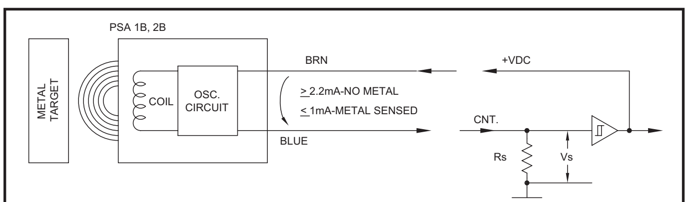


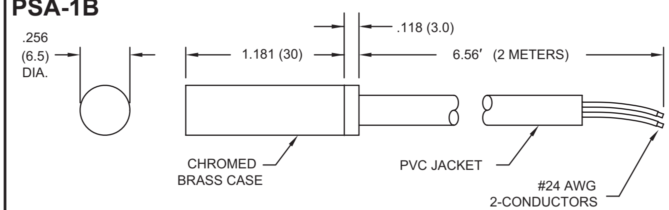
Figure 2

PSA-1B & PSA-2B SPECIFICATIONS

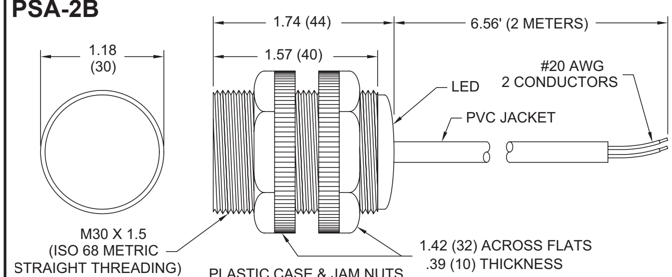
	PSA-1B	PSA-2B
1. Power Supply:	+5 to +30 VDC	
2. Maximum Switching Frequency:	5 KHz	500 Hz
3. Output:	Less than 1 mA Target Sensed; Greater than 2.2 mA No Target.	
4. Maximum Sensing Distance:	0.059" (1.5 mm)	0.394" (10 mm)
5. Wire Color Code:	Brown = +VDC; Blue = Count	
6. Operating Temperature:	-25°C to +70°C (-13°F to +158°F)	
7. Construction:	NEMA 1, 3, 4, 6, 13, and IEC IP 67.	

DIMENSIONS In inches (mm)

PSA-1B



PSA-2B



In addition to the coil and oscillator circuit, the 3-wire Models PSA-6B, 7B, and 8B each contain a Detector Circuit and NPN Transistor Output *(See Figure 3)*. In these units, the Detector Circuit senses when the oscillator stops, and turns on the Output Transistor which controls the load. The Detector Circuit also turns on an integrally case mounted L.E.D., visually indicating when a metal object is sensed.

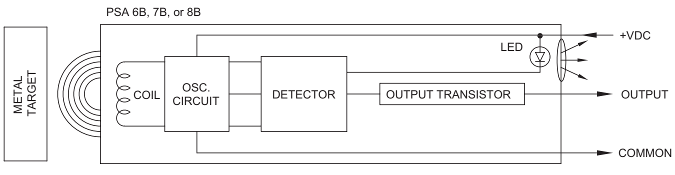


Figure 3

PSA-6B, 7B, & 8B

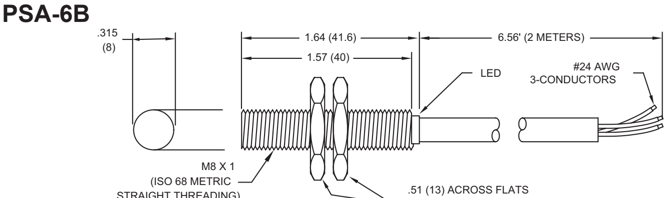
These Inductive Proximity Sensors have a maximum sensing distance of 0.059" (1.5 mm), 0.197" (5 mm) and 0.394" (10 mm) respectively, and operate over a wide power supply range *(See Specifications Below)*. They are each housed in threaded metal cases and are supplied with 2 metal jam nuts for mounting. The NPN transistor outputs are true open collector and are compatible with most RLC counter and rate input circuits. Maximum sensing frequencies are ≤ 3 KHz, 1 KHz, and 500 Hz respectively. In addition, the outputs are overload and short circuit protected. These sensors are shielded for flush mounting in metal applications.

PSA-6B, 7B, & 8B SPECIFICATIONS

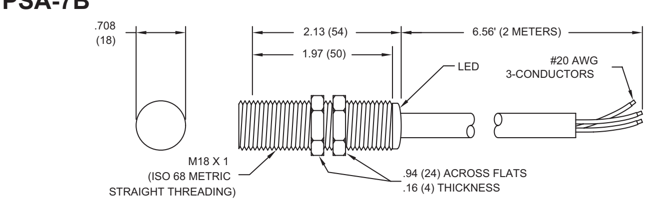
	PSA-6B	PSA-7B	PSA-8B
1. Power Supply:	+10 to +30 VDC @ 10 mA max.		
	REVERSE POLARITY PROTECTION		
2. Maximum Switching Frequency:	≤ 3 KHz	1 KHz	500 Hz
3. Output:	NPN Open Collector Output, Overload and Short Circuit protected.		
	V_{SAT} = 1.8 V @ 150 mA max. load	V_{SAT} = 1.8 V @ 200 mA max. load	
4. Maximum Sensing Distance:	0.059" (1.5 mm)	0.197" (5 mm)	0.394" (10 mm)
5. Wire Color Code:	Brown = +VDC; Blue = Common; Black = Output		
6. Operating Temperature:	-25°C to +70°C (-13°F to +158°F)		
7. Construction:	NEMA 1, 3, 4, 6, 13 and IEC IP 67		

DIMENSIONS In inches (mm)

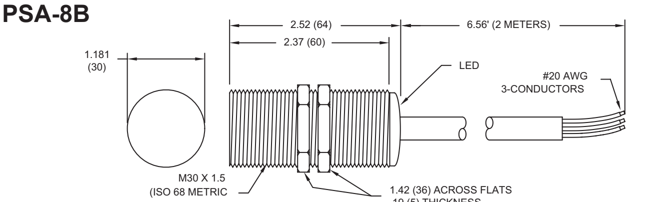
PSA-6B



PSA-7B



PSA-8B



NOTES:
1. PSA 6B case material = #303 stainless steel.
2. PSA 7B & 8B case = chromed brass.
3. PVC Cable Jacket.

SELECTION & APPLICATION OF PROXIMITY SENSORS

Selection of the proper proximity sensor depends on the size, material, and spacing of the target being sensed and the sensing distance that can be maintained. The maximum sensing distance is defined as the distance in which the sensor is just close enough to detect a ferrous target whose diameter is equal to or greater than the sensor diameter. In actual application, the sensing distance should be between 50 to 80% of the maximum sensing range to assure reliable detection. For target sizes smaller than the sensor diameter, the maximum sensing distance can be estimated from the curve *(See Figure 4)*. A further reduction factor must also be applied if the target material is non-ferrous metal *(See Figure 5)*. Ideally, spacing between adjacent targets should be at least one sensor diameter so that the first target completely leaves the sensors field before the next target appears. Individual targets can still be resolved as separate objects if this spacing is reduced to 70 or 75% of the sensor diameter, however, this can introduce a minimum limit on sensing distance that makes adjustment more critical. All Proximity sensors are internally shielded which allows the sensor face to be flush mounted in metal applications without reducing sensing distance. In applications where proximity sensors must be placed next to each other, a distance of at least 1 sensor diameter should separate sensors to eliminate any frequency interference *(See Figure 6)*.

MAXIMUM SENSING DISTANCE REDUCTION FACTORS

Reduction in the max. sensing distance due to decrease in diameter of ferrous targets.

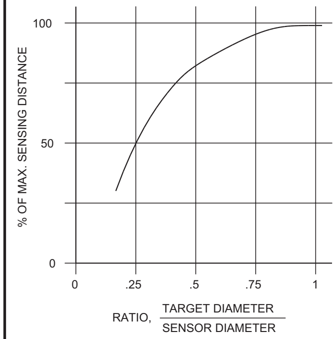
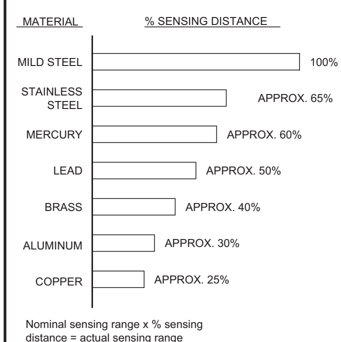


Figure 4

Typical reduction factors for various non-ferrous targets with diameters equal to or greater than sensor diameter.



Nominal sensing range x % sensing distance = actual sensing range

Figure 5

MINIMUM SENSOR SPACING

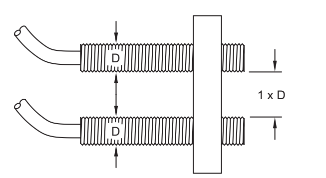
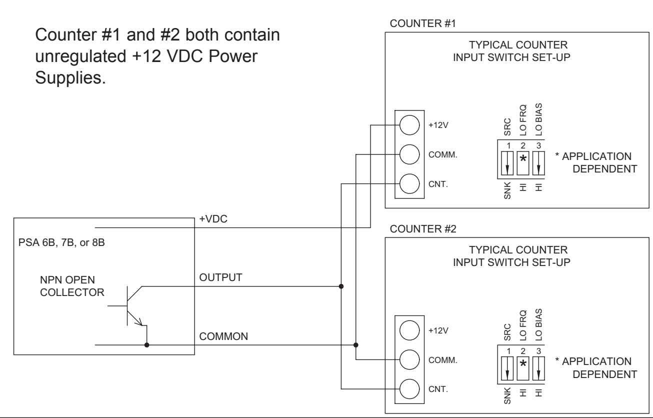


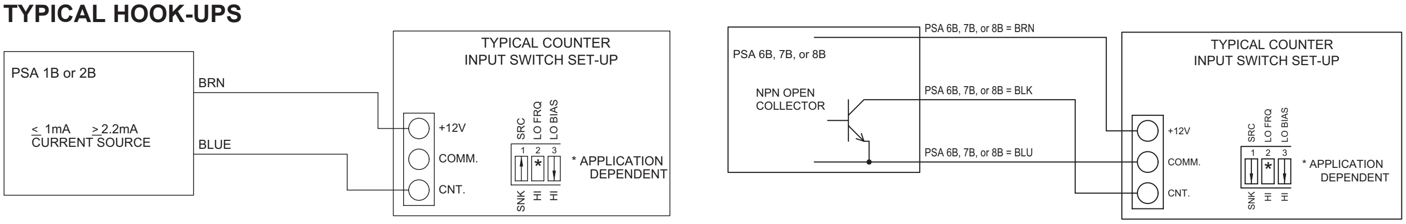
Figure 6

Note: PSA-6B, 7B, and 8B outputs are NPN open collector outputs. A PSA-6B, 7B, or 8B may be used as an input to more than 1 indicator or control only if the respective power supplies of each unit are *"unregulated"* and can load share. It is recommended to use only one power supply for sensor power. An indicator or control with a regulated power supply may not be paralleled.

Counter #1 and #2 both contain unregulated +12 VDC Power Supplies.



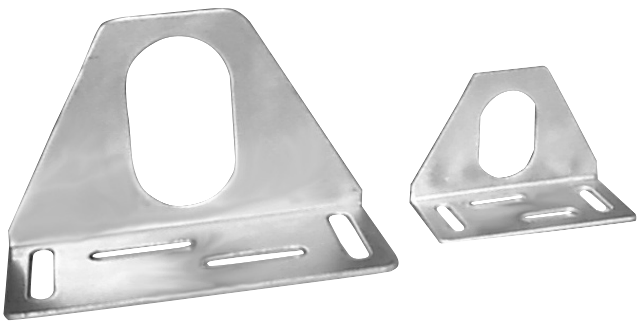
TYPICAL HOOK-UPS



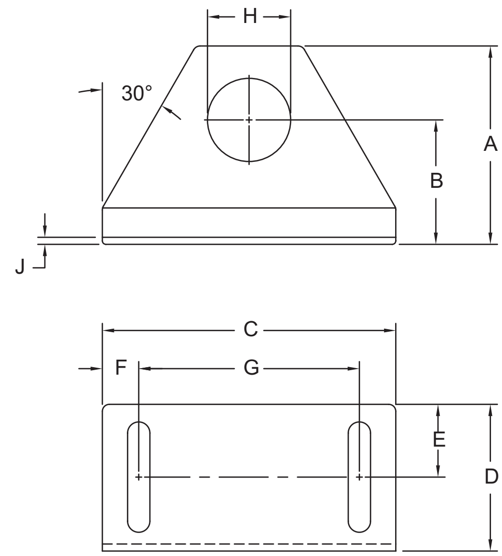
APPLICATION SELECTION CHART

	PSA-1B	PSA-2B	PSA-6B	PSA-7B	PSA-8B
MAX. SENSING DISTANCE	0.059" (1.5 mm)	0.394" (10 mm)	0.059" (1.5 mm)	0.197" (5 mm)	0.394" (10 mm)
MAX. SWITCHING FREQ.	5 KHz	500 Hz	≤ 3 KHz	1 KHz	500 Hz
POWER SUPPLY	5-30 VDC	5-30 VDC	10-30 VDC	10-30 VDC	10-30 VDC
OUTPUT	<1 mA> 2.2 mA	<1 mA> 2.2 mA	NPN Open Collector Transistor		
L.E.D. TARGET INDICATOR	No	Yes	Yes	Yes	Yes

MODELS MB4B & 5B MOUNTING BRACKETS



DIMENSIONS



The Models MB4B and 5B are stainless steel right angle mounting brackets, designed to provide easy mounting and adjustment of PSA-7B and 8B respectively, using the 2 hex jam nuts provided with each sensor.

DIMENSIONS In inches (mm)

BRACKET MODEL NO.	SENSOR MODEL	DIMENSIONS									
		A	B	C	D	E	F	G	H	J	SLOT
MB4B	PSA7B	1.63 (41.5)	1.00 (25.4)	2.5 (63.5)	1.25 (31.8)	0.62 (15.7)	0.31 (7.9)	1.88 (47.8)	0.75 (19.1)	0.06 (1.5)	0.22 X 0.75 (5.6 X 19.1)
MB5B	PSA8B	2.62 (66.5)	1.75 (44.5)	4.25 (108.0)	1.75 (44.5)	0.88 (22.4)	0.37 (9.5)	3.50 (88.9)	1.19 (30.2)	0.07 (1.8)	0.28 X 1.25 (7.1 X 31.8)

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PSA1B	2-Wire Cylindrical Proximity Sensor	PSA1B000
PSA2B	2-Wire, 30 mm Threaded Proximity Sensor	PSA2B000
PSA6B	8mm Threaded Proximity Sensor	PSA6B000
PSA7B	18mm Threaded Proximity Sensor	PSA7B000
PSA8B	30mm Threaded Proximity Sensor	PSA8B000
MB4B	Mounting Bracket for PSA7B	MB4B0000
MB5B	Mounting Bracket for PSA8B	MB5B0000

Do not dispose of unit in trash - Recycle

MODEL PSAC - 3-WIRE INDUCTIVE PROXIMITY SENSOR WITH CURRENT SINK OUTPUT

I

- *SENSE FERROUS AND NON-FERROUS METAL OBJECTS*
- *OPERATES FROM ZERO TO 5 KHZ PULSE OUTPUT RATE*
- *SENSES TARGETS AS SMALL AS 12 D.P. GEAR TEETH*
- *IDEAL FOR TACHOMETER, COUNTER AND CONTROL INPUT*

DESCRIPTION

The PSAC offers a NPN Open Collector output that is compatible with most Red Lion Controls' Motion Monitors, Counters, and Controls. This sensor has a maximum sensing distance of 0.059" (1.5 mm) and can detect ferrous and non-ferrous metal targets from zero speed to 5 KHz.

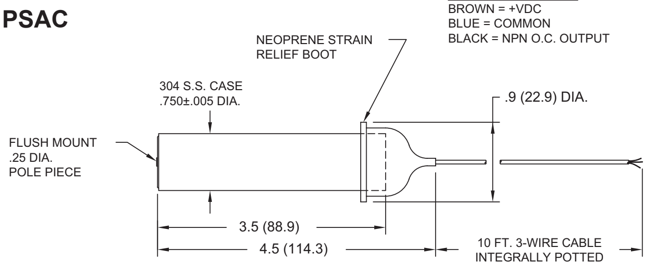
The 0.25" diameter pole piece is epoxy encapsulated in a stainless steel case measuring 0.75" Dia. x 3.5" L and is supplied with a 10, 25 or 50 ft., 3-wire, cable. Overall dimensions, including the neoprene strain-relief boot are 0.90" Dia. x 4.5" L. Operating temperature range is -25 ° to +70 °C.

SPECIFICATIONS

1. **SUPPLY VOLTAGE:** +10 - 30 VDC @ 20 mA max.; **Unit is not Reverse Polarity Protected.**
2. **MAXIMUM SWITCHING FREQUENCY:** 5 KHz
3. **OUTPUT:** NPN Open Collector Transistor;
   V_{OH} = 30 VDC max.; V_{OL} = 1 V max @ 150 mA.
4. **MAXIMUM SENSING DISTANCE:** 0.059" (1.5 mm)
5. **OUTPUT CABLE:** Integrally potted 10, 25, or 50 feet ± 6 inches; PUR jacketed 3-wire 24 AWG conductors.
   BROWN = +VDC, **BLUE** = Common, **BLACK** = NPN O.C. Output
6. **OPERATING TEMPERATURE RANGE:** -25 °C to +70 °C (-13 °F to +158 °F)
7. **CONSTRUCTION:** Epoxy Encapsulated 0.25" dia. sensor in 0.750" ±0.005" dia. #304 stainless steel case.

DIMENSIONS In inches (mm)

PSAC



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PSAC	NPN O.C. Proximity Sensor, 10 ft. Cable	PSAC0000
	NPN O.C. Proximity Sensor, 25 ft. Cable	PSAC0025
	NPN O.C. Proximity Sensor, 50 ft. Cable	PSAC0050
	Block Mount for 3/4" Cylindrical Sensors	5400100
	Steel Plug Mount	5403701
	Stainless Steel Plug Mount	5403702

PSAC APPLICATION

PSAC application depends on the size, material, and spacing of the targets being sensed and the sensing distance that can be maintained. The maximum sensing distance is defined as that distance where the sensor is just close enough to detect a ferrous target whose diameter is equal to or greater than the sensor diameter. For the PSAC, the internally potted sensor diameter is 0.25". In an actual application the sensing distance should be between 50-70% of the maximum to assure reliable detection. For target sizes smaller than the 0.25" sensor diameter, the maximum sensing distance can be estimated from the curve in Fig. 2. A further reduction factor must also be applied if the target material is a non-ferrous metal as shown in Fig. 3.

Ideally, spacing between adjacent targets should be at least 0.25" so that the first target completely leaves the sensors' viewing field before the next target appears. Individual targets can still be resolved as separate objects if this spacing is reduced to 70 or 75% of the sensor diameter, however this can introduce a minimum limit on sensing distance that makes adjustment a bit more critical

The PSAC is internally shielded which allows the sensor face to be flush mounted in metal applications without reducing sensing distance.

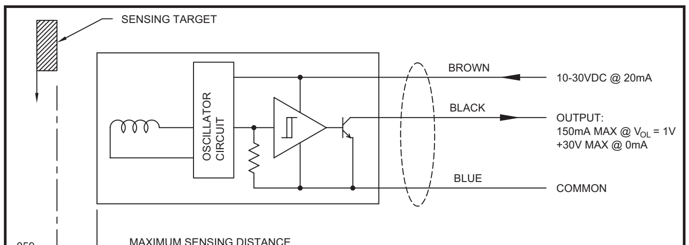


Figure 1

MAXIMUM SENSING DISTANCE REDUCTION FACTORS

Reduction in the max. sensing distance due to decrease in diameter of ferrous targets.

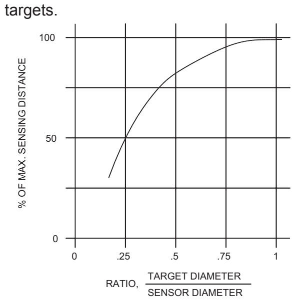


Figure 2

Typical reduction factors for various nonferrous targets with diameters equal to or greater than sensor diameter.

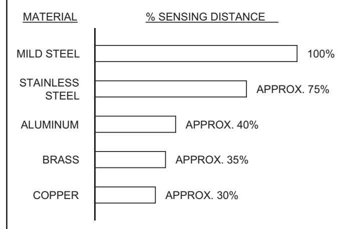
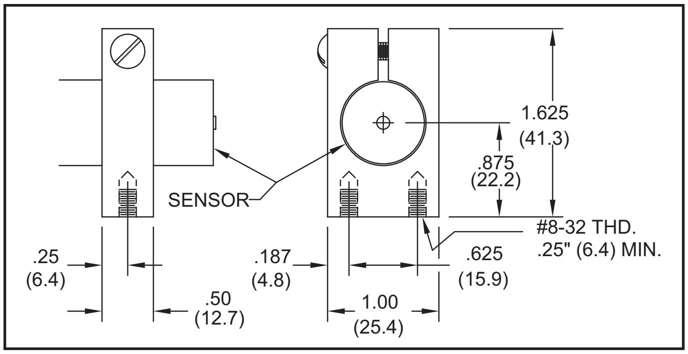


Figure 3

3/4" DIAMETER CYLINDRICAL SENSOR MOUNTING

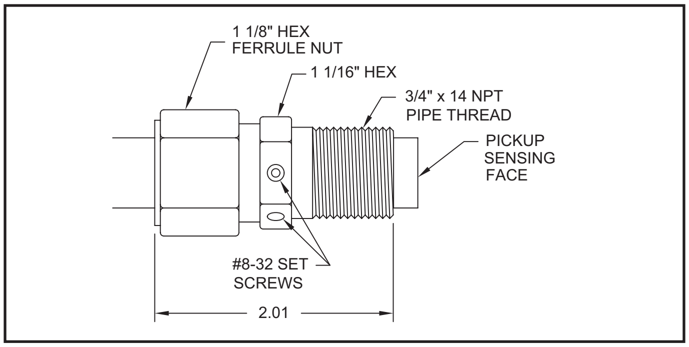
BLOCK MOUNT

The PSAC and other Red Lion Controls 3/4" diameter cylindrical pickups may be easily mounted using Model 5400100 **BLOCK MOUNT** *(see diagram below)*. This machined block of solid aluminum provides for rigid mounting using the two included #8-32 x 1/2" screws. The one screw split-clamp design allows for easy adjustment of airgap and locks the unit securely without deforming the case.



PLUG MOUNT

The **PLUG MOUNT** *(see diagram below)* allows 3/4" dia. cylindrical sensors to be mounted in "thru-wall" applications. The Plug Mounts 3/4-14 NPT thread is installed into a threaded wall or casing. The sensor is then installed through the plug mount. The sensor-to-target airgap is adjusted and the sensor is tightened into position by two #8-32 set screws. Tightening the ferrule nut compresses a teflon ferrule around the sensor providing an oil tight seal. Plug Mounts are available in both steel and stainless steel *(see ordering information)*.



I

“FLAT PACK” RECTANGULAR INDUCTIVE PROXIMITY SENSORS

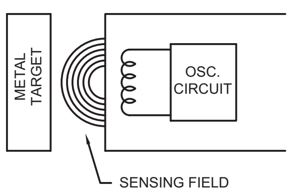
I

- IDEAL FOR LIMITED SPACE APPLICATIONS
- SENSE FERROUS & NON-FERROUS METAL OBJECTS TO “ZERO SPEED”
- 3-WIRE NPN TRUE OPEN COLLECTOR OUTPUTS
- 2 SIZES & SENSING DISTANCES FOR APPLICATION VERSATILITY
- L.E.D. TARGET INDICATOR

DESCRIPTION & OPERATION

Inductive Proximity Sensors detect the presence of metal objects that come within range of their oscillating field and provide target detection to *“zero speed”*. Internally, an oscillator creates a high frequency electromagnetic field (RF) that is radiated from the coil and out from the sensor face *(See Figure 1)*. When a metal object enters this field, eddy currents are induced into the object.

As the metal moves closer to the sensor, these eddy currents increase and result in an absorption of energy from the coil that dampens the oscillator amplitude until it finally stops.



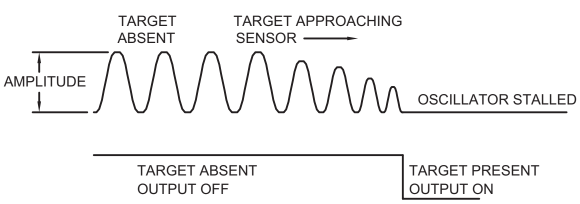


Figure 1

MODELS PSAFP1 & PSAFP2

In addition to the coil and oscillator circuit, the 3-wire Models PSAFP1 and PSAFP2 each contain a Detector Circuit and NPN Transistor Output *(See Figure 2)*. In these units, the Detector Circuit senses when the oscillator stops, and turns on the Output Transistor that controls the load. The Detector Circuit also turns on an integrally case mounted L.E.D., visually indicating when a metal object is sensed.

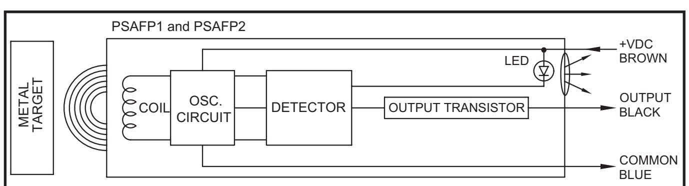


Figure 2

LED STATES

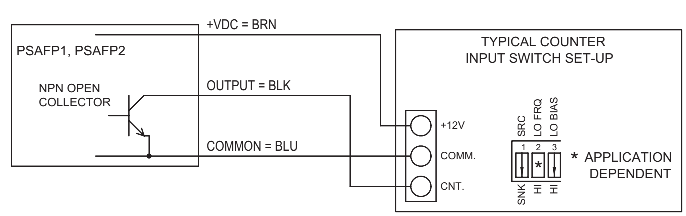
LED ON (GREEN) POWER ON
LED ON (YELLOW) OUTPUT ENERGIZED
LED ON (FLASHING GREEN) SHORT CIRCUIT WARNING

These Inductive Proximity Sensors have a maximum sensing distance of 0.078" (2 mm) and 0.393" (10 mm) respectively, and operate over a wide power supply range *(See Specifications Below)*. They are each housed in plastic with a top active face. The NPN transistor outputs are true open collector and are compatible with most Red Lion counter and rate meter input circuits. Maximum sensing frequencies are 2 KHz and 500 Hz respectively. In addition, the outputs are overload and short circuit protected. These sensors are shielded for flush mounting in metal applications.

PSAFP1 AND PSAFP2 SPECIFICATIONS

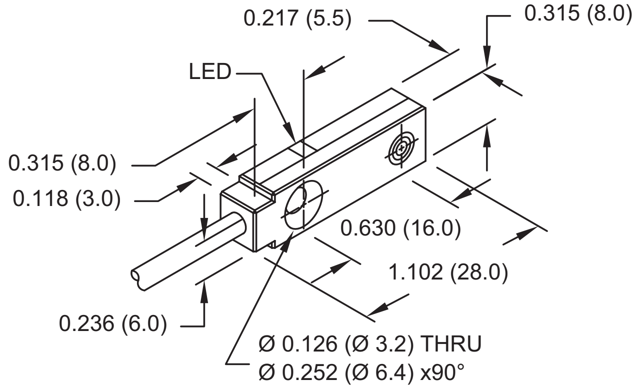
	PSAFP100	PSAFP200
1. Power Supply:	+10 to +30 VDC @ 15 mA max.	
	REVERSE POLARITY PROTECTION	
2. Maximum Switching Frequency:	2 KHz	500 Hz
3. Output:	NPN Open Collector Output, Overload and Short Circuit protected.	
	V_{SAT} = 1.8 V @ 150 mA max. load	V_{SAT} = 1.8 V @ 200 mA max. load
4. Maximum Sensing Distance:	0.078" (2 mm)	0.393" (10 mm)
5. Wire Color Code:	Brown = +VDC; Blue = Common; Black = Output	
6. Operating Temperature:	-25° to +85°C (-14° to +185°F)	-25° to +70°C (-14° to +158°F)
7. Construction:	NEMA 1, 3, 4, 6, 13 and IEC IP 67	
8. Trigger Current for Overload Protection:	170 mA	220 mA

TYPICAL HOOKUP

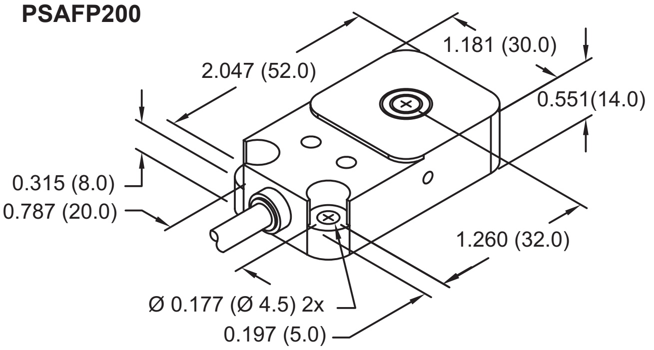


DIMENSIONS In inches (mm)

PSAFP100

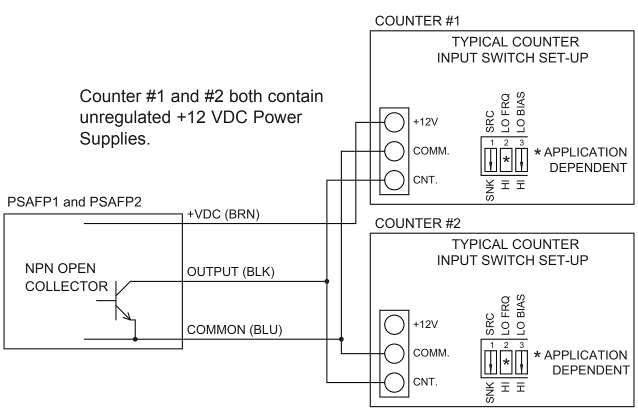


PSAFP200



Notes:
1. PSAFP100 Housing: Plastic, PA12-GF30
   Cable: 2 meter standard length
2. PSAFP200 Housing: Plastic, PBT-GF30-VO
   Cable: 2 meter standard length

PSAFP100 and PSAFP200 outputs are NPN open collector outputs. A PSAFP100 and PSAFP200 may be used as an input to more than 1 indicator or control only if the respective power supplies of each unit are "unregulated" and can load share. It is recommended to use only one power supply for sensor power. An indicator or control with a regulated power supply may not be paralleled.



SELECTION & APPLICATION OF PROXIMITY SENSORS

Selection of the proper proximity sensor depends on the size, material, and spacing of the target being sensed and the sensing distance that can be maintained. The maximum sensing distance is defined as the distance when the sensor is just close enough to detect a ferrous target whose diameter is equal to or greater than the sensor diameter. In actual application, the sensing distance should be between 50 to 80% of the maximum sensing range to assure reliable detection. For target sizes smaller than the sensor diameter, the maximum sensing distance can be estimated from the curve *(See Figure 3)*. A further reduction factor must also be applied if the target material is non-ferrous metal *(See Figure 4)*. Ideally, spacing between adjacent targets should be at least one sensor diameter so that the first target completely leaves the sensors field before the next target appears. Individual targets can still be resolved as separate objects if this spacing is reduced to 70 or 75% of the sensor diameter, however, this can introduce a minimum limit on sensing distance that makes adjustment more critical. All proximity sensors are internally shielded which allows the sensor face to be flush mounted in metal applications without reducing sensing distance. In applications where proximity sensors must be placed next to each other, a distance of at least 1 sensor diameter should separate sensors to eliminate any frequency interference *(See Mounting below)*.

MAXIMUM SENSING DISTANCE REDUCTION FACTORS

Reduction in the maximum sensing distance due to decrease in diameter of ferrous targets.

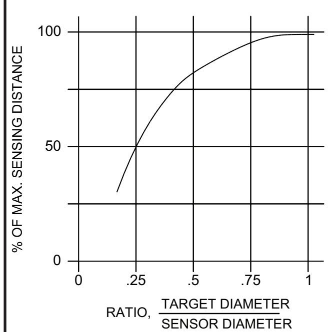


Figure 3

Typical reduction factors for various non-ferrous targets with diameters equal to or greater than sensor diameter.

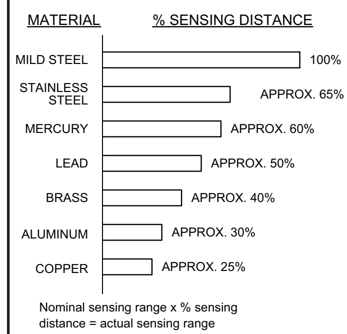
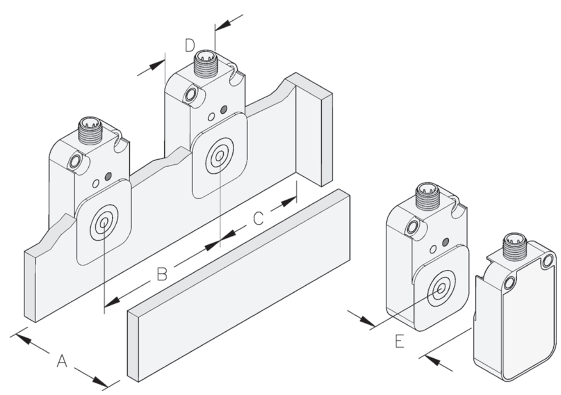


Figure 4

PSAFP200 MOUNTING

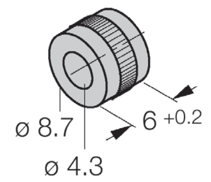


A	B	C	D	E
30.00 mm	45.00 mm	30.00 mm	30.00 mm	60.00 mm

MODELS MB7 & MB8 MOUNTING ACCESSORIES FOR PSAFP200

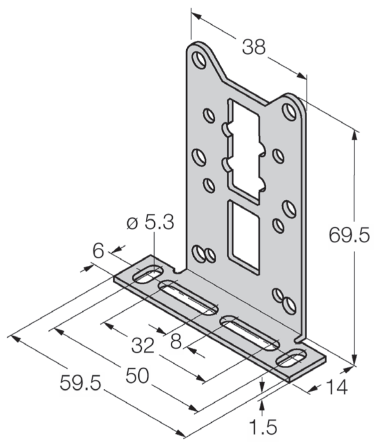
I

MB700000



- *MOUNTING SPACER*
- *FOR MOUNTING WITH ACTIVE FACE DOWNWARDS*
- *METAL, Cu2n*

MB800000



- *MOUNTING BRACKET*
- *STAINLESS STEEL: VA 1.4301*

The Model MB7 and MB8 mounting accessories are designed to provide easy mounting and adjustment of the PSAFP200.

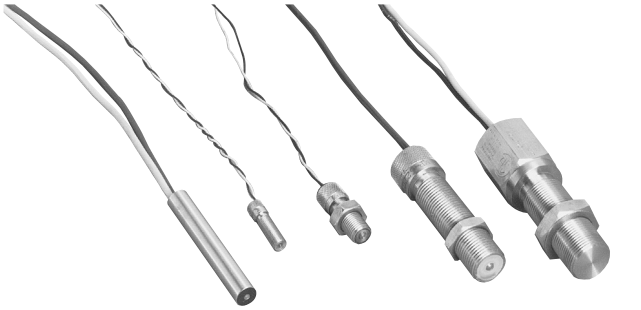
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PSAFP1	2 mm Flat Pack Rectangular Proximity Sensor	PSAFP100
PSAFP2	10 mm Flat Pack Rectangular Proximity Sensor	PSAFP200
MB7	Spacer for PSAFP200	MB700000
MB8	Mounting Bracket for PSAFP200	MB800000

Do not dispose of unit in trash - Recycle

MAGNETIC PICKUPS & IN-LINE PREAMPLIFIER

SIMPLE, RELIABLE & ECONOMICAL PULSE GENERATORS FOR:



SPEED SWITCHES
DIGITAL TACHOMETERS
FREQUENCY TO D.C. CONVERTERS

I

FEATURES INCLUDE

- *SELF-GENERATING, NO EXT. POWER NEEDED*
- *WIDE OPERATING TEMPERATURE RANGE*
- *EPOXY ENCAPSULATED, MECHANICALLY RUGGED*
- *IMPERVIOUS TO DIRT, OIL & WATER*
- *NO MAINTENANCE REQUIRED*
- *LOW COST*
- *M12 CONNECTOR (MODEL SPECIFIC)*

DESCRIPTION OF OPERATION

A Magnetic Pickup consists of a permanent magnet, a pole-piece, and a sensing coil all encapsulated in a cylindrical case. An object *(target)* of iron, steel, or other magnetic material, passing closely by its pole-piece causes distortion of the magnetic flux field passing through the sensing coil and pole-piece, which in turn generates a signal voltage. The magnitude of the signal voltage depends on the relative size of the magnetic target, its speed of approach, and how close it approaches. The polarity of the signal depends on whether the target is moving toward or away from the pole-piece.

Magnetic Pickups are most frequently used to sense passing teeth on a gear, sprocket, or timing belt wheel, to bolt-heads, key-ways, or other moving machine mounted targets. Typical targets and resulting signal wave forms are shown below in Fig. 1.

SELECTING A MAGNETIC PICKUP

Selecting a magnetic pickup is a matter of matching a pickup to a gear *(or other target)*, to provide enough input signal to a tachometer, speed-switch, or other device for operation at the required minimum speed. The open-circuit output from a magnetic pickup is directly proportional to speed, and once the minimum operating speed conditions have been met, excess signal will always be available at higher speeds.

The *"1-Volt Threshold Speed"* column in the Application and Ordering Table *(next pg.)* provides a convenient guide for estimating minimum operating speeds. This value is the linear surface-speed of a reference gear required to generate a 1-Volt peak, open-circuit output at an air-gap of 0.005". The reference gear listed for each pickup is near the optimum size for that pickup, as defined by the criteria in Fig. 1B. The RPM listed is for a reference gear with 60 teeth running at that surface-speed. Gears with larger teeth provide about the same or somewhat more output at the same surface-speed, while gears with smaller teeth or fewer number of teeth yield lower outputs. Figures 1C - 1F need a very high surface speed to generate a 1-Volt peak. The *"Minimum Gear Size"* column lists the Diametral Pitch size at which the output drops to 40-60% of the output when the reference gear is used. Gears with very small teeth in relation to the pole-piece diameter, deliver greatly reduced outputs, as shown in Fig. 1A. Threshold outputs when using targets other than gear teeth can be estimated by their relative size with respect to the reference gear teeth. For more information on gears, definitions and relationships, see the Sensing Gears Bulletin.

The 1-Volt Threshold Speeds are based on a 0.005" air-gap. In applications where this air-gap cannot be maintained or where the air-gap can vary due to eccentricity of the sensing gear, a correction factor can be applied from the curve in Fig 2. The effect of electrical loading is usually minimal at low speeds and low output frequencies, however, output voltage drop due to loading at high frequency or with low impedance inputs can be estimated based on the Output Impedance data.

Note: Magnetic Pickups are used primarily for tachometer and other speed related functions. They are not normally used for counting since loss of counts will occur at low speeds. Therefore, counters are not designed to accept outputs directly from conventional magnetic pickups. In special applications where counting occurs only at running speed or where low-speed count loss is acceptable, a Model ASTC can be used, or a different type of sensor can be used as a substitute.

TYPICAL APPLICATION EXAMPLE

A Digital Tachometer, with an input sensitivity of 0.25 V is to be used with a Magnetic Pickup and gear to indicate speed down to 75 RPM. What are the alternative choices?

Since the input voltage required by the tachometer is only 0.25 V, the surface speeds and reference gear RPM's required would only be 2 of the 1-Volt Threshold Speeds listed. The MP-25TA with a 60-tooth, 24 D.P. reference gear would obviously fall short since this combination will not develop 0.25 V until the reference gear speed reaches 250 RPM.

The MP-37CA with the 60-tooth, 20 D.P. reference gear would both prove suitable since they would deliver the required 0.25 V at 50 and 45 RPM respectively. They would also provide some additional margin for air-gap variation. The curve of Fig. 2 shows a typical output drop of about 25% when the air-gap is increased from 0.005" to 0.0075". Since the minimum operating speed in this application is 75 RPM, the additional sensitivity can be traded for a wider air-gap allowance.

The MP-62TA and MP-75TX with their respective reference gears would allow operation at even lower speeds. With both of these pickups it would be possible to drop to a smaller gear pitch for this application.

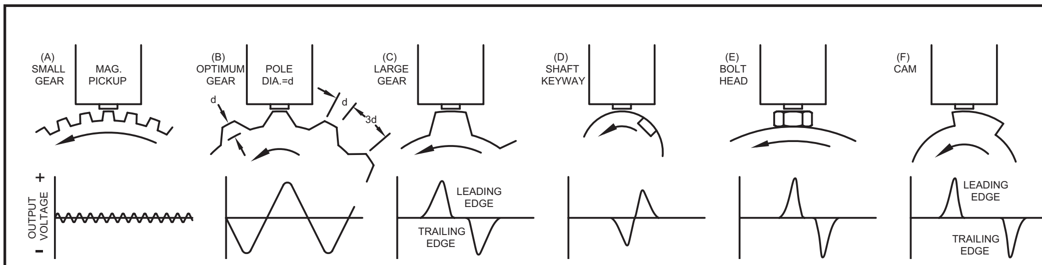


FIG. 1 OUTPUT WAVEFORMS WITH VARIOUS TARGET SHAPES & SIZES

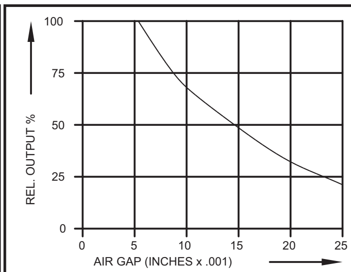
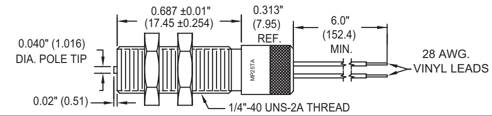
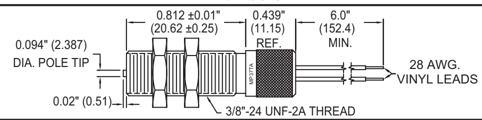
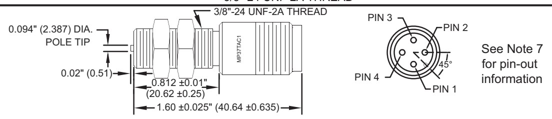
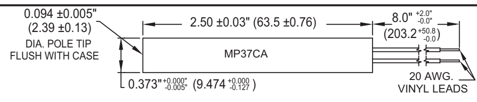
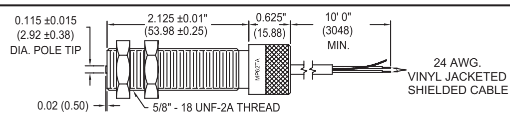
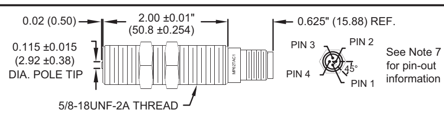
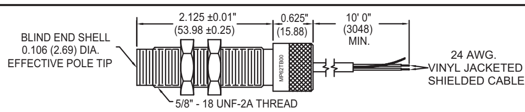
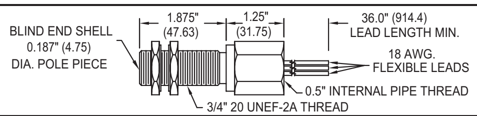


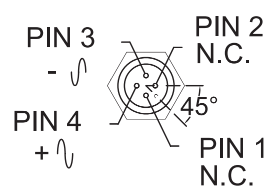
FIG. 2 TYPICAL OUTPUT/AIR-GAP

MAGNETIC PICKUP APPLICATION & ORDERING INFORMATION

MODEL NO.	DIMENSIONS	1-VOLT THRESHOLD SPEED (1)	MINIMUM GEAR PITCH (2)	TEMP. RANGE °C	OUTPUT IMPENDANCE	PART NUMBER
MP-25TA		135 in/sec 1000 RPM 60T 24 D.P. Ref. Gear	48 D.P.	-40 to +107	130 Ω ±20% 15 mH	MP25TA00
MP-37TA		33 in/sec 200 RPM 60T 20 D.P. Ref. Gear	32 D.P.	-40 to +107	340 Ω ±20% 44 mH	MP37TA00
MP-37TAC1		33 in/sec 200 RPM 60T 20 D.P. Ref. Gear	32 D.P.	-40 to +107	340 Ω ±20% 44 mH	MP37TAC1 *
MP-37CA		30 in/sec 180 RPM 60T 20 D.P. Ref. Gear	32 D.P.	-40 to +107	300 Ω ±30% 65 mH	MP37CA00
MP-62TA		10 in/sec 50 RPM 60T 16 D.P. Ref. Gear	24 D.P.	-40 to +107	1200 Ω ±20% 400 mH	MP62TA00
MP-62TAC1		10 in/sec 50 RPM 60T 16 D.P. Ref. Gear	24 D.P.	-40 to +107	1200 Ω ±20% 400 mH	MP62TAC1 *
MP-62TB		20 in/sec 100 RPM 60T 16 D.P. Ref. Gear	24 D.P.	-40 to +107	1200 Ω ±20% 400 mH	MP62TB00
MP-75TX Explosion Proof (3)		30 in/sec 100 RPM 60T 10 D.P. Ref. Gear	12 D.P.	-73 to +93	230 Ω ±20% 100 mH	MP75TX00

NOTES:

1) Surface speed of listed reference gear to produce 0.8 volt peak min., open-circuit output @ 0.005" air-gap.
2) Gear pitch where output will drop to 40-60% of that generated by the reference gear size, at the same surface speed.
3) UL Listed CSA Certified, Class I Group A, B, C and D; Class II Group E, F and G. (AI-TEK Instruments) PN#AIRPAX/70085-1010-005, UL File #E40545 (N), CSA File #042648.
4) Polarity, all pickups: white output lead goes positive with respect to black when target approaches pole.
5) 2-Wire shielded cable is recommended for all magnetic pickup outputs. Connect the shield to the *"COMMON"* or *"GROUND"* terminal of the instrument being used and leave the shield un-connected at the pickup. Magnetic Pickup signal leads should never be run in conduit, troughs, or bundles with other power or control voltage lines.
6) Lead length of magnetic pickup should not be extended. An in-line pre-amplifier (ASTC) can be placed on the end of the provided length which would allow longer length after the in-line pre-amplifier.
7) M12 unit color codes for 1 meter cable is:
   PIN 3 - Blue (-)
   PIN 4 - Black (+)
   PIN 2 - NC
   PIN 1 - NC



ORDERING INFORMATION

The following cables are for use with magnetic pickups MP37TAC1 and MP62TAC1, which have M12 connectors.

MODEL NO.	DESCRIPTION	PART NUMBERS
CCM	Mating Cable With M12 Connector, 1 Meter In Length	CCM12S01

Do not dispose of unit in trash - Recycle

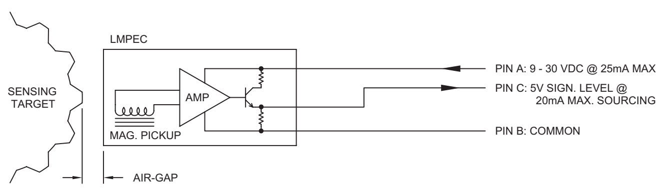
LOGIC MAGNETIC PICKUPS - SUPER-SENSITIVE MAGNETIC PICKUPS WITH CURRENT SINKING OUTPUT OR CURRENT SOURCING OUTPUT

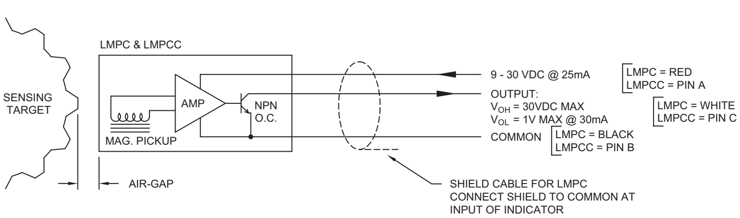
- *DETECTS STEEL SENSING GEARS OR OTHER MOVING FERROUS TARGETS*
- *BUILT-IN PULSE SHAPING AMPLIFIER PROVIDES ULTRA-LOW-SPEED OPERATION WITH LARGE AIR GAPS*
- *TWO OUTPUT SIGNAL VERSIONS*
- *3/4" DIAMETER STAINLESS STEEL CASE*
- *EPOXY ENCAPSULATED SENSOR FOR OIL, DIRT & MOISTURE RESISTANCE*

DESCRIPTION

LOGIC MAGNETIC PICKUPS (LMP's) provide sensing sensitivities several orders of magnitude greater than standard magnetic pickups when detecting moving ferrous targets. By locating a high gain pre-amplifier & signal processing circuit "inside" the mag pickup housing, larger airgaps and slower target surface speeds can be achieved thereby greatly expanding application versatility as compared with conventional mag pickups. In addition, these units have excellent noise immunity and a frequency response to 10 KHz. The stainless steel sensing pole is mounted flush to the plastic sensing face allowing greater ease of setting airgaps and eliminating snagging the pole with a moving target.

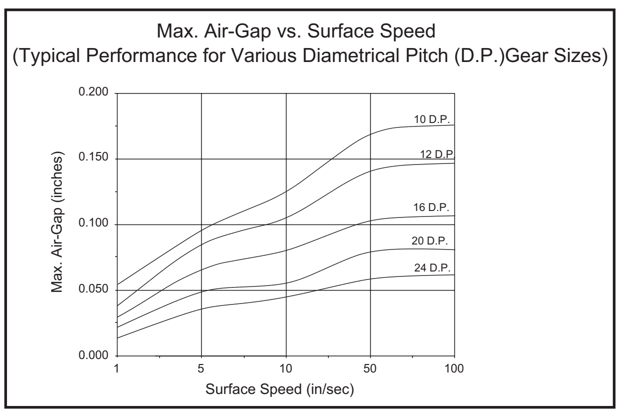
Two output types are available *(see ordering information)*. The **NPN Open Collector Transistor Output** unit provides a negative going current sinking output with the approach of a ferrous target and is current limited to 40 mA. The **Transistor Emitter-Follower Output** unit provides positive going 5 V pulses with the approach of a ferrous target and can source 20 mA of load current. The Open Collector units are available with either an integrally potted 10, 25 or 50 foot 3-wire shielded cable with neoprene strain relief boot or a polarized 3-pin 5/8"-24 threaded connector for quick change versatility *(see following page for mating extension cable)*. The Emitter-Follower output unit is available in the 3-pin connector version only.





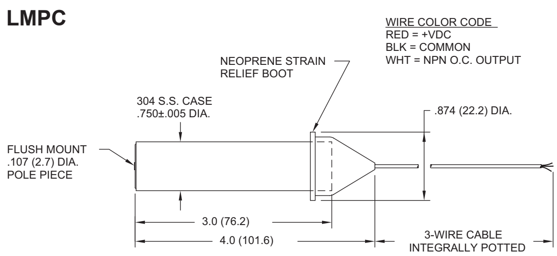
SPECIFICATIONS

1. **SUPPLY VOLTAGE (all versions):** +9 to +30 VDC @ 25 mA max.
2. **NPN OPEN COLLECTOR OUTPUT (LMPC & LMPCC):** V_{OH} = 30 VDC max.; V_{OL} = 1 Vmax. @ 30 mA, output current is limited to 40 mA.
3. **EMITTER-FOLLOWER OUTPUT (LMPEC):** +5 V signal level @ 20 mA max. current sourcing.
4. **OPERATING FREQUENCY (all versions):** 10 KHz max.
5. **OPERATING TEMPERATURE:** -18°C to +60°C (0°F to +140°F)
6. **CONSTRUCTION:** Epoxy encapsulated in 0.750" ±0.005" dia. #304 stainless steel case. Plastic sensing face with stainless steel sensing pole.
7. **OUTPUT CABLE (LMPC only):** Integrally potted 10, 25 or 50 ft. PVC jacketed, 3-wire 22 AWG conductors, with stranded shield and 100% foil shield coverage.
   RED = +VDC, **BLK** = COMMON, **WHT** = NPN O.C. OUTPUT
8. **OUTPUT CONNECTOR (LMPCC & LMPEC):** Polarized 5/8"-24 thread 3-pin connector.
   A = +VDC, **B** = COMMON, **C** = SIGNAL OUTPUT

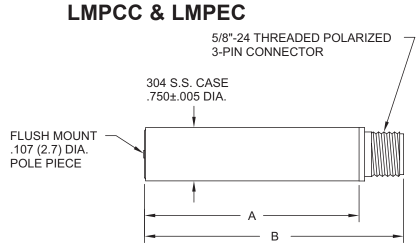


DIMENSIONS In inches (mm)

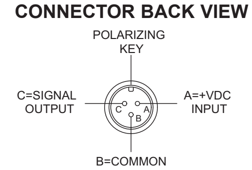
LMPC



LMPCC & LMPEC



CONNECTOR BACK VIEW

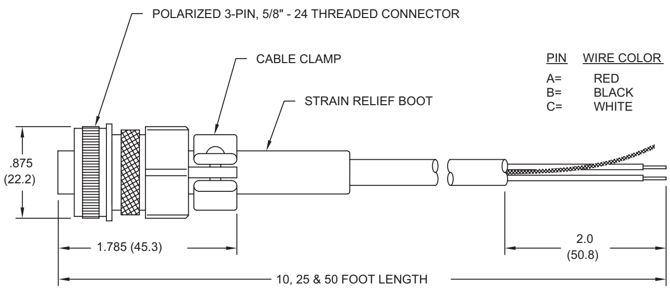


	DIMENSIONS	
MODEL	A	B
LMPCC	3.5" (88.9)	4.125" (104.8)
LMPEC	3.0" (76.2)	3.625" (92.1)

3-PIN CONNECTOR EXTENSION CABLE (LMPCC & LMPEC)

This cable and connector assembly *(see diagram below)* is composed of PVC jacketed, 3-wire 22 AWG conductors with stranded shield and 100% foil shield coverage for noise immunity and is oil and water resistant. Connector/cable junctions are silicone sealed. The 5/8"-24 threaded ring is fitted with an O-ring to make a moisture proof connection. Cable is available in 10, 25, or 50 foot lengths.

DIMENSIONS In inches (mm)



3-PIN CONNECTOR EXTENSION CABLE

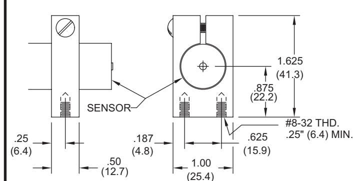
PVC jacketed, 3-wire, 22 AWG conductors with stranded shield and 100% foil shield coverage. There is no connection of stranded shield wire to 3-pin connector. Shield may be connected to instrument common for increased noise immunity.

3/4" DIAMETER CYLINDRICAL SENSOR MOUNTING

Logic Magnetic Pickups and other Red Lion Controls 3/4" dia. cylindrical pickups may be easily mounted using Model 5400100 **BLOCK MOUNT** *(see diagram below)*. This machined block of solid aluminum provides for rigid mounting using the two included #8-32 x 1/2" screws. The one screw split-clamp design allows for easy adjustment of airgap and locks the unit securely without deforming the case.

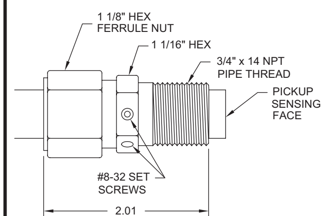
The **PLUG MOUNT** *(see diagram below)* allows 3/4" dia. cylindrical sensors to be mounted in "thru-wall" applications. The Plug Mounts 3/4-14 NPT thread is installed into a threaded wall or casing. The sensor is then installed through the plug mount. The sensor-to-target airgap is adjusted and the sensor is tightened into position by two #8-32 set screws. Tightening the ferrule nut compresses a teflon ferrule around the sensor providing an oil tight seal. Plug Mounts are available in both steel and stainless steel *(see ordering information)*.

BLOCK MOUNT



For 3/4" cylindrical sensors
Qty. 2 #8-32 x 1/2" Mounting screws included
P/N 5400100

PLUG MOUNT



For 3/4" cylindrical sensors

P/N 5403701 - steel
P/N 5403702 - stainless steel

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LMPC	Logic Magnetic Pickup, NPN O.C., 10 ft. Cable	LMPC0000
	Logic Magnetic Pickup, NPN O.C., 25 ft. Cable	LMPC0025
	Logic Magnetic Pickup, NPN O.C., 50 ft. Cable	LMPC0050
LMPCC	Logic Magnetic Pickup, NPN O.C., 3-Pin Connector	LMPCC000
LMPEC	Logic Magnetic Pickup, Emitter Follower, 3-Pin Connector	LMPEC000
	Block Mount for 3/4" Cylindrical Sensors	5400100
	Steel Plug Mount	5403701
	Stainless Steel Plug Mount	5403702
CCA3	3-Pin Connector without Cable	2500030
	3-Pin Connector with 10 ft. Cable	CCA3PC00
	3-Pin Connector with 25 ft. Cable	CCA3PC25
	3-Pin Connector with 50 ft. Cable	CCA3PC50

Do not dispose of unit in trash - Recycle

MODEL ARCJ - NEMA "C" FACE-MOUNTED MOTOR ADAPTER KITS

FOR CONVENIENT ADAPTATION OF SENSORS & SENSING GEARS TO GEAR CASE OR FOOT-MOUNTED NEMA "C" FACE MOTORS

DESCRIPTION

ARCJ Ring Adapters can be quickly and easily installed on foot-mounted motors with NEMA type *"C"* face mount end bells, or between motor and gear case flange.

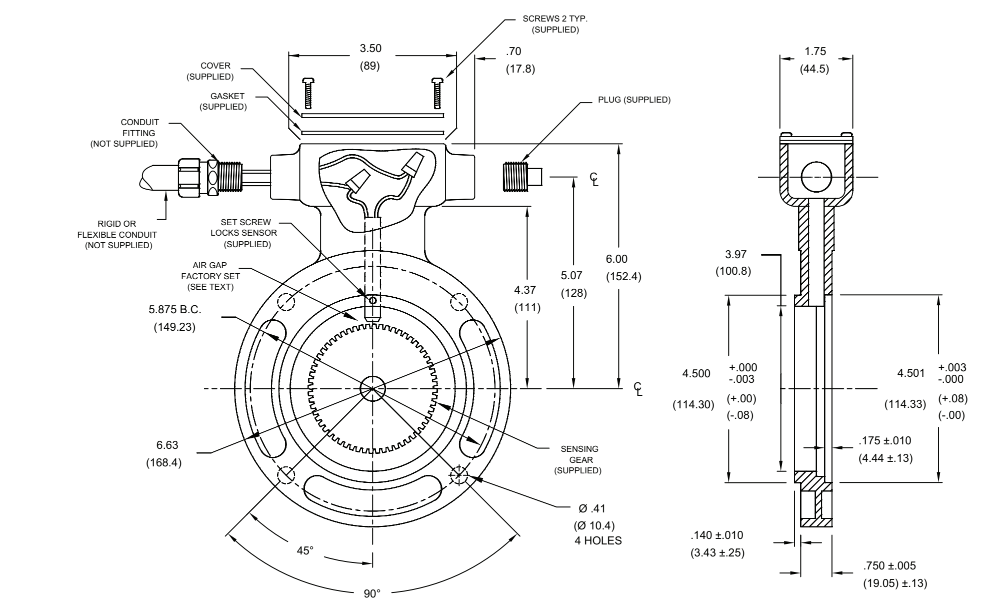
The ARCJ ring, with integral junction box, is cast aluminum with precision machined mounting surfaces. Kits are supplied complete with a 60-tooth sensing gear, factory installed magnetic pickup or HESS sensor, and mounting hardware. The maximum recommended gear speed for all kits is 5,000 RPM. Two ARCJ ring sizes and five gear bores cover the range of motor frame sizes as listed in the Ordering Information.

Wiring connections to the sensor are made by removing the gasketed junction box cover. Two threaded female (½" NPT) conduit connections are provided for right or left conduit entry (as shown in the Dimension drawing). A threaded plug is supplied with each kit for sealing the un-used conduit entry.

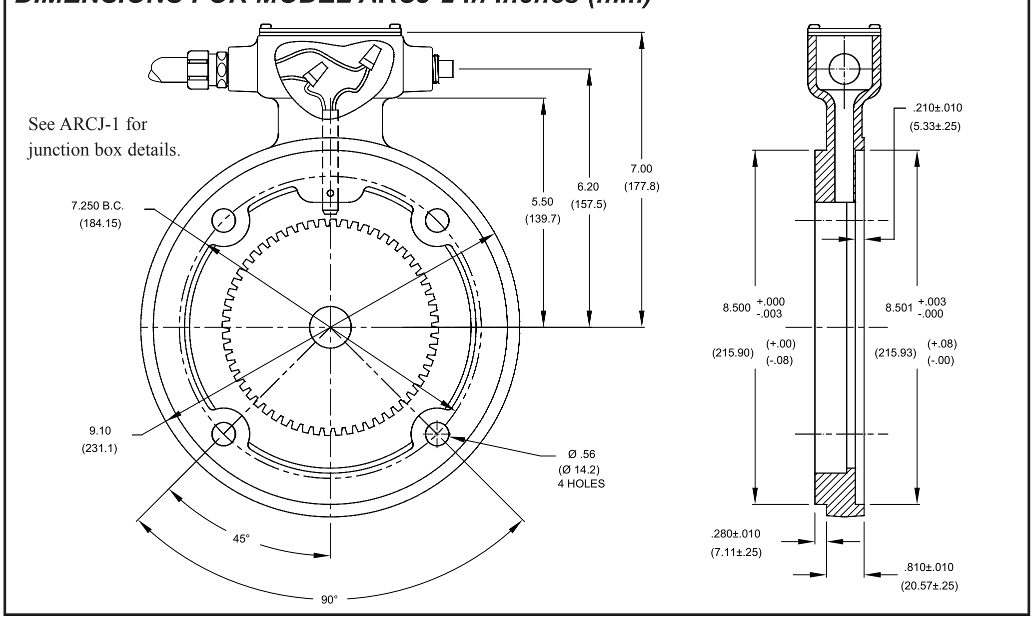
The 60-tooth steel sensing gear (kit supplied) results in direct RPM indication when used with a 1 second time-base rate indicator (tachometer).

Red Lion Controls rate indicators can be configured to provide a complete speed sensing and indication system. The following two sensor options (next page) are available with the ARCJ kits in order to meet a wide variety of applications.

DIMENSIONS FOR MODEL ARCJ-1 In Inches (mm)



DIMENSIONS FOR MODEL ARCJ-2 In Inches (mm)



MAGNETIC PICKUP SENSOR

The ARCJ kits with this sensor option use the Red Lion Controls MP-37CA Magnetic Pickup.This sensor does not require external power.

The Magnetic Pickup is factory installed in the ring to provide a nominal sensor/gear air gap of 0.007" *(0.18 mm)* to 0.010" *(0.25 mm)*. This provides adequate output from the sensor for most applications. However, if output must be maximized, the air gap can be easily user-adjusted to 0.005" *(0.13 mm)* minimum, once the particular gear being used is mounted on the motor shaft. *(Refer to Magnetic Pickup literature for more details, enclosed in ARCJ kits.)*

HALL EFFECT SPEED SENSOR (HESS)

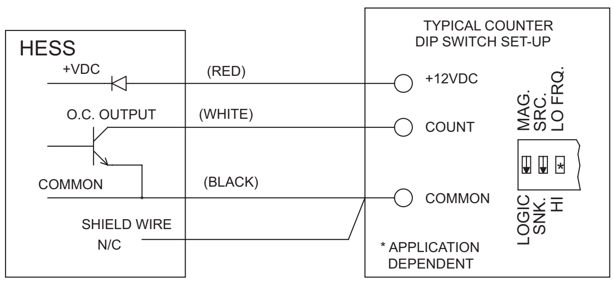
The ARCJ kits with the HESS sensor requires an external +8 to +30 VDC power source. This sensor does **NOT** have a minimum threshold speed as does a magnetic pickup sensor. However, when the sensor is first powered up, the output state is indeterminate when the sensor is not detecting metal. The sensor face can be mounted flush into metal panels. The case is stainless steel and is supplied with 10 feet (3 M) of cable. The stranded shield wire is not connected to the sensor circuit or the case.

The sensor to gear air gap is factory set to a nominal gap of 0.015" *(0.38 mm)*. The air gap can be adjusted by the user from 0.005" *(0.13 mm)* to 0.040" *(1.02 mm)*, which allows 0.005" *(0.13 mm)* maximum total gear runout.

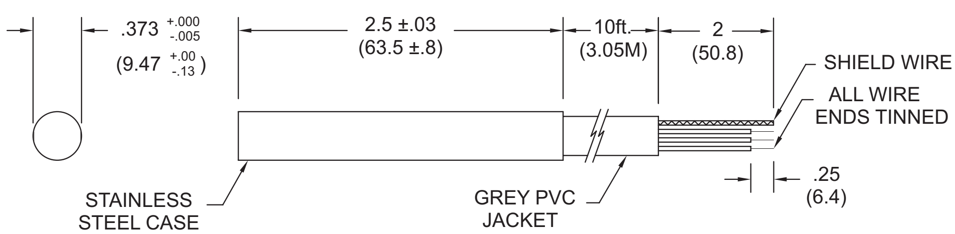
SPECIFICATIONS (HESS Sensor)

1. **POWER SUPPLY:** +8 to +30 VDC @ 30 mA max; Reverse Polarity Protected.
2. **MAXIMUM SENSING DISTANCE:** 0.040" *(1 mm)*.
3. **OUTPUT:** NPN O.C. transistor; V_{SAT} = 1 V max @ 30 mA max. load.
4. **OPERATING TEMPERATURE RANGE:** -25°C to 70°C *(-14°F to 158°F)*
5. **CABLE LENGTH:** 10 feet (3.05 M)
6. **OPERATING FREQUENCY:** 0 to 10 KHz
7. **WIRE COLOR CODE:** 3-wire, 22 AWG with stranded drain wire and 100% foil coverage; grey PVC jacket.
8. **CABLE STRAIN RELIEF:** 10 lbs *(4.5 Kg)* for 1 minute.

*Note: Do **NOT** adjust sensor air gap while target (gear) is moving.*



HESS DIMENSIONS In Inches (mm)



ORDERING INFORMATION

MOTOR FRAME SIZE	SHAFT DIA. (Gear Bore)	RING MODEL NO.	GEAR P/N (Ref.)	SENSOR MAG. PICKUP	SENSOR HESS	COMPLETE KIT PART NO.
56C	5/8"	ARCJ-1	0960625	X		ARCJ1A00
					X	ARCJ1AZ0
143TC, 145TC, 182C, 184C	7/8"	ARCJ-1	0960875	X		ARCJ1B00
					X	ARCJ1BZ0
182TC, 184TC, 213C, 215C, 254C	1 1/8"	ARCJ-2	0941125	X		ARCJ2A00
					X	ARCJ2AZ0
213TC, 215TC, 254UC, 256UC	1 3/8"	ARCJ-2	0941375	X		ARCJ2B00
					X	ARCJ2BZ0
254TC, 256TC	1 5/8"	ARCJ-2	0941625	X		ARCJ2C00
					X	ARCJ2CZ0

MODEL NO.	DESCRIPTION	PART NUMBER
HESS	Replacement Sensor for HESS Option	HESS0000
MP-37CA	Replacement Sensor for Magnetic Pickup Option	MP37CA00

Do not dispose of unit in trash - Recycle

MODEL ZR - C-FACE ENCODER WITH LINE DRIVER OUTPUT FOR MOTOR FEEDBACK

- THRU-SHAFT DESIGN FOR EASY MOUNTING
- EXCELLENT CHOICE FOR VECTOR MOTOR DRIVE CONTROL
- DESIGNED FOR INDUSTRIAL ENVIRONMENTS
- GASKET KIT INCLUDED
- QUADRATURE LINE DRIVER OUTPUT
- POSITIVE INDEX PULSE

DESCRIPTION

The Model ZR C-face encoder for motor feedback is a rugged, high resolution, high temperature (100°C) encoder designed to mount directly on NEMA C-face motors. The ZR contains a precision bearing and internal coupling that virtually eliminates inaccuracies induced by motor shaft runout. This encoder is ideal for applications using high performance AC vector motors.

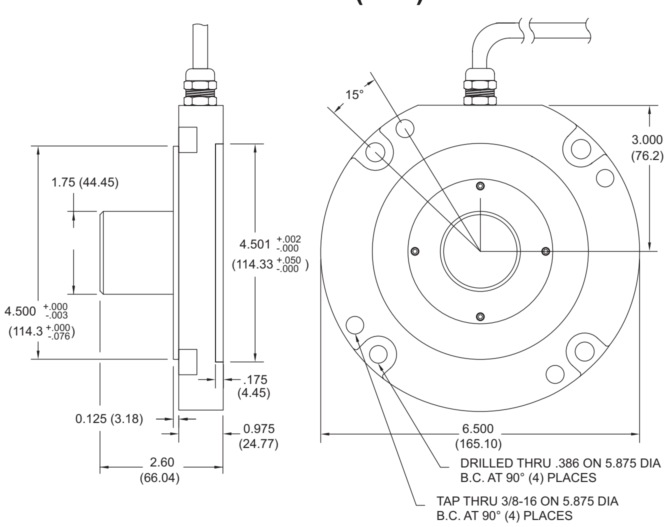
The thru-shaft design allows fast and simple mounting of the encoder directly to the accessory shaft or to the drive shaft of the motor, using the standard motor face (NEMA sizes 56C, 143TC, 145TC, 182C, 184C). The tough anodized aluminum housing with thru-shaft design resists the vibration and hazards of an industrial environment.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY:** 4.75 to 28 VDC, 40 mA current draw typical, 100 mA maximum.
2. **OUTPUT:** Quadrature Line driver, 20 mA max per channel (meets RS-422 at 5 VDC supply). Incremental - two square waves in quadrature with A leading B for clockwise shaft rotation. Positive pulse index.
   Note: Line driver outputs are intended for motion controllers that have line driver receivers.
3. **CYCLES PER REVOLUTION:** 1024 or 2048

DIMENSIONS In inches (mm)



4. **MAX. FREQUENCY**: 200 KHz
5. **NOISE IMMUNITY**: Tested to BS EN61000-4-2; IEC801-3; BS EN61000-4-4; DDENV 50141; DDENV 50204; BS EN55022; BS EN61000-6-2; BS EN50081-2
6. **SYMMETRY**: 180° (±18°) electrical
7. **QUAD PHASING**: 90° (±22.5) electrical
8. **MIN EDGE SEP**: 67.5° electrical
9. **RISE TIME**: Less than 1 microsecond

MECHANICAL SPECIFICATIONS

1. **MAX MECHANICAL SPEED**: 6000 RPM
2. **BORE DIAMETER:** 0.625" or 1.0"
3. **BORE TOLERANCE**: +0.0015"/-0.000"
4. **MOMENT OF INERTIA:** 3.3×10^{-3} oz-in-sec^2 typical
5. **USER SHAFT TOLERANCES**:
   Radial Runout:0.005"
   Axial Endplay: ±0.015"
6. **ELECTRICAL CONNECTION**: 10-pin MS type connector or 36" (914.4 mm) cable. 24 AWG foil and braid shield.

FUNCTION	PIN	CABLE WIRE COLOR
+VDC	D	RED
COM	F	BLACK
DATA A	A	WHITE
DATA A′	H	BROWN
DATA B	B	BLUE
DATA B′	I	VIOLET
DATA Z	C	ORANGE
DATA Z′	J	YELLOW
SHIELD	—	BARE

7. **HOUSING**: All metal construction
8. **MOUNTING**: NEMA 56C to 184C when proper bore size is selected
9. **WEIGHT**: 2.60 lb. (1.18 Kg) typical

ENVIRONMENTAL CONDITIONS

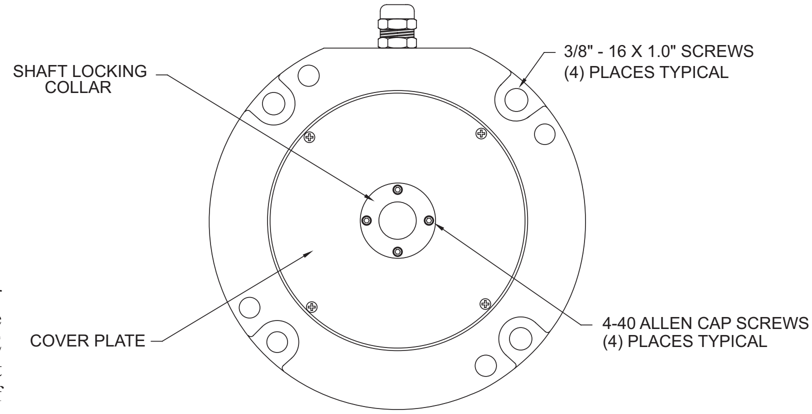
1. **OPERATING TEMPERATURE**:0 to +100°C @ 4.75 to 24 VDC
   0 to +70°C @ 4.75 to 28 VDC
2. **STORAGE TEMPERATURE**: -25 to +100°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 50 g @ 11 msec duration
6. **SEALING**: IP65 with included shaft cover and gaskets installed.

I

MOUNTING INSTRUCTIONS

Mounting Kit Items Included:
4 ea. - 3/8" 16 x 1.0" Length Socket Head Cap Screws, Black Alloy.
4 ea. - 3/8" High Collar Spring Lock washer, Steel Zinc.
1 ea. 3/32" Hex Allen Wrench, Long arm.

Note: The ZR encoder can mount to many types of C face devices. In these mounting instructions, we will refer to the device as a motor.



Step 1

After carefully unpacking the unit, inspect to insure the motor shaft is the correct size and free of all burrs or aberrations. Slide the ZR Encoder over the motor shaft. DO NOT USE EXCESSIVE FORCE: There is a rubber O-ring in the Encoder locking collar that will provide a small amount of resistance as it engages the shaft. If the encoder does not slide easily See Note 1 below.

Step 2

Install the four 3/8" 16 x 1.0" socket head cap screws with lock washers through the holes in the Encoder C face and tighten securely to the motor.

Step 3

Insure the shaft locking collar is flush with the Encoder cover plate. Prevent the motor shaft from turning (See Note 2 for additional information) and tighten the four 4-40 Allen head cap screws in the locking collar evenly in a crossing pattern. See Figure 1. Make sure the screws are securely tightened and the front of the locking collar remains flush with the encoder cover plate. If the collar does not turn true when the motor shaft is rotated, loosen the four screws and repeat the procedure.

In Case of Difficulty:

Note 1: Make sure the four 4-40 Allen head cap screws in the front of the Encoder locking collar are loose and the collar is not cocked or jammed. Clean the shaft of any burrs using fine crocus cloth. The O- ring in the Encoder locking collar may need a small amount of additional lubrication.

Note 2: When tightening the screws in the locking collar avoid holding the motor shaft with anything that may scar or burr the shaft.

ORDERING INFORMATION

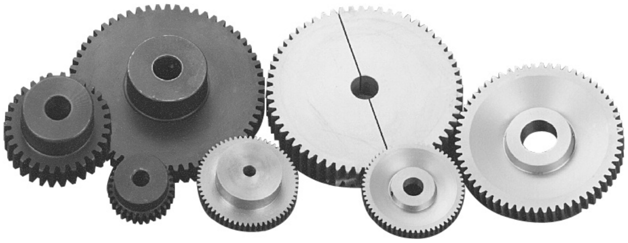
MODEL NO.	DESCRIPTION	PPR	BORE SIZE	CONNECTION	PART NUMBER
ZRJ	NEMA C Face Encoder 56C to 184C (Must select proper bore size)	1024	0.625	MS 10-Pin	ZRJ1024Z
		2048	0.625	MS 10-Pin	ZRJ2048Z
		1024	0.625	36" Pigtail	ZRJ1024R
		2048	0.625	36" Pigtail	ZRJ2048R
ZRL		1024	1.0	MS 10-Pin	ZRL1024Z
		2048	1.0	MS 10-Pin	ZRL2048Z
		1024	1.0	36" Pigtail	ZRL1024R
		2048	1.0	36" Pigtail	ZRL2048R

Only factory stocked part numbers are listed. Consult Factory for part number and availability of other PPR and output configurations.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
CCBRPG	10-Pin MS Connector	CCBRPG04
	10-Pin MS Connector with 10 ft 24 AWG 5 Conductor Cable w/drain	CCBRPG05
	10-Pin MS Connector with 20 ft 24 AWG 5 Conductor Cable w/drain	CCBRPG06

MACHINED STEEL SENSING GEARS FOR EXCITING SENSORS

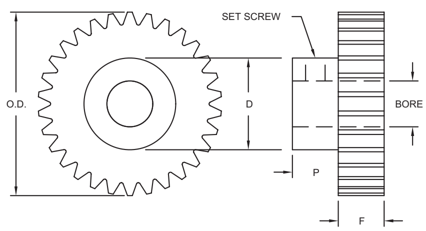


Sensing Gears are available in a variety of sizes to cover most applications where a sensor is to be used, but a suitable existing machine gear is not available. Split-type gears are convenient for use on machine drive shafts where a shaft-end is not available to mount a standard gear. Hubless gears are ideal for mounting in tight locations or when only a short shaft stub is available. Hub-type, Split, and Hubless gears can be supplied with special bores (See notes below Ordering Information & Dimensions table).

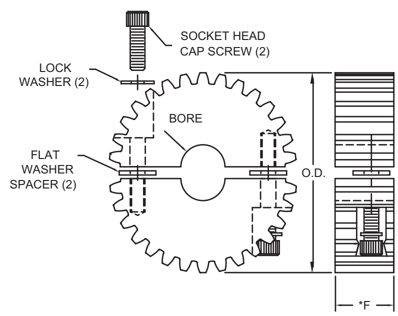
*Caution: RLC's machined steel sensing gears are **NOT** to be used as driving or driven gears in a power transmission system.*

I

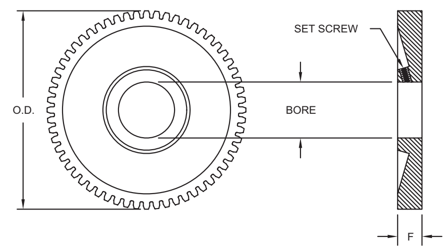
HUB TYPE GEARS



SPLIT GEARS



HUBLESS GEARS



ORDERING INFORMATION & DIMENSIONS

TYPE	NO. OF TEETH & DIAMETRAL PITCH	STOCK BORE +0.003" -0.000"	MAX. SPL. BORE +0.003" -0.000"	O.D. ±0.003"	HUB		FACE "F" ±0.010"	RECOMMENDED TORQUE FOR SET & CAP SCREWS	RECOMMENDED MAXIMUM GEAR SPEEDS	PART NUMBER
					± DIA "D" 0.010"	PROJ "P" ±0.020"				
HUB TYPE	30 T. 16 D.P.	0.500"	1.375"	2.000"	1.625"	0.500"	0.500"	25 in. lbs.	5000 RPM	0950500
	60 T. 20 D.P.	0.375"	1.750"	3.100"	2.000"	0.500"	0.375"	25 in. lbs.	5000 RPM	0970375
	60 T. 10 D.P.	0.875"	2.250"	6.200"	2.500"	0.875"	1.000"	55 in. lbs.	5000 RPM	0910875
SPLIT GEAR	30 T. 10 D.P.	0.750"	1.875"	3.200"			*1.000"	182 in. lbs.	3000 RPM	0920750
	60 T. 10 D.P.	0.875"	4.250"	6.200"			*1.000"	182 in. lbs.	1500 RPM	0930875
HUBLESS	60 T. 20 D.P.	0.625"	0.870"	3.100"			0.375"	25 in. lbs.	5000 RPM	0960625
	60 T. 20 D.P.	0.875"	0.875"	3.100"			0.375"	25 in. lbs.	5000 RPM	0960875
	60 T. 12 D.P.	1.125"	1.370"	5.160"			0.656"	40 in. lbs.	5000 RPM	0941125
	60 T. 12 D.P.	1.375"	1.620"	5.160"			0.656"	40 in. lbs.	5000 RPM	0941375
	60 T. 12 D.P.	1.625"	1.625"	5.160"			0.656"	40 in. lbs.	5000 RPM	0941625

* A portion of the teeth near the cap screws are milled away. However, at least ¼" of the teeth face width is available, allowing sensing of all teeth.

SPECIAL BORES: Hub-Type, Split, and Hubless gears can be supplied with special bore sizes between the Stock Bore and Max. Special Bore sizes listed above. To order Special Bores, substitute 9999 for the last 4 digits of the part number and specify special bore size required.

ASSEMBLY NOTE FOR SPLIT GEARS: When tightening the split gear halves on a shaft, it is recommended that the flat washer spacers be used to help keep the gap between halves equal.

Run-out should be checked after installation is complete. Always use the supplied lock washers when tightening the socket head cap screws. Torque these screws to 182 in. lbs.

STANDARD SPUR GEAR DEFINITIONS, RELATIONSHIPS & FORMULA

Gear parameters are fundamentally related to their use as power transmission elements. Although these parameters are not the most convenient when using gears to excite magnetic pickups, they can be easily converted to more useful form, once the basic definitions are understood.

I

PITCH DIAMETER (P.D.) - The diameter of the circle described by the tooth-to-tooth contact point when running in mesh with the teeth of another gear. This point is roughly half way between the root (bottom) and the tip of the gear tooth. The Pitch Diameter is slightly smaller than the outside diameter of the gear.

DIAMETRAL PITCH (D.P.) - The number of teeth/inch of Pitch Diameter. Thus a 20 D.P. gear has 20 teeth for each inch of Pitch Diameter. A 60-tooth, 20 D.P. gear would have a pitch diameter of 3', a 60T, 10 D.P. gear has a Pitch Diameter of 6'.

PRESSURE ANGLE - Pressure angle relates to tooth shape and strength. It has no significant effect on the operation of the gear for exciting magnetic pickups, and pickups can be used with gears of any pressure angle.

OUTSIDE DIAMETER (O.D.) - The outside diameter is the overall diameter of the gear to the tops of the teeth, and is used for calculating surface speed when the gear is used to excite a magnetic sensor. The O.D. can be determined from the following formula:

$$\text{O.D.} = \frac{\text{RPM x Nt}}{60}$$

Example: A 60T, 16 D.P. Gear has an O.D. of:

$$\text{O.D.} = \frac{10 \text{ x } 60}{3.1 \text{ x } \pi} = 3.875 \text{ inches}$$

SURFACE SPEED - The output of a magnetic pickup depends on the linear surface speed of the tops of the passing gear teeth. Surface speed is normally expressed in inches/sec. and can be calculated for a given gear as follows:

$$\text{Surface Speed in inches /sec.} = \frac{50 \text{ x } 3.1 \text{ x } \pi}{60}$$

$$\textbf{or}; \quad \text{RPM} = \frac{60 + 2}{20}$$

Example: What is the surface speed of the 60T, 20 D.P. Gear when running at 50 RPM? At what RPM will the 1-Volt Threshold Speed (10 inches/sec.) for the MP-62TA be realized?

$$\text{Gear O.D.} = \frac{\text{Surface Speed x 60}}{\text{O.D. x } \pi} = 3.1\text{" (From O.D. formula above)}$$

$$\text{Surface Speed} = \frac{\text{RPM x O.D. x } \pi}{60} = 8.115 \text{ inches /sec.}$$

$$\text{1-Volt Threshold RPM (@ 10 in/sec.)} = \frac{60 + 2}{16} = 61.61 \text{ RPM}$$

OUTPUT SIGNAL FREQUENCY - The frequency generated by passing gear teeth is related to gear RPM and the number of gear teeth (Nt) by the following:

$$\text{Output frequency (Hz or teeth/sec.)} = \frac{\text{Nt(No. of teeth) + 2}}{\text{D.P. (Diametral Pitch)}}$$

MODELS ZUJ AND ZUL - LARGE THRU-BORE Rotary pulse generators FOR MOTOR FEEDBACK

I

GENERAL DESCRIPTION

The ZUJ and ZUL are high performance units that are ideal for fast revving motor mount applications. The injection molded housing is grooved with “cooling fins”, and can take the extreme heat of the motion control industry.

The unit comes equipped with a 3.5" to 5.90" B.C. tether arm to mount to a 4.5" motor face.

This revolutionary encoder can also be adapted to various standard and metric sized motor shafts by using individual sleeves (Sold separately).

Electrically the unit offers line driver outputs, limited to 20 mA per channel. The outputs are standard quadrature with index and are also available with reverse phasing for the typical motor drive controller application. The separation is 90° with output A leading output B for clockwise rotation. Output B leads output A for the reverse phased output, for clockwise rotation.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE**: 4.75 to 28 VDC @ 100 mA max. -20°C to 85°C; 4.75 to 24 VDC @ 100 mA max. -20°C to 105°C
2. **OUTPUTS**: Line driver, V_{OH} = 40 VDC max.; 20 mA max. current. Incremental - two square waves with A leading B for clockwise rotation. B leads output A for the reverse phased.
   Note: Line driver outputs are intended for motion controllers that have line driver receivers.
3. **MAX. PULSE RATE**: 250 KHz
4. **INDEX:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Once per revolution centered over output Channel A. Index is a positive going pulse.
5. **MINIMUM EDGE SEPARATION**: 45° electrical min, 63° electrical or better typical
6. **RISE TIME**: Less than 1 microsecond
7. **ACCURACY**: Within 0.1° mechanical from one cycle to any other cycle, or 6 arc minutes.

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 4000 RPM
2. **BORE SIZE**: 0.625" or 1.0" (15.875 or 25.4 mm)
3. **BORE TOLERANCES**: -0.0000"/+0.0008"
4. **USER SHAFT TOLERANCES**:
   Radial Runout: 0.005" max
   Axial Endplay: +/- 0.050" max
5. **MAXIMUM ACCELERATION**: $1X10^5$ rad/sec^2
6. **STARTING TORQUE**: 4.0 oz-in typical (28.24 N-mm)
7. **MOMENT OF INERTIA**:
   7.6×10^{-4} oz-in-sec^2
8. **ELECTRICAL CONNECTOR**: 10-pin MS type connector

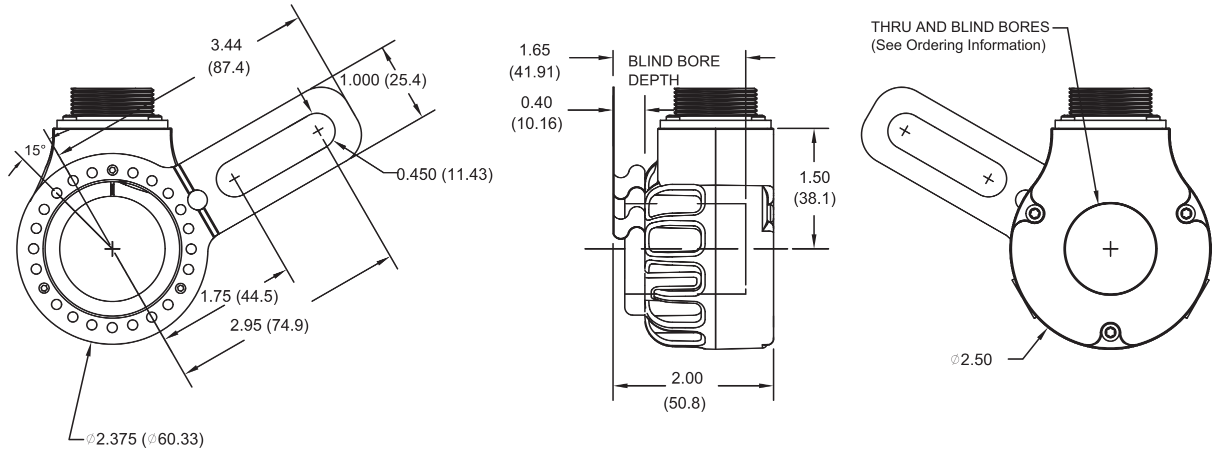
FUNCTION	PIN	CABLE WIRE COLOR
+VDC	D	RED
COM	F	BLACK
DATA A	A	WHITE
DATA A′	H	BROWN
DATA B	B	BLUE
DATA B′	I	VIOLET
DATA Z	C	ORANGE
DATA Z′	J	YELLOW
SHIELD	-	BARE
N/A	G	GREEN

9. **HOUSING**: Proprietary nylon composite
10. **MOUNTING**: 3.5" to 5.90" B.C. (4.5" C-Face) tether arm kit
11. **WEIGHT**: 8 oz. (226.7 g)

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 105°C (See Supply Voltage)
2. **STORAGE TEMPERATURE**: -20°C to 85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 20 g @ 5 to 2000 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP66

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZUJ	0.625" Thru-Bore Rotary Pulse Generators For Motor Feedback	1024	ZUJ1024Z
		2048	ZUJ2048Z
ZUL	1" Thru-Bore Rotary Pulse Generators For Motor Feedback	1024	ZUL1024Z
		2048	ZUL2048Z

Only factory stocked part numbers are listed. Consult Factory for part number and availability of other PPR and output configurations.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
CCBRPG	10-Pin MS Connector	CCBRPG04
	10-Pin MS Connector with 10 ft 24 AWG 9 Conductor Cable w/drain	CCBRPG05
	10-Pin MS Connector with 20 ft 24 AWG 9 Conductor Cable w/drain	CCBRPG06
RPGBSI	0.500 Inch Bore Sleeve	RPGBSI00
	0.625 Inch Bore Sleeve	RPGBSI01
	0.750 Inch Bore Sleeve	RPGBSI02
	0.875 Inch Bore Sleeve	RPGBSI03
RPGBSM	19 mm Bore Sleeve	RPGBSM00
	20 mm Bore Sleeve	RPGBSM01
	24 mm Bore Sleeve	RPGBSM02
	25 mm Bore Sleeve	RPGBSM03
RPGMK	Standard Tether Arm Kit 4.5 Inch	RPGMK002
	Elongated Tether Arm Kit 8.5 Inch	RPGMK003
RPGMB *	Magnetic Coupling Kit (0.625 inch shaft)	RPGMB001
RPGPC	56C Protective Cover	RPGPC000

** ZUL encoders require 0.625 " bore sleeve to accomodate magnetic coupling.*

Do not dispose of unit in trash - Recycle

MODEL ZR - C-FACE ENCODER WITH NPN OPEN COLLECTOR OUTPUT

- *THRU-SHAFT DESIGN FOR EASY MOUNTING*
- *EXCELLENT CHOICE FOR VECTOR MOTOR DRIVE CONTROL*
- *DESIGNED FOR INDUSTRIAL ENVIRONMENTS*
- *QUADRATURE OUTPUT*
- *POSITIVE INDEX PULSE*
- *C-FACE GASKET KIT INCLUDED*

DESCRIPTION

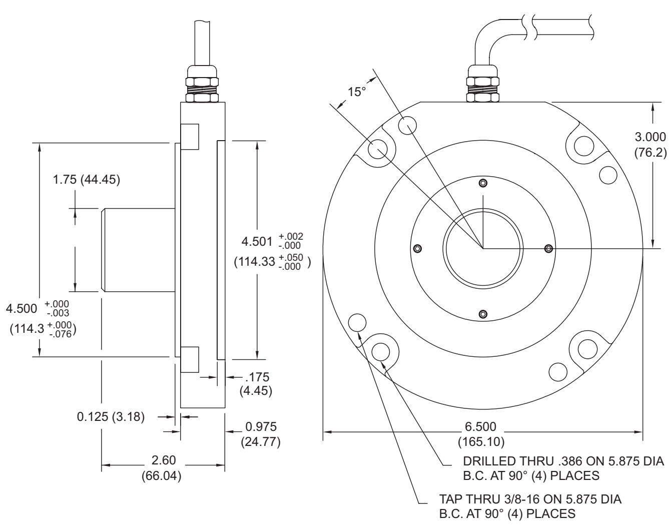
The Model ZR C-face encoder is a rugged, high resolution, high temperature (100°C) encoder designed to mount directly on NEMA C-face motors. The ZR contains a precision bearing and internal coupling that virtually eliminates inaccuracies induced by motor shaft runout. This encoder is ideal for applications using high performance AC vector motors.

The thru-shaft design allows fast and simple mounting of the encoder directly to the accessory shaft or to the drive shaft of the motor, using the standard motor face (NEMA sizes 56C, 143TC, 145TC, 182C, 184C). The tough anodized aluminum housing with thru-shaft design resists the vibration and hazards of an industrial environment. In addition, a C-face gasket kit is included free for motor shaft protection and enclosure.

Open Collector Output Wiring

The ZR series of sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be "pulled up" to external voltages different than the encoder supply voltage (40 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

DIMENSIONS In inches (mm)



SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY:** 4.75 to 28 VDC, 40 mA current draw typical, 100 mA maximum.
2. **OUTPUT:** NPN Open Collector transistor , V_{OH} = 40 VDC max.; 100 mA max. current. Incremental - two square waves in quadrature with A leading B for clockwise rotation. Positive pulse index.
3. **CYCLES PER REVOLUTION:** 256 or 1024
   Note: Review the max. input rate of the RLC counter being used. The high output rate of the 1024 version will quickly reach the max. input capability of RLC quadrature counters. At 1024 PPR, high pulse rates are reached at low RPM.
4. **MAX. FREQUENCY**: 200 KHz
5. **NOISE IMMUNITY**: Tested to BS EN61000-4-2; IEC801-3; BS EN61000-4-4; DDENV 50141; DDENV 50204; BS EN55022; BS EN61000-6-2; BS EN50081-2
6. **SYMMETRY**: 180° (±18°) electrical
7. **QUAD PHASING**: 90° (+22.5) electrical
8. **MIN EDGE SEP**: 67.5° electrical
9. **RISE TIME**: Less than 1 microsecond

MECHANICAL SPECIFICATIONS

1. **MAX MECHANICAL SPEED**: 6000 RPM
2. **BORE DIAMETER:** 0.625" or 1.0"
3. **BORE TOLERANCE**: +0.0015"/-0.000"
4. **MOMENT OF INERTIA:** 3.3×10^{-3} oz-in-sec^2 typical
5. **USER SHAFT TOLERANCES**:
   Radial Runout:0.005"
   Axial Endplay: ±0.015"
6. **ELECTRICAL CONNECTION**: 36" (914.4 mm) cable. 24 AWG foil and braid shield.

FUNCTION	WIRE COLOR
+ VDC	RED
COMMON	BLACK
DATA A	WHITE
DATA B	GREEN
INDEX Z	ORANGE

7. **HOUSING:** All metal construction.
8. **MOUNTING**: NEMA 56C to 184C when proper bore size is selected
9. **WEIGHT**: 2.60 lb. (1.18 Kg) typical

ENVIRONMENTAL CONDITIONS

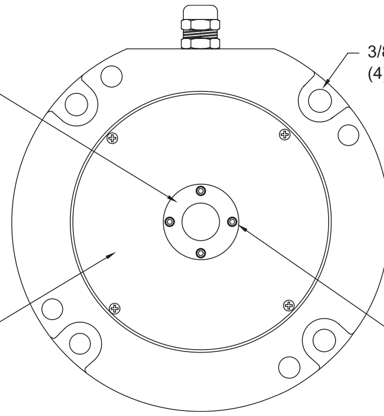
1. **OPERATING TEMPERATURE**: 0 to +100°C @ 4.75 to 24 VDC
   0 to +70°C @ 4.75 to 28 VDC
2. **STORAGE TEMPERATURE**: -25 to +100°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 50 g @ 11 msec duration
6. **SEALING**: IP65 with included shaft cover and gaskets installed.

MOUNTING INSTRUCTIONS

Mounting Kit Items Included:

4 ea. - 3/8" 16 x 1.0" Length Socket Head Cap Screws, Black Alloy.
4 ea. - 3/8" High Collar Spring Lock washer, Steel Zinc.
1 ea. 3/32" Hex Allen Wrench, Long arm.

Note: The ZR encoder can mount to many types of C face devices. In these mounting instructions, we will refer to the device as a motor.



Step 1

After carefully unpacking the unit, inspect to insure the motor shaft is the correct size and free of all burrs or aberrations. Slide the ZR Encoder over the motor shaft. DO NOT USE EXCESSIVE FORCE: There is a rubber O-ring in the Encoder locking collar that will provide a small amount of resistance as it engages the shaft. If the encoder does not slide easily See Note 1 below.

Step 2

Install the four 3/8" 16 x 1.0" socket head cap screws with lock washers through the holes in the Encoder C face and tighten securely to the motor.

Step 3

Insure the shaft locking collar is flush with the Encoder cover plate. Prevent the motor shaft from turning (See Note 2 for additional information) and tighten the four 4-40 Allen head cap screws in the locking collar evenly in a crossing pattern. See Figure 1. Make sure the screws are securely tightened and the front of the locking collar remains flush with the encoder cover plate. If the collar does not turn true when the motor shaft is rotated, loosen the four screws and repeat the procedure.

In Case of Difficulty:

Note 1: Make sure the four 4-40 Allen head cap screws in the front of the Encoder locking collar are loose and the collar is not cocked or jammed. Clean the shaft of any burrs using fine crocus cloth. The O- ring in the Encoder locking collar may need a small amount of additional lubrication.

Note 2: When tightening the screws in the locking collar avoid holding the motor shaft with anything that may scar or burr the shaft.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	BORE SIZE	PART NUMBER
ZR	NEMA C Face Encoder 56C to 184C (Must select proper bore size)	256	0.625	ZRJ0256A
		1024	0.625	ZRJ1024A
		256	1.0	ZRL0256A
		1024	1.0	ZRL1024A
		256	0.875	ZRI0256A *
		1024	0.875	ZRI1024A *

** Replaces ARC1. Available by special order, consult factory.*

MODEL ZSD - 0.25" SHAFT STANDARD SERVO MOUNT ROTARY PULSE GENERATOR

GENERAL DESCRIPTION

The Model ZSD encoder is ideal for applications requiring a miniature, high precision, low cost encoder, designed with all metal construction for years of trouble-free operation.

The NPN Open Collector outputs are each current limited to 20 mA. The outputs are standard quadrature with index, available in resolutions up to 2500 pulses per shaft revolution. The quadrature separation is typically 90 electrical degrees. Output A leads output B for clockwise rotation of the encoder shaft.

Open Collector Output Wiring

The ZSD sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages (30 VDC max.) different than the encoder supply voltage. NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE**: 4.75 to 28 VDC, 100 mA max. with no output load
2. **OUTPUTS**: NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - Two square waves in quadrature with Channel A leading Channel B for clockwise rotation.
3. **MAX. FREQUENCY**: 200 KHz
4. **INDEX**: NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Once per revolution centered over Output Channel A. Index is a positive going pulse.
5. **NOISE IMMUNITY**: Tested to BS EN61000-6-2; BS EN50081-2; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-6; BS EN500811
6. **SYMMETRY**: 180° (±18°) electrical
7. **QUAD PHASING**: 90° (±22.5°) electrical
8. **MIN EDGE SEP**: 67.5° electrical
9. **ACCURACY**: Within 0.017° mechanical or 1 arc minute from true position (for PPR>189)

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 8000 RPM
2. **SHAFT SIZE**: 0.25" (6.33 mm)
3. **RADIAL SHAFT LOAD**: 5 lbs. max. (2.25 kg)
4. **AXIAL SHAFT LOAD**: 5 lbs. max. (2.25 kg)
5. **STARTING TORQUE**: 0.4 oz-in. (2.82 N-mm)
6. **MOMENT OF INERTIA**: 6.7 x 10^{-5} oz-in-sec^2 (4.8 gm-cm^2)
7. **ELECTRICAL CONNECTION**: 36" (914.4 mm) cable. 24 AWG foil and braid shield.

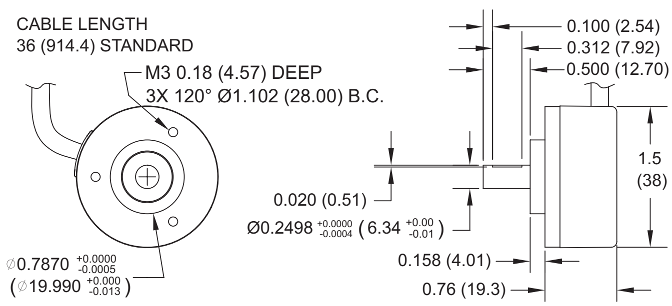
FUNCTION	WIRE COLOR
+VDC	Red
Common	Black
Data A	White
Data B	Green
Index Z	Orange

8. **WEIGHT**: 3 oz. (85.0 g)

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 85°C
2. **STORAGE TEMPERATURE**: -25°C to +85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP64

DIMENSIONS In inches (mm)



ORDERING INFORMATION

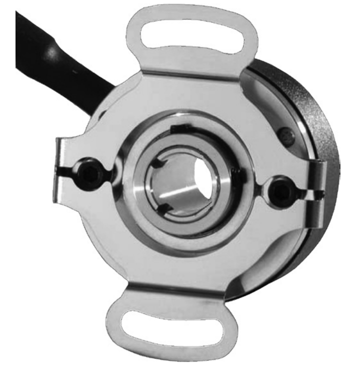
MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZSD	0.25" Shaft Standard Servo Mount Rotary Pulse Generators	60	ZSD0060A
		100	ZSD0100A
		500	ZSD0500A
		600	ZSD0600A
		1000	ZSD1000A
		1200	ZSD1200A
		2000	ZSD2000A
		2500	ZSD2500A

Only factory stocked part numbers are listed. Consult the factory for part number and availability of other PPR and output configurations.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
RPGFC	Flexible Coupling (1" Length) 0.25" - 0.25"	RPGFC001
	Flexible Coupling (1" Length) 0.25" - 0.375"	RPGFC002
	Flexible Coupling (1" Length) 0.25" - 6 mm	RPGFC005

MODELS ZOD AND ZOH - THRU-BORE Rotary pulse generators
(ZOH Replaces the Model RPGO)



GENERAL DESCRIPTION

The Model ZOD and ZOH are Thru-Bore Encoders. The ZOD has a bore of 0.25" (6.35 mm) and the ZOH is a 0.375" (9.5 mm) bore. These units are ideal for applications requiring a miniature, high precision, low cost encoder, designed with all metal construction for years of trouble-free operation.

The encoders have a flexible butterfly mount and blind hollow shaft. These encoders use two set screws that are 90° apart to clamp the encoder's hub to the motor shaft. The NPN Open Collector outputs are each current limited to 100 mA. The outputs are standard quadrature with index, and are available in resolutions up to 2500 pulses per shaft revolution. The quadrature separation is typically 90 electrical degrees. Output A leads output B for clockwise rotation of the encoder shaft.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE:** 4.75 to 28 VDC, 100 mA max. with no output load
2. **OUTPUTS:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - Two square waves in quadrature with A leading B for clockwise rotation.
3. **MAX. FREQUENCY**: 200 KHz
4. **INDEX:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Once per revolution centered over output Channel A. Index is a positive going pulse.
5. **NOISE IMMUNITY**: Tested to BS EN61000-6-2; BS EN50081-2; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-6; BS EN500811
6. **SYMMETRY**: 180° (±18°) electrical
7. **QUAD PHASING**: 90° (±22.5°) electrical
8. **MIN EDGE SEP**: 67.5° electrical
9. **ACCURACY**: Within 0.017° mechanical or 1 arc minute from true position (for PPR>189)

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 8000 RPM
2. **BORE SIZE**:
   ZOD: 0.25" (6.35 mm)
   ZOH: 0.375" (9.5 mm)
3. **BORE TOLERANCE**: -0.0000"/+0.0006"
4. **USER SHAFT TOLERANCES**:
   Radial Runout: 0.008" max
   Axial Endplay: +/- 0.030" max
5. **STARTING TORQUE**: 0.6 oz-in (4.24 N-mm)
6. **MOMENT OF INERTIA**:
   6.7×10^{-5} oz-in-sec^2 (4.8 gm-cm^2)
7. **ELECTRICAL CONNECTIONS**:
   Cable is 36" (914.4 mm) in length with 24 AWG conductors w/shield.

FUNCTION	WIRE COLOR
+VDC	Red
Common	Black
Data A	White
Data B	Green
Index Z	Orange

8. **MOUNTING**: 1.811 (46 mm) slotted flex mount
9. **WEIGHT**: 3 oz. (85.0 g)

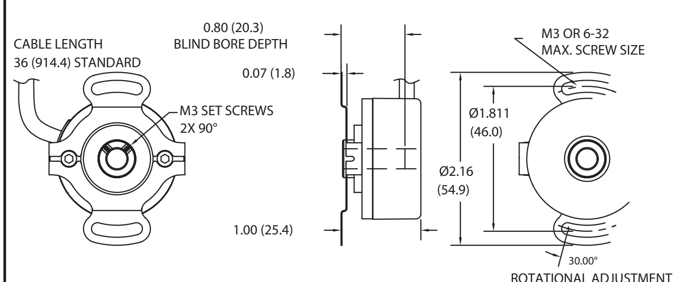
ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 85°C
2. **STORAGE TEMPERATURE**: -25°C to +85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP64

Open Collector Output Wiring

The ZOD and ZOH encoders have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be "pulled up" to external voltages different than the encoder supply voltage (30 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

DIMENSIONS In inches (mm)



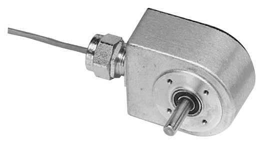
ORDERING INFORMATION

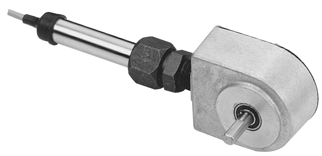
MODEL NO.	DESCRIPTION	PPR	PART NUMBER	
			0.25" Thru-Bore	0.375" Thru-Bore
ZOD & ZOH	Thru-Bore Rotary Pulse Generators	60	ZOD0060A	ZOH0060A
		100	ZOD0100A	ZOH0100A
		500	ZOD0500A	ZOH0500A
		600	ZOD0600A	ZOH0600A
		1000	ZOD1000A	ZOH1000A
		1200	ZOD1200A	ZOH1200A
		2000	ZOD2000A	ZOH2000A
		2500	ZOD2500A	ZOH2500A

Only factory stocked part numbers are listed. Consult factory for part number and availability of other PPR and output configurations.

MODEL ZCG - SINGLE CHANNEL OUTPUT ROTARY PULSE GENERATOR
MODEL ZFG and ZGG - SINGLE CHANNEL OUTPUT LENGTH SENSORS
(Replaces MODELS RPGC, LSCS and LSCD respectively)

- *VARIOUS PULSE PER REVOLUTION (PPR) RATES*
  Up to 200 PPR for fine, high-resolution counting or precision speed measurement from slow shaft speeds.
- *UP TO 10 KHz OUTPUT FREQUENCY*
- *CURRENT SINK OUTPUT*
- *LENGTH SENSORS AVAILABLE WITH:*
  Single or Dual Ended Shaft
- *SEALED PRECISION BALL BEARINGS*
- *VARIOUS CABLE LENGTHS AVAILABLE*





- *RUGGED CAST ALUMINUM HOUSING*
- *3/8" DIA. STAINLESS STEEL SHAFT*
- *WIDE INPUT SUPPLY VOLTAGE RANGE & LOW CURRENT OPERATION*
- *EASY INSTALLATION*
  Eliminates air-gap, sensing distance, and beam alignment procedures of other types of sensing.
- *IDEAL FOR DUSTY, DIRTY ENVIRONMENTS*
  Where “Non Contact” sensing means are impractical.

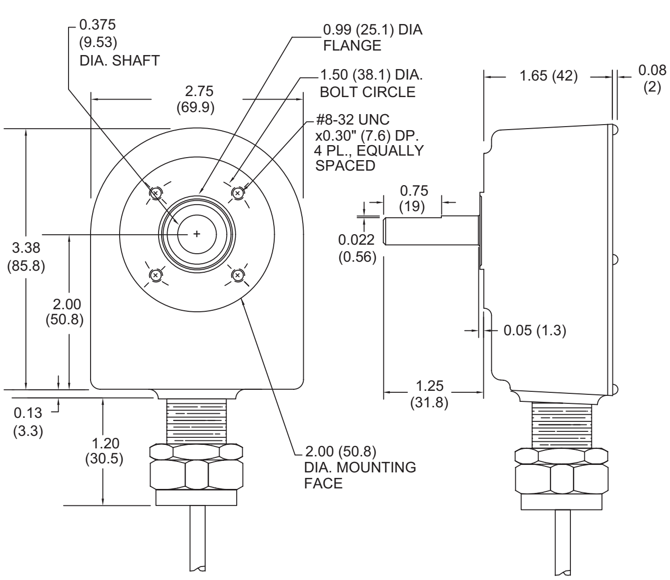
DESCRIPTION

The units are rugged, incremental encoders that convert shaft rotation into a current sinking pulse train.

Internally, a single L.E.D. light source and a photologic sensor in conjunction with a shaft-mounted, durable, metal-etched encoder disc, provides signal accuracy and reliability to 10 KHz. The DC input power supply requirement is a versatile +8 to +35 VDC, and is reverse polarity protected. The NPN Open Collector Transistor Output is current limited to 40 mA and is compatible with most RLC counters, rate indicators, controllers and accessories.

All units are packaged in a rugged cast aluminum housing with a gasketed, rear aluminum cover. The 3/8" (9.53 mm) diameter heavy duty stainless steel shaft and sealed, lifetime-lubricated precision ball bearings are preloaded for minimum end play and rated for continuous use up to 6000 RPM. They are designed to meet NEMA 13/IP54 environmental requirements. All units are supplied with 10 feet (3M) of PVC jacketed 3-wire, 22 AWG cable with stranded shield wire and 100% foil shield coverage. Operating Temperature range is -18°C to +60°C.

ZCG DIMENSIONS In inches (mm)



ROTARY PULSE GENERATOR

The ZCG can be direct-coupled to a machine shaft by means of a flexible bellows, spring or rubber sleeve type coupler, etc., that allows for axial and radial misalignment. They can also be coupled with instrument timing belts and pulleys or gears. The housing may be rigidly face-mounted with the 4, #8-32 threaded holes. The 3-wire shielded cable exits through a cord connector.

LENGTH SENSOR

The length sensors are available in both Single Ended Shaft *(ZFG)* and Double Ended Shaft *(ZGG)* versions, both of which include a Stainless Steel Handle Tube for mounting and 10 feet (3.05 M) of 3-wire shielded cable. When mounted to a Length Sensor Hinge Clamp Assembly *(See Model LSAHC001)* and coupled with one or two Measuring Wheels *(See Measuring Wheels)*, a low cost, versatile and highly accurate length measurement system can be configured.

LENGTH SENSOR MEASUREMENT ACCURACY

Factors which affect measurement accuracy include Measuring Wheel accuracy and wear, and material conditions. Ideally, materials which are hard, thin and strong provide good readings. Conversely, soft, thick and elastic materials can present problems in obtaining true readings. Count or Rate Indicators with *“input scaling”* can compensate for Measuring Wheel wear and material elasticity and compliance errors. In addition, English/Metric conversions may also be accomplished.

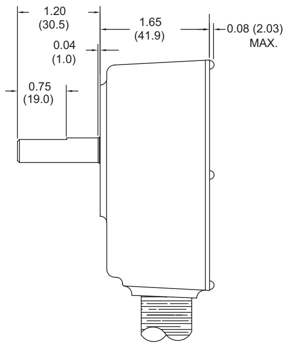
Open Collector Output Wiring

The ZCG, ZFG, and ZGG series of sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages (40 VDC max.) different than the encoder supply voltage. NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

LENGTH SENSOR MOUNTING CONSIDERATION

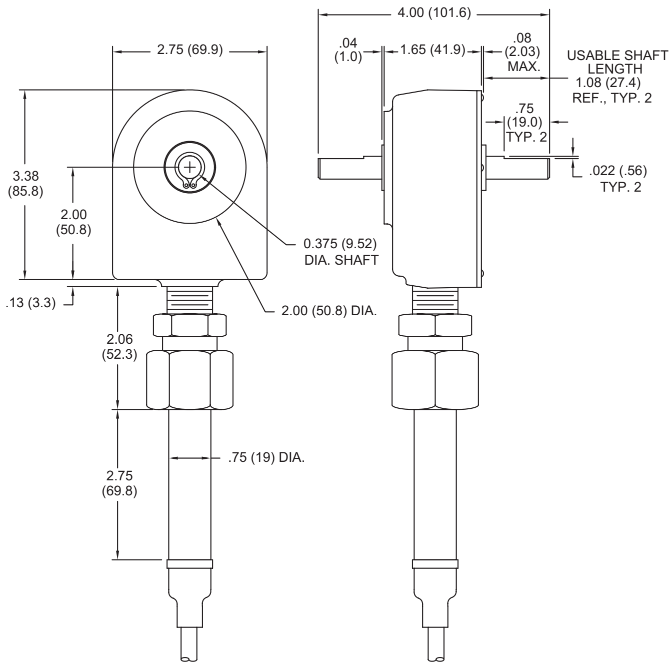
1. Length Sensors should be mounted so measuring wheel*(s)* contact ribbon, strip or web as it passes over a roller. As an alternative, wheel*(s)* can be driven by roller surface next to material being measured.
2. Note: The weight at the Length Sensor unit provides sufficient traction for accurate operation when mounted, with arm angle from horizontal not exceeding ±30°.
3. Tension on signal cable can cause wheel*(s)* to lift. Make sure cable is clamped to machine frame near the unit and allow slack.

ZFG DIMENSIONS
In inches (mm)



This is the side view of the Model ZFG. All other dimensions (including the handle tube) are the same as the Model ZGG. See below.

ZGG DIMENSIONS In inches (mm)



ELECTRICAL SPECIFICATIONS

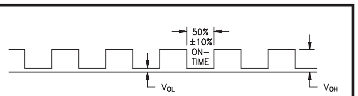
1. **SUPPLY VOLTAGE:** +8 to +35 VDC *(including power supply ripple)* @ 50 mA max. *(30 mA typ.)*; Reverse polarity protected.
2. **OUTPUTS:** NPN Open Collector Transistor;
   V_{OH} = 30 VDC max., V_{OL} = 1 V max. @ 40 mA
   Output current is limited to 40 mA.
3. **OUTPUT FREQUENCY:** Up to 10 KHz
4. **CABLE CONNECTIONS:**
   RED = +VDC; BLACK = Common; WHITE = NPN O.C. Output.

MECHANICAL SPECIFICATIONS

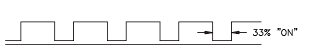
1. **MAXIMUM MECHANICAL SPEED:** 6000 RPM
2. **RADIAL SHAFT LOAD:** 15 lbs. max. (66.7N)
3. **AXIAL SHAFT LOAD:** 15 lbs. max. (66.7N)
4. **STARTING TORQUE:** 3 oz.-in. (21.2N-mm)
5. **MOMENT OF INERTIA:**
   Single Shaft = 2.82×10^{-4} oz. - in. - sec.^{2} (1.99×10^{-3}N - mm - sec^2)
   Dual Shaft = 3.09×10^{-4} oz. - in. - sec.^{2} (2.19×10^{-3}N - mm - sec^2)
6. **OPERATING TEMPERATURE:** -18°C to +60°C
7. **WEIGHT (LESS CABLE):**
   Rotary Pulse Generator = 15 oz (0.42 Kg)
   Length Sensors = 22 oz (0.62 Kg)

WAVE OUTPUT DIAGRAM

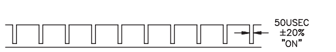
Square wave output for models with PPR 1, 10, 12, 20, 60 and 100. Square wave, 50/50 duty cycle ±10%.



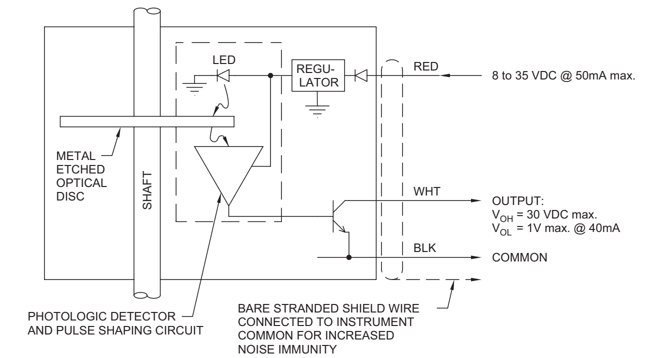
Models that use 1/3 yd. or 1/3 mtr wheels with internal ÷ 3 circuits. 66/33 duty cycle.



Models with 120 and 200 PPR utilize internal doubling. (50 µsec ±20% neg. going pulse.)



EQUIVALENT CIRCUIT & CONNECTIONS



ORDERING INFORMATION

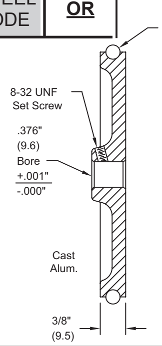
MODEL NO.	DESCRIPTION	PPR	OUTPUT PULSE RATE CODE	PART NUMBER
ZCG	Rotary Pulse Generator (Replaces RPGC)	1		ZCG0001C
		10		ZCG0010C
		12		ZCG0012C
		60		ZCG0060C
		100		ZCG0100C
		*120		ZCG0120C
		*200		ZCG0200C
ZFG	Length Sensor Single Shaft (Replaces LSCS)	1	1/Foot	ZFG0001C
		10	10/Foot	ZFG0010C
		12	1/inch	ZFG0012C
		20	60/Mt or Yd	ZFG0020C
		60	60/Foot	ZFG0060C
		100	100/Foot	ZFG0100C
		*120	10/Inch	ZFG0120C
		*200	600/Mt or Yd	ZFG0200C
		.333	1/Mt or Yd	ZFG00/3C
		3.333	10/Mt or Yd	ZFG03/3C
		33.333	100/Mt or Yd	ZFG33/3C
ZGG	Length Sensor Double Shaft (Replaces LSCD)	1	1/Foot	ZGG0001C
		10	10/Foot	ZGG0010C
		12	1/inch	ZGG0012C
		20	60/Mt or Yd	ZGG0020C
		60	60/Foot	ZGG0060C
		100	100/Foot	ZGG0100C
		*120	10/Inch	ZGG0120C
		*200	600/Mt or Yd	ZGG0200C
		.333	1/Mt or Yd	ZGG00/3C
		3.333	10/Mt or Yd	ZGG03/3C
		33.333	100/Mt or Yd	ZGG33/3C
RPGFC	Flexible Coupling (1" Length) 0.250" - 0.375"			RPGFC002
	Flexible Coupling (1" Length) 0.375" - 0.375"			RPGFC003
	Flexible Coupling (1" Length) 0.375" - 0.500"			RPGFC004
	Flexible Coupling (1" Length) 0.375" - 6 mm			RPGFC006

* Rotary pulse generators and length sensors with 120 & 200 PPR outputs employ an internal doubling circuit and deliver a fixed 50 µsec ±20% output pulse at the leading and trailing edge of a passing slot. Additional doubling in external indicators or circuits may not be applicable. These outputs are derated to 7300 Hz due to internal x2 circuitry. *(See Wave Output Diagram)*

Notes:
1. For 25 foot cable, replace the last character of the part number ("C") with "D".
For 50 foot cable, replace the last character of the part number ("C") with "E".
2. Wheels and mounting brackets are sold separately, see Length Sensor Accessories.

SEPARATE LENGTH MEASURING WHEELS - DIMENSIONS In Inches (mm)

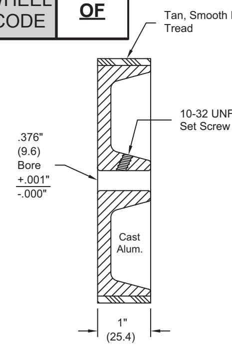
WHEEL CODE	**OR**



FOR USE ON: Metal, paper, foil, film and hard plastics. Line contact on material being measured, convenient when available measuring track is narrow or for measuring on end of roller beside passing material.

Max. Speed: 600 RPM

WHEEL CODE	**OF**

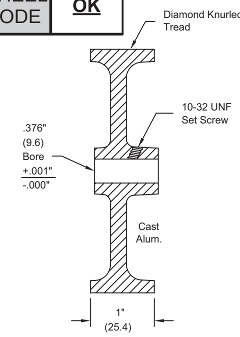


FOR USE ON: Soft, smooth materials such as soft paper, matting, cardboard, fine weave textiles. Broad wheel tread minimizes contact pressure and tan polyurethane tread minimizes marking.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

WHEEL CODE	**OK**



FOR USE ON: Rubber, coarse weave fabrics, rough wood surfaces, foam, insulation.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

I

SELECTING APPROPRIATE WHEEL SIZE & PPR (Pulses Per Rev.) OF ROTARY PULSE GENERATOR

When the desired output of a length sensor and wheel combination is either in inches, feet, yards, or meters selection of the proper combination is relatively straight forward. For example, with a 1-foot wheel circumference, a 1 PPR Rotary Pulse Generator will deliver 1 pulse/ft, 12 PPR would deliver 12 pulses/ft *(1 pulse/inch);* 100 PPR would yield 100 pulses/ft; and 120 PPR would permit measuring to 1/10th of an *inch (1/120th of a foot).*

WHEELS & REPLACEMENT TIRES FOR CODE OR WHEELS

ORDERING INFORMATION

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OR	1 foot (1/3 yd)	±0.40%	WF1000OR
	1/3 meter	±0.40%	WM0333OR
	4/10ths yard	±0.40%	WY0400OR
	4/10ths meter	±0.40%	WM0400OR
OF	1 foot (1/3 yd)	±0.35%	WF1000OF
	1/3 meter	±0.30%	WM0333OF
	4/10ths yard	±0.30%	WY0400OF
	4/10ths meter	±0.30%	WM0400OF
BF (Balanced)	1 foot (1/3 yd)	±0.40%	WF1000BF

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OK	1 foot (1/3 yd)	±0.35%	WF1000OK
	1/3 meter	±0.30%	WM0333OK
	4/10ths yard	±0.30%	WY0400OK
	4/10ths meter	±0.30%	WM0400OK
BK (Balanced)	1 foot (1/3 yd)	±0.35%	WF1000BK
Replacement Tires for **OR** Wheels	1 foot (1/3 yd)		TORF1000
	1/3 meter		TORM0333
	4/10ths yard		TORY0400
	4/10ths meter		TORM0400

Note: After installation of measuring wheels, ensure guards,shields or other devices are in place to protect personnel from rotating equipment.

MODEL LSAHC - LENGTH SENSOR HINGE CLAMP ASSEMBLY

The Length Sensor Hinge Clamp Assembly provides an easy method for attachment and mounting of the Length Sensors and LSCB1 Conversion Bracket. The removable top on the solid zinc LSAHC mounting block allows quick installation of the Length Sensor handle tube and provides secure clamping retention. The mounting block pivots freely in zinc right angle brackets to allow mounting the assembly via clearance holes for 1/4" dia. bolts.

The lock washers must be used as indicated (between the bolt head and the top clamp piece). Assemble the top clamp piece as follows.

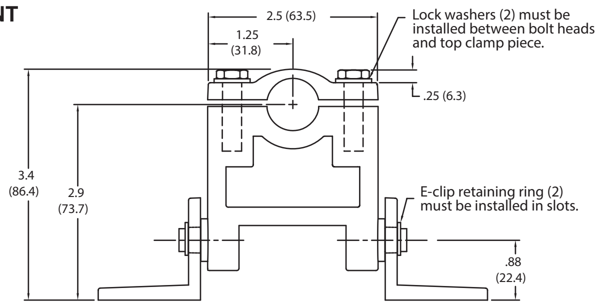
1. Tighten both bolts so that the top clamp half draws down evenly on the sensor tube.
2. Tighten the bolts until both lock washers are flat.
3. Then turn each bolt an additional ½ to ¾ turn.

CAUTION: Downward tension on signal cable can cause wheel(s) to lift. Make sure cable is clamped to machine frame near encoder and allow slack.

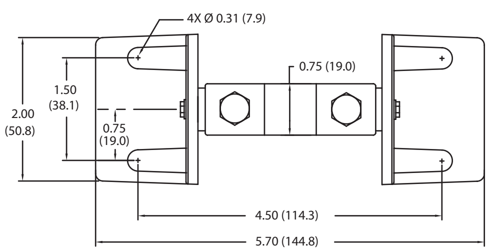
NOTE: The weight at the Length Sensor unit provides sufficient traction for accurate operation when mounted as shown, with arm angle from horizontal not exceeding ±30°, and with hinge clamp toward the far extreme of the extension arm.

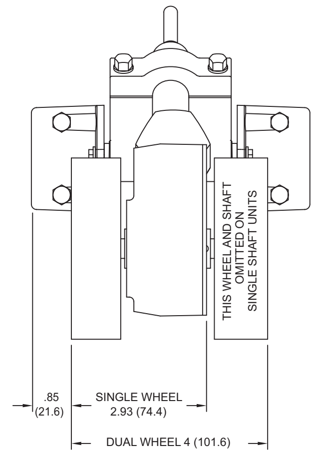
DIMENSIONS In inches (mm)

FRONT VIEW

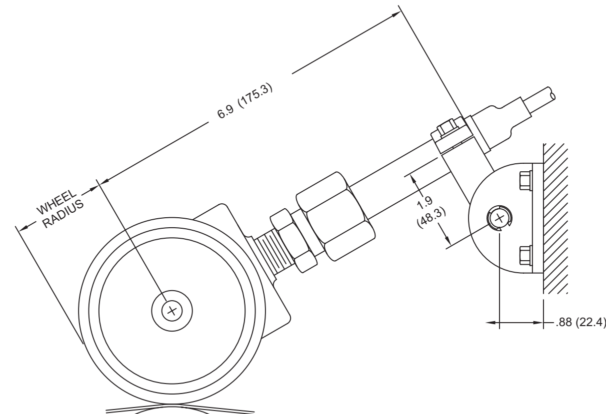


TOP VIEW





Model ZGG Shown



Model ZFG Shown

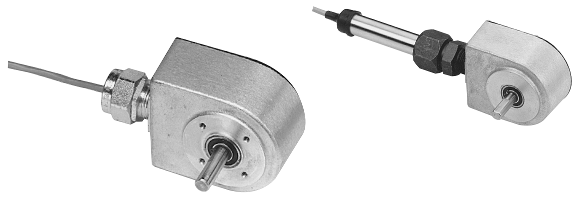
Length Sensors should be mounted so measuring wheel(s) contact ribbon, strip or web as it passes over a roller. As an alternative, wheel(s) can be driven by roller surface next to material being measured.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LSAHC	Length Sensor Hinge Clamp Assembly	LSAHC001

MODEL ZCH - QUADRATURE OUTPUT ROTARY PULSE GENERATOR
MODEL ZFH and ZGH - QUADRATURE OUTPUT LENGTH SENSORS
(Replaces MODELS RPGQ, LSQS and LSQD respectively)

- *100, 200 & 500 PULSES PER REVOLUTION*
- *QUADRATURE CURRENT SINKING OUTPUTS TO 50 KHz*
  For position measurement, bi-directional counting and systems with mechanical backlash
- *SEALED PRECISION BALL BEARINGS*
- *RUGGED CAST ALUMINUM HOUSING*
- *3/8" DIA. STAINLESS STEEL SHAFT*
- *WIDE INPUT SUPPLY VOLTAGE RANGE & LOW CURRENT OPERATION*
- *VARIOUS CABLE LENGTHS AVAILABLE*



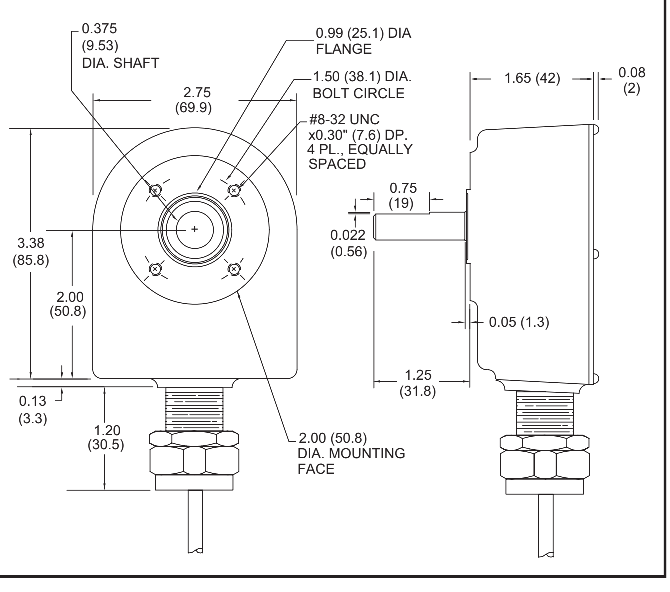
DESCRIPTION

The units are rugged, incremental encoders that convert shaft rotation into a current sinking pulse train.

Internally, a single L.E.D. light source and a photologic sensor in conjunction with a shaft-mounted, durable, metal-etched encoder disc, provides signal accuracy and reliability to 50 KHz. The DC input power supply requirement is a versatile +8 to +28 VDC, and is reverse polarity protected. The NPN Open Collector Transistor Output is current limited to 40 mA and is compatible with most RLC counters, rate indicators, controllers and accessories.

All units are packaged in a rugged cast aluminum housing with a gasketed, rear aluminum cover. The 3/8" (9.53 mm) diameter heavy duty stainless steel shaft and sealed, lifetime-lubricated precision ball bearings are preloaded for minimum end play and rated for continuous use up to 6000 RPM. They are designed to meet NEMA 13/IP54 environmental requirements. All units are supplied with 10 feet (3M) of PVC jacketed 3-wire, 22 AWG cable with stranded shield wire and 100% foil shield coverage.

ZCH DIMENSIONS In inches (mm)



ROTARY PULSE GENERATOR

The ZCH can be direct-coupled to a machine shaft by means of a flexible bellows, spring or rubber sleeve type coupler, etc., that allows for axial and radial misalignment. They can also be coupled with instrument timing belts and pulleys or gears. The housing may be rigidly face-mounted with the 4, #8-32 threaded holes. The 3-wire shielded cable exits through a cord connector.

LENGTH SENSOR

The length sensors are available in both Single Ended Shaft *(ZFH)* and Double Ended Shaft *(ZGH)* versions, both of which include a Stainless Steel Handle Tube for mounting and 10 feet (3.05 M) of 3-wire shielded cable. When mounted to a Length Sensor Hinge Clamp Assembly *(See Model LSAHC001)* and coupled with one or two Measuring Wheels *(See Measuring Wheels)*, a low cost, versatile and highly accurate length measurement system can be configured.

LENGTH SENSOR MEASUREMENT ACCURACY

Factors which affect measurement accuracy include Measuring Wheel accuracy and wear, and material conditions. Ideally, materials which are hard, thin and strong provide good readings. Conversely, soft, thick and elastic materials can present problems in obtaining true readings. Count or Rate Indicators with *"input scaling"* can compensate for Measuring Wheel wear and material elasticity and compliance errors. In addition, English/Metric conversions may also be accomplished.

LENGTH SENSOR ACCESSORIES

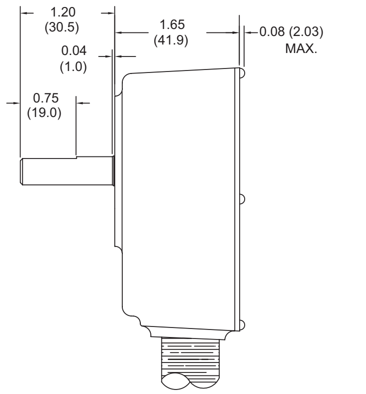
The Length Sensor Hinge Clamp Assembly provides an easy method for attachment & mounting the Length Sensors and LSCB1 Conversion Bracket. The removable top on the solid aluminum LSAHC mounting block allows quick installation of the Length Sensor handle tube and provides secure clamping retention. The mounting block steel shaft pivots freely in oil impregnated sintered bronze bushings, and aluminum right angle brackets allow mounting the assembly via clearance holes for 1/4" *(6.35 mm)* dia. bolts *(See LSAHC Dimensions & Mounting)*.

Open Collector Output Wiring

The ZCH, ZFH, and ZGH series of sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be "pulled up" to external voltages (40 VDC max.) different than the encoder supply voltage . NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

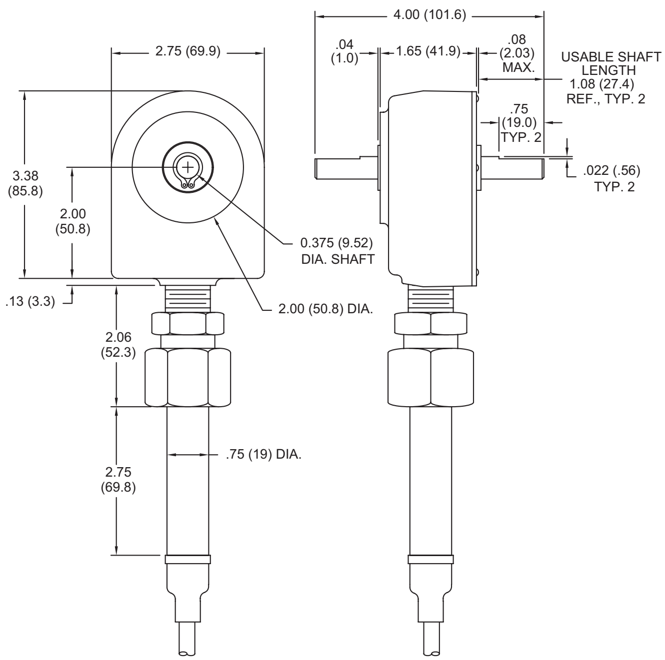
I

ZFH DIMENSIONS In inches (mm)

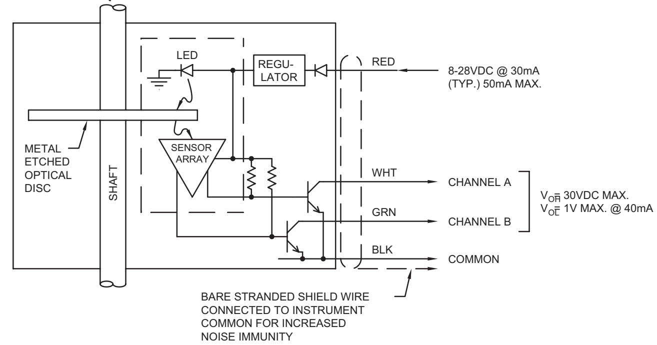


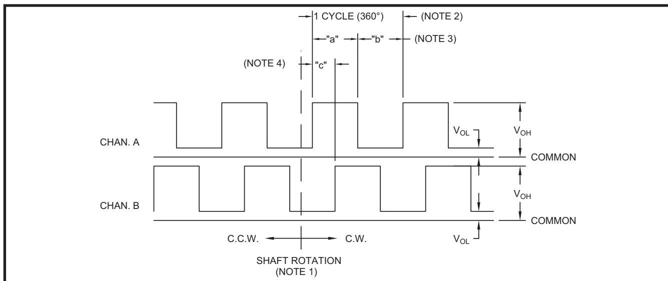
This is the side view of the Model ZFH. All other dimensions (including the handle tube) are the same as the Model ZGH. See below.

ZGH DIMENSIONS In inches (mm)



EQUIVALENT CIRCUIT & CONNECTIONS





NOTES:

1. Channel A leads Channel B for clockwise shaft rotation when viewed from housing front. Conversely, Channel B leads Channel A for Counterclockwise shaft rotation.
2. The number of lines on the optical disc determines the Pulses Per Revolution *(PPR)*.
3. Duty Cycle is the relationship of output "High" time, *"a"*, to output "Low" time, *"b"*, and is expressed as a High/Low percentage ratio, ie....% High time = a/(a+b) x 100; % Low time = b/(a+b) x 100.
4. Quadrature Phase "c" is specified as the lead or lag between Channel A & B in electrical degrees. Nominally 90° *(1/4 cycle)*.

LENGTH SENSOR MOUNTING CONSIDERATION

1. Length Sensors should be mounted so measuring wheel*(s)* contact ribbon, strip or web as it passes over a roller. As an alternative, wheel*(s)* can be driven by roller surface next to material being measured.
2. Note: The weight at the Length Sensor unit provides sufficient traction for accurate operation when mounted, with arm angle from horizonal not exceeding ±30°.
3. Tension on signal cable can cause wheel*(s)* to lift. Make sure cable is clamped to machine frame near thev unit and allow slack.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE:** +8 to +28 VDC *(including power supply ripple)* @ 50 mA max. *(30 mA typ.)*; Reverse polarity protected.
2. **OUTPUTS:** NPN Open Collector Transistor, V_{OH} = 30 VDC max., V_{OL} = 1 V max @ 40 mA. Output current is limited to 40 mA. Incremental - Two square waves in quadrature with Channel A leading B for clockwise rotation.
3. **OUTPUT FREQUENCY:** Up to 50 KHz
4. **OUTPUT DUTY CYCLE:** Channel A & B: 50/50 nominal. *(See Figure 1, Note 3)*
5. **QUADRATURE OUTPUT PHASE:** 90° ±15° *(See Figure 1, Note 3)*
6. **CABLE CONNECTIONS:** RED = +VDC; BLACK = Common; WHITE = Channel A Output; GREEN = Channel B Output.

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED:** 6000 RPM
2. **RADIAL SHAFT LOAD:** 15 lbs. max. (66.7N)
3. **AXIAL SHAFT LOAD:** 15 lbs. max. (66.7N)
4. **STARTING TORQUE:** 3 oz.-in. (21.2N-mm)
5. **MOMENT OF INERTIA:**
   Single Shaft = 1.03 x 10^{-4} oz. - in. - sec.^{2} (7.30 x 10^{-4}N - mm - sec^2)
   Dual Shaft = 1.30 x 10^{-4} oz. - in. - sec.^{2} (9.21 x 10^{-4}N - mm - sec^2)
6. **OPERATING TEMPERATURE:** 0°C to +70°C
7. **WEIGHT (LESS CABLE):**
   ZCH: 14.3 oz (406 g)
   ZFH: 22.0 oz (623 g)
   ZGH: 22.7 oz (643 g)

ORDERING INFORMATION

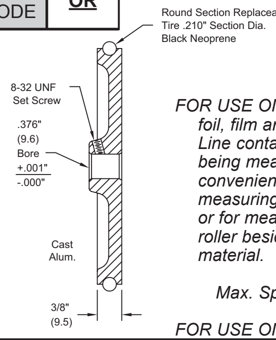
MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZCH	Rotary Pulse Generator (Replaces RPGQ)	100	ZCH0100C
		200	ZCH0200C
		500	ZCH0500C
ZFH	Length Sensor Single Shaft (Replaces LSQS)	100	ZFH0100C
		200	ZFH0200C
		500	ZFH0500C
ZGH	Length Sensor Double Shaft (Replaces LSQD)	100	ZGH0100C
		200	ZGH0200C
		500	ZGH0500C
RPGFC	Flexible Coupling (1" Length) 0.250" - 0.375"	--	RPGFC002
	Flexible Coupling (1" Length) 0.375" - 0.375"	--	RPGFC003
	Flexible Coupling (1" Length) 0.375" - 0.500"	--	RPGFC004
	Flexible Coupling (1" Length) 0.375" - 6 mm	--	RPGFC006

* 25 and 50 foot cable versions available. Consult factory for details.

LENGTH SENSOR ACCESSORIES

SEPARATE LENGTH MEASURING WHEELS - DIMENSIONS In Inches (mm)

WHEEL CODE	OR

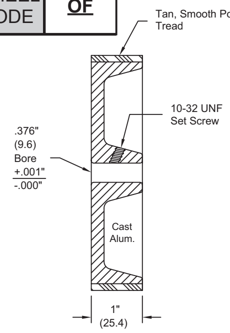


FOR USE ON: Metal, paper, foil, film and hard plastics. Line contact on material being measured, convenient when available measuring track is narrow or for measuring on end of roller beside passing material.

Max. Speed: 600 RPM

FOR USE ON: Soft, smooth

WHEEL CODE	OF



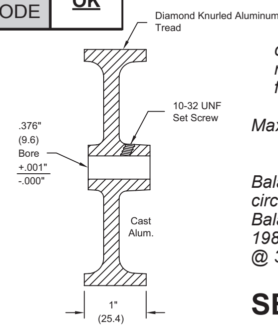
materials such as soft paper, matting, cardboard, fine weave textiles. Broad wheel tread minimizes contact pressure and tan polyurethane tread minimizes marking.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

FOR USE ON: Rubber,

WHEEL CODE	OK



coarse weave fabrics, rough wood surfaces, foam, insulation.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

SELECTING APPROPRIATE WHEEL SIZE & PPR (Pulses Per Rev.) OF ROTARY PULSE GENERATOR

When the desired output of a length sensor and wheel combination is either in inches, feet, yards, or meters selection of the proper combination is relatively straight forward. For example, with a 1-foot wheel circumference, a 1 PPR Rotary Pulse Generator will deliver 1 pulse/ft, 12 PPR would deliver 12 pulses/ft *(1 pulse/inch);* 100 PPR would yield 100 pulses/ft; and 120 PPR would permit measuring to 1/10th of an *inch (1/120th of a foot).*

WHEELS & REPLACEMENT TIRES FOR CODE OR WHEELS

ORDERING INFORMATION

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OR	1 foot (1/3 yd)	±0.40%	WF1000OR
	1/3 meter	±0.40%	WM0333OR
	4/10ths yard	±0.40%	WY0400OR
	4/10ths meter	±0.40%	WM0400OR
OF	1 foot (1/3 yd)	±0.35%	WF1000OF
	1/3 meter	±0.30%	WM0333OF
	4/10ths yard	±0.30%	WY0400OF
	4/10ths meter	±0.30%	WM0400OF
BF (Balanced)	1 foot (1/3 yd)	±0.40%	WF1000BF

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OK	1 foot (1/3 yd)	±0.35%	WF1000OK
	1/3 meter	±0.30%	WM0333OK
	4/10ths yard	±0.30%	WY0400OK
	4/10ths meter	±0.30%	WM0400OK
BK (Balanced)	1 foot (1/3 yd)	±0.35%	WF1000BK
Replacement Tires for **OR** Wheels	1 foot (1/3 yd)		TORF1000
	1/3 meter		TORM0333
	4/10ths yard		TORY0400
	4/10ths meter		TORM0400

Note: After installation of measuring wheels, ensure guards,shields or other devices are in place to protect personnel from rotating equipment.

MODEL LSAHC - LENGTH SENSOR HINGE CLAMP ASSEMBLY

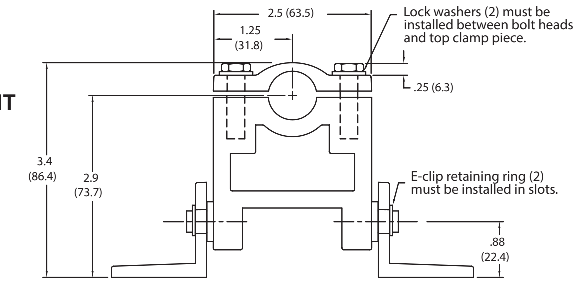
The Length Sensor Hinge Clamp Assembly provides an easy method for attachment and mounting of the length sensors and LSCB1 Conversion Bracket. The removable top on the solid zinc LSAHC mounting block allows quick installation of the Length Sensor handle tube and provides secure clamping retention. The mounting block pivots freely in zinc right angle brackets to allow mounting the assembly via clearance holes for 1/4" dia. bolts.

The lock washers must be used as indicated (between the bolt head and the top clamp piece). Assemble the top clamp piece as follows.

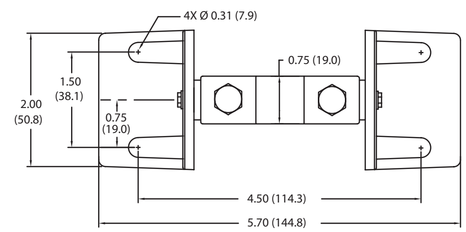
1. Tighten both bolts so that the top clamp half draws down evenly on the sensor tube.
2. Tighten the bolts until both lock washers are flat.
3. Then turn each bolt an additional ½ to ¾ turn.

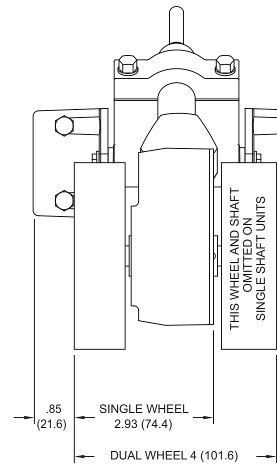
DIMENSIONS In inches (mm)

FRONT VIEW



TOP VIEW

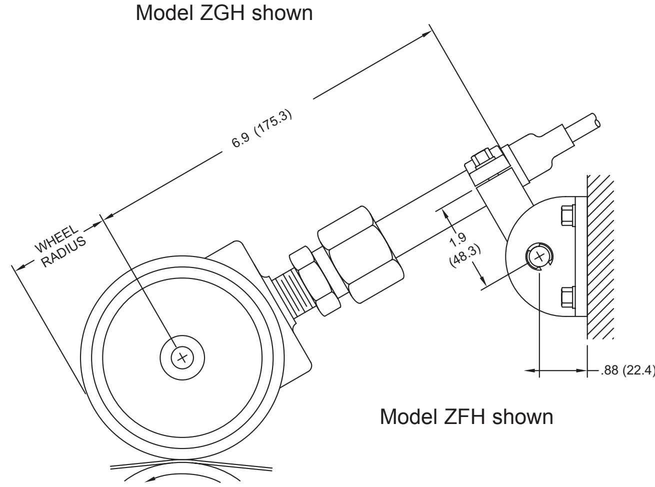




Model ZGH shown

CAUTION: Downward tension on signal cable can cause wheel(s) to lift. Make sure cable is clamped to machine frame near encoder and allow slack.

NOTE: The weight at the Length Sensor unit provides sufficient traction for accurate operation when mounted as shown, with arm angle from horizontal not exceeding ±30°, and with hinge clamp toward the far extreme of the extension arm.



Model ZFH shown

Length Sensors should be mounted so measuring wheel(s) contact ribbon, strip or web as it passes over a roller. As an alternative, wheel(s) can be driven by roller surface next to material being measured.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LSAHC	Length Sensor Hinge Clamp Assembly	LSAHC001

MODEL ZUK - LARGE THRU-BORE Rotary pulse generators

GENERAL DESCRIPTION

The ZUK is a high performance unit that is ideal for fast revving motor mount applications. This industrial strength model features the largest thru bore available in a 2.5" encoder, mounting directly on shafts as large as 1.125" (28 mm.) The injection molded housing is grooved with "cooling fins", and can take the extreme heat of the motion control industry.

The ZUK comes equipped with a 3 point Flex Mount adapting to both 2.25" and 2.75" motor faces. It is also available with an optional "tether arm" mounting kit for additional motor compatibility.

This revolutionary encoder can also be adapted to various standard and metric sized motor shafts by using an accessory sleeve kit, or individual sleeves (Sold separately).

Electrically the ZUK offers NPN open collector outputs, each limited to 100 mA. The outputs are standard quadrature with index and are also available with quadrature reverse phasing for the typical motor drive controller application. The quadrature separation is 90° with output A leading output B for clockwise rotation. Output B leads output A for the reverse phased output, for clockwise rotation.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE:** 4.75 to 28 VDC, 100 mA max. (no load)
2. **OUTPUTS:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - two square waves in quadrature with A leading B for clockwise rotation.
3. **MAX. PULSE RATE:** 250 KHz
4. **INDEX:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Once per revolution centered over output Channel A. Index is a positive going pulse.
5. **MIN EDGE SEP**: 45° electrical min, 63° electrical or better typical
6. **RISE TIME**: Less than 1 microsecond
7. **ACCURACY**: Within 0.1° mechanical from one cycle to any other cycle, or 6 arc minutes.

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED:** 4000 RPM
2. **BORE SIZE:** 1.125" (28.58 mm)
3. **BORE TOLERANCES**: -0.0000"/+0.0008"
4. **USER SHAFT TOLERANCES**:
   Radial Runout: 0.005" max
   Axial Endplay: +/- 0.050" max
5. **STARTING TORQUE**: 4.0 oz-in typical (28.24 N-mm) IP66
6. **MOMENT OF INERTIA**:
   7.6×10^{-4} oz-in-sec^2
7. **MAX ACCELERATION:** 1×10^5 rad/sec^2
8. **ELECTRICAL CONNECTOR:** 7-pin MS type connector

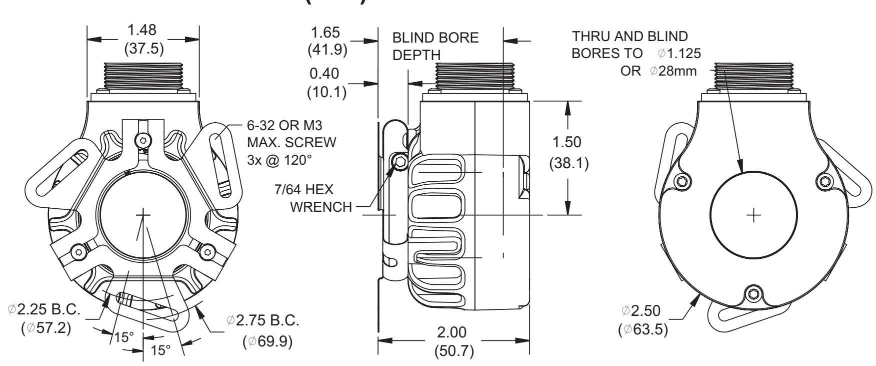
FUNCTION	PIN	CABLE WIRE COLOR
+VDC	A	Red
Common	B	Black
Data A	C	White
Data B	D	Green
Data Z	E	Orange
CASE	F	Bare

9. **HOUSING**: Nylon composite
10. **MOUNTING**: 2.25" to 2.75" B.C. 3-point flex mount
11. **WEIGHT**: 8 oz. (226.7 g)

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 85°C
2. **STORAGE TEMPERATURE**: -20°C to 85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 20 g @ 5 to 2000 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP66

DIMENSIONS In inches (mm)



Open Collector Output Wiring

The ZUK series of sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages different than the encoder supply voltage (30 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZUK	1.125" Large Thru-Bore Rotary Pulse Generators	60	ZUK0060H
		100	ZUK0100H
		500	ZUK0500H
		600	ZUK0600H
		1000	ZUK1000H
		1200	ZUK1200H
		2000	ZUK2000H
		2500	ZUK2500H

Do not dispose of unit in trash - Recycle

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
CCBRPG	7-Pin MS Connector	CCBRPG00
	7-Pin MS Connector with 10 ft 24 AWG 5 Conductor Cable w/drain	CCBRPG02
	7-Pin MS Connector with 20 ft 24 AWG 5 Conductor Cable w/drain	CCBRPG03
RPGBI	Inch Bore Insert Kit (includes 0.5, 0.625, 0.875, and 1 inch sleeves)	RPGBII00
	Large Metric Bore Insert Kit (includes 19, 20, 24, and 25 mm sleeves)	RPGBIM00
RPGBSI	0.500 Inch Bore Sleeve	RPGBSI00
	0.625 Inch Bore Sleeve	RPGBSI01
	0.750 Inch Bore Sleeve	RPGBSI02
	0.875 Inch Bore Sleeve	RPGBSI03
	1 Inch Bore Sleeve	RPGBSI04
RPGBSM	19 mm Bore Sleeve	RPGBSM00
	20 mm Bore Sleeve	RPGBSM01
	24 mm Bore Sleeve	RPGBSM02
	25 mm Bore Sleeve	RPGBSM03
RPGMK	Standard Tether Arm Kit 4.5 Inch	RPGMK002
	Elongated Tether Arm Kit 8.5 Inch	RPGMK003
RPGMB *	Magnetic Coupling Kit (0.625 inch shaft)	RPGMB001
RPGPC	56C Protective Cover	RPGPC000

** ZUK encoders require 0.625 " bore sleeve to accomodate magnetic coupling.*

Only factory stocked part numbers are listed. Consult Factory for part number and availability of other PPR and output configurations.

MODELS ZPJ - LARGE THRU-BORE Rotary pulse generator

GENERAL DESCRIPTION

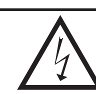
The Model ZPJ ia a thru-bore encoder with a bore of 0.625" (15.875 mm). Additional mounting kits are available to adapt it to both standard and metric shaft sizes. This unit is ideal for applications requiring a miniature, high precision, low cost encoder, designed with all metal construction for years of trouble-free operation.

The ZPJ encoder has a flexible arm mount and blind hollow shaft. It uses two set screws that are 90° apart to clamp the encoder's hub to the motor shaft. The NPN Open Collector outputs are each current limited to 20 mA. The outputs are standard quadrature with index, and are available in resolutions up to 2500 pulses per shaft revolution. The quadrature separation is typically 90 electrical degrees. Output A leads output B for clockwise rotation of the encoder shaft.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.



CAUTION: Risk of electric shock.

Open Collector Output Wiring

The ZPJ encoder has open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages different than the encoder supply voltage (30 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE:** 4.75 to 28 VDC, 100 mA max.
2. **OUTPUTS:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - Two square waves in quadrature with A leading B for clockwise rotation.
3. **MAX. FREQUENCY:** 200 KHz
4. **INDEX:** NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Once per revolution centered over output Channel A. Index is a positive going pulse.
5. **NOISE IMMUNITY**: Tested to BS EN61000-6-2; BS EN50081-2; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-6; BS EN55011
6. **SYMMETRY**: 180° (±18°) electrical
7. **QUAD PHASING**: 90° (±22.5°) electrical
8. **MIN EDGE SEP**: 67.5° electrical
9. **ACCURACY**: Within 0.01° mechanical from one cycle to any other cycle, or 0.6 arc minutes.

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 7500 RPM
2. **BORE SIZE:** 0.625" (15.875 mm)
3. **BORE TOLERANCES**: -0.0000"/+0.0006"
4. **USER SHAFT TOLERANCES**:
   Radial Runout: 0.007" max
   Axial Endplay: +/- 0.030" max
5. **STARTING TORQUE**: 2.5 oz-in (17.65 N-mm) IP64
6. **MOMENT OF INERTIA**:
   3.9×10^{-4} oz-in-sec^2 (27.5 gm-cm^2)
7. **MAX ACCELERATION:** 1×10^5 rad/sec^2
8. **ELECTRICAL CONNECTION**: 36" (914.4 mm) cable (foil and braid shield, 24 AWG conductors)

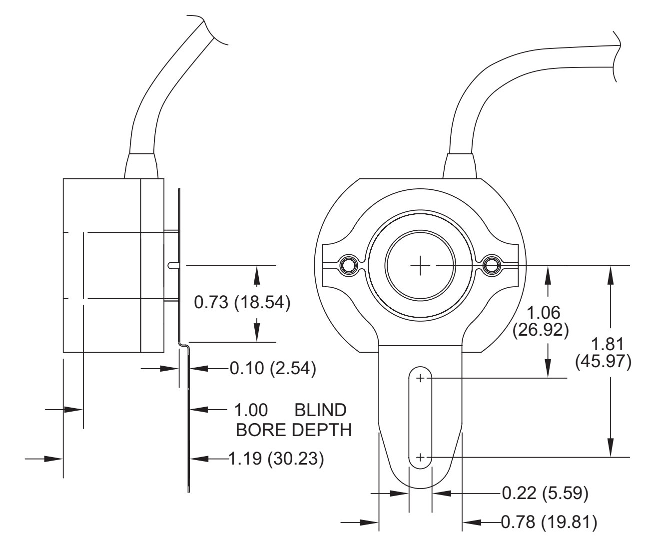
FUNCTION	WIRE COLOR
+VDC	Red
Common	Black
Data A	White
Data B	Green
Index Z	Orange

9. **HOUSING**: Black non-corosive finish
10. **MOUNTING**: Flex arm 1.06" to 1.81" radius mounting
11. **WEIGHT**: 3.5 oz. typical (99.2 g)

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: 0°C to +70°C
2. **STORAGE TEMPERATURE**: -40°C to +100°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 50 g @ 11 msec duration
6. **SEALING**: IP64

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZPJ	0.625" Thru-Bore Rotary Pulse Generators	60	ZPJ0060A
		100	ZPJ0100A
		500	ZPJ0500A
		600	ZPJ0600A
		1000	ZPJ1000A
		1200	ZPJ1200A
		2000	ZPJ2000A
		2500	ZPJ2500A

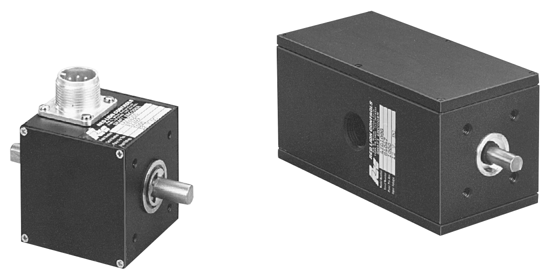
Do not dispose of unit in trash - Recycle

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
RPGMK	1.575" (40 mm) Bolt Circle Flex Mount Kit	RPGMK000
	1.811" (46 mm) Bolt Circle Flex Mount Kit	RPGMK001
RPGBI	Inch Std Bore Insert Kit (includes 0.25, 0.375, and 0.50 inch sleeves)	RPGBII01
	Large Metric Bore Insert Kit (includes 11, 12, and 14 mm sleeves)	RPGBIM01
	Small Metric Bore Insert Kit (includes 6, 8, and 10 mm sleeves)	RPGBIM02
RPGMB	Mag Coupling Kit (0.625 inch shaft)	RPGMB001

Only factory stocked part numbers are listed. Consult Factory for part number and availability of other PPR and output configurations.

MODELS ZBG AND ZBH STANDARD DUTY ENCODER ***(Replaces MODEL RPGB)***
MODEL ZHG HEAVY DUTY ENCODER ***(Replaces MODEL RPGH)***

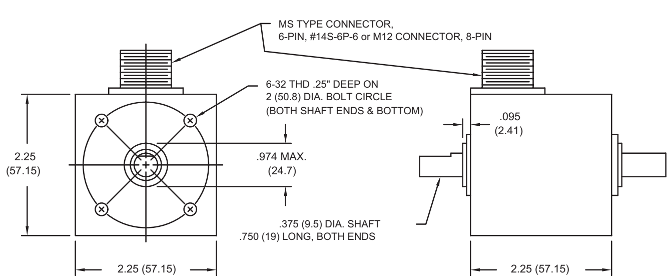


- *CURRENT SINK OUTPUTS*
- *HIGH PULSE PER REVOLUTION (PPR) RATES*
  Up to 1200 PPR for fine, high-resolution counting or precision speed measurement from slow shaft speeds.
- *QUADRATURE OUTPUT*
  For position measurement, bi-directional counting and in systems with backlash counting requirements.
- *AVAILABLE WITH MS AND M12 CONNECTORS*

MODEL ZBG and ZBH - FOR GENERAL INDUSTRIAL SERVICE (Replaces Model RPGB)

The units contain an L.E.D. light source and a photo sensor that scans a shaft-mounted, slotted disc. An internal pulse-shaping amplifier circuit delivers a rectangular pulse signal from the current sinking output in response to the passing slots as it rotates. They can be direct-coupled to a machine shaft by means of a flexible-bellows, spring, or rubber sleeve type coupling that allows for axial and radial misalignment. They can also be coupled with light instrument timing-belts. Timing-belt drives also allow convenient gear-up or gear-down speed ratio changes that can be useful for obtaining non-standard PPR rates.

DIMENSIONS In Inches (mm)

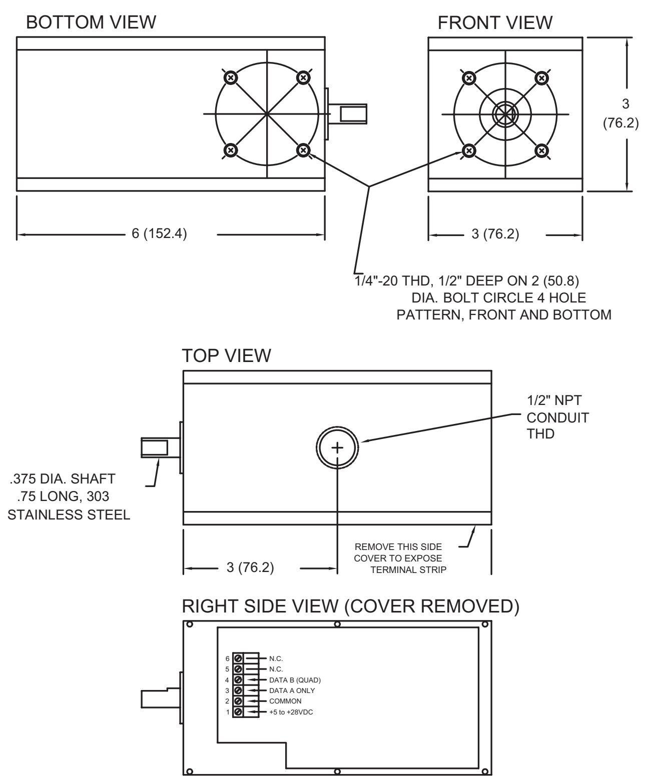


MODEL ZHG - HEAVY-DUTY SEALED HOUSING (Replaces Model RPGH)

These heavy duty units feature a heavy cast aluminum housing with 1/4" thick aluminum cover plates and 0-ring seals. Heavy duty bearings are double-sealed and allow radial shaft loading of 40 lbs (18 Kg).

A 1/2" (12.7 mm) NPT Conduit entry permits signal wiring to be run via flex-conduit to an internal terminal block. Electrical characteristics are identical to those for the Model ZBG. Terminal board markings correspond to the Pin-Out identification of the ZBG.

DIMENSIONS In inches (mm)



SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **SUPPLY VOLTAGE**:
   +4.75 to +28 VDC @ 80 mA max. from 0 °C to 85 °C
   +4.75 to +24 VDC @ 80 mA max. from 0 °C to 100 °C
2. **OUTPUT**: Current Sinking
   ZBG and ZHG (Single Channel): 250 mA max.
   ZBH (Quadrature): 250 mA max. current per output. Incremental - two square waves in quadrature with Channel A leading Channel B for clockwise rotation. (Quad. Phase relationship is 90° ±22.5 electrical degrees)
   Note: NPN Transistor outputs have 1.5 KΩ load resistors returned to supply for internal feed back purposes. This does not interfere with the ability to use these outputs as conventional "Open-Collector" outputs as long as the supply voltage for the ZB is supplied by the indicator or control receiving its output signal. The ZB's internal load resistor also allows the output to be used as a current source, however, load current must be limited to 1 mA max.
3. **MAXIMUM FREQUENCY**:
   Single Channel: 20 KHz
   Quadrature: 20 KHz
   PPR available up to 1270 for both single channel and quadrature.

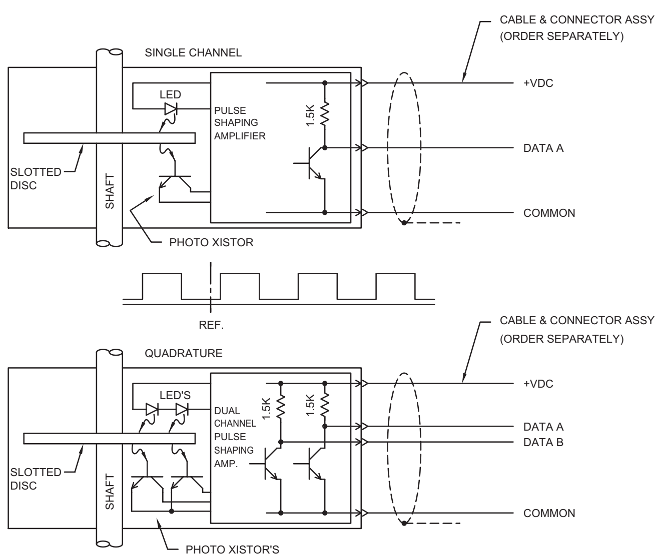
MECHANICAL SPECIFICATIONS

1. **MAXIMUM SHAFT SPEED**: 6000 RPM
2. **SHAFT DIAMETER**: 0.375" (9.5 mm)
3. **RADIAL SHAFT LOAD**: 40 lbs. operating (18 kg)
4. **AXIAL SHAFT LOAD**: 30 lbs operating (13.6 kg)
5. **STARTING TORQUE**:
   ZBG & ZBH: 0.38 oz-in (2.68 N-mm)
   ZHG: 3 oz-in (21.18 N-mm)
6. **MOMENT OF INERTIA**: 6.5 x 10^{-6} oz-in-sec^2
7. **CONNECTIONS**: 6-pin MS style or 8-Pin M12 connector. (Male) Mating connector and cable assembly sod separately. For wiring cofiguration, see Cable Connections. For Ordering Information, see Accessories.
8. **HOUSING**: Black non-corrosive finished 6063-T6 aluminum.
9. **BEARINGS**: ABEC3 double sealed ball bearings
10. **WEIGHT**:
    ZBG & ZBH: 10 oz (283.5 g)
    ZHG: 3.8 lbs (1.72 Kg)

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: 0 ° to 100 °C (See supply voltage)
2. **STORAGE TEMPERATURE**: -25°C to +85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 50 g @ 11 msec duration

ELECTRICAL CONNECTIONS



Cable Connections

The tables below list the pin connections from the ZBG and ZHG single channel and ZBH quadrature encoder to the optional CCARPG or CCM cable.

FUNCTION	6-PIN MS CONN	M12 CONN	CABLE WIRE COLOR
+VDC	A	1	RED
COMMON	B	2	BLACK
DATA A	C	3	WHITE
DATA B if appl. (quad)	D	4	GREEN
NO CONNECTION	E	5	—

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR*	PART NUMBER
ZHG	Single Channel - Heavy Duty Rotary Pulse Generator * For Dual Channel contact factory	600	ZHG06004
		1000	ZHG10004
		1200	ZHG12004
ZBG	Single Channel General Service 6-Pin MS Connector	60	ZBG00602
		100	ZBG01002
		600	ZBG06002
		1000	ZBG10002
		1200	ZBG12002
	Single Channel General Service M12 Connector	100	ZBG01003
		600	ZBG06003
ZBH	Dual Channel General Service 6-Pin MS Connector	10	ZBH00102
		12	ZBH00122
		100	ZBH01002
		120	ZBH01202
		500	ZBH05002
		600	ZBH06002
	Dual Channel General Service M12 Connector	100	ZBH01003
		600	ZBH06003

Note: Only factory stocked part numbers are listed. Consult factory for part number and availability of other PPR and output configurations.

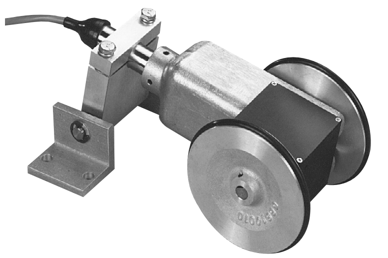
Do not dispose of unit in trash - Recycle

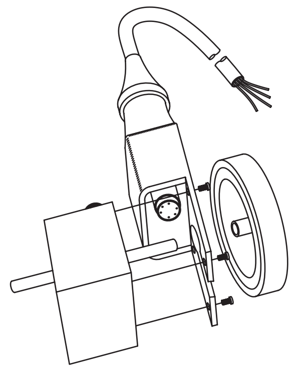
ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
RPGFC	Flexible Coupling (1" Length) 0.250"-0.375"	RPGFC002
	Flexible Coupling (1" Length) 0.375"-0.375"	RPGFC003
	Flexible Coupling (1" Length) 0.375"-0.500"	RPGFC004
	Flexible Coupling (1" Length) 0.375"-6 mm	RPGFC006
Mating 6-Pin MS Connector		CCARPG00
6-Pin MS Connector w/10 feet 22 AWG 4-conductor w/drain		CCARPG01
6-Pin MS Connector w/25 feet 22 AWG 4-conductor w/drain		CCARPG25
6-Pin MS Connector w/50 feet 22 AWG 4-conductor w/drain		CCARPG50
M12 Connector w/4 Meter 24 AWG 5-conductor w/drain		CCM12894
M12 Connector w/10 Meter 24 AWG 5-conductor w/drain		CCM12890

LENGTH SENSOR CONVERSION BRACKET WITH 6-PIN MS CONNECTOR

ADAPTS APPROPRIATE ZBG and ZBH ROTARY PULSE GENERATOR TO LENGTH MEASUREMENT





DESCRIPTION

This conversion bracket allows the customer to assemble a custom length sensor by purchasing the following items separately.

1. Length Sensor Conversion Bracket (P/N LSCB1000)
2. An encoder with appropriate connector, PPR and output type.
3. One or two measuring wheels. Install OF & OK measuring wheels with set screw hub facing encoder shaft *(as shown)*. Apply thread locking material to wheel set screw threads during installation to the encoder shaft.
4. Hinge Clamp Assembly (P/N LSAHC001)

Note: To complete installation, insure guards, shields or other devices are in place to protect personnel from rotating equipment.

I

The tubular arm length of this bracket, related to the wheel axis center-line of the encoder is 6.8" similar to the length sensors. The 10´ long, 4-wire, shielded cable with 6-pin MS connector *(included with conversion bracket)* has the same color coding as described for the encoder cable P/N CCARPG01. Screws for mounting the conversion bracket are included.

ORDERING INFORMATION

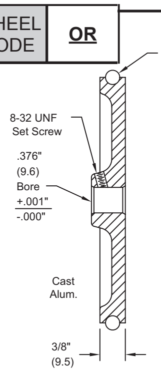
MODEL NO.	DESCRIPTION	PART NUMBER
LSCB	Length Sensor Conversion Bracket	LSCB1000
	Length Sensor Conversion Bracket (Special Length)	LSCB1099
--	Hinge Clamp Assembly for Length Sensors & Conversion Bracket (Above)	LSAHC001

LENGTH SENSOR MEASUREMENT ACCURACY

Factors which affect measurement accuracy include Measuring Wheel accuracy and wear, and material conditions. Ideally, materials which are hard, thin and strong provide good readings, conversely, soft, thick and elastic materials can present problems in obtaining true readings. The great majority of these situations, where this effect is consistant, can be compensated for by applying a multiplier to the quadrature output pulse train so as to obtain a corrected measurement. Counter or Rate Indicators with "input scaling" can compensate for Measuring Wheel wear and material elastic and compliance errors. In addition, English/Metric conversions may also be accomplished *(See RLC catalog for more information)*.

LENGTH SENSOR ACCESSORIES
SEPARATE LENGTH MEASURING WHEELS - DIMENSIONS In Inches (mm)

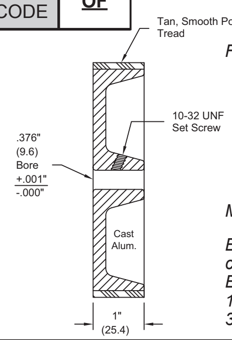
WHEEL CODE **OR**



FOR USE ON: Metal, paper, foil, film and hard plastics. Line contact on material being measured, convenient when available measuring track is narrow or for measuring on end of roller beside passing material.

Max. Speed: 600 RPM

WHEEL CODE **OF**

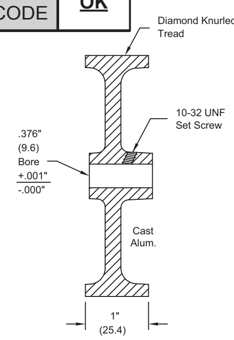


FOR USE ON: Soft, smooth materials such as soft paper, matting, cardboard, fine weave textiles. Broad wheel tread minimizes contact pressure and tan polyurethane tread minimizes marking.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

WHEEL CODE **OK**



FOR USE ON: Rubber, coarse weave fabrics, rough wood surfaces, foam, insulation.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

SELECTING APPROPRIATE WHEEL SIZE & PPR (Pulses Per Rev.) OF ROTARY PULSE GENERATOR

When the desired output of a length sensor and wheel combination is either in feet or inch units, selection of the proper combination is relatively straight forward. For example, with a 1-foot wheel circumference, a 1 PPR Rotary Pulse Generator will deliver 1 pulse/ft, 12 PPR would deliver 12 pulses/ft *(1 pulse/inch);* 100 PPR would yield 100 pulses/ft; and 120 PPR would permit measuring to 1/10th of an *inch (1/120th of a foot).*

WHEELS & REPLACEMENT TIRES FOR CODE OR WHEELS

ORDERING INFORMATION

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OR	1 foot (1/3 yd)	±0.40%	WF1000OR
	1/3 meter	±0.40%	WM0333OR
	4/10ths yard	±0.40%	WY0400OR
	4/10ths meter	±0.40%	WM0400OR
OF	1 foot (1/3 yd)	±0.35%	WF1000OF
	1/3 meter	±0.30%	WM0333OF
	4/10ths yard	±0.30%	WY0400OF
	4/10ths meter	±0.30%	WM0400OF
BF (Balanced)	1 foot (1/3 yd)	±0.40%	WF1000BF

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OK	1 foot (1/3 yd)	±0.35%	WF1000OK
	1/3 meter	±0.30%	WM0333OK
	4/10ths yard	±0.30%	WY0400OK
	4/10ths meter	±0.30%	WM0400OK
BK (Balanced)	1 foot (1/3 yd)	±0.35%	WF1000BK
Replacement Tires for OR Wheels	1 foot (1/3 yd)		TORF1000
	1/3 meter		TORM0333
	4/10ths yard		TORY0400
	4/10ths meter		TORM0400

Note: After installation of measuring wheels, ensure guards,shields or other devices are in place to protect personnel from rotating equipment.

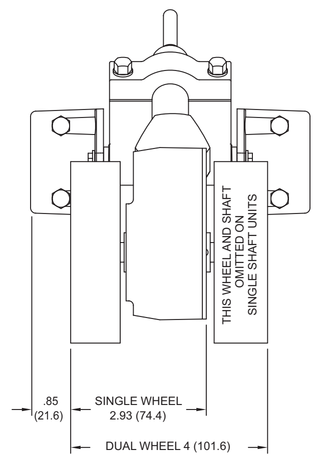
MODEL LSAHC - LENGTH SENSOR HINGE CLAMP ASSEMBLY

The Length Sensor Hinge Clamp Assembly provides an easy method for attachment and mounting of the Length Sensors and LSCB1 Conversion Bracket. The removable top on the solid zinc LSAHC mounting block allows quick installation of the Length Sensor handle tube and provides secure clamping retention. The mounting block pivots freely in zinc right angle brackets to allow mounting the assembly via clearance holes for 1/4" dia. bolts.

The lock washers must be used as indicated (between the bolt head and the top clamp piece). Assemble the top clamp piece as follows.

1. Tighten both bolts so that the top clamp half draws down evenly on the sensor tube.
2. Tighten the bolts until both lock washers are flat.
3. Then turn each bolt an additional ½ to ¾ turn.

CAUTION: Downward tension on signal cable can cause wheel(s) to lift. Make sure cable is clamped to machine frame near encoder and allow slack.

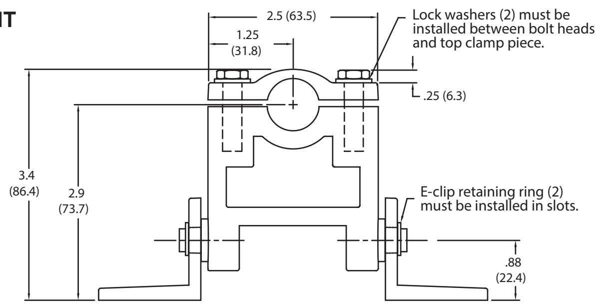


Model ZGH Shown

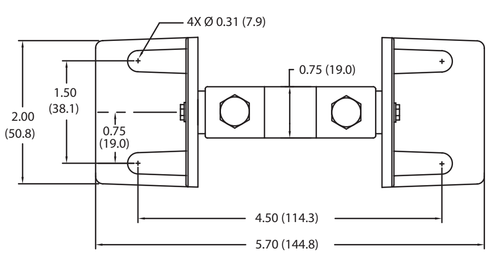
NOTE: The weight at the Length Sensor unit provides sufficient traction for accurate operation when mounted as shown, with arm angle from horizontal not exceeding ±30°, and with hinge clamp toward the far extreme of the extension arm.

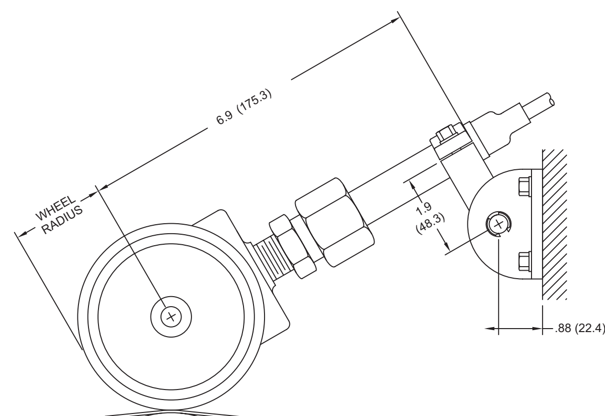
DIMENSIONS In inches (mm)

FRONT VIEW



TOP VIEW





Model ZFH Shown

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LSAHC	Length Sensor Hinge Clamp Assembly	LSAHC001

Length Sensors should be mounted so measuring wheel(s) contact ribbon, strip or web as it passes over a roller. As an alternative, wheel(s) can be driven by roller surface next to material being measured.

MODEL ZMH - HEAVY DUTY LENGTH SENSOR

- *HEAVY DUTY INDUSTRIAL CONSTRUCTION*
- *QUADRATURE OUTPUT*
- *BUILT-IN SPRING TENSIONING*
- *VERTICAL, HORIZONTAL, OR UPSIDE-DOWN MOUNTING*
- *EASY INSTALLATION*
- *VARIOUS MEASURING WHEELS AVAILABLE*
- *VARIOUS MOUNTING CONFIGURATIONS*

I

DESCRIPTION

Designed for heavy duty sensing applications, the Heavy Duty Length Sensor, Model ZMH, is versatile and easy-to-use.

It features a built-in spring-loaded torsion arm that provides a simple-to-adjust torsion load, allowing the unit to be mounted in almost any orientation, including upside down. Using a properly selected wheel, the ZMH can be used on almost any surface, while operating at speeds up to 3000 feet per minute. Whether you need to measure speed, position, or distances, the Model ZMH is the ideal solution.

Open Collector Output Wiring

The ZMH sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be "pulled up" to external voltages different than the encoder supply voltage (30 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZMH *	Heavy Duty Length Sensor with Quadrature Output	250	ZMH0250B
		500	ZMH0500B
		1000	ZMH1000B
		2000	ZMH2000B
		2500	ZMH2500B
MBZM	Mounting Bracket and Shaft	N/A	MBZM0001
	Double Wheel Pivot Mount and Shaft	N/A	MBZM0002

** Mounting shaft not included.*

LENGTH SENSOR MEASUREMENT ACCURACY

Factors which affect measurement accuracy include Measuring Wheel accuracy and wear, and material conditions. Ideally, materials which are hard, thin and strong provide good readings, conversely, soft, thick and elastic materials can present problems in obtaining true readings. Where this effect is consistant, Counter or Rate Indicators with "input scaling" can compensate for Measuring Wheel wear and material elastic and compliance errors. In addition, English/Metric conversions may also be accomplished.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

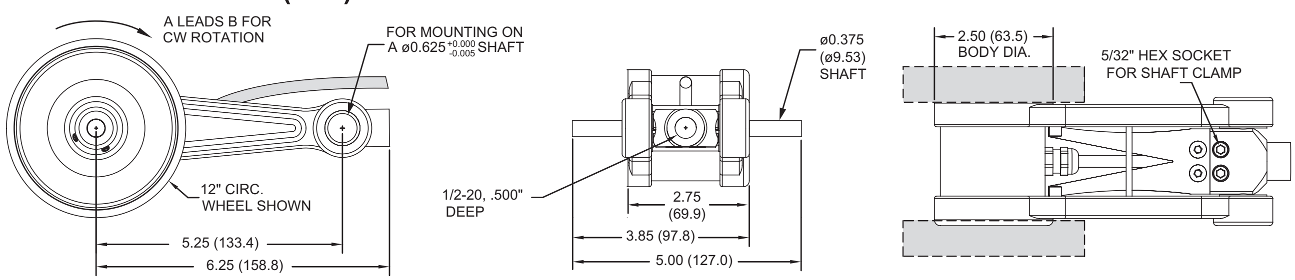
CAUTION: Risk of electric shock.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **INPUT VOLTAGE**: 4.75 to 28 VDC.
2. **INPUT CURRENT**: 100 mA max (65 mA typical) with no output load
3. **OUTPUTS**: NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - Two square waves in quadrature with A leading B for clockwise rotation, as viewed from the wheel side.
4. **MAX FREQUENCY**: 200 KHz
5. **NOISE IMMUNITY**: Tested to BS EN61000-6-2; BS EN50081-2; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-6, BS EN500811
6. **SYMMETRY**: 180º (±18º) electrical

DIMENSIONS In inches (mm)



Note: All dimensions are in inches with a tolerance of +0.01" unless otherwise specified.

7. **QUAD. PHASING**: 90º (±22.5º) electrical
8. **MIN. EDGE SEP**: 67.5º electrical
9. **ACCURACY**: Within 0.017º mechanical or 1 arc-minute from true position. (for PPR>189)

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 3000 RPM
2. **SHAFT MATERIAL**: Stainless Steel
3. **SHAFT SIZE**: 0.375"
4. **RADIAL SHAFT LOAD**: 10 lb. max. controlled by spring torsion.
5. **STARTING TORQUE**: 1.0 oz-in typical
6. **ELECTRICAL CONNECTION**: 2 meter Cable, (foil and braid shield, 24 AWG conductors).

FUNCTION	CABLE WIRE COLOR
+VDC	Red
Com	Black
A	White
B	Green
Shield	Bare

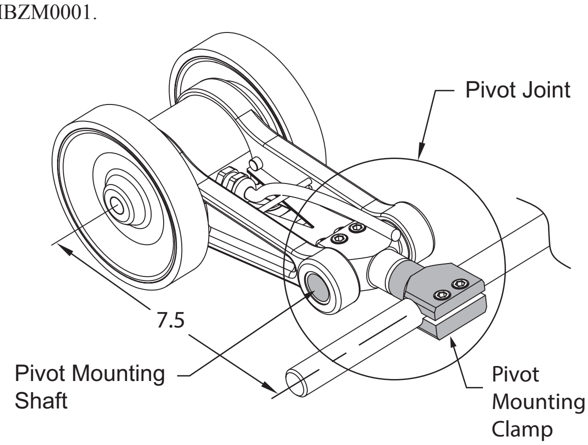
7. **MOUNTING**: 5/8" diameter thru hole with clamp
8. **HOUSING**: powder coated aluminum.
9. **WEIGHT**:
   ZMH: 2.15 lb. (0.975 Kg)
   MBZM0001: 1.5 lb. (0.68 Kg)
   MBZM0002: 0.15 lb.. (68.04 g)

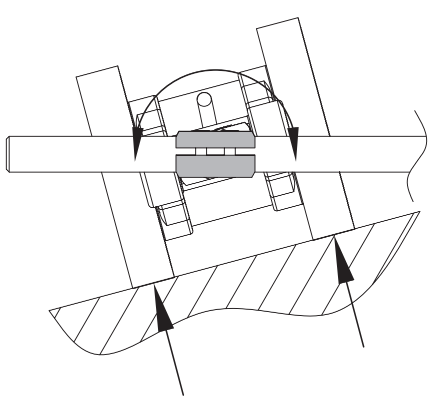
ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 85°C
2. **STORAGE TEMPERATURE**: -25°C to +85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP50

DOUBLE WHEEL PIVOT MOUNT - MBZM0002

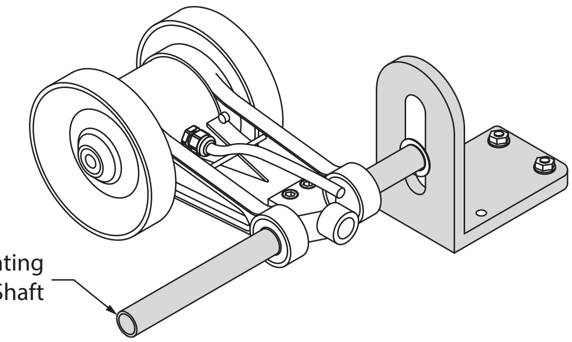
This accessory allows the unit to rotate freely to maintain equal pressure on both wheels, accomodating uneven/angled surfaces and mounting misalignment. Pivot mounting shaft included with MBZM0002. For installation of unit, use the mounting bracket and shaft included with MBZM0001.



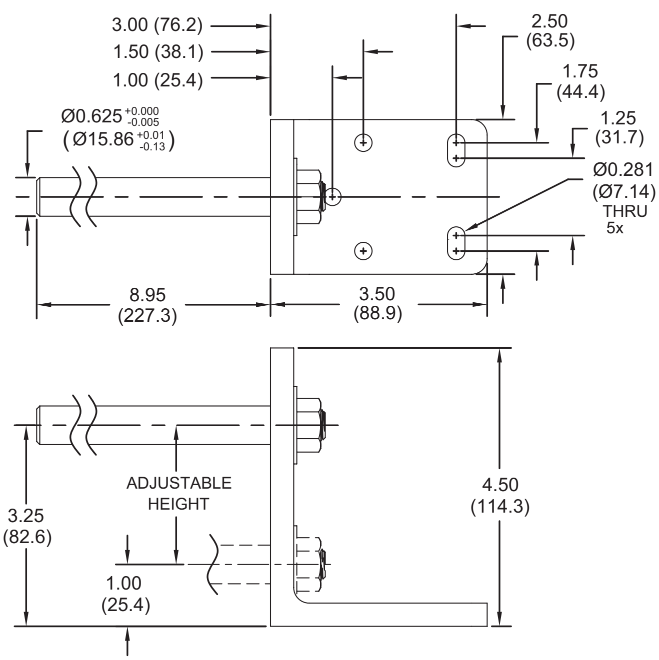


MOUNTING BRACKET - MBZM0001

This accessory angle mounting bracket allows for a variety of mounting positions and makes installation of the ZMH even easier. Mounting shaft included with mounting bracket.



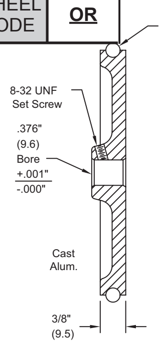
DIMENSIONS In inches (mm)



LENGTH SENSOR ACCESSORIES

SEPARATE LENGTH MEASURING WHEELS - DIMENSIONS In Inches (mm)

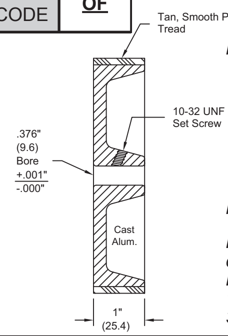
WHEEL CODE **OR**



FOR USE ON: Metal, paper, foil, film and hard plastics. Line contact on material being measured, convenient when available measuring track is narrow or for measuring on end of roller beside passing material.

Max. Speed: 600 RPM

WHEEL CODE **OF**

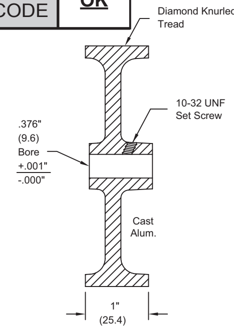


FOR USE ON: Soft, smooth materials such as soft paper, matting, cardboard, fine weave textiles. Broad wheel tread minimizes contact pressure and tan polyurethane tread minimizes marking.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

WHEEL CODE **OK**



FOR USE ON: Rubber, coarse weave fabrics, rough wood surfaces, foam, insulation.

Max. Speed: 600 RPM

Balanced version of 1ft. circumference available. Balanced to ANSI S2.19-1989 Quality Grade 6.3 @ 3000 RPM.

I

SELECTING APPROPRIATE WHEEL SIZE & PPR (Pulses Per Rev.) OF ROTARY PULSE GENERATOR

When the desired output of a length sensor and wheel combination is either in feet or inch units, selection of the proper combination is relatively straight forward. For example, with a 1-foot wheel circumference, a 1 PPR Rotary Pulse Generator will deliver 1 pulse/ft, 12 PPR would deliver 12 pulses/ft *(1 pulse/inch);* 100 PPR would yield 100 pulses/ft; and 120 PPR would permit measuring to 1/10th of an *inch (1/120th of a foot).*

WHEELS & REPLACEMENT TIRES FOR CODE OR WHEELS

ORDERING INFORMATION

WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OR	1 foot (1/3 yd)	±0.40%	WF1000OR
	1/3 meter	±0.40%	WM0333OR
	4/10ths yard	±0.40%	WY0400OR
	4/10ths meter	±0.40%	WM0400OR
OF	1 foot (1/3 yd)	±0.35%	WF1000OF
	1/3 meter	±0.30%	WM0333OF
	4/10ths yard	±0.30%	WY0400OF
	4/10ths meter	±0.30%	WM0400OF
BF (Balanced)	1 foot (1/3 yd)	±0.40%	WF1000BF

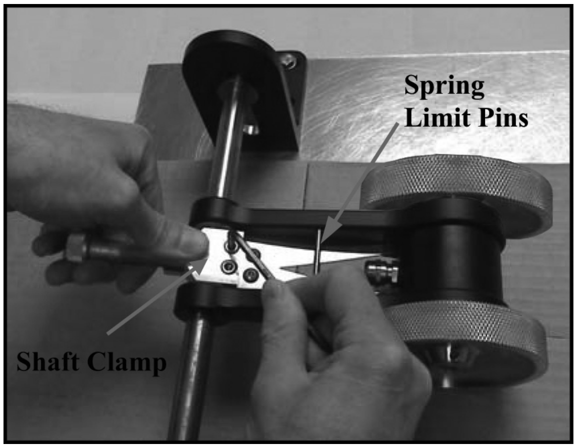
WHEEL CODE	CIRCUMFERENCE	TOLERANCE	PART NUMBER
OK	1 foot (1/3 yd)	±0.35%	WF1000OK
	1/3 meter	±0.30%	WM0333OK
	4/10ths yard	±0.30%	WY0400OK
	4/10ths meter	±0.30%	WM0400OK
BK (Balanced)	1 foot (1/3 yd)	±0.35%	WF1000BK
Replacement Tires for **OR** Wheels	1 foot (1/3 yd)		TORF1000
	1/3 meter		TORM0333
	4/10ths yard		TORY0400
	4/10ths meter		TORM0400

Note: After installation of measuring wheels, ensure guards,shields or other devices are in place to protect personnel from rotating equipment.

ZMH INSTALLATION

INSTALLATION:

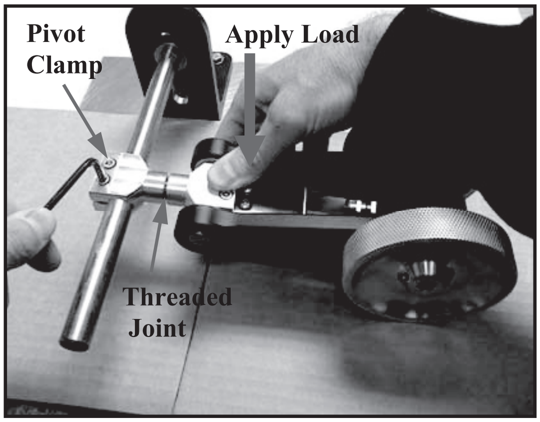
1. Slide ZMH over a fixed Ø5/8" (Ø0.625 +0/-0.005") shaft. The optional ZMH Mounting Bracket (MBZM0001) is shown in the picture.
2. While rotating the ZMH clamp to apply a spring load, securely tighten the two clamp bolts with a 5/32" (supplied) or 4 mm hex “L” key.
   Note 1: A 1/2 – 20 bolt can be threaded into the end of the clamp to aid in loading the spring as shown. If a 1/2 – 20 bolt is not handy, then a Ø0.45"or smaller rod, bolt, screw driver etc. works as well.
   Note 2: The spring should not be preloaded too much or it may come in contact with the spring limit pins and the ZMH will not have sufficient travel to accommodate variations in the surface height of the material being measured. For most applications, the spring setting in its mid-range (5-6 lbs.) is sufficient.



DOUBLE WHEEL PIVOT INSTALLATION (MBZM0002):

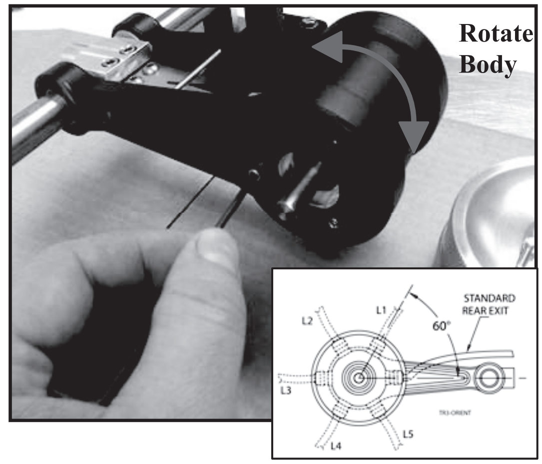
Note: It is recommended that double wheel ZMH's be installed with the optional Double Wheel Pivot. The pivot allows the unit to rotate freely to maintain equal pressure on both wheels, accommodating uneven/angled surfaces and mounting misalignment.

1. Thread the pivot clamp into the end of the ZMH's clamp by hand until the threads just bottom out then back out approximately 1 revolution to allow for rotation after installation.
2. Slide the pivot clamp over a fixed Ø5/8" (Ø0.625 +0/-0.005") shaft. The optional ZMH Mounting Bracket (MBZM0001) is shown in the picture.
3. While applying a load to the spring, securely tighten the two clamp bolts with a 5/32" (supplied) or 4mm hex "L" key.



CONNECTOR EXIT ORIENTATION ADJUSTMENT:

1. Slide the ZMH over a Ø5/8" (Ø0.625 +0/-0.005") shaft and tighten the clamp bolts with the supplied 5/32" hex "L" key.
2. Remove the measuring wheel(s) using the supplied 3/32" hex "L" wrench to loosen the set screws.
3. Remove 6 screws (3 on each side) from the side plates using the supplied 7/64" hex "L" key.
4. Rotate body of encoder to desired orientation, aligning bolt pattern with one of six unique positions (see inset drawing).
5. Replace side plate screws and measuring wheel(s), making sure to tighten screws securely.



I

MODEL ZDH - 2" FLANGE MOUNT ROTARY PULSE GENERATOR
MODEL ZNH - 2.5" FLANGE MOUNT ROTARY PULSE GENERATOR

(Replaces the Model RPGD and RPGN respectively)

GENERAL DESCRIPTION

The ZDH and ZNH series of sensors are heavy duty, extremely rugged, reliable, yet compact encoders designed for harsh factory and plant floor environments. Both models are flange mount and conform to NEMA 4, 13 and IP66 standards. Typical applications include motion control feedback, machine control, process control, elevator controls, conveyors, textile equipment, robotics and food processing.

Open Collector Output Wiring

The ZDH and ZNH series of sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages different than the encoder supply voltage (40 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

REPLACEMENT

Note: The RPGD connections are made by a 24 inch cable. The ZDH uses a 7-Pin MS connector.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

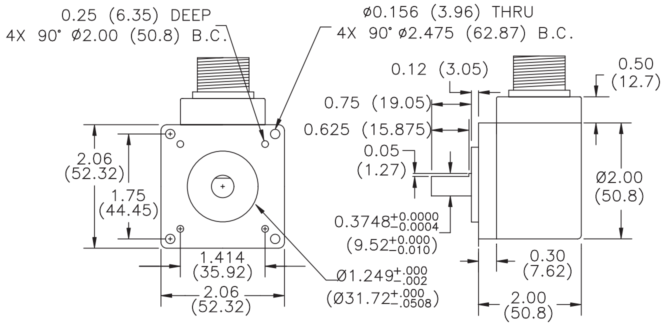
1. **SUPPLY VOLTAGE**: 4.75 to 28 VDC, 100 mA max. with no output load
2. **OUTPUTS**: NPN Open Collector Transistor, V_{OH} = 40 VDC max.; 100 mA max. current. incremental - two square waves in quadrature with A leading B for clockwise shaft rotation.
3. **MAX. FREQUENCY**: Up to 1 MHz
4. **INDEX**: NPN Open Collector Transistor, V_{OH} = 40 VDC max.; 100 mA max. current. Once per revolution centered over Output Channel A. Index is a positive pulse.
5. **INPUT RIPPLE**: 100 mV peak to peak at 0 to 100 KHz.
6. **NOISE IMMUNITY**: Tested to BS EN61000-4-2; IEC801-3; BS EN61000-4-4; DDENV 50141; DDENV 50204; BS EN55022; BS EN61000-6-2; BS EN50081-2
7. **SYMMETRY**:
   1 to 6000 CPR: 180° (±18°) electrical at 100 KHz output
   6001 to 20,480 CPR: 180° (±36°) electrical
8. **QUAD PHASING**:
   1 to 6000 CPR: 90° (±22.5°) electrical
   6001 to 20,480 CPR: 90° (±36°) electrical
9. **MIN EDGE SEP**:
   1 to 6000 CPR: 67.5° electrical at 100 KHz output
   6001 to 20,480 CPR: 54° electrical
   >20,480 CPR: 50° electrical
10. **RISE TIME**: Less than 1 microsecond
11. **ACCURACY**:
    Instrument and Quadrature Error: From one cycle to any other cycle.
    200 to 1999 CPR: 0.017° mechanical (1.0 arc minutes)
    2000 to 3000 CPR: 0.01° mechanical (0.6 arc minutes)
    Interpolation error (units >3000 CPR only) within 0.005° mechanical. (Total Optical Encoder Error = Instrument + Quadrature + Interpolation)

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 8000 RPM
2. **SHAFT DIAMETER**:
   ZDH: 0.375" (9.5 mm)
   ZNH: 0.375" (9.5 mm)
3. **RADIAL SHAFT LOAD**: 80 lbs. max. Rated load of 20 to 40 lbs. for bearing life of 1.5 X 10^9 revolutions.
4. **AXIAL SHAFT LOAD**: 80 lbs. max. Rated load of 20 to 40 lbs. for bearing life of 1.5 X 10^9 revolutions.
5. **STARTING TORQUE**: 3.0 oz-in. (21.18 N-mm)

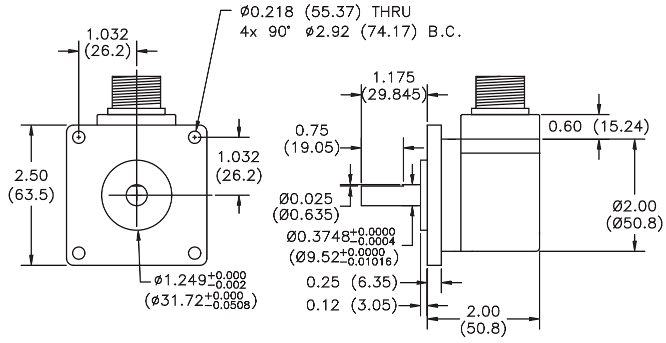
DIMENSIONS In inches (mm)

ZDH



DIMENSIONS In inches (mm)

ZNH



6. **MOMENT OF INERTIA**: 5.2×10^{-4} oz-in-sec^2 (3.66×10^{-3} N-mm-sec^2)
7. **CONNECTOR TYPE**: 7-Pin MS type connector

FUNCTION	PIN	WIRE COLOR
+VDC	A	RED
COMMON	B	BLACK
DATA A	C	WHITE
DATA B	D	GREEN
INDEX Z	E	ORANGE
CASE GROUND	F	BARE WIRE

8. **HOUSING**: Black non-corrosive finish
9. **MOUNTING**:
   ZDH: 2.0" Flange Mount
   ZNH: 2.5" Flange Mount
10. **WEIGHT**: 11 oz. (311.8 g)

I

ENVIRONMENTAL CONDITIONS

1. **OPERATING TEMPERATURE**: 0 to +70 °C
2. **STORAGE TEMPERATURE**: -25 to +85 °C
3. **HUMIDITY**: 98% RH non-condensing
4. **SHOCK**: 75 g @ 11 msec duration
5. **SEALING**: NEMA 4, 13 and IP66 with shaft seal

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER	
			2" Flange Mount	2.5" Flange Mount
ZDH & ZNH	Rotary Pulse Generators	60	ZDH0060H	ZNH0060H
		100	ZDH0100H	ZNH0100H
		500	ZDH0500H	ZNH0500H
		600	ZDH0600H	ZNH0600H
		1000	ZDH1000H	ZNH1000H
		1200	ZDH1200H	ZNH1200H
		2000	ZDH2000H	ZNH2000H
		2500	ZDH2500H	ZNH2500H

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
CCBRPG	7-Pin MS Connector	CCBRPG00
	7-Pin MS Connector w/10 ft 24 AWG 5 Conductor w/drain	CCBRPG02
	7-Pin MS Connector w/20 ft 24 AWG 5 Conductor w/drain	CCBRPG03
RPGFC	Flexible Coupling (1" Length) 0.25" - 0.375"	RPGFC002
	Flexible Coupling (1" Length) 0.375" - 0.375"	RPGFC003
	Flexible Coupling (1.5" Length) 0.375" - 0.5"	RPGFC004
	Flexible Coupling (1" Length) 0.375" - 6 mm	RPGFC006

Note: Only Factory Stocked part numbers are listed. Consult Factory for part number and availability of other PPR and Output Configurations.

MODEL ZMD – MINIATURE LENGTH SENSOR

(Replaces MODEL LSM)

- COMPACT SIZE
- QUADRATURE OUTPUT
- BUILT-IN SPRING TENSIONING
- VERTICAL, HORIZONTAL, OR UPSIDE-DOWN MOUNTING
- REDUCES INSTALLATION TIME
- VARIOUS MEASURING WHEELS AVAILABLE

CE

DESCRIPTION

Designed for light to medium duty sensing applications, the Miniature Length Sensor, Model ZMD, is compact in size and easy-to-use.

It features a built-in spring-loaded torsion arm that provides a simple-to-adjust torsion load, allowing the unit to be mounted in almost any orientation, including upside down. Using a 6" or 200 mm wheel, the ZMD can be used on almost any surface, while operating at speeds up to 3000 feet per minute. The housing is a durable, conductive composite material that will eliminate static build up. Whether you need to measure speed, position, or distances, the Model ZMD is the ideal solution. For other pulse rates and/or wiring configurations, contact the factory for further details.

Open Collector Output Wiring

The ZMD sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be “pulled up” to external voltages different than the encoder supply voltage (30 VDC maximum). NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

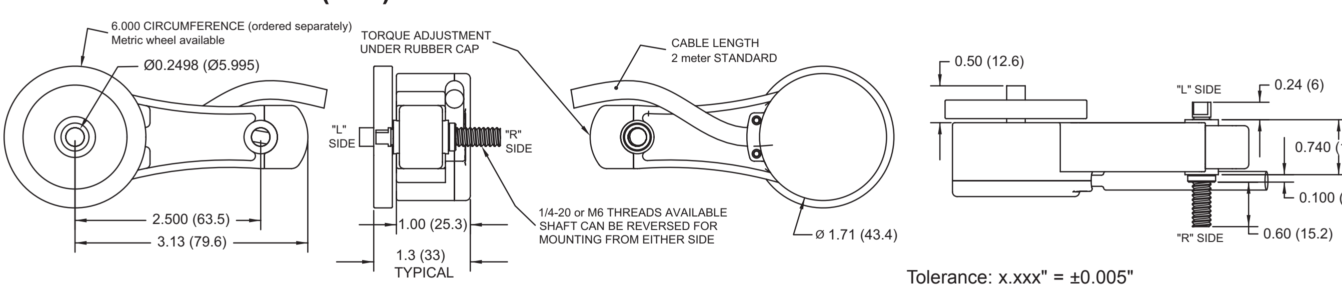
1. **INPUT VOLTAGE**: 4.75 to 28 VDC max for temperatures up to 85ºC; 4.75 to 24 VDC for temperatures between 85ºC to 100ºC, reverse polarity protected.
2. **INPUT CURRENT**: 100 mA max (65 mA typical) with no output load
3. **OUTPUTS**: NPN Open Collector Transistor, V_{OH} = 30 VDC max.; 20 mA max. current. Incremental - Two square waves in quadrature with A leading B for clockwise rotation, as viewed from the wheel side.
4. **MAX FREQUENCY**: 200 KHz standard
5. **NOISE IMMUNITY**: Tested to BS EN61000-6-2; BS EN50081-2; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-6, BS EN500811 (Tested with 2 meter cable)
6. **SYMMETRY**: 180º (±18º) electrical
7. **QUAD. PHASING**: 90º (±22.5º) electrical
8. **MIN. EDGE SEP**: 67.5º electrical
9. **ACCURACY**: Within 0.017º mechanical or 1 arc-minute from true position. (for PPR>189)

MECHANICAL SPECIFICATIONS

1. **MAXIMUM MECHANICAL SPEED**: 6000 RPM. Higher speeds may be achievable, contact the factory.
2. **SHAFT MATERIAL**: Stainless Steel
3. **SHAFT TOLERANCE**: +0.0000/-0.0004" (+0.000/-0.010 mm)
4. **RADIAL SHAFT LOAD**: 5 lb. max. Rated load of 2 to 3 lb for bearing life of 1.2×10^{10} revolutions
5. **AXIAL SHAFT LOAD**: 5 lb. max. Rated load of 2 to 3 lb for bearing life of 1.2×10^{10} revolutions
6. **STARTING TORQUE**: 0.05 oz-in
7. **ELECTRICAL CONNECTION**: 2 meter Cable, (foil and braid shield, 24 AWG conductors). Drain wire internally connected to case.

FUNCTION	CABLE WIRE COLOR
+VDC	Red
Com	Black
A	White
B	Green
Shield	Bare

DIMENSIONS In inches (mm)



Tolerance: x.xxx" = ±0.005"
x.xx" = ±0.01"

8. **MOUNTING**: Pivot Shaft can be mounted from either side of the housing and is field reversible.
9. **HOUSING**: Stainless steel fibers in a high temperature nylon composite
10. **WEIGHT**: 5 oz typical

ENVIRONMENTAL SPECIFICATIONS

1. **OPERATING TEMPERATURE**: -20°C to 85°C
2. **STORAGE TEMPERATURE**: -25°C to +85°C
3. **HUMIDITY**: 98% RH non-condensing
4. **VIBRATION**: 10 g @ 58 to 500 Hz
5. **SHOCK**: 80 g @ 11 msec duration
6. **SEALING**: IP50

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PPR	PART NUMBER
ZMD	Miniature Length Sensor with Quadrature Output	250	ZMD0250B
		500	ZMD0500B
		1000	ZMD1000B
		2000	ZMD2000B
		2500	ZMD2500B

Do not dispose of unit in trash - Recycle

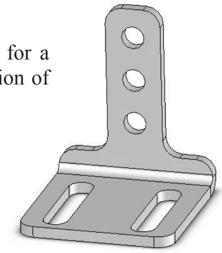
ACCESSORIES

DESCRIPTION	PART NUMBER
Mounting Bracket	RPGMB002
Urethane (6" Circumference) Wheel	WI0006OF
Knurled (6" Circumference) Wheel	WI0006OK
Urethane (200 mm Circumference) Wheel	WM0200OF
Knurled (200 mm Circumference) Wheel	WM0200OK

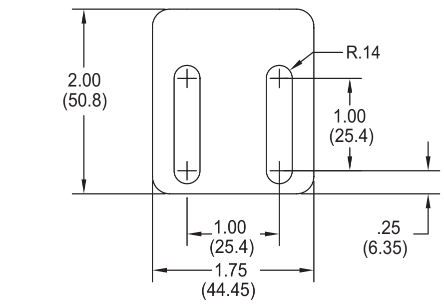
Only factory stocked part numbers are listed. Consult the factory for part number and availability of other PPR and output configurations.

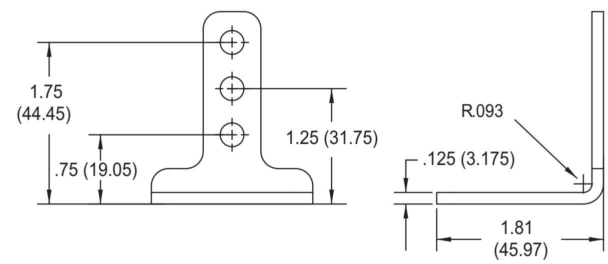
MOUNTING BRACKET

This accessory angle mounting bracket allows for a variety of mounting positions and makes installation of the ZMD even easier.



DIMENSIONS In inches (mm)





MODEL ZLZ - LINEAR CABLE ENCODER
(Replaces MODEL LES)

- *LOW COST LINEAR SOLUTION*
- *50 OR 500 PULSES PER INCH*
- *STAINLESS STEEL CABLE*
- *0 TO 50 INCHES OF CABLE MEASUREMENT*
- *VARIOUS CABLE ASSEMBLIES AVAILABLE*

DESCRIPTION

The Linear Cable Encoder can provide an accurate, yet low cost solution for Linear Measurement applications. Common applications include robotics, extrusion presses, valve positioning, textile machinery, and gate control positioning, just to name a few. The ZLZ has some unique advantages over other sensing solutions. Using a stainless steel cable, perfect parallel alignment is no longer required and with a 50 inch cable reach, it can easily be mounted away from harsh environments. The ZLZ is available in a quadrature output, allowing the sensor to operate in positioning applications.

Additional cable exit configurations, pulses per inch, and mating connectors are available on special request. Contact the factory for details.

Open Collector Output Wiring

The ZLZ sensors have open collector outputs. An open collector output brings the uncommitted collector of the encoder switching device to the external world. Because the collector element is not associated with the sensor supply voltage, the sensor output collector may be "pulled up" to external voltages (40 VDC max.) different than the encoder supply voltage . NPN open collector outputs are current sinking devices. An output signal will not be generated unless a pull-up resistor is connected from the open-collector to the positive side of an external supply. The same supply can be used for powering the unit and for the pull-up resistor.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

1. **INPUT VOLTAGE**: 4.75 to 28 VDC
2. **INPUT CURRENT**: 80 mA maximum with no output load
3. **INPUT RIPPLE**: 100 mV peak-to-peak at 0 to 100 KHz
4. **OUTPUT**: NPN open collector; 250 mA max per channel; Incremental - square wave with channel A leading B during linear extension.
5. **INDEX**: Once per 5" cable extension or retraction
6. **MAX FREQUENCY**: 0 to 125 KHz
7. **SYMMETRY**: 180° (±18°) electrical
8. **QUAD PHASING**: 90° (±22.5°) electrical
9. **RISE TIME**: Less than 1 µsec

MECHANICAL SPECIFICATIONS

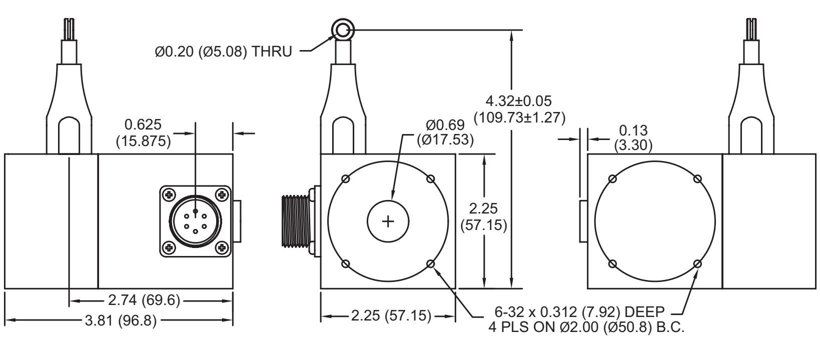
1. **FULL STROKE LENGTH (FSL)**: 50" standard.
2. **FINISH**: Black powder coated aluminum
3. **ACCURACY**: ±0.10% FSL
4. **REPEATABILITY**: ±0.015% FSL
5. **LINEAR RESOLUTION**: Up to 500 cycles per inch (0.002" per cycle)
6. **CABLE MATERIAL**: 0.034" nylon coated stainless steel rope
7. **CABLE TENSION**: 20 oz maximum typical
8. **LIFE (CYCLES)**: 1,000,000 predicted at zero angle cable exit
9. **CONNECTOR TYPE**: 6-Pin MS type connector
10. **WEIGHT**: 19 oz (538.64 g)

ENVIRONMENTAL SPECIFICATIONS

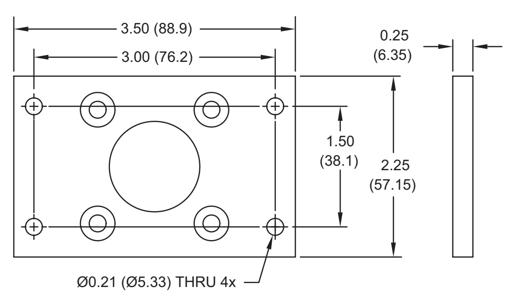
1. **OPERATING TEMPERATURE**: 0 °C to 85 °C
2. **SEALING**: IP65 standard

DIMENSIONS In inches (mm)

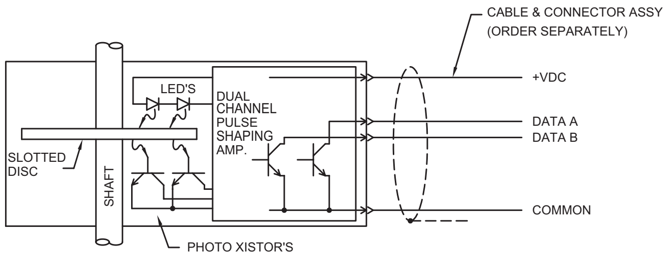
ZLZ



MOUNTING BRACKET



ZLZ ELECTRICAL CONNECTIONS



I

ZLZ WIRING SPECIFICATIONS

FUNCTION	LE PIN	CCARPG WIRE COLOR
+VDC	A	RED
COMMON	B	BLACK
DATA A	C	WHITE
DATA B	D	GREEN
NO CONNECTION	E	

ORDERING INFORMATION

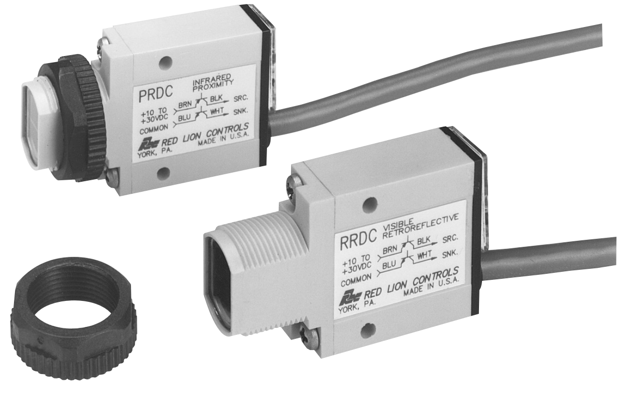
MODEL NO.	DESCRIPTION	PART NUMBER
ZLZ	Quadrature output, 50 PPI, Standard Housing	ZLZ0050G
	Quadrature output, 500 PPI, Standard Housing	ZLZ0500G

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBER
	ZLZ Mounting Bracket	LEMTBR00
CCARPG	Mating 6-Pin MS Connector	CCARPG00
	10' 6-Pin 4-Wire Cable/Connector	CCARPG01
	25' 6-Pin 4-Wire Cable/Connector	CCARPG25
	50' 6-Pin 4-Wire Cable/Connector	CCARPG50

COMPACT DC POWERED PHOTO-ELECTRIC SENSORS

- *RETROREFLECTIVE, PROXIMITY (DIFFUSE) & OPPOSED BEAM PAIRS*
- *MODULATED LED LIGHT BEAMS FOR IMMUNITY TO AMBIENT LIGHT*
- *+10 to +30 VDC OPERATION WITH REVERSE POLARITY PROTECTION*
- *NPN & PNP (CURRENT SINKING AND SOURCING) OUTPUTS*
- *RUGGED VALOX HOUSING MEETS NEMA 1, 2, 3, 3S, 4, 4X, 12, & 13 STANDARDS*
- *LED SIGNAL STRENGTH INDICATOR MAKES ALIGNMENT EASY & PROVIDES INDICATION OF LIGHT SIGNAL DETERIORATION*



DESCRIPTION

These compact self-contained and powerful Retroreflective, Proximity (Diffuse) and Opposed Beam Pair Photo-electric Sensors provide application flexibility in counting, positioning and object detection. All units are interchangeable with conventional 18 mm threaded barrel-type photo-electrics and inductive proximity sensors. Their small 2-1/8" x 1-1/4" x 1/2" size, in addition to various mounting options, greatly increases alignment ease and application possibilities.

All units can be powered from +10 to +30 VDC and are reverse polarity protected. Current sinking NPN and current sourcing PNP Open Collector Transistors are protected from continuous overload and inductive load transients and are rated to 150 mA, with low saturation voltage and less than 1 µA offstate leakage current. In addition, no false outputs are generated at power-up. A 6 foot long 4 conductor PVC jacketed cable with strain relief provides supply input and transistor outputs.

A gasketed removable back cover provides access to the LIGHT/DARK Operate Mode Selector. When in the "Light Operate" (LO) position, outputs turn on when light **is** received by the detector. When in the "Dark Operate" (DO) position, the outputs are turned on when sensor light is **not** detected. Also accessible is a 15-turn screwdriver adjustable GAIN potentiometer that enables precise adjustment of system sensitivity. A rear mounted LED Signal Strength Indicator "lights" whenever the sensor sees a light condition and "blinks" at a rate proportional to the received signals strength (the stronger the signal, the faster the rate). This LED allows for easy alignment and monitoring of signal strength deterioration due to dirty optics or changes in alignment.

SPECIFICATIONS

1. **POWER REQUIREMENTS:** +10 to +30 VDC, 10% Ripple Max., Reverse Polarity Protected, 25 mA max. (Model EMDC = 20 mA max.)
2. **OUTPUTS:** Current Sinking NPN and Current Sourcing PNP Open Collector Transistors; Short Circuit Protected to +30 VDC, Internal Zener Diode Protected;
   I_{SNK} = 150 mA each; V_{OH} = 30 VDC max.
   NPN V_{SAT} = 0.2 V @ 10 mA load; 1 V max. @ 150 mA max. load
   PNP V_{SAT} = Less than 1 V @ 10 mA load; less than 2 V @ 150 mA max. load
   Offstate Leakage Current = Less than 1 µA
3. **RESPONSE TIME:** Responds to a "light" or "dark" signal duration of 1 msec. or greater.
4. **OPERATING TEMPERATURE:** -4° to+158°F (-20° to +70°C)
5. **WEIGHT:** 3.5 oz (99.2 g)

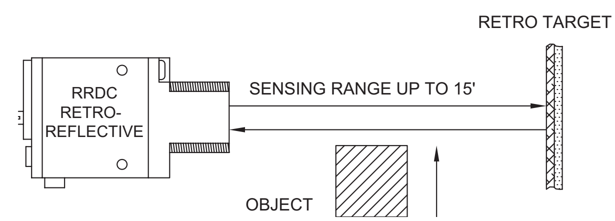
MOUNTING

Various mounting methods have been designed to simplify alignment and provide versatility in any industrial environment. The integral 18 mm threaded lense can be interchanged with existing threaded entries common to 18 mm barrel sensors and inductive proximity switches. The threaded lense can also be installed into panel thicknesses of 5/16" through a 0.71" diameter hole and tightened into place with the supplied mounting nut. Two #4 screw clearance through-holes on 0.95" centers are available for side mounting or side nesting of multiple units on 1/2" centers for scanning large areas or for code reading applications. Units may also be mounted using the stainless steel Bottom-Mount or Side-Mount Bracket Kits (Models MB2 or MB3). These brackets allow 2 axes of movement & greatly simplify alignment.

MODEL RRDC - RETROREFLECTIVE SENSOR

The Model RRDC is a compact, DC powered, retroreflective photo-electric sensor with maximum detection range of 15 feet (with 3" dia. reflector Model RT2). The "visible" LED light beam allows for easy alignment and is modulated, providing immunity to ambient light. The small beam size of 1/2" at 1 foot from the lense, makes it a good choice for detecting relatively small objects.

In operation, the visible LED light beam is directed at a prismatic photo transistor, amplified and demodulated. An object which then breaks this beam will trigger the outputs.



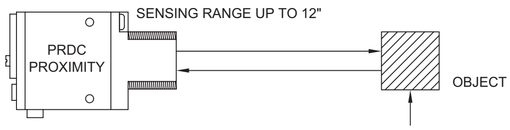
ALIGNMENT

Apply DC power to the RRDC and direct its visible light beam at a reflective target (Models RT1 or RT2) while observing the Signal Strength LED on the back of the unit. Optimum alignment occurs when the sensor is receiving the maximum amount of reflected light and the GAIN (sensitivity) potentiometer is adjusted for the highest pulse rate on the Signal Strength LED. Note that glass, metallic objects, and other highly reflective surfaces may not be detected. In these applications, mount the sensor and reflector at any angle to the object to minimize direct reflections.

MODEL PRDC - PROXIMITY SENSOR

The Model PRDC is a compact, DC powered, Proximity (Diffuse) photo-electric sensor with a 12" maximum detecting distance (as measured with a 90% reflective white test card). This sensor requires no special reflectors or reflective tapes and the limited 12" sensing range reduces detection of background reflections. It is ideally suited for detection of transparent or translucent objects, parts ejected from presses, and rotating targets such as pulley spokes. A modulated "infrared" LED light beam provides immunity to ambient light.

In operation, the modulated light beam is reflected by the object to be detected. Actual sensing range is determined by the surface area and the amount of reflectivity of the object. This reflected light is sensed by a photo-transistor, amplified, demodulated and then energizes the outputs.

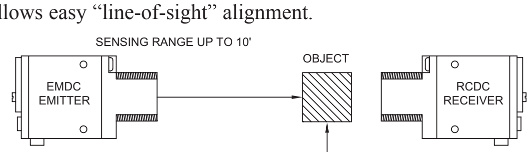


ALIGNMENT

With the PRDC in its sensing position, apply DC Power and direct the infrared light beam at the object to be detected. While observing the Signal Strength LED, adjust the GAIN (sensitivity) potentiometer for the highest LED pulse rate. Now remove the sensed object. If the LED goes out, no further adjustment is necessary. If the LED remains lit, the sensor is "seeing" reflected light from the background. Reduce the GAIN by steps until the sensor "sees" the object but not the background. Then turn the pot counter clockwise 2 more full turns. If the background is still being sensed, it will be necessary to reduce its reflectivity by either moving it back or painting it flat black.

MODELS EMDC & RCDC - OPPOSED BEAM EMITTER/ RECEIVER SENSOR PAIR

The Models EMDC (Emitter) and the RCDC (Receiver) are compact, DC powered, Opposed Beam photo-electric sensor pairs with a 10 foot sensing range. The Emitter contains a high power modulated "infrared" LED. The Receiver contains a sensitive photo-transistor, amplifier-demodulator and output transistors. In operation, these outputs will be triggered when the Receiver detects that an object begins to break the Emitter beam. Due to their high gain, they are ideally suited for detecting opaque objects in dirty and dusty areas or when condensation or oil film environments are present. The small 1/8" well defined beam size allows for sensing small parts accurately and provides repeatable edge sensing of opaque objects to better than 0.01" for accurate positioning applications. Greater accuracies can be achieved by aperturing the Emitter, Receiver or both. However, aperturing will result in reduced sensing distances. While the beam size is small, the Receiver has a wide field of view which allows easy "line-of-sight" alignment.

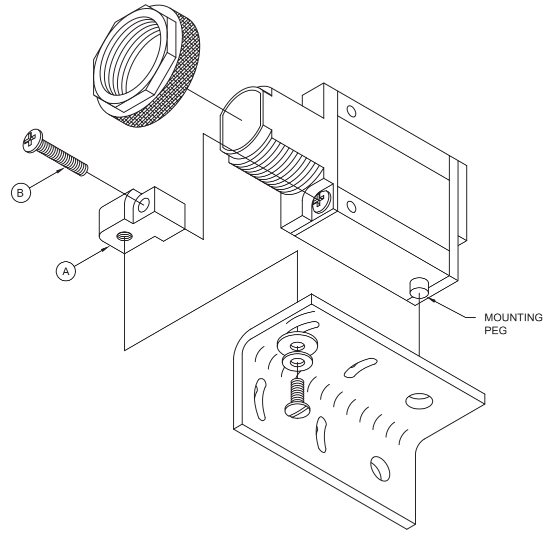


ALIGNMENT

Temporarily mount the Emitter-Receiver Pair opposite, and in line-of-sight, to each other. Apply DC power to both and aim the Emitter at the Receiver. Move the Receiver up-down-left-right until the Signal Strength LED lights. Optimum alignment occurs when the Signal Strength LED flashes at the highest rate obtainable with the GAIN (Sensitivity) potentiometer adjusted to the lowest setting needed to light the LED. Mount the units in place. Opposed Beam Pairs should be used at their highest possible gain. Therefore, have the object to be detected in "sensing position" and adjust the GAIN potentiometer fully clockwise (maximum gain). If the Signal Strength LED comes on, "burn-through" is occurring, and will require that the GAIN pot be backed off (counter clockwise) until the LED goes out and then backed off 2 more full turns. Note that Opposed Beam Pairs must be aligned properly and mounted securely. Excessive movement or vibration can cause loss of alignment and intermittent or false operation.

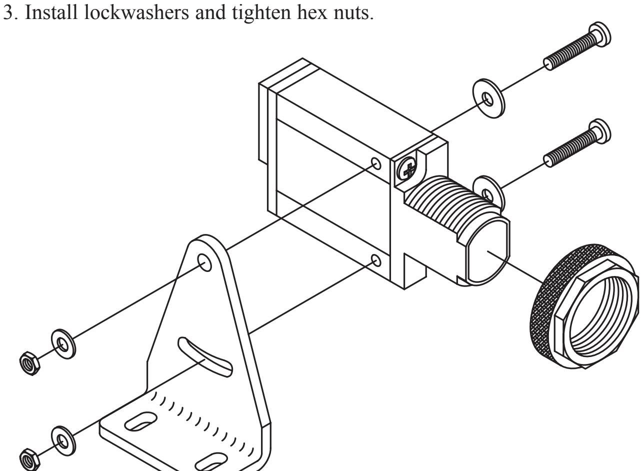
MB2 BOTTOM MOUNT BRACKET KIT INSTALLATION

1. Remove lense mounting nut on sensor and bottom lense screw.
2. Align mounting foot A under lense as shown with threaded insert facing down and attach to lense with long kit supplied screw B .
3. Place sensor mounting peg into bracket hole.
4. Install screw, with washers, into long slotted bracket hole and into mounting foot threaded insert.



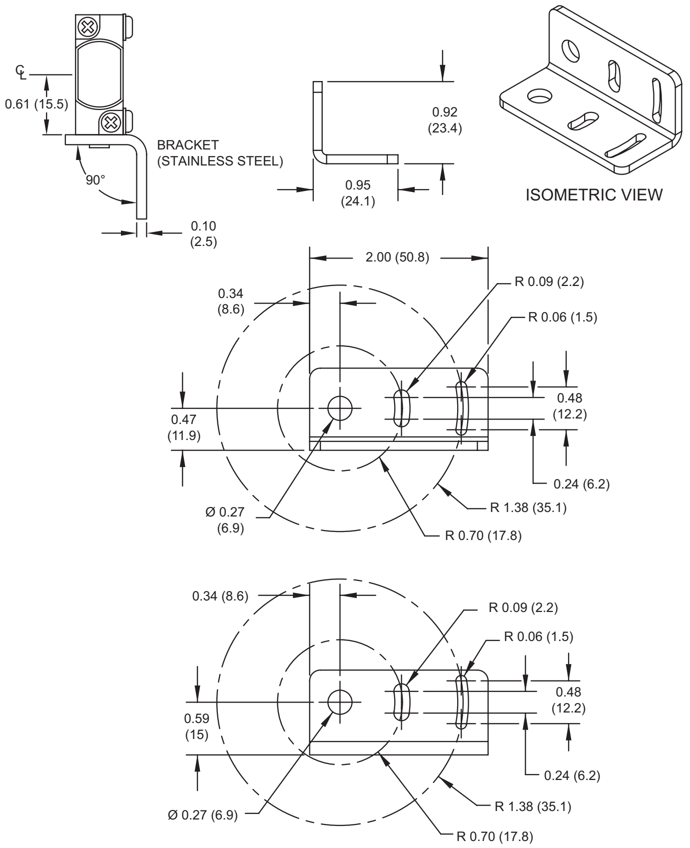
MB3 SIDE MOUNT BRACKET KIT INSTALLATION

1. Remove lense mounting nut from sensor.
2. Install screws with flat washers, through side clearance holes in sensor and through top hole and slot of bracket.
3. Install lockwashers and tighten hex nuts.

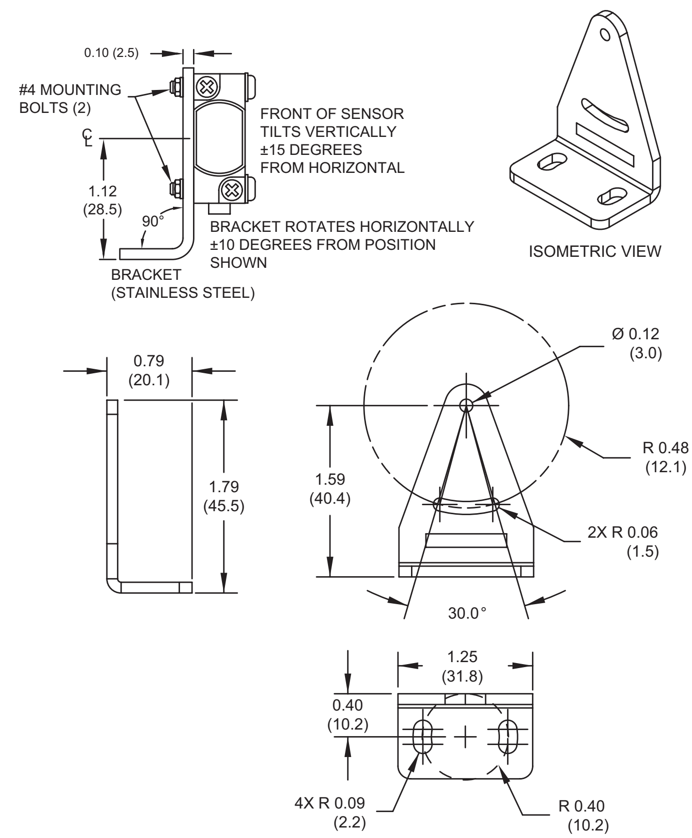


MOUNTING OPTIONS
DIMENSIONS In inches (mm)

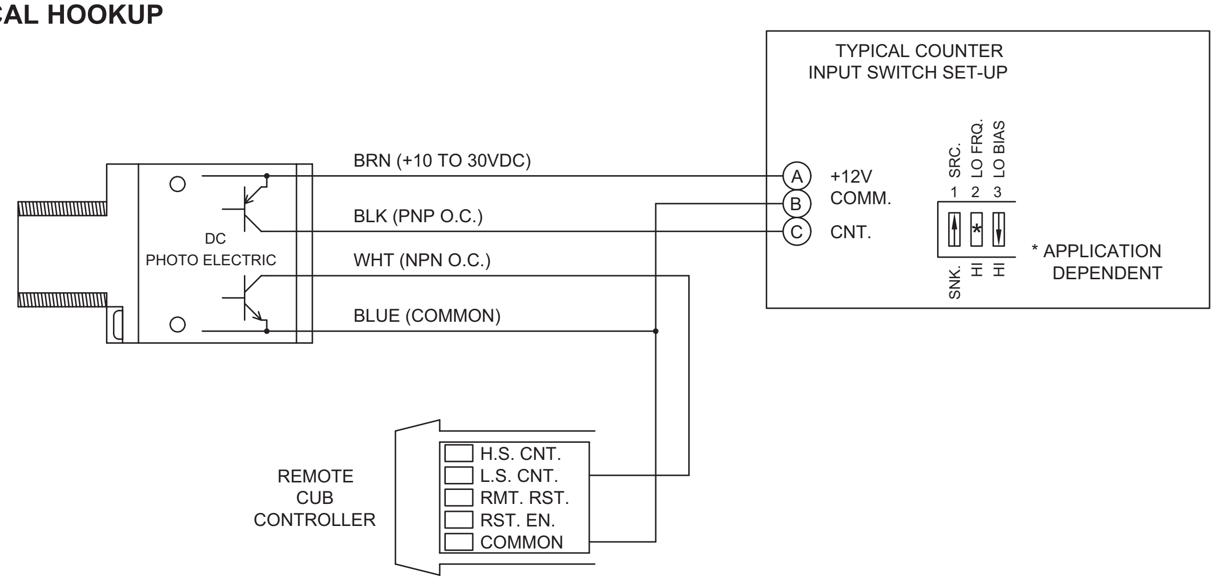
MB2 BOTTOM MOUNTING BRACKET



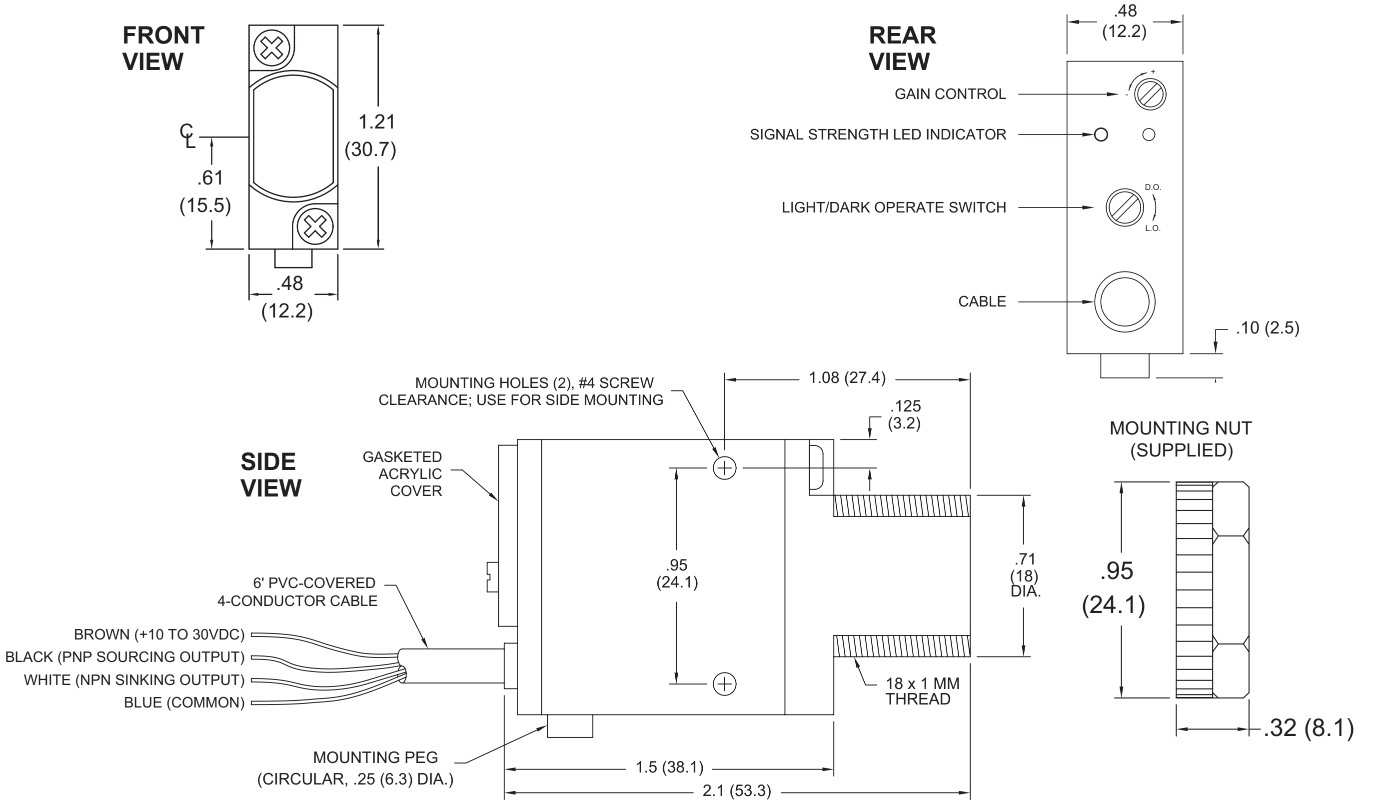
MB3 SIDE MOUNTING BRACKET



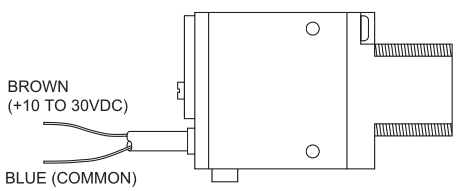
TYPICAL HOOKUP



DIMENSIONS In inches (mm)



EMDC HOOKUP



1. GAIN (sensitivity) control: rotate clockwise to increase gain.
2. “SIGNAL STRENGTH” LED indicator pulse at a rate proportional to received light signal strength.
3. LIGHT/DARK OPERATE SELECT control: DARK OPERATE = fully counter clockwise; LIGHT OPERATE = fully clockwise.
4. 6´ PVC-jacketed 4-wire cable supplied (2-wire, EMDC).

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
RRDC	Retroreflective DC Photo-Electric Sensor	RRDC0000
PRDC	Proximity (Diffuse) DC Photo-Electric Sensor	PRDC0000
EMDC	DC Emitter (Opposed Beam Pair)	EMDC0000
RCDC	DC Receiver (Opposed Beam Pair)	RCDC0000
MB2	Bottom Mount Bracket Kit	MB200000
MB3	Side Mount Bracket Kit	MB300000
RT1	1-1/2" Dia. Prismatic Reflector (Model RRDC)	RT100000
RT2	3" Dia. Prismatic Reflector (Model RRDC)	RT200000


Do not dispose of unit in trash - Recycle

MODELS PRM & RRM – MINIATURE DC POWERED PHOTO-ELECTRIC SENSOR

- RETROREFLECTIVE, PROXIMITY (DIFFUSE) & OPPOSED BEAM PAIRS
- +10 to +30 VDC OPERATION WITH REVERSE POLARITY PROTECTION
- COMPLEMENTARY NPN (CURRENT SINKING) OUTPUTS
- DURABLE BLACK POLYCARBONATE/ABS ALLOY HOUSING MEETS NEMA 6 AND IP65 STANDARDS
- LED's DISPLAY OPERATING STATUS
- PUSH BUTTON DIGITAL GAIN ADJUSTMENT

GENERAL DESCRIPTION

These miniature self-contained and powerful Retroreflective, Proximity (Diffuse) and Opposed Beam Pair Photo-electric Sensors provide application flexibility in counting, positioning and object detection. All units are interchangeable with conventional 12 mm threaded barrel-type photo-electrics and inductive proximity sensors. Their small size, in addition to various mounting options, greatly increases alignment ease and application possibilities.

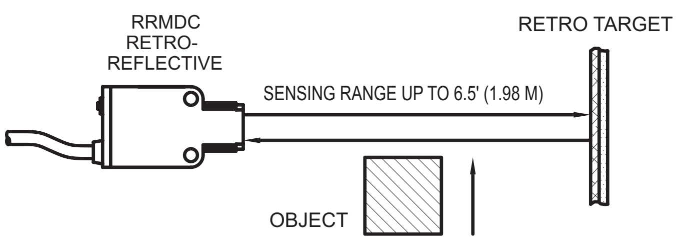
All units can be powered by supplies ranging from +10 to +30 VDC and are reverse polarity protected. The complementary NPN open collector (Current Sinking) outputs are protected from continuous overload and inductive load transients and are rated to 150 mA, with low saturation voltage and less than 10 µA off-state leakage current. In addition, no false outputs are generated at power-up. Two versions of the sensor are available, a 6 foot (1.83 M) long 4 conductor PVC jacketed cable or 6 inch long quick disconnect Pico-style connector provides supply input and transistor output.

These miniature sensors offer a digital gain adjustment that uses a single sealed push button to streamline installation and setup. The user simply holds the button in to achieve maximum sensitivity, and then can click the button for seven decremental settings to fine tune for your application. They also feature smart new status indicators. Green and amber LED's display operating status from three directions, indicate "power on" and "light sensed" and flash to signal "maximum gain," "gain reduced one increment" and "minimum gain" conditions. You can tell operating status of your sensors at a glance.

MODEL RRMDC - RETROREFLECTIVE SENSOR

The Model RRMDC is a miniature, DC powered, retroreflective photo-electric sensor with maximum detection range of 6.5 feet [1.98 M] (with 3" dia. reflector Model RT2). The "visible" LED light beam allows for easy alignment and is modulated, providing immunity to ambient light. The small beam size makes it a good choice for detecting relatively small objects.

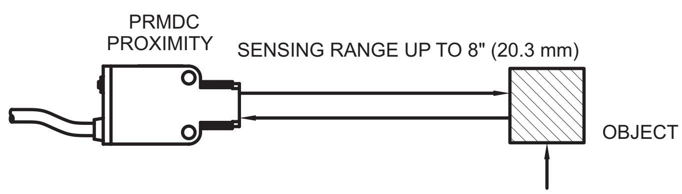
In operation, the visible LED light beam is directed at a photo transistor, amplified and demodulated. An object which then breaks this beam will trigger the output.



MODEL PRMDC - PROXIMITY SENSOR

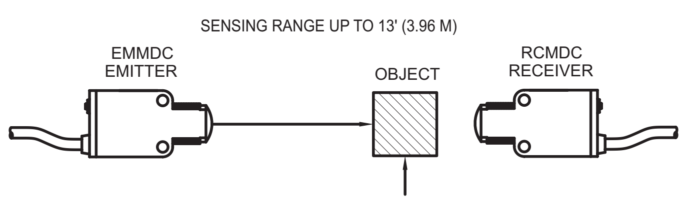
The Model PRMDC is a miniature, DC powered, Proximity (Diffuse) photo-electric sensor with a 8" maximum detecting distance. This sensor requires no special reflectors or reflective tapes and the limited 8" sensing range reduces detection of background reflections. It is ideally suited for detection of transparent or translucent objects, parts ejected from presses, and rotating targets such as pulley spokes. A modulated "infrared" LED light beam provides immunity to ambient light.

In operation, the modulated light beam is reflected by the object to be detected. Actual sensing range is determined by the surface area and the amount of reflectivity of the object. This reflected light is sensed by a photo-transistor, amplified, demodulated and then energizes the outputs.



MODELS EMMDC & RCMDC - OPPOSED BEAM EMITTER/ RECEIVER SENSOR PAIR

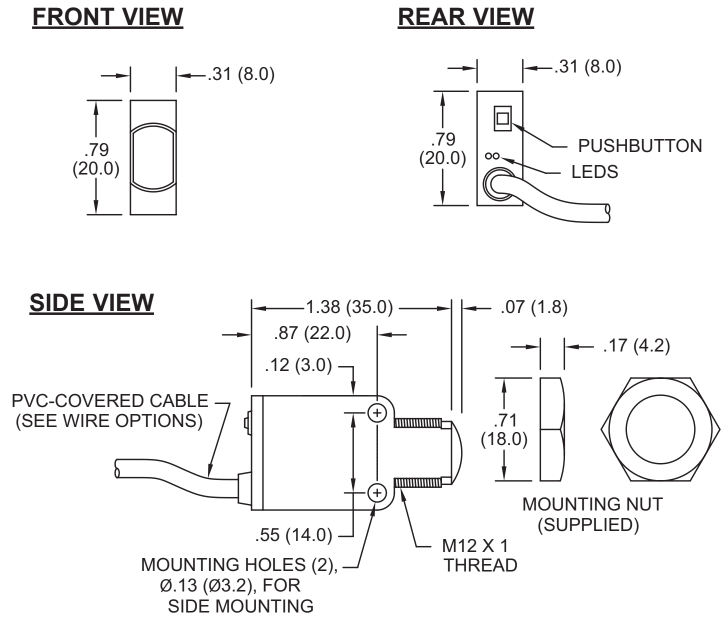
The Models EMMDC (Emitter) and the RCMDC (Receiver) are miniature, DC powered, Opposed Beam photo-electric sensor pairs with a 13 foot sensing range. The Emitter contains a high power modulated "infrared" LED. The Receiver contains a sensitive photo-transistor, amplifier-demodulator and output transistor. In operation, this output will be triggered when the Receiver detects that an object begins to break the Emitter beam. Due to their high gain, they are ideally suited for detecting opaque objects in dirty and dusty areas or when condensation or oil film environments are present.



SPECIFICATIONS

1. **POWER REQUIREMENTS**: +10 to +30 VDC (10% Ripple Max.)
   Current Draw: 25 mA max. (exclusive of load)
   Reverse Polarity Protected
2. **REPEATABILITY**: Opposed Mode: 1 msec, All others: 175 µsec.
3. **OUTPUTS**: Current Sinking Complementary NPN Open Collector Transistor; Short Circuit Protected
   I_{SNK}: 150 mA max. each; V_{OH} = 30 VDC max.
   V_{SAT}: 1 V @ 10 mA load
   Offstate Leakage Current : Less than 10 µA @ 30 VDC
4. **OUTPUT RESPONSE TIME**: Opposed Mode: 8 msec ON, 4 msec OFF, All others 1.5 msec
5. **OPERATING TEMPERATURE**: -4° to+131°F (-20° to +55°C)
6. **WEIGHT**: 0.4 oz. (1.13 g)

DIMENSIONS In inches (mm)



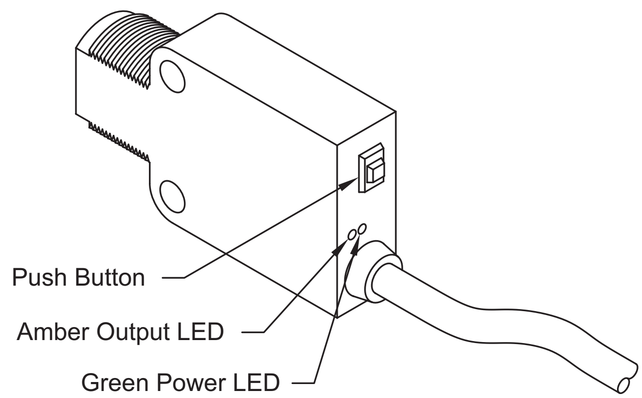
SET-UP AND INSTALLATION

USING THE PHOTOELECTRIC

LED INDICATORS

The photoelectric has two bright LEDs; both are visible from the back, and each is visible from one side of the sensor. They indicate the following:

Green steady: Power ON
Amber steady: Light sensed
Green flashing rapidly 5 times: Maximum gain
Single green flash: Push button "click" registered, gain reduced by one increment
Amber/Green alternating: Minimum gain (can not reduce further)



SETTING SENSITIVITY

The unit features an extremely simple method for setting sensitivity (gain). Simply hold the push button until the LED flashes rapidly, 5 times. The sensor is automatically set to maximum gain.

Reduce gain by pressing the push button briefly ("clicking" it) up to 7 times; gain will reduce in single increments with each click. Amber and green LEDs alternate after the lowest setting is reached.

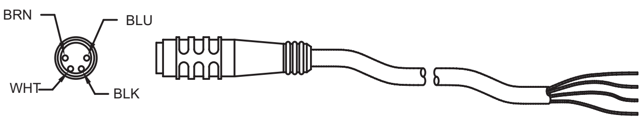
If the gain is accidentally set too low, hold the push button until gain increases to the maximum level, then click the push button down to the approrpriate level. Gain may be readjusted in this way at any time.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS	
		w/ 2 Meter Cable	w/ Pico Connector
RRMDC	Retroreflective DC Photo-Electric Sensor	RRMDC000	RRMDC001
PRMDC	Proximity (Diffuse) DC Photo-Electric Sensor	PRMDC000	PRMDC001
EMMDC	DC Emitter (Opposed Beam Pair)	EMMDC000	EMMDC001
RCMDC	DC Receiver (Opposed Beam Pair)	RCMDC000	RCMDC001
MB2	Bottom Mount Bracket Kit	MBM20000	
MB3	Side Mount Bracket Kit	MBM30000	
RT1	1-1/2" Dia. Prismatic Reflector (Model RRMDC)	RT100000	
RT2	3" Dia. Prismatic Reflector (Model RRMDC)	RT200000	
CCMPE	Pico-Style Quick Disconnect Connector & Cable, 2 meters	CCMPE000	

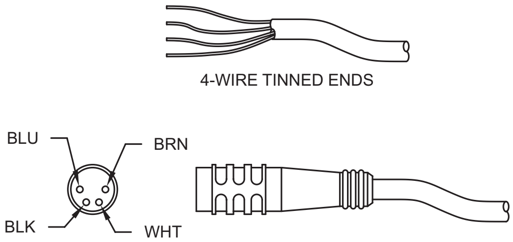
Do not dispose of unit in trash - Recycle

CCMPE



4-PIN FEMALE PICO-STYLE CONNECTOR [6.5' (2 m)]

WIRE OPTIONS

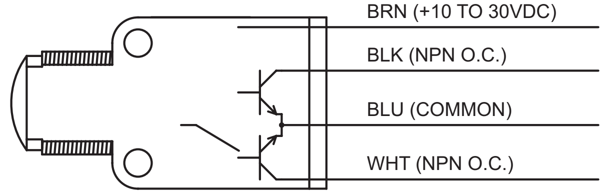


4-PIN MALE PICO-STYLE CONNECTOR

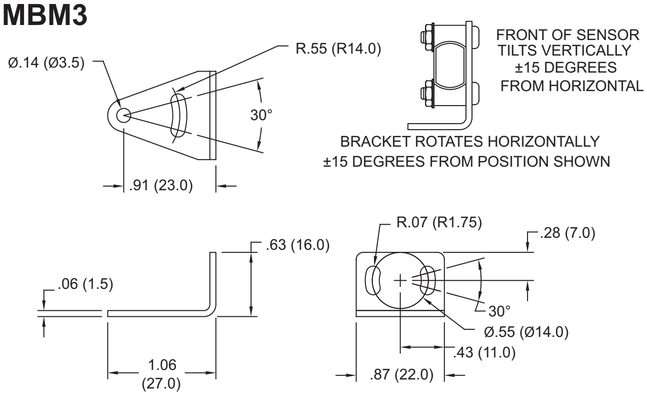
MOUNTING

Various mounting methods have been designed to simplify alignment and provide versatility in any industrial environment. The integral 12 mm threaded lense can be interchanged with existing threaded entries common to 12 mm barrel sensors and inductive proximity switches. The threaded lense can also be installed into panel thicknesses of 3/16" through a 0.51" diameter hole and tightened into place with the supplied mounting nut. Two #4 screw clearance through-holes on 0.55" centers are available for side mounting or side nesting of multiple units on 1/2" centers for scanning large areas or for code reading applications. Units may also be mounted using the stainless steel Bottom-Mount or Side-Mount Bracket Kits (Models MBM2 or MBM3). These brackets allow 2 axes of movement & greatly simplify alignment.

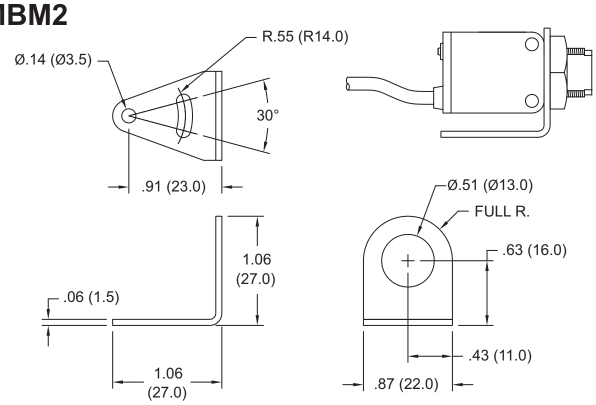
WIRING DIAGRAM



MBM3



MBM2



MODEL PT - PRESSURE TRANSMITTER

- *COMPACT STAINLESS STEEL HOUSING*
- *M12 QUICK DISCONNECT*
- *EXCELLENT EMC RESISTANCE*
- *SHORT CIRCUIT AND REVERSE POLARITY PROTECTION*
- *IP67 PROTECTION RATING*
- *CERAMIC TECHNOLOGY THAT PROVIDES LONG TERM RELIABLE OPERATION*

DESCRIPTION

The PT Series Pressure Transmitters are designed to provide accurate and dependable pressure measurement, even in the most demanding applications. The reliability of solid-state design and the durability of the stainless steel case are the cornerstone of their design.

Proven ceramic component technology allows long-term stability and high tolerance to overpressure conditions. The 4 to 20 mA output can easily be connect to any Red Lion process meter for monitoring and/or control. Short circuit and reverse polarity protection are built-in to the circuitry, further enhancing this pressure transmitters.

The transmitter housing is constructed of stainless steel and provides an IP 67 level of protection. The fluid connection is a standard G ¼ thread, while the electrical connection is a M12 connector.

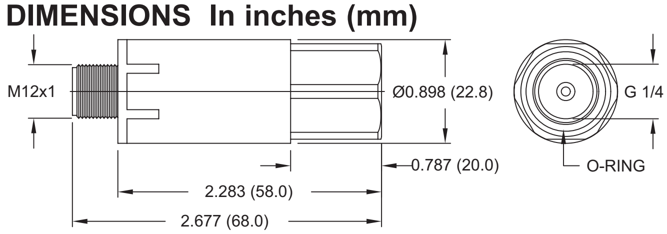
Additional pressure ranges and accessories are available on special request, contact the factory for more details.

SAFETY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Read complete instructions prior to installation and operation of the unit.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

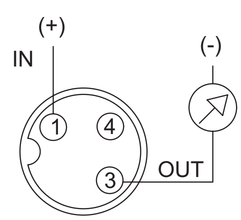
MODEL NO.	DESCRIPTION	BAR	PSI	PART NUMBER
PT	2 Wire Relative Pressure Transmitter	0 - 1	0 - 14.5	PT00001R
		0 - 1.6	0 - 23.2	PT00002R
		0 - 10	0 - 145	PT00010R
		0 - 250	0 - 3625	PT00250R
CCM	4 Wire 22 AWG unshielded 2 meter cable/ connector			CCM12U02

Do not dispose of unit in trash - Recycle

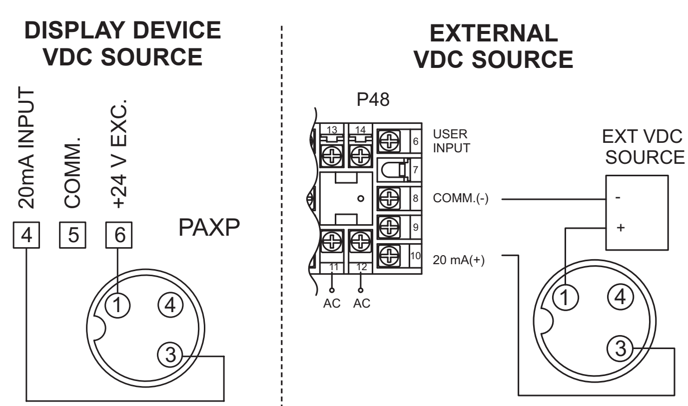
SPECIFICATIONS

1. **ACCURACY**: ≤0.3% Full Scale
2. **MEDIUM TEMPERATURE**: -40°F to + 302°F (-40°C to +150°C)
3. **OPERATING VOLTAGE**: 8 to 33 VDC
4. **OUTPUT**: 4 to 20 mA
5. **CURRENT CONSUMPTION**: ≤20 mA
6. **DYNAMIC RESPONSE**: < 2 msec
7. **SHORT CIRCUIT PROTECTION**: Yes
8. **REVERSE POLARITY PROTECTION**: Yes
9. **DEGREE OF PROTECTION**: IP 67
10. **HOUSING MATERIAL**: SST 1.4305 (AISI 303)
11. **ELECTRICAL CONNECTION**: M12x1
12. **FLUID CONNECTION**: G ¼
13. **SHOCK RESISTANCE**: 75 G, 11 msec per IEC 68-2-27
14. **VIBRATION RESISTANCE**: 20 G, 15 mm per IEC 68-2-6

WIRING PINOUT AND SPECIFICATIONS



PT PIN	FUNCTION	WIRE COLOR
1	+VDC	BROWN
3	4-20 mA OUT	BLUE
4	N/C	—



MODEL TMP - FIELD CUTTABLE TEMPERATURE SENSOR PROBES and ACCESSORIES

- *THERMOCOUPLE OR RTD*
- *24" PROBE CUTTABLE TO 3.5"*
- *MEASURE TEMPERATURES UP TO 704 °C/1300 °F*
- *MOUNTING AND WIRING ACCESSORIES*

GENERAL DESCRIPTION

Model TMP Thermocouple and RTD Temperature Probes are field cuttable to the desired length. The probes can be trimmed to within 3.5" (88.9 mm) of the probe tip allowing for greater application flexibility. Accessory hardware is available to wire and mount the probes in the user's existing thermowell.

Optional spring loaded fittings (sold separately) slide along the probe sheath to proper immersion depth as determined by the user. These fittings allow for strong contact between the probe and the thermowell to improve response.

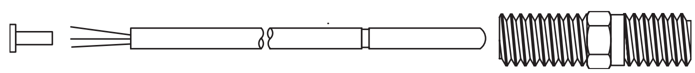
SPECIFICATIONS

1. **THERMOCOUPLE**: Ungrounded J, K, T and E calibration available.
2. **RTD**: 3 Wire, 100Ω, Class "A" DIN Platinum per IEC751 (385 ALPHA)
3. **PROBE SHEATH**: 0.25" (6.35 mm)
4. **PROBE LENGTH**: 24" (0.6 M) as supplied, can be field cut down to 3.5" (88.9 mm).
5. **LEAD WIRE**: 6" (152.4 mm) 24 gauge
6. **WIRE INSULATION**: Neoflon PFA, Fiberglass or High Temperature Glass. As specified by part number.

CUTTING THE TUBING

The thermocouple and RTD probes have a crimp mark located 3" (76.2 mm) from the tip. This indicates the end of the internal seal. Damage to the probe will occur if trimmed within 3.5" (88.9 mm) of the tip.

1. Determine the desired probe length and mark it with a pen or marker. Secure the probe within a tube vice being careful not to deform or flatten the probe.
2. "Score" the tubing with a tubing cutter. Make one or two revolutions with the cutter. Do not cut completely through the tubing to prevent burrs or a sharp lip on the inside of the tubing.
3. Use a pair of pliers to grasp the excess tubing to be removed.
4. Use a narrow range of motion to slowly work the excess tubing from side to side until it separates from the probe. Using a wide range of motion will deform the tube and prevent installation of the tube sleeve.
5. Remove the excess tubing and trim the leads to the desired length.
6. Install the tube sleeve in the open end of the tube to protect the leads from any sharp edges on the inside of the tube.



TMPXXXXX TMPACC01

(One tube sleeve is included with each probe.)

INSTALLATION

1. Orient the probe and the spring loaded fitting as shown above.
2. Screw the spring loaded fitting one complete turn into the thermowell (not included).
3. Push the probe into the fitting until it touches the bottom of the thermowell.
4. Hold the probe to the bottom of the thermowell and tighten the fitting. This ensures good contact between the probe and the bottom of the thermowell.
5. Completely tighten the fitting into the thermowell.
   Note: The probe must be inserted only as shown above to prevent damage to the fitting.

If it becomes necessary to separate the probe and the fitting, first disconnect the wires and then unscrew the fitting completely from the thermowell. Pull the probe through the fitting from the end that was screwed into the thermowell. The fitting will present resistance to the probe removal if you attempt to go in the wrong direction.

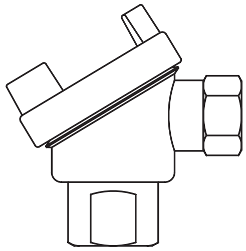
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	TYPE	WIRE COLOR	WIRE INSULATION	TEMPERATURE RANGE	PART NUMBER
TMP	TC Probe	J	White (+) Red (-)	Neoflon PFA	0 to 260 °C / 32 to 500 °F	TMPJ2SU1
				Fiberglass	0 to 370 °C / 32 to 700 °F	TMPJ2SU2
				High Temp Glass	0 to 370 °C / 32 to 700 °F	TMPJ2SU3
		K	Yellow (+) Red (-)	Neoflon PFA	-200 to 260 °C / -328 to 500 °F	TMPK2SU1
				Fiberglass	-200 to 482 °C / -328 to 900 °F	TMPK2SU2
				High Temp Glass	-200 to 704 °C / -328 to 1300 °F	TMPK2SU3
		T	Blue (+) Red (-)	Neoflon PFA	-200 to 200 °C / -328 to 400 °F	TMPT2SU1
		E	Violet (+) Red (-)	Neoflon PFA	-200 to 260 °C / -328 to 500 °F	TMPE2SU1
				Fiberglass	-200 to 430 °C / -328 to 800 °F	TMPE2SU2
				High Temp Glass	-200 to 430 °C / -328 to 800 °F	TMPE2SU3
	RTD Probe	385	**	Neoflon PFA	-200 to 260 °C / -328 to 500 °F	TMPA2S01
				Fiberglass	-200 to 600 °C / -328 to 1112 °F	TMPA2S02

*** RTDs do not have color standard. Excitation and Signal+ are the same color. Signal common is the odd color.*

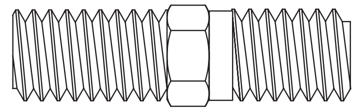
ACCESSORIES *(sold separately)*

Weatherproof Heads:
- Cast Aluminum
- Protects against dust, rain, splashing, and hose directed water
- Weatherproof gasket
- Stainless steel chain



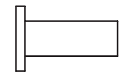
TMPACC02

Spring Loaded Fittings: Connects probe to thermowell and attaches to weatherhead 1/2" NPT X 1/2" NPT Stainless Steel.



TMPACC01

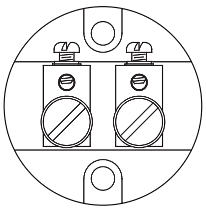
Tube Sleeve
Tube sleeve to protect probe leads from burrs after cutting probe.



TMPACC03

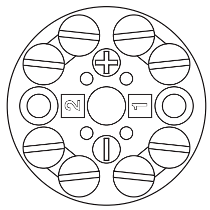
Terminal Blocks

2-Terminal for use with TCs



TMPACC04

4-Terminal for use with RTDs

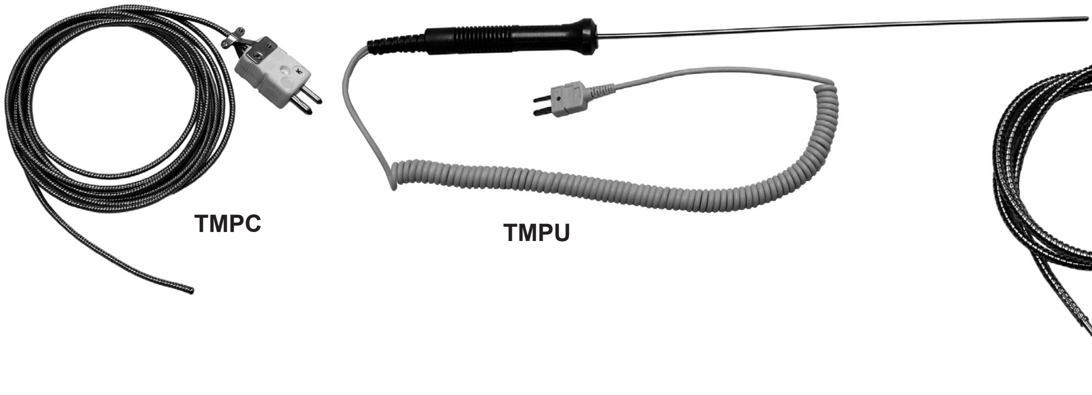


TMPACC05

ACCESSORIES (All accessories are sold separately)

MODEL NO.	DESCRIPTION	PART NUMBER
TMPACC	Spring Loaded Fitting	TMPACC01
	Cast Aluminum Weatherproof Head	TMPACC02
	Spare Tube Sleeve	TMPACC03
	2-Terminal Block (for TCs)	TMPACC04
	4-Terminal Block (for RTDs)	TMPACC05

MODELS TMPC, TMPU, & TMPB THERMOCOUPLES



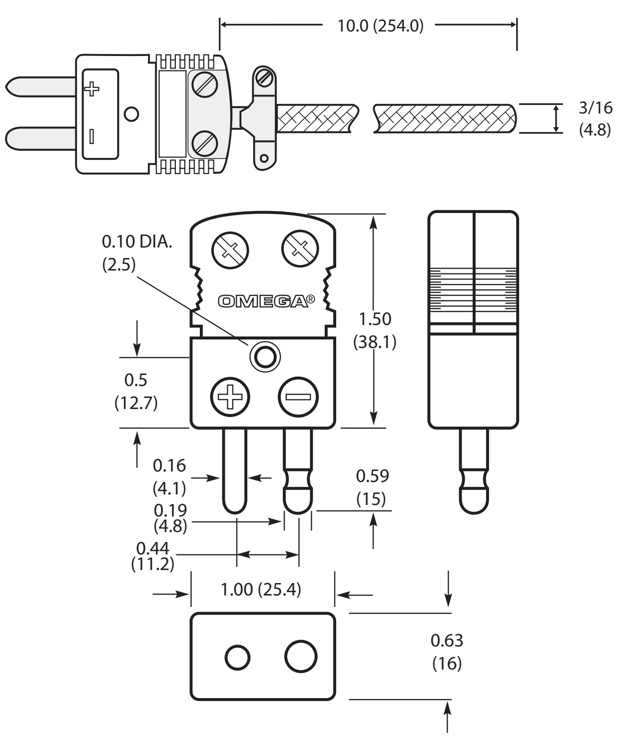
MODEL TMPC - HIGH TEMPERATURE THERMOCOUPLE

GENERAL DESCRIPTION

The model TMPC thermocouple is double-protected with abrasion resistant Inconel overbraid with high temperature ceramic fiber insulation. A temperature rating of up to 980 ºC (1796 ºF) continuous service and 1090 ºC (1994 ºF) short-term service makes these probes ideal for many high temperature measurement applications. Ideal applications include profiling ovens and furnaces.

- *Flexible and Abrasion Resistant*
- *Smooth, rounded tip on "hot" side*
- *Male high temperature standard size ceramic connector on "cold" side*

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **WIRE**: 20 AWG, 10 feet in length; standard limits of error
2. **INSULATION**: Nextel® ceramic fiber. (Not to be exported) *
3. **TEMPERATURE**: 980 ºC (1796 ºF) continuous
   1090 ºC (1994 ºF) short-term service depending on TC type
4. **CONNECTOR**: High temperature ceramic standard size style connector -29 to 650 ºC (-20 to 1202 ºF)
5. **PROBE**: Grounded TC junction with Inconel overbraid welded to form a smooth, round tip

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
TMPC	Type K OVERBRAIDED CERAMIC TC	TMPKCF01

** Nextel can not be exported. Consult factory for available options.*

Do not dispose of unit in trash - Recycle

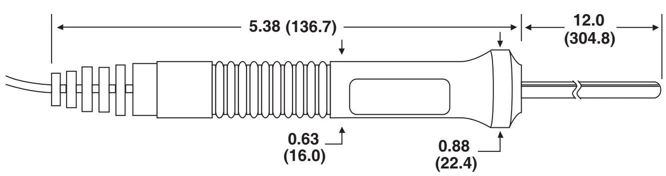
MODEL TMPU - UTILITY THERMOCOUPLES

GENERAL DESCRIPTION

Utility thermocouple probes are basic products for temperature measurement. They are typically connected to a hand held thermometer. The unit features a rugged handle that is permanently molded to a probe sheath. A retractable cable is connected with strain relief to the handle end, and termination is provided by a miniature male connector.

- *RETRACTABLE CABLE WITH SUPERIOR MEMORY*
- *MINIATURE CONNECTOR FOR USE WITH HAND HELD THERMOMETERS*
- *MOLDED HANDLE RATED TO 220 ºC (428 ºF)*
- *MEETS OR EXCEEDS SLE AND EN 60584-2: TOLERANCE CLASS 1*

DIMENSIONS In inches (mm)



* For connector information see the TMPCNM01 bulletin.

SPECIFICATIONS

1. **HANDLE TEMPERATURE RATING**: 220 ºC (428 ºF)
2. **THERMOCOUPLE JUNCTION**: Grounded
3. **CABLE LENGTH**: 1 foot, expands to 5 feet
4. **PROBE LENGTH**: 12 inches
5. **MAX PROBE TEMPERATURE**:
   304SS: 900 °C (1652 °F)
   Inconel: 1150 °C (2102 °F)

ORDERING INFORMATION

MODEL NUMBER	DESCRIPTION	TC ANSI TYPE	SHEATH MATERIAL	SHEATH DIAMETER	CABLE LENGTH	TC JUNCTION	PART NUMBER
TMPU	TC HANDLE PROBE	K	304 SS	.125	1' EXPANDS TO 5'	GROUNDED	TMPKUT01
	TC HANDLE PROBE	K	INCONEL 600	.125	1' EXPANDS TO 5'	GROUNDED	TMPKUT02

Do not dispose of unit in trash - Recycle

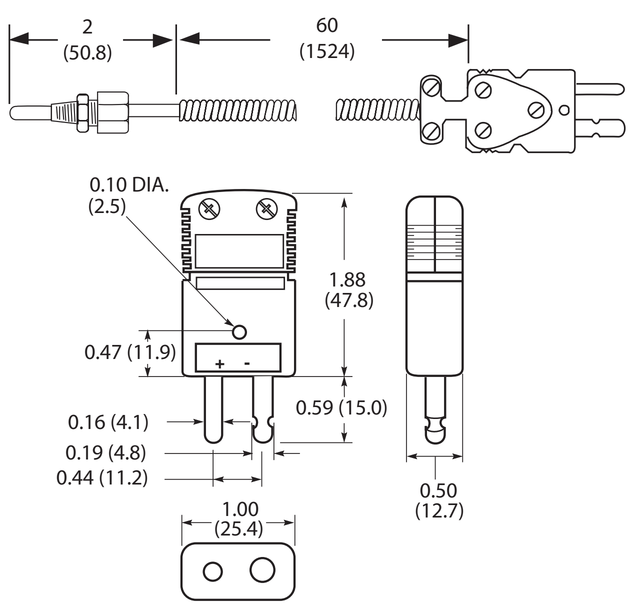
MODEL TMPB - SPRING LOADED COMPRESSION FITTING THERMOCOUPLES

GENERAL DESCRIPTION

The spring-loaded compression fitting thermocouple is ideally suited for measuring plastic processing machinery temperatures at the crosshead, die or barrel. It has a 5 foot stainless steel cable, with a 3/16" sheath diameter and a brass compression fitting with 1/8" NPT.

- *IDEAL FOR EXTRUDERS/MOLDING AND MACHINE PROCESS TEMPERATURE*
- *COLD END TERMINATION IS HIGH TEMPERATURE NICKEL ZINC FERRITE CORE STANDARD MALE CONNECTOR*
- *STANDARD MALE CONNECTOR IS DESIGNED FOR SUPPRESSION OF ELECTROMAGNETIC INTERFERENCE*

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **THERMOCOUPLE JUNCTION**: Type K, grounded
2. **CABLE**: 5 feet, 0.188 dia. stainless steel
3. **CONNECTOR SPECIFICATIONS**: Extra heavy duty solid male pin male connector
   Case Material: High temperature liquid crystal polymer (LCP)
   Temperature ratings:
   Ferrite core effectiveness: 120º C (248º F)
   LCP Material: 260º C (500º F)
   Impedance: (±20%): 35 ohms @ 25 MHz
   70 ohms @ 100 MHz

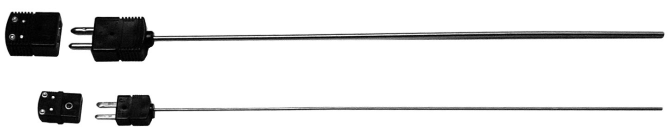
ORDERING INFORMATION

MODEL NUMBER	DESCRIPTION	PART NUMBER
TMPB	COMPRESSION TC ASSEMBLY	TMPKBT01

Do not dispose of unit in trash - Recycle

QUICK DISCONNECT TEMPERATURE PROBES AND ACCESSORIES

MODEL TMP - QUICK DISCONNECT TEMPERATURE PROBES



- *MATING FEMALE CONNECTOR (with "write on label") AND PLCM CABLE CLAMP WITH LOCKING CLIP INCLUDED WITH MINIATURE AND STANDARD SIZE PROBES*
- *CHOICE OF 304 SS, INCONEL 600 OR XL SHEATH*
- *XL HIGH TEMPERATURE PROBE AVAILABLE*
- *MEETS OR EXCEEDS SLE AND EN 60584-2: TOLERANCE CLASS 1*
- *COLOR CODED CONNECTOR BODY*
- *WIRE SOLD SEPARATELY*

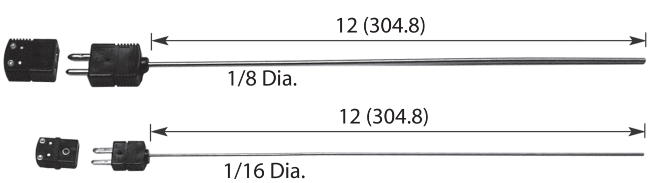
GENERAL DESCRIPTION

Model TMP Quick Disconnect Thermocouples are available with both miniature and standard size connector termination. These rugged probes feature a variety of calibration types, sheath materials and diameters, and are available with an ungrounded junction. A high temperature probe is also available that can be mated with a standard female universal connector. All temperature probes are rated at the tolerance standard SLE, (Special Limits Of Error), which is ±2 °C degrees of error.

SPECIFICATIONS

1. **SHEATH**: Constructed of 304 stainless steel, Inconel 600, or XL (High Temperature Probe only)
2. **SHEATH DIAMETER**: 1/16" or 1/8"
3. **PROBE LENGTH**: 12" Ungrounded junction.
4. **CONNECTOR BODY**: Glass Filled Nylon, rated to 220 ºC.
5. **WIRE**: Sold separately, see accessory details

DIMENSIONS In inches (mm)



ORDERING INFORMATION

DESCRIPTION	ANSI TYPE TC	SHEATH MATERIAL	SHEATH DIAMETER INCHES	PART NUMBER
MINI QUICK DISCONNNECT TC PROBE W/ MOLDED CONN	J	304SS	1/16	TMPJQD01
	K	304SS	1/16	TMPKQD01
	T	304SS	1/16	TMPTQD01
	E	304SS	1/16	TMPEQD01
	J	INCONEL 600	1/16	TMPJQD02
	K	INCONEL 600	1/16	TMPKQD02
	T	INCONEL 600	1/16	TMPTQD02
	E	INCONEL 600	1/16	TMPEQD02
STANDARD QUICK DISCONNNECT TC PROBE W/ MOLDED CONN	J	304SS	1/8	TMPJQD03
	K	304SS	1/8	TMPKQD03
	T	304SS	1/8	TMPTQD03
	E	304SS	1/8	TMPEQD03
	J	INCONEL 600	1/8	TMPJQD04
	K	INCONEL 600	1/8	TMPKQD04
	T	INCONEL 600	1/8	TMPTQD04
	E	INCONEL 600	1/8	TMPEQD04
	K	XL	1/8	*TMPKQD05

** XL probes have a very low drift and are for use in high temperature applications up to 1335 °C.*

Do not dispose of unit in trash - Recycle

MODEL TMWS - THERMOCOUPLE WIRE

GENERAL DESCRIPTION

Thermocouple wire is for use with the Mini and Standard Quick Disconnect Temperature Probes. It is available in a variety of insulation and calibration types, and spool lengths.

SPECIFICATIONS

1. **WIRE LENGTH**: 25 or 100 Foot Spools
2. **INSULATION**: Duplex Insulated
3. **TYPE**: 24 AWG Solid Wire
4. **COLOR CODE**: ANSI color codes

ANSI TYPE	POSITIVE	NEGATIVE	JACKET
J	WHITE	RED	BROWN
K	YELLOW	RED	BROWN
T	BLUE	RED	BROWN
E	PURPLE	RED	BROWN

ORDERING INFORMATION

DESCRIPTION	ANSI TYPE	MAX TEMP		INSULATION TYPE	NOMINAL SIZE (IN.)	PART NUMBER
		ºC	ºF			
WIRE 100' SPL	J	260	500	NEOFLON PFA	.056 X .093	TMWSJ100
	K	260	500	NEOFLON PFA	.056 X .093	TMWSK100
	T	200	400	NEOFLON PFA	.056 X .092	TMWST100
	E	260	500	NEOFLON PFA	.056 X .092	TMWSE100
	J	370	700	GLASS BRAID	.050 X .085	TMWGJ100
	K	482	900	GLASS BRAID	.050 X .080	TMWGK100
	T	200	400	GLASS BRAID	.050 X .080	TMWGT100
	E	430	800	GLASS BRAID	.050 X .080	TMWGE100
WIRE 25' SPL	J	260	500	NEOFLON PFA	.056 X .093	TMWSJ025
	K	260	500	NEOFLON PFA	.056 X .093	TMWSK025
	T	200	400	NEOFLON PFA	.056 X .092	TMWST025
	E	260	500	NEOFLON PFA	.056 X .092	TMWSE025
	J	370	700	GLASS BRAID	.050 X .085	TMWGJ025
	K	482	900	GLASS BRAID	.050 X .080	TMWGK025
	T	200	400	GLASS BRAID	.050 X .080	TMWGT025
	E	430	800	GLASS BRAID	.050 X .080	TMWGE025

Do not dispose of unit in trash - Recycle

MODEL TMPCB - RETRACTABLE SENSOR CABLES

GENERAL DESCRIPTION

The retractable sensor cables are color coded and for use with thermocouples. The cables have a superior jacket construction, employing the latest in jacketing material: TPE (thermoplastic elastomer), a unique family of thermoplastics which exhibits characteristics previously found only in rubber compounds. TPE is extremely tough and flexible, and has excellent abrasion resistance. This special construction technique yields an expansion rate of up to 500%. These retractable cables are for use with electronic type indicators, either panel, handheld or bench type models.

- *COMPATIBLE WITH J, K, T AND E THERMOCOUPLE CALIBRATIONS*
- *EXPANSION RATIO UP TO 500% - 1 Ft (300 mm) OF CABLE STRETCHES TO 5 Ft (1500 mm)*
- *IDEAL FOR USE WITH HANDHELD AND BENCH STAND ELECTRONIC INDICATORS*
- *BARE WIRE ENDS*

ORDERING INFORMATION

DESCRIPTION	TYPE	JACKET	+WIRE	-WIRE	PART NUMBER
2 FT RETRACT CABLE	J	BLACK	WHITE	RED	TMPCBS01
	K	YELLOW	YELLOW	RED	TMPCBS02
	T	BLUE	BLUE	RED	TMPCBS03
	E	PURPLE	PURPLE	RED	TMPCBS04

Do not dispose of unit in trash - Recycle

SPECIFICATIONS

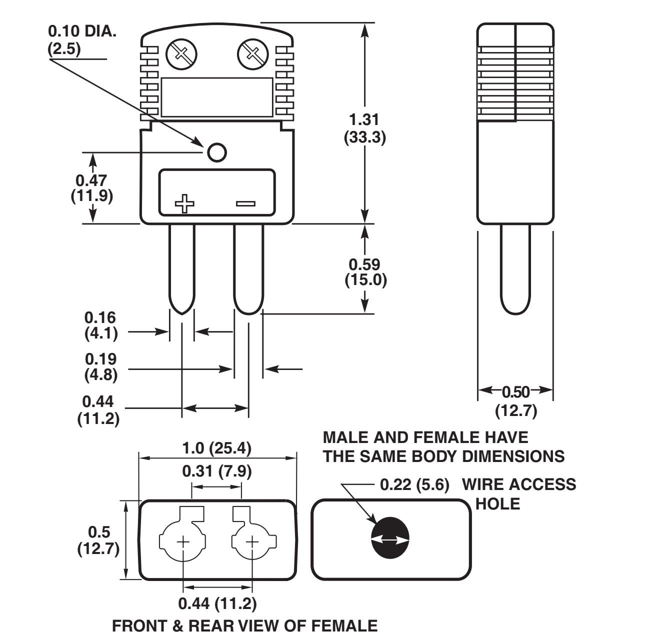
1. **INSULATION**: TPE Thermoplastic Elastomer outer jacket
2. **INNER CONDUCTORS**: Neoflon PFA
3. **CALIBRATIONS**: J, K, T, E
4. **THERMOCOUPLE WIRE CONFORMITY**: SLE Standard limit of error per ANSI MC 96.1 (1975)
5. **TEMPERATURE RATING**: -30 to 105 ºC (-22 to 220 ºF)
6. **CONSTRUCTION**: 28 AWG stranded wire (7 strand x 36 gauge)
7. **LENGTH**: 2 feet (600 mm)

MODEL TMPCN - QUICK DISCONNECT STANDARD CONNECTORS

GENERAL DESCRIPTION

Standard Connectors are for use with the Standard Quick Disconnect TC Probes. They are available in both male and female termination, and include a "write on label" for easy identification. The female standard connector is a universal connector, meaning it can be used to terminate male versions of both the standard and miniature connector.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220 ºC (-20 to 428 °F).
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 14 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

ORDERING INFORMATION

DESCRIPTION	TYPE	TERMINATION	PART NUMBER
STANDARD CONNECTOR	K	MALE	TMPCNS01
		FEMALE	TMPCNS02
	T	MALE	TMPCNS03
		FEMALE	TMPCNS04
	E	MALE	TMPCNS05
		FEMALE	TMPCNS06
	J	MALE	TMPCNS07
		FEMALE	TMPCNS08

Covered by US and Foreign Patents.

Do not dispose of unit in trash - Recycle

MODEL TMPCN - QUICK DISCONNECT MINIATURE CONNECTORS

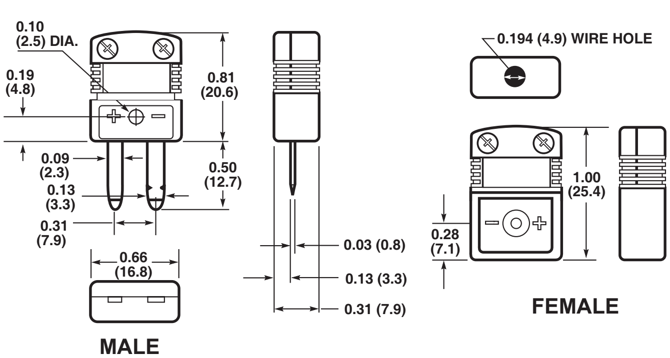
GENERAL DESCRIPTION

Miniature Connectors are for use with the Miniature Quick Disconnect TC Probes. They are available in both male and female termination, and include a "write on label" for easy identification.

SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220 ºC (-20 to 428 °F).
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 20 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

DIMENSIONS In inches (mm)



ORDERING INFORMATION

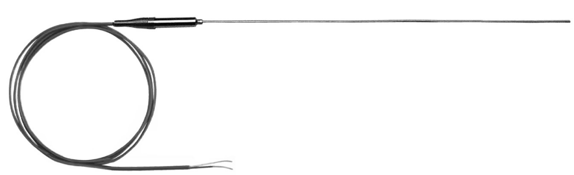
DESCRIPTION	TYPE	TERMINATION	PART NUMBER
MINIATURE CONNECTOR	K	MALE	TMPCNM01
		FEMALE	TMPCNM02
	T	MALE	TMPCNM03
		FEMALE	TMPCNM04
	E	MALE	TMPCNM05
		FEMALE	TMPCNM06
	J	MALE	TMPCNM07
		FEMALE	TMPCNM08

Covered by US and Foreign Patents.

Do not dispose of unit in trash - Recycle

TRANSITION JOINT PROBES AND ACCESSORIES

MODEL TMP - TRANSITION JOINT PROBES



- *CHOICE OF 304 SS, INCONEL 600 OR XL SHEATH*
- *STRIPPED BARE WIRE ENDS*
- *XL HIGH TEMPERATURE PROBE AVAILABLE*
- *EASILY ATTACHES TO STANDARD AND MINI STYLE CONNECTORS (SEE ACCESSORIES)*
- *MEETS OR EXCEEDS SLE AND EN 60584-2: TOLERANCE CLASS 1*

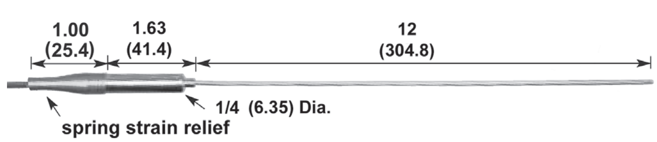
GENERAL DESCRIPTION

Model TMPTJ transition joint probes are rugged temperature probes that feature a spring strain relief at the “cold” end of the probe that prevents pinching of the thermocouple wire that can occur in certain applications. These versatile probes come in a variety of sheath diameters and materials. The probes are standard 12" long transitioning to 40" of wire with exposed leads.

SPECIFICATIONS

1. **SHEATH**: Constructed of 304 stainless steel, Inconel 600, or XL (High Temperature Probe)
2. **SHEATH DIAMETER**: 1/16" or 1/8"
3. **PROBE LENGTH**: 12" Ungrounded junction.
4. **CONNECTOR BODY**: Glass Filled Nylon, rated to 260 ºC.
5. **WIRE INSULATION**: Neoflon PFA
6. **LEAD LENGTH**: 40" (1 meter) with stripped ends

DIMENSIONS In inches (mm)



Note: Probe supplied with 1M (40") cable

ORDERING INFORMATION

DESCRIPTION	ANSI TYPE TC	SHEATH MATERIAL	SHEATH DIAMETER INCHES	UPPER TEMP GUIDELINES °C (°F) TC JUNCTION	PART NUMBER
TRANSITION JOINT PROBES	K	INCONEL 600	1/16	921 (1690)	TMPKTJ01
	K	INCONEL 600	1/8	1071 (1960)	TMPKTJ02
	K	304 SS	1/16	899 (1650)	TMPKTJ03
	K	304 SS	1/8	899 (1650)	TMPKTJ04
	K	XL	1/8	1038 (1900)	TMPKTJ05
	K	XL	1/16	1149 (2100)	TMPKTJ06

** XL probes have a very low drift and are for use in high temperature applications up to 1335 °C.*

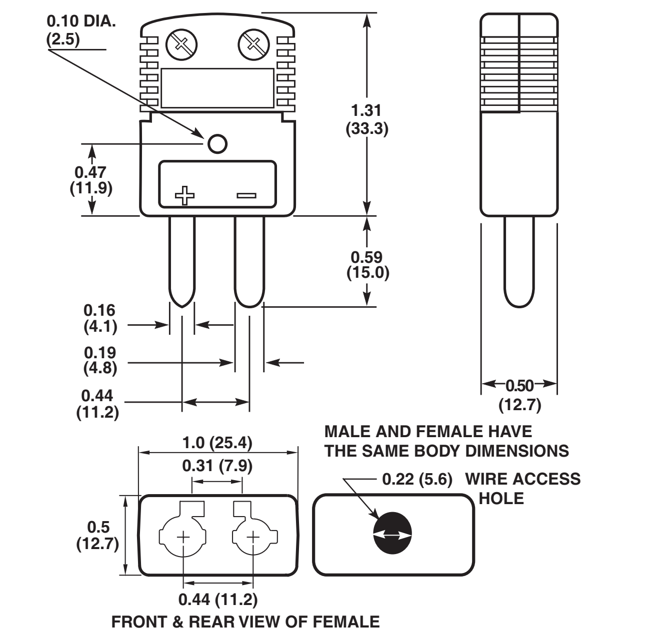
Do not dispose of unit in trash - Recycle

MODEL TMPCN - QUICK DISCONNECT STANDARD CONNECTORS

GENERAL DESCRIPTION

Standard Connectors are for use with the Standard Quick Disconnect TC Probes. They are available in both male and female termination, and include a "write on label" for easy identification. The female standard connector is a universal connector, meaning it can be used to terminate male versions of both the standard and miniature connector.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220º C. (-20 to 428 °F)
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 14 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

ORDERING INFORMATION

DESCRIPTION	TYPE	TERMINATION	PART NUMBER
STANDARD CONNECTOR	K	MALE	TMPCNS01
		FEMALE	TMPCNS02
	T	MALE	TMPCNS03
		FEMALE	TMPCNS04
	E	MALE	TMPCNS05
		FEMALE	TMPCNS06
	J	MALE	TMPCNS07
		FEMALE	TMPCNS08

Do not dispose of unit in trash - Recycle

MODEL TMPCN - QUICK DISCONNECT MINIATURE CONNECTORS

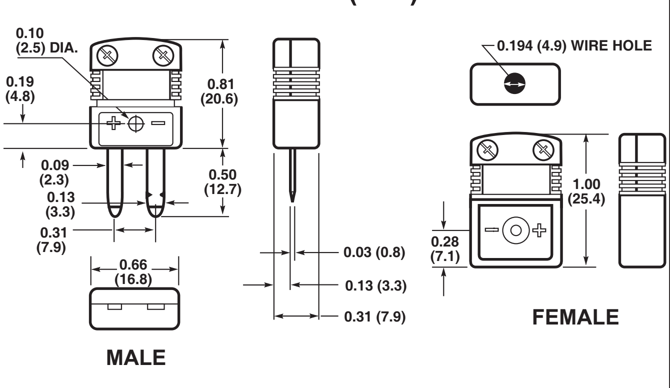
GENERAL DESCRIPTION

Miniature Connectors are for use with the Miniature Quick Disconnect TC Probes. They are available in both male and female termination, and include a "write on label" for easy identification.

SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220º C. (-20 to 428 °F)
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 20 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

DIMENSIONS In inches (mm)



ORDERING INFORMATION

DESCRIPTION	TYPE	TERMINATION	PART NUMBER
MINIATURE CONNECTOR	K	MALE	TMPCNM01
		FEMALE	TMPCNM02
	T	MALE	TMPCNM03
		FEMALE	TMPCNM04
	E	MALE	TMPCNM05
		FEMALE	TMPCNM06
	J	MALE	TMPCNM07
		FEMALE	TMPCNM08

Do not dispose of unit in trash - Recycle

MODEL TMPRT - SURFACE MOUNT AND PIPE PLUG RTD SENSORS

SURFACE MOUNT

PIPE PLUG

MODEL TMPRT - ADVANCED DESIGN SURFACE MOUNT RTD SENSOR

GENERAL DESCRIPTION

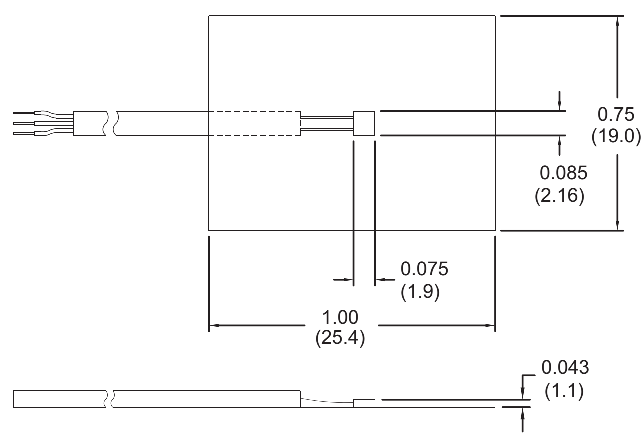
Model TMPRT "stick-on" style RTD temperature sensor mounts on flat surfaces and provides Class B accuracy for critical monitoring applications. Based on a bare 2 X 2 X 0.08 mm thin film platinum RTD, the unit is supplied in a Neoflon PFA insulated configuration and can be easily applied using its self-adhesive backing. Some of the applications of this versatile RTD sensor include monitoring chip, heat sink, and environmental temperatures in electronic devices; checking piping or ducting temperatures; monitoring motor and transformer core heat; testing insulation capabilities, as well as checking other applications in which surface and/or gradient temperatures need to be monitored and controlled.

- *100 Ω DIN CLASS B (± 0.12 % AT 0 °C) ACCURACY STANDARD*
- *EASY-INSTALLATION SILICONE BASED, SELF BACKING RATED TO 260 °C (500 °F)*
- *SENSOR CAN BE REAPPLIED*
- *STRIPPED 3 WIRE LEADS (CONNECTORS SOLD SEPARATELY)*
- *10 FOOT LEAD LENGTH*
- *IDEAL FOR FLAT OR CURVED SURFACES*

SPECIFICATIONS

1. **MINIMUM/MAXIMUM TEMPERATURE**:
   -73 °C (-100 °F) to 260 °C (500 °F) continuous
2. **SENSING ELEMENT**: 100 Ω at 0 °C (32 °F)
   Temperature coefficient of 0.00385 Ω/Ω/°C (IEC60751)
3. **ACCURACY**: ± 0.12% at 0 °C (DIN Class B)
4. **RESPONSE TIME**: Less than 0.9 sec (63% response time in water flowing at 3 feet per second), less than 2 sec response time on a hot plate.
5. **LEAD WIRE**:10 foot 26 AWG stranded nickel plated copper, Neoflon PFA-insulated and jacket cable
6. **ADHESIVE PAD DIMENSIONS**: 1 x ¾ " (25 X 19 mm)

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	INSULATION TYPE	TERMINATION (COLD SIDE)	CABLE LENGTH (IN FEET)	PART NUMBER
TMPRT	SMT RTD	NEOFLON PFA	Stripped Wire Bare Ends	10	TMPRT001

MODEL TMPRT - PIPE PLUG RTD SENSOR

GENERAL DESCRIPTION

The pipe plug RTD sensor is a unit specially designed for use in pressure vessel applications. Its 3 wire construction provides connectivity to most hand held instruments with Red/Red/White per IE/ASTM-E-1137. The unit features a high accuracy 100 Ω Class A DIN platinum element and steel braided, Neoflon PFA insulated wires for the necessary durability and protection demanded by harsher environments.

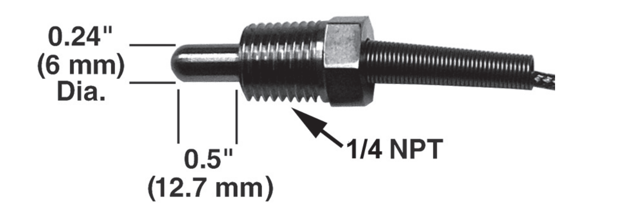
- *IDEAL FOR USE IN PRESSURE VESSEL APPLICATIONS, 172 BAR (2500 PSI) MAXIMUM*
- *6 MM (0.24") DIAMETER, SST PROBE*
- *STEEL BRAIDED, NEOFLON PFA INSULATED LEAD WIRES*
- *HIGH ACCURACY 100 Ω CLASS A DIN PLATINUM ELEMENT (ALPHA = 0.00385)*
- *STRAIN RELIEF SPRING*

I

SPECIFICATIONS

1. **WIRE**: 6´ long 26 AWG insulated Neoflon PFA
2. **MAX TEMPERATURE**: 230 ºC (450 ºF)
3. **TERMINATION**: Stripped bare wire ends
4. **OVERBRAID**: Stainless Steel
5. **THREADS**: ¼" NPT
6. **SENSING ELEMENT END DIAMETER**: 0.24" (6mm)

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	CABLE LENGTH (IN FEET)	TERMINATION (COLD SIDE)	PART NUMBER
TMPRT	Pipe Plug RTD Sensor	6 '	Stripped Bare Wire Ends	TMPRT002

MODEL TMPCN - RTD PROBE CONNECTORS

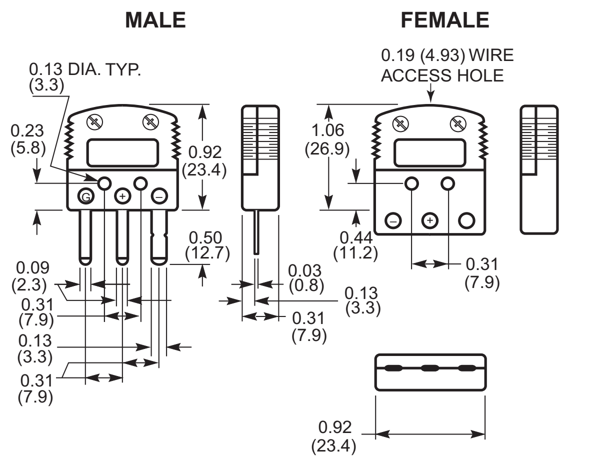
GENERAL DESCRIPTION

RTD Mini Connectors are for use with RTD probes. They are miniature size, and are available in both male and female termination.

SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220 ºC.
2. **CONNECTOR BODY COLOR**: White
3. **WIRE GAGE**: Accepts stranded or solid wire up to 20 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws
5. **CONNECTOR ENDS**: Copper

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	TYPE	TERMINATION	PART NUMBER
TMPCN	RTD Miniature Male Connector	U	Male	TMPCNM09
	RTD Miniature Female Connector	U	Female	TMPCNM10

MODELS TMPT AND TMPTR - THERMOCOUPLE OR RTD CONNECTOR WITH BUILT IN 4-20 mA TEMPERATURE TRANSMITTER

- HIGH ACCURACY, REPEATABILITY AND STABILITY
- CONNECTOR DESIGN CONVERTS INPUT SIGNAL TO A STANDARD 2-WIRE, 4-20 mA OUTPUT
- PROVIDES "OPEN SENSOR WIRE" SIGNAL INDICATION
- ENCAPSULATED HOUSING
- COMPENSATES FOR LONG LEAD WIRES
- FACTORY CALIBRATED, NO ADJUSTMENTS REQUIRED
- MODELS FOR J, K, T (UNGROUNDED) THERMOCOUPLES AND 100 OHM, 0.00385 3-WIRE RTD'S

GENERAL DESCRIPTION

The model TMPT's internal circuitry conditions the non-linear millivolt output of a thermocouple, across a specified temperature range, and retransmits it as a standard 2-wire 4–20 mA analog output. The TMPTR also provides a 2-wire 4–20 mA output by conditioning the resistive change of a 100Ω, 0.00385 RTD sensor and transmitting it as a 4–20 mA output.

SPECIFICATIONS

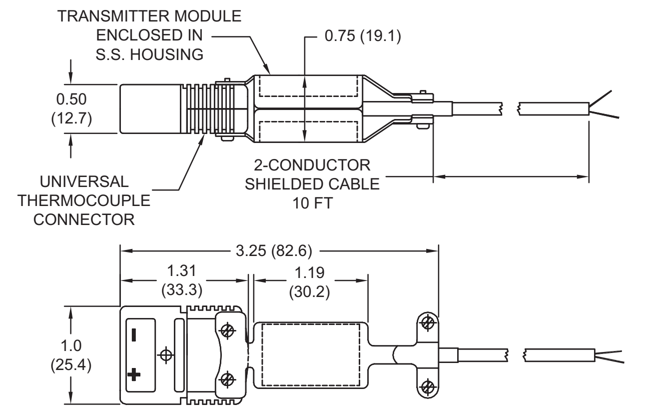
TMPT SPECIFICATIONS

1. **SUPPLY VOLTAGE**: 9 to 24 VDC @ 30 mA
2. **OUTPUT**: 4 to 20 mA
3. **TEMPERATURE RANGE**: See Ordering Information
4. **ACCURACY**: ± 0.5% of full scale millivolt input @ 23º C plus the non-linearity of the thermocouple type (note that the TMPT does not compensate for thermocouple non-linearity)
5. **TEMPERATURE COEFFICIENT**: ± 0.002 mA/ºC
6. **MAX LOOP LOAD**: (Ω) = (V supply - 9 V)/0.02 A
7. **TRANSMITTER OPERATING TEMPERATURE**: -40º to 85ºC
8. **AGENCY APPROVAL**: CE
9. **RESPONSE TIME**: 120 msec (0 to 63% FS)
10. **THERMOCOUPLE JUNCTION**: Ungrounded
11. **INPUT CONNECTION**: Standard size female connector mates with both standard and miniature male connectors.
12. **CABLE CONNECTIONS**: 10 foot 2-wire shielded cable

WIRE COLOR CODE	FUNCTION
RED	+VDC
BLACK	OUTPUT
WHITE	SHIELD

* Max cable run is determined by max loop load and wire resistance (≈1000ft).

DIMENSIONS In inches (mm)



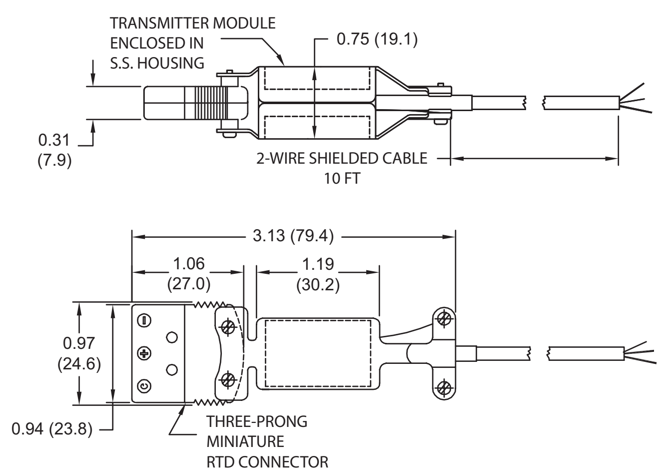
TMPTR SPECIFICATIONS

1. **SUPPLY VOLTAGE**: 9 to 24 VDC @ 30 mA
2. **OUTPUT**: 4 to 20 mA
3. **TEMPERATURE RANGE**: 2 – 569º C (36 – 1056º F)
4. **INPUT**: 3 wire, PT100 (α = 0.00385)
5. **OPEN SENSOR WIRE INDICATION**:
   - Leg 1: Open = 27 mA
   - Leg 2: Open = 2.2 mA
   - Leg 3: Open = 2.2 mA
6. **INPUT CONNECTION**: 3 prong minature connector mates with TMPCNM09
7. **CABLE CONNECTIONS**: 10 foot 2-wire shielded cable

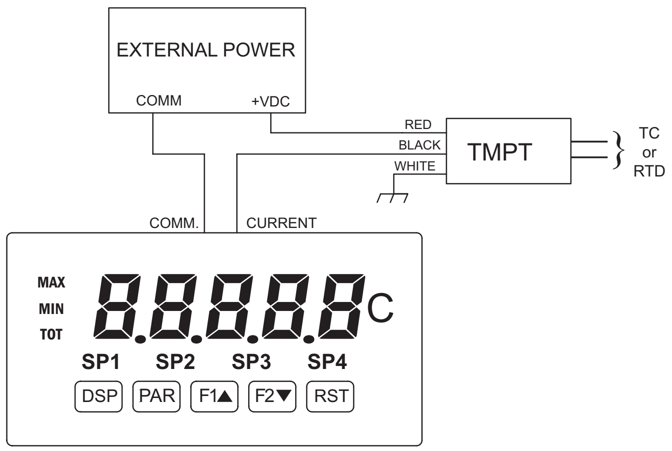
WIRE COLOR CODE	FUNCTION
RED	+VDC
BLACK	OUTPUT
WHITE	SHIELD

* Max cable run is determined by max loop load and wire resistance (≈1000ft).

DIMENSIONS In inches (mm)



WIRING CONNECTION



PROCESS METER

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	TC ANSI TYPE	TEMPERATURE RANGE	PART NUMBER
TMPT	TC TRANSMITTER WITH FEMALE CONNECTOR	K	-18 to 1093 °C (0 to 2000 °F)	TMPTRN01
		K	-18 to 538 °C (0 to 1000 °F)	TMPTRN02
		T	-18 to 121 °C (0 to 250 °F)	TMPTRN03
		T	-18 to 399 °C (0 to 750 °F)	TMPTRN04
		J	-18 to 121 °C (0 to 250 °F)	TMPTRN05
		J	-18 to 538 °C (0 to 1000 °F)	TMPTRN06
TMPTR	RTD TRANSMITTER WITH FEMALE CONNECTOR	-	2 to 569 °C (36 to 1056 °F)	TMPTRN07

Covered by US and Foreign Patents.

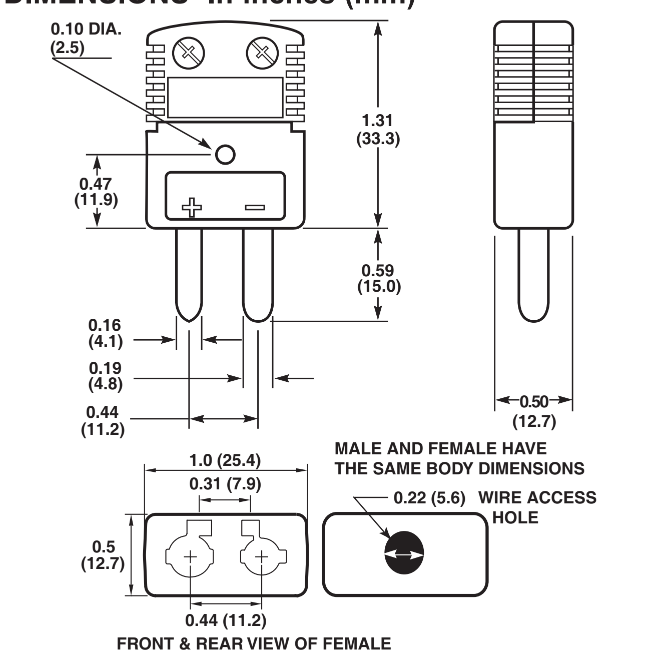
ACCESSORIES

MODEL TMPCN - QUICK DISCONNECT STANDARD CONNECTORS

GENERAL DESCRIPTION

Standard Connectors are for use with the Standard Quick Disconnect TC Probes. They are available in both male and female termination, and include a “write on label” for easy identification. The female standard connector is a universal connector, meaning it can be used to terminate male versions of both the standard and miniature connector.

DIMENSIONS In inches (mm)



SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220º C. (-20 to 428 °F)
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 14 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

ORDERING INFORMATION

DESCRIPTION	TYPE	TERMINATION	PART NUMBER
STANDARD CONNECTOR	K	MALE	TMPCNS01
		FEMALE	TMPCNS02
	T	MALE	TMPCNS03
		FEMALE	TMPCNS04
	E	MALE	TMPCNS05
		FEMALE	TMPCNS06
	J	MALE	TMPCNS07
		FEMALE	TMPCNS08

MODEL TMPCN - QUICK DISCONNECT MINIATURE CONNECTORS

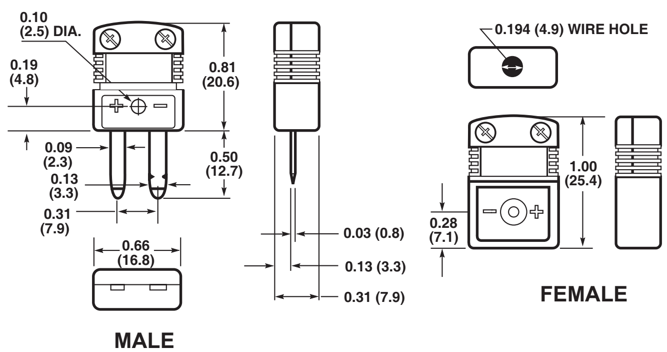
GENERAL DESCRIPTION

Miniature Connectors are for use with the Miniature Quick Disconnect TC Probes. They are available in both male and female termination, and include a "write on label" for easy identification.

SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220º C. (-20 to 428 °F)
2. **CONNECTOR BODY COLOR**: ANSI color coded
3. **WIRE GAGE**: Accepts stranded or solid wire up to 20 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws

DIMENSIONS In inches (mm)



ORDERING INFORMATION

DESCRIPTION	TYPE	TERMINATION	PART NUMBER
MINIATURE CONNECTOR	K	MALE	TMPCNM01
		FEMALE	TMPCNM02
	T	MALE	TMPCNM03
		FEMALE	TMPCNM04
	E	MALE	TMPCNM05
		FEMALE	TMPCNM06
	J	MALE	TMPCNM07
		FEMALE	TMPCNM08

MODEL TMPCN - RTD PROBE CONNECTORS

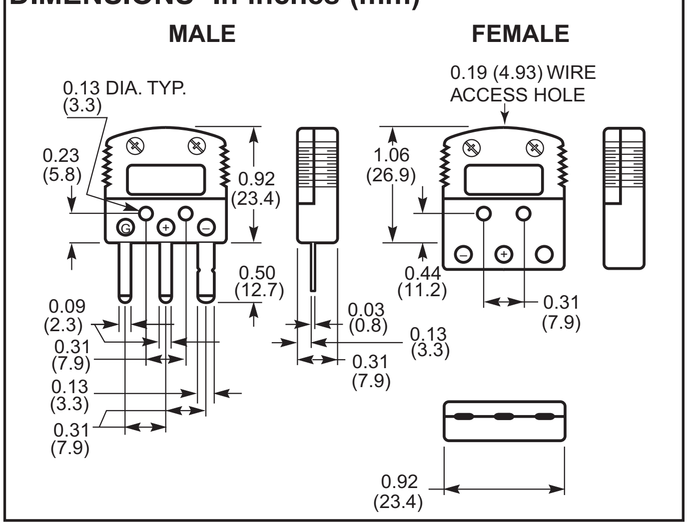
GENERAL DESCRIPTION

RTD Mini Connectors are for use with RTD probes. They are miniature size, and are available in both male and female termination.

SPECIFICATIONS

1. **CONNECTOR BODY MATERIAL**: Glass Filled Nylon, for temperature ranges of -29 to 220 ºC.
2. **CONNECTOR BODY COLOR**: White
3. **WIRE GAGE**: Accepts stranded or solid wire up to 20 AWG
4. **WIRE TERMINATION**: Combination Phillips/Slot Screws
5. **CONNECTOR ENDS**: Copper

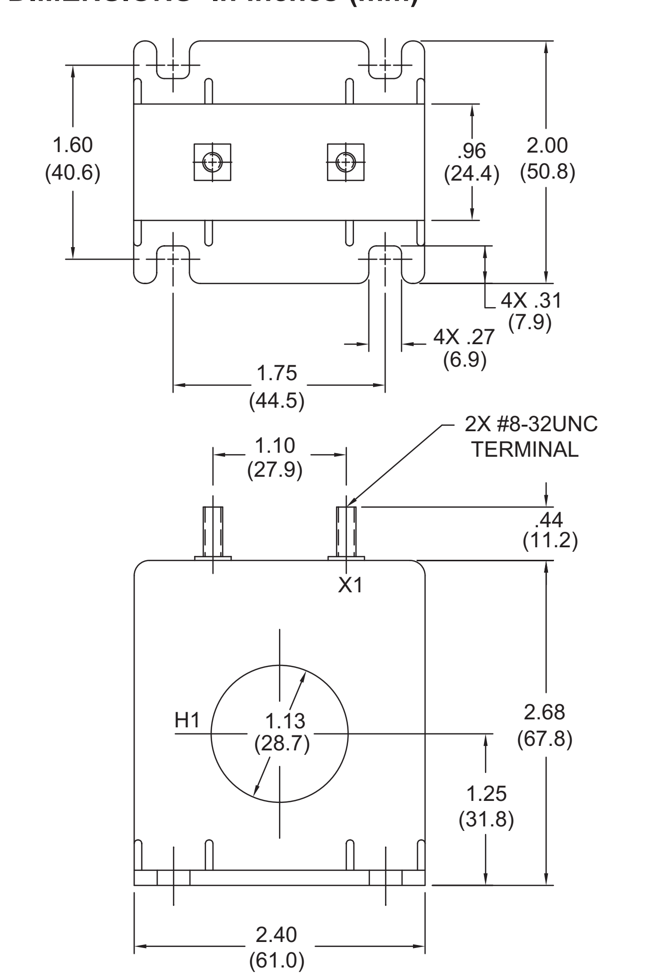
DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	TYPE	TERMINATION	PART NUMBER
TMPCN	RTD Miniature Male Connector	U	Male	TMPCNM09
	RTD Miniature Female Connector	U	Female	TMPCNM10

MODEL CT - CURRENT TRANSFORMER



SPECIFICATIONS

1. **Operating Frequency:** 50 to 400 Hz.
2. **Insulation Class:** 0.6 KV BIL 10 KV full wave.
3. **Terminals:** Brass studs No. 8-32 UNC with flat washer and hex nuts.
4. **Window Diameter:** 1.13" (28.7 mm).
5. **Weight:** 8.0 oz (226.0 g).

	UL FILE #	CSA FILE #
Instrument Transformers, Inc.	E93779	89403
Tyco Electronics	E348387	253481
Crompton Instruments a Tyco Electronics Company	E257877	237637

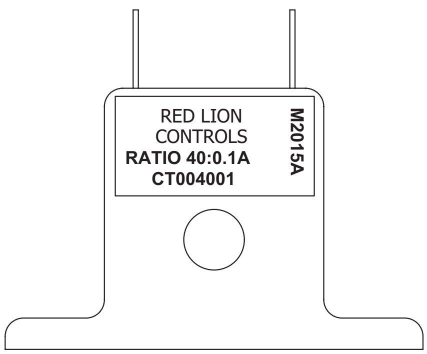
Note: The listed current ratio of the current transformer is based on the primary conductor passing once through the transformer opening. The ratio is reduced in multiples by looping the conductor through the opening. A transformer having a ratio 200:5 changes to a ratio of 100:5 if two loops are made through the transformer with the primary conductor. The ratio of the transformer will be 50:5 if four loops are made with the primary conductor, etc.

ORDERING INFORMATION

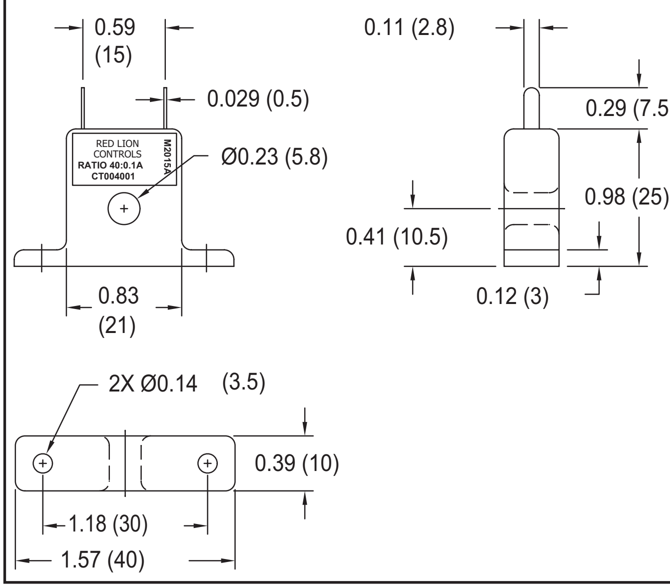
CURRENT RATIO	ACCURACY @ 60 Hz	VA 60 Hz BURDEN	MAXIMUM OUTPUT WIRE DISTANCE BETWEEN CT AND METER				PART NUMBERS
			18 AWG	16 AWG	14 AWG	12 AWG	
50:0.1	±5.0%	2.5	Wire distance is not an issue due to the low current flow. Wires may be as long as needed.				CT005001
50:5	±3.0%	2.0	5.0 ft.	7.5 ft.	12 ft.	18 ft.	CT005050
200:5	±1.0%	4.0	10 ft.	17.5 ft.	28 ft.	43 ft.	CT020050

Do not dispose of unit in trash - Recycle

MODEL CT004 - CURRENT TRANSFORMER



DIMENSIONS In inches (mm)



DESCRIPTION

The CT004 is intended for use with temperature controllers for monitoring heater current. The CT004 is suitable for general purpose AC current monitoring applications up to 40 Amps.

SPECIFICATIONS

1. **CURRENT RATIO:** 40:0.1A
2. **MAX HEATER CURRENT:** 50 A.
3. **DIELECTRIC STRENGTH:** 1000 VAC (For 1 minute)
4. **VIBRATION RESISTANCE:** 50 Hz (Approx. 10 G)
5. **TERMINALS:** Solder type
6. **WINDOW DIAMETER**: 0.228" (5.8 mm).
7. **WEIGHT:** 0.406 oz (11.5 g).

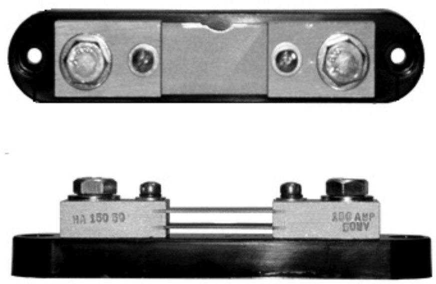
Notes: Refer to the instruction manual of the temperature controller for connection information and max. heater current allowable by the temperature controller.

ORDERING INFORMATION

MODEL NO.	CURRENT RATIO	PART NUMBER
CT004	40 : 0.1 A	CT004001

Do not dispose of unit in trash - Recycle

MODEL APSCM - DC CURRENT SHUNT

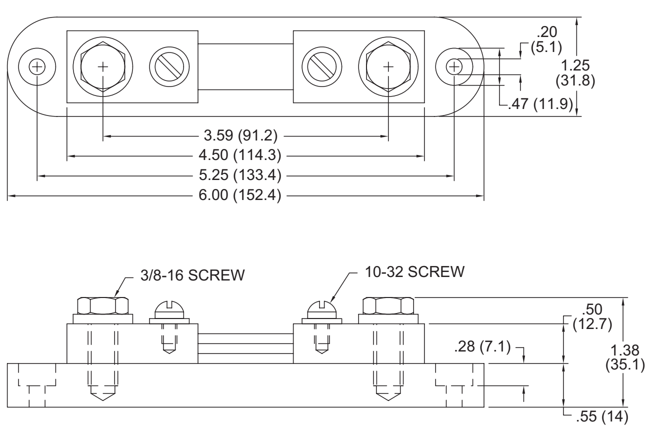


- *10 AND 100 AMP DC CURRENT SHUNTS*
- *CONVERTS DC CURRENT to DC MILLIVOLTS*
- *PROVIDES A 0 to 100 MILLIVOLT OUTPUT*

DESCRIPTION

The APSCM current shunts accept signals over 2 Amp VDC and convert the output to a millivolt signal compatible with most standard DC meters. Two models are available; a 0 to 10 Amp and a 0 to 100 Amp version. Both models provide a 100 mVDC output proportional to the DC current input.

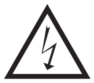
DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety regulations, local codes and instructions that appear in this and corresponding literature, or on equipment, must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.



CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **INPUT**: 10 or 100 Amps
2. **MAX CURRENT**: 110% of rating, not recommetnded for continuous use at Maximum Amp rating.
3. **TERMINALS**:
   Bolt Connections for Curent Input
   Screw Connections for Millivolt Output
4. **WEIGHT**: 1 lbs. (0.45 Kg)

ORDERING INFORMATION

DC RATIO	DESCRIPTION	PART NUMBER
10 A : 100 mV	10 Amp Current Shunt	APSCM010
100 A : 100 mV	100 Amp Current Shunt	APSCM100

MODEL CTD - DC CURRENT TRANSDUCER

- *THREE JUMPER SELECTABLE INPUT RANGES*
- *OUTPUT IS MAGNETICALLY ISOLATED FROM THE INPUT*
- *INTERNAL POWER REGULATION*
- *SPLIT-CORE CASE FOR EASY INSTALLATION*

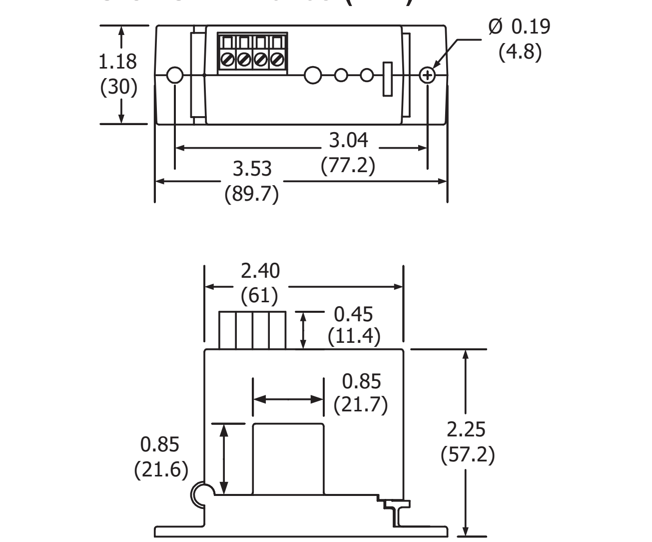
GENERAL DESCRIPTION

CTD transducer combines a Hall Effect sensor and a signal conditioner into a single package. This provides higher accuracy, lower wiring costs, easier installation and saves valuable panel space. The CTD has jumper selectable current input ranges and industry standard 4-20 mA output with a split-core case.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

SPECIFICATIONS

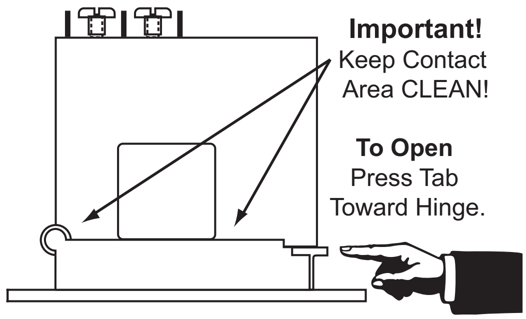
1. **OUTPUT SIGNAL**: 4-20 mA
2. **OUTPUT LIMIT**: 23 mA
3. **ACCURACY**: 1.0% FS
4. **REPEATABILITY**: 1.0% FS
5. **RESPONSE TIME**: to 90% of step change 100 msec
6. **FREQUENCY RANGE**: DC
7. **POWER SUPPLY**: 22 – 26 VAC/VDC
   Power input and output signal are not isolated.
8. **POWER CONSUMPTION**: 2 VA
9. **LOADING**: 650Ω max.
10. **ISOLATION VOLTAGE**: 3 kV (monitored line to output)
11. **LINEARITY**: 0.75% FS
12. **CURRENT RANGES**: Three selectable Ranges: 0 – 50 A
    0 – 75 A
    0 – 100 A
13. **CASE**: UL 94V-0 Flammability rated thermoplastic
14. **ENVIRONMENTAL**: -4 to 122 °F (-20 to 50 °C)
    0-95% RH, non-condensing

INSTALLATION

Run wire to be monitored through opening in the sensor. Be sure the monitored current flows in the same direction as the arrow on the sensor. The arrow is just above the hinge, with the "+" symbol on the left, the "-" symbol on the right. The CTD transducers work in the same environment as motors, contactors, heaters, pull-boxes, and other electrical enclosures. They can be mounted in any position or hung directly on wires with a wire tie. Just leave at least one inch (25.4 mm) distance between sensor and other magnetic devices.

Split-Core Versions

Press the tab in the direction as shown to open the sensor. After placing the wire in the opening, press the hinged portion firmly downward until a definite click is heard and the tab pops out fully.



KEEP SPLIT-CORE SENSORS CLEAN.

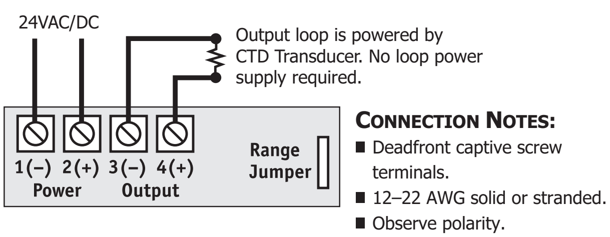
Silicone grease is factory applied on the mating surfaces to prevent rust and improve performance. Be careful not to allow grit or dirt onto the grease in the contact area. Operation can be impaired if the mating surfaces do not have good contact. Check visually before closing.

OUTPUT WIRING

Connect control or monitoring wires to the sensor. Use up to 14 AWG copper wire and tighten terminals to 4 inch-pounds torque.

4-20mA:

The current loop is powered by the CTD Transducer.
Maximum loop impedance is 650 Ω.



RANGE SELECT

CTD transducers feature field selectable ranges. The ranges are factory calibrated, eliminating time consuming and inaccurate field setting of zero or span.

1. Determine the normal operating amperage of your monitored circuit.
2. Select the range that is equal to or slightly higher than the normal operating amperage.
3. Place the range jumper in the appropriate position.

TROUBLE SHOOTING

1. Output Signal Too Low

A. The jumper may be set in a range that is too high for current being monitored. Move jumper to the correct range.

B. Power supply is inadequate. Check power supply. Make sure it is of sufficient voltage with all loads at maximum. CTD Series draw 2.0 VA.

C. Output load too high. Check output load, be sure it is no more than 650 Ω.

2. Output Signal is always at maximum

A. The jumper may be set in a range that is too low for current being monitored. Move jumper to the correct range.

3. Sensor has no output

A. Polarity is not properly matched. Check and correct wiring polarity

B. Monitored load is not DC or is not on. Check that the monitored load is DC and that it is actually on.

C.Split Core models: The core contact area may be dirty. Open the sensor and clean the contact area.

I

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CTD	DC/DC, Split Case	CTD00000

MODEL CTL - AVERAGE RESPONDING AC CURRENT TRANSDUCERS

I

- *AVERAGE RESPONDING OUTPUT: 0-10 VDC or 4-20 mA*
- *JUMPER SELECTABLE RANGES*
- *OUTPUT IS MAGNETICALLY ISOLATED FROM THE INPUT*
- *SPLIT-CORE AND FIXED-CORE CASES*

C UL US LISTED
IND. CONT. EQ.
22SV

GENERAL DESCRIPTION

CTL Series transducers combine a current transformer and a signal conditioner into a single package. This provides higher accuracy, lower wiring costs, easier installation and saves valuable panel space.

The CTL Series transducers have jumper selected current input ranges and industry standard 0-10 VDC or 4-20 mA outputs. The CTL Series is designed for application on “linear” or sinusoidal AC loads. Available in a split-core or solid-core case. Select the CTL Series for constant speed loads or On/Off loads.

SAFETY SUMMARY

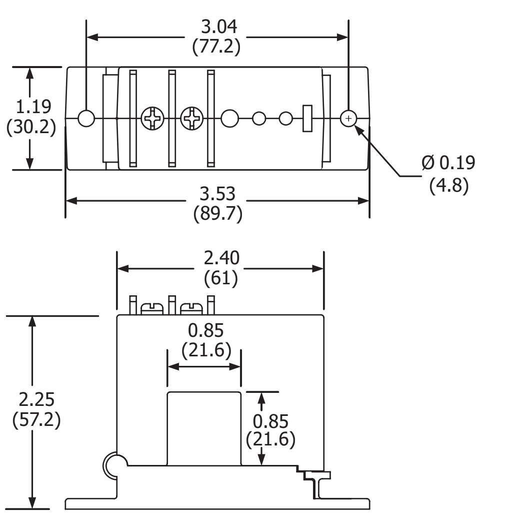
All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm) — SPLIT-CORE



SPECIFICATIONS

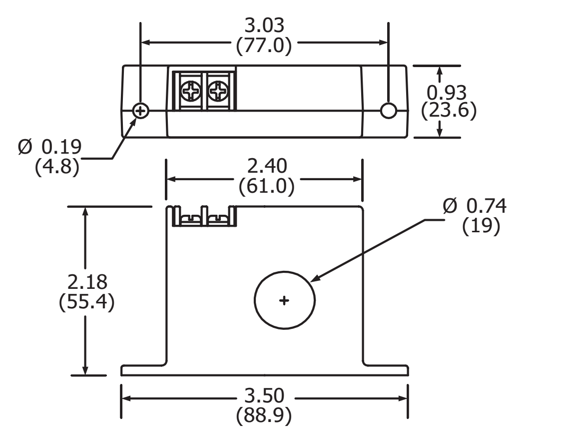
	0-10 VDC	4-20 mA
1. **OUTPUT SIGNAL:**	0-10 VDC	4-20 mA
2. **OUTPUT LIMIT:**	15 VDC	40 mA
3. **FREQUENCY RANGE:**	50-60 Hz	20-100 Hz
4. **RESPONSE TIME:**	100 msec	300 msec
5. **ACCURACY:**	1.0% FS	0.5% FS
6. **POWER SUPPLY**:	Self-powered	24 VDC Nominal, 40 VDC max.

7. **INPUT RANGES**: (Jumper Selectable)

MODEL	RANGE	MAXIMUM		
		Continuous	6 sec	1 sec
CTL005	2 A	80 A	125 A	250 A
	5 A	100 A	125 A	250 A
CTL050	10 A	80 A	125 A	250 A
	20 A	110 A	150 A	300 A
	50 A	175 A	215 A	400 A
CTL200	100 A	200 A	300 A	600 A
	150 A	300 A	450 A	800 A
	200 A	400 A	500 A	1000 A

8. **ISOLATION VOLTAGE**: 3 kV
9. **CASE**: UL 94V-0 Flammability rated thermoplastic
10. **ENVIRONMENTAL**: -4 to 122 °F (-20 to 50 °C)
0-95% RH, non-condensing
11. **TORQUE RATINGS**: 7 in-lbs on Fixed-core models; 9 in-lbs on Split-core models.
12. **LISTING**: UL 508 Industrial Control Equipment, CSA C22.2 No. 14-M95, and CE Certified.

DIMENSIONS In inches (mm) — FIXED-CORE

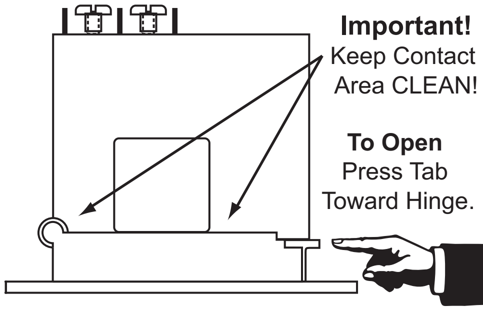


INSTALLATION

Run wire to be monitored through opening in the sensor. The CTL Series transducers work in the same environment as motors, contactors, heaters, pull-boxes, and other electrical enclosures. They can be mounted in any position or hung directly on wires with a wire tie. Just leave at least one inch (25.4 mm) distance between sensor and other magnetic devices.

Split-Core Versions

Press the tab in the direction as shown to open the sensor. After placing the wire in the opening, press the hinged portion firmly downward until a definite click is heard and the tab pops out fully.



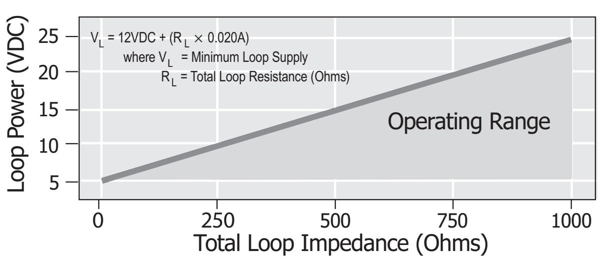
KEEP SPLIT-CORE SENSORS CLEAN.

Silicone grease is factory applied on the mating surfaces to prevent rust and improve performance. Be careful not to allow grit or dirt onto the grease in the contact area. Operation can be impaired if the mating surfaces do not have good contact. Check visually before closing.

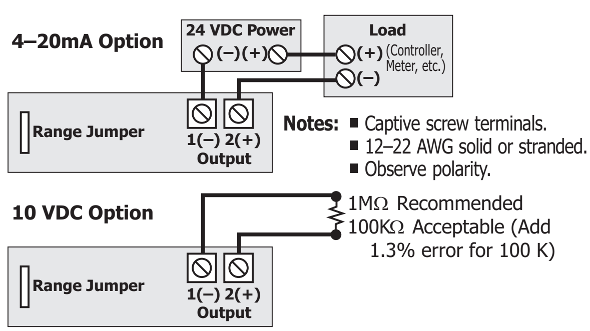
OUTPUT WIRING

Connect control or monitoring wires to the sensor. Use up to 14 AWG copper wire and tighten terminals to 7 inch-pounds torque for solid-core models and 9 inch-pounds torque for split-core models. Be sure the output load or loop power requirements are met (see diagram).

POWER SUPPLY



CONNECTIONS



RANGE SELECT

CTL series transducers feature field selectable ranges. The ranges are factory calibrated, eliminating time consuming and inaccurate field setting of zero or span.

1. Determine the normal operating amperage of your monitored circuit
2. Select the range that is equal to or slightly higher than the normal operating amperage.
3. Place the range jumper in the appropriate position.

TROUBLE SHOOTING

0-10 VDC OUTPUT MODELS

1. Sensor Has No Output

A. Polarity is not properly matched. Check and correct wiring polarity.

B. Monitored load is not AC or is not on. Check that the monitored load is AC and that it is actually on.

C. Split Core models: The core contact area may be dirty. Open the sensor and clean the contact area.

2. Output Signal Too Low

A. The jumper may be set in a range that is too high for current being monitored. Move jumper to the correct range.

B. Output load too low. Check output load, be sure that it is at least 100KΩ and preferably 1 MΩ.

C. Monitored current is below minimum required. Loop the monitored wire several times through the aperture until the "sensed" current rises above minimum. Sensed Amps = (Actual Amps) x (Number of Loops). Count loops on the inside of the aperture.

3. Output Signal Is Always At Maximum

A. The jumper may be set in a range that is too low for current being monitored. Move jumper to the correct range.

4-20 mA OUTPUT MODELS

1. Sensor Has No Output

A. Power supply is not properly sized. Check power supply voltage and current rating.

B. Polarity is not properly matched. Check and correct wiring polarity

C. Split Core models: The core contact area may be dirty. Open the sensor and clean the contact area.

2. Output Signal Too Low

A. The jumper may be set in a range that is too high for current being monitored. Move jumper to the correct range.

B. The load current is not sinusoidal.

C. Monitored current is below minimum required. Loop the monitored wire several times through the aperture until the "sensed" current rises above minimum. Sensed Amps = (Actual Amps) x (Number of Loops). Count loops on the inside of the aperture.

3. Sensor Is Always At 4 mA

A. Monitored load is not AC or is not on. Check that the monitored load is AC and that it is actually on.

4. Output Signal Is Always At 20 mA

A. The jumper may be set in a range that is too low for current being monitored. Move jumper to the correct range.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
CTL005	2-5A / 4-20 mA, Split Case	CTL0052S
CTL050	10A-50 A / 10 VDC, Fixed Case	CTL0501F
	10A-50 A / 4-20 mA, Fixed Case	CTL0502F
	10A-50 A / 4-20 mA, Split Case	CTL0502S
CTL200	100A-200 A / 10 VDC, Fixed Case	CTL2001F
	100A-200 A / 4-20 mA, Fixed Case	CTL2002F
	100A-200 A / 4-20 mA, Split Case	CTL2002S

I

MODEL CTR - TRUE RMS AC CURRENT TRANSDUCER

- TRUE RMS OUTPUT
- JUMPER SELECTABLE RANGES
- OUTPUT IS MAGNETICALLY ISOLATED FROM THE INPUT
- SPLIT-CORE CASE

c UL US LISTED IND. CONT. EQ. 22SV

CE

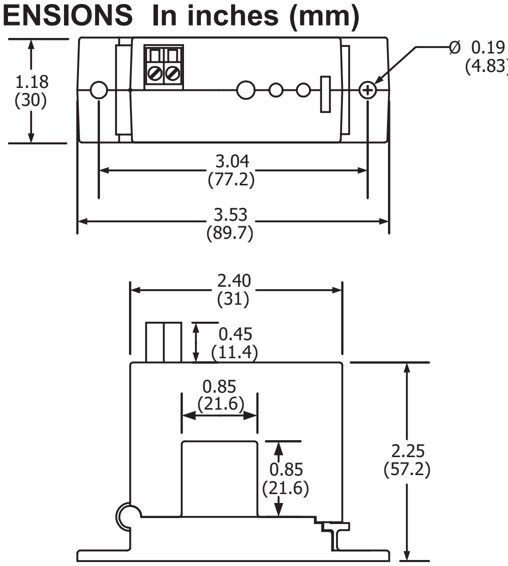
GENERAL DESCRIPTION

CTR Series transducers combine a current transformer and a signal conditioner into a single package. This provides higher accuracy, lower wiring costs, easier installation and saves valuable panel space.

The CTR Series transducers are available in 4-20 mA output only. The CTR Series provides a "True RMS" output on distorted waveforms found on VFD or SCR outputs, and on linear loads in "noisy" power environments. Select the CTR Series for variable speed or SCR controlled loads.

The current waveform of a typical linear load is a pure sine wave. In VFD and SCR applications, however, output waveforms are rough approximations of a sine wave. There are numerous spikes and dips in each cycle. CTR transducers use a mathematical algorithm called "True RMS", that integrates the actual waveform over time. The output is the amperage component of the true power (heating value) of the AC current waveform.True RMS is the only way to accurately measure distorted AC waveforms.

DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

1. **OUTPUT SIGNAL**: 4 to 20 mA DC, loop-powered, True RMS
2. **OUTPUT LIMIT**: 23 mA
3. **FREQUENCY RANGE**: 10-400 Hz (All Waveforms)
4. **RESPONSE TIME**: to 90% of step change 600 msec
5. **ACCURACY**: 0.8% FS
6. **POWER SUPPLY**: 24 VDC Nominal, 40 VDC Max.
7. **INPUT RANGES**: (Jumper Selectable)

MODEL	RANGE	MAXIMUM		
		Continuous	6 sec	1 sec
CTR05	10 A	80 A	125 A	250 A
	20 A	110 A	150 A	300 A
	50 A	175 A	215 A	400 A
CTR2	100 A	200 A	300 A	600 A
	150 A	300 A	450 A	800 A
	200 A	400 A	500 A	1000 A

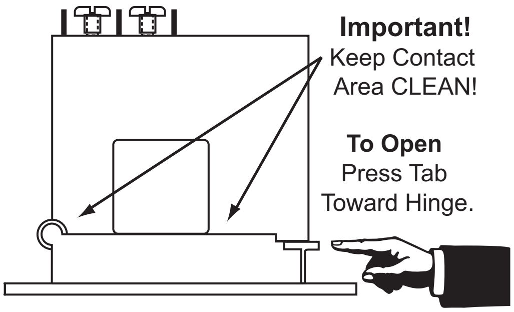
8. **ISOLATION VOLTAGE**: 3 kV
9. **CASE**: UL 94V-0 Flammability rated thermoplastic
10. **ENVIRONMENTAL**: -4 to 122 °F (-20 to 50 °C)
    0-95% RH, non-condensing
11. **TORQUE RATINGS**: 9 in-lbs
12. **LISTING**: UL 508 Industrial Control Equipment, CSA C22.2 No. 14-M95, and CE Certified.

INSTALLATION

Run wire to be monitored through opening in the sensor. Be sure the monitored current flows in the same direction as the arrow on the sensor. The CTR Series transducers work in the same environment as motors, contactors, heaters, pull-boxes, and other electrical enclosures. They can be mounted in any position or hung directly on wires with a wire tie. Just leave at least one inch (25.4 mm) distance between sensor and other magnetic devices.

Split-Core Versions

Press the tab in the direction as shown to open the sensor. After placing the wire in the opening, press the hinged portion firmly downward until a definite click is heard and the tab pops out fully.



KEEP SPLIT-CORE SENSORS CLEAN.

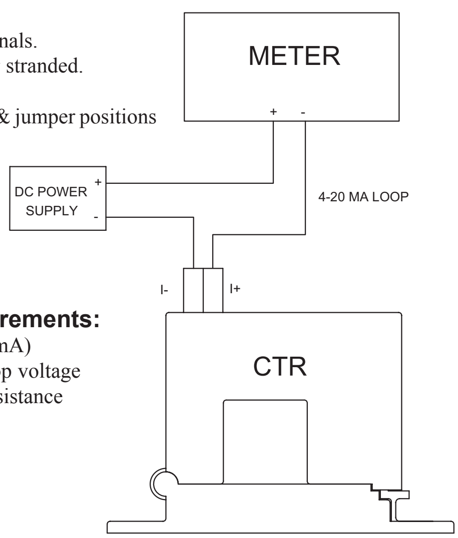
Silicone grease is factory applied on the mating surfaces to prevent rust and improve performance. Be careful not to allow grit or dirt onto the grease in the contact area. Operation can be impaired if the mating surfaces do not have good contact. Check visually before closing.

OUTPUT WIRING

Connect control or monitoring wires to the sensor. Use up to 14 AWG copper wire and tighten terminals to 9 inch-pounds torque. Be sure the output load or loop power requirements are met (see diagram).

Connection Notes:

- Captive screw terminals.
- 14-22 AWG solid or stranded.
- Observe Polarity
- See label for ranges & jumper positions



Loop Voltage Requirements:

$V_L = 12V + (R_L \times 20 \text{ mA})$
Where: V_L = Min. Loop voltage
R_L = Loop Resistance

RANGE SELECT

CTR series transducers feature field selectable ranges. The ranges are factory calibrated, eliminating time consuming and inaccurate field setting of zero or span.

1. Determine the normal operating amperage of your monitored circuit
2. Select the range that is equal to or slightly higher than the normal operating amperage.
3. Place the range jumper in the appropriate position.

TROUBLE SHOOTING

1. Sensor Has No Output

A. Power supply is not properly sized. Check power supply voltage and current rating.
B. Polarity is not properly matched. Check and correct wiring polarity.
C. Split Core models: The core contact area may be dirty. Open the sensor and clean the contact area.

2. Output Signal Too Low

A. The jumper may be set in a range that is too high for current being monitored. Move jumper to the correct range.
B. Output load too high. Check output load, be sure that V_L does not exceed 40 VDC.
C. Monitored current is below minimum required. Loop the monitored wire several times through the aperture until the "sensed" current rises above minimum. Sensed Amps = (Actual Amps) x (Number of Loops). Count loops on the inside of the aperture.

3. Output Signal Is Always At 4mA

A. Monitored load is not AC or is not on. Check that the monitored load is AC and that it is actually on.

4. Output Signal Is Always At 20mA

A. The jumper may be set in a range that is too low for current being monitored. Move jumper to the correct range.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CTR	50 A/4-20 mA, Split Case	CTR05000
	200 A/4-20 mA, Split Case	CTR20000

I

MODEL CTS - AC CURRENT OPERATED SWITCH

- *UNIVERSAL OUTPUT*
- *SELF-POWERED*
- *EASILY ADJUSTABLE SETPOINT*
- *FIXED OR SPLIT-CORE CASE*

c UL US LISTED
IND. CONT. EQ.
22SV

GENERAL DESCRIPTION

CTS Series Transducers are self-powered, solid-state current-operated switches that trigger when the current level sensed through the aperature exceeds the adjusted setpoint. The solid state output contacts can switch AC or DC; this "universal" output makes them well suited for application in automation systems.

CTS Series Current Operated Switches combine a current transformer, signal conditioner and limit alarm into a single package for use in status monitoring or proof of operation applications. Offering an extended setpoint range of 1-150 A and universal, solid-state outputs, the self-powered CTS can be tailored to provide accurate and dependable digital indication of over-current conditions across a broad range of applications. Available in solid-core enclosure styles or in a split-core case to maximize ease of installation.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

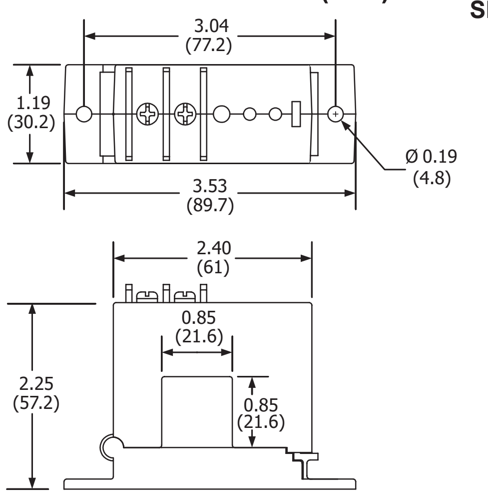
1. **POWER SUPPLY**: None - self powered
2. **OUTPUT**: Magnetically isolated normally open solid-state switch
3. **OUTPUT RATING**: 0.15A, 240 VAC/VDC
4. **OFF STATE LEAKAGE:** <10 µA
5. **RESPONSE TIME**: 120 msec
6. **HYSTERESIS**: Approx 5% of Setpoint
7. **SETPOINT RANGES AND MAXIMUM AMPS**:

MODEL	SETPOINT RANGE	MAXIMUM INPUT AMPS		
		Continuous	6 sec	1 sec
CTSF	Fixed-Core: 1 - 150 A	150 A	400 A	1000 A
CTSS	Split-Core: 1.75 - 150 A	150 A	400 A	1000 A
CTSG	Fixed-Core Go/No Go: 0.75 A max	250 A	400 A	1000 A

8. **SETPOINT ADJUST**: 4 Turn potentiometer (CTSS)
   15 Turn Potentiometer (CTSF)
9. **FREQUENCY RANGE**: 6-100 Hz
10. **ISOLATION VOLTAGE**: UL Listed to 1,270 VAC. Tested to 5,000 VAC
11. **CASE**: UL 94V-0 Flammability rated thermoplastic
12. **ENVIRONMENTAL**: -58 to 149 °F (-50 to 65 °C)
    0-95% RH, non-condensing
13. **TORQUE RATINGS**: 5 in-lbs
14. **LISTING**: UL 508 Industrial Control Equipment, CSA C22.2 No. 14-M95, and CE Certified.

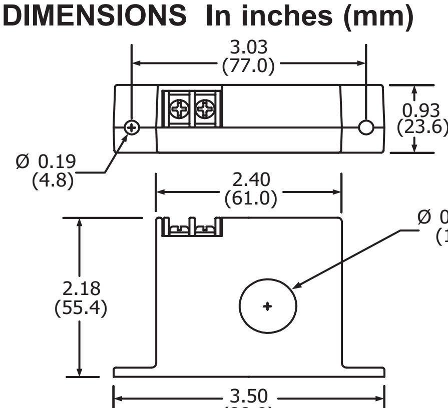
DIMENSIONS In inches (mm)

SPLIT-CORE



DIMENSIONS In inches (mm)

FIXED-CORE

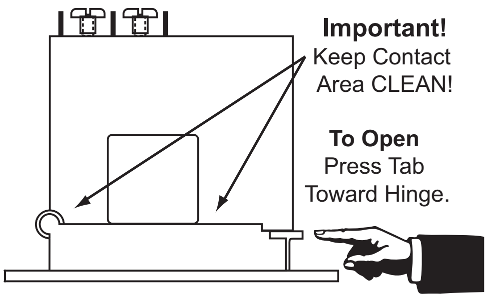


INSTALLATION

Run wire to be monitored through opening in the sensor. The CTS Series transducers work in the same environment as motors, contactors, heaters, pull-boxes, and other electrical enclosures. They can be mounted in any position or hung directly on wires with a wire tie. Just leave at least one inch (25.4 mm) distance between sensor and other magnetic devices.

Split-Core Versions

Press the tab in the direction as shown to open the sensor. After placing the wire in the opening, press the hinged portion firmly downward until a definite click is heard and the tab pops out fully.



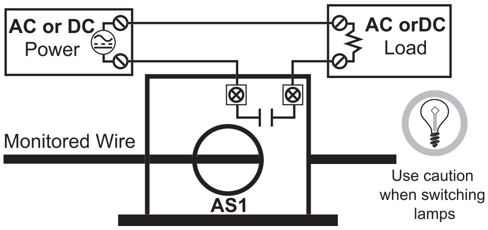
KEEP SPLIT-CORE SENSORS CLEAN.

Silicone grease is factory applied on the mating surfaces to prevent rust and improve performance. Be careful not to allow grit or dirt onto the grease in the contact area. Operation can be impaired if the mating surfaces do not have good contact. Check visually before closing.

OUTPUT WIRING

Connect control or monitoring wires to the sensor. Use up to 14 AWG copper wire and tighten terminals to 5 inch-pounds torque. Be sure the output load does not exceed the switch rating.

CAUTION: Incandescent lamps can have "Cold Filament Inrush" current of up to 10 times their rated amperage. Use caution when switching lamps.



SETPOINT ADJUSTMENT

CTS Series SETPOINT is adjusted with a 4-turn potentiometer (CTSS) or a 15-turn potentiometer (CTSF). The pot is shipped factory set to the lowest setpoint, fully clockwise (CW). Turning the pot counter-clockwise (CCW) will increase the setpoint. The pot has a slip-clutch to prevent damage at either end of its rotation. To determine where the adjustment is, turn the pot all the way CW. This will return it to the minimum setpoint.

Adjustment Notes:

1. Output contacts are solid-state. Check output status by applying voltage to the contacts and reading the voltage drop across the contacts. An Ohmmeter set on "Continuity" will give misleading results.
2. It is recommended that the setpoint be adjusted to allow for voltage variations of 10-15%.

Typical Adjustment

1. Turn the pot to minimum setpoint (4 or 15 turns CW).
2. Have normal operating current running through the sensor. The output should be tripped since the pot is at its minimum setpoint. For units with LED, it should be flashing fast (2 to 3 times per second).
3. Turn the pot CCW until the unit un-trips. This is indicated by the slow flashing of the LED (once every 2 to 3 seconds), or by the changing of the output switch status.
4. Now turn the pot CW slowly until the unit trips again. It is now set at the current level being monitored.
   A. To Set UNDERLOAD - Turn the pot about 1/8 turn further CW.
   B. To Set OVERLOAD - Turn the pot about 1/8 turn further CCW.

MONITORED AMPS	OUTPUT	SMART-LED
None or <Min.	OPEN	OFF
Below Trip Level	OPEN	SLOW (2 sec)
Above Trip Level	CLOSED	FAST (0.5 sec)

TROUBLE SHOOTING

1. Sensor Is Always Tripped

A. The setpoint may be too low. Turn pot CCW to increase setpoint.
B. Switch has been overloaded and contacts are burned out. Check the output load, remembering to include inrush on inductive loads (coils, motors, ballasts).

2. Sensor Will Not Trip

A. The setpoint may be too high. Turn pot CW to decrease setpoint.
B. Split Core models: The core contact area may be dirty. Open the sensor and clean the contact area.
C. Monitored current is below minimum required. Loop the monitored wire several times through the aperture until the "sensed" current rises above minimum. Sensed Amps = (Actual Amps) x (Number of Loops). Count loops on the inside of the aperture.
D. Switch has been overloaded and contacts are burned out. Check the output load, remembering to include inrush on inductive loads (coils, motors, ballasts).

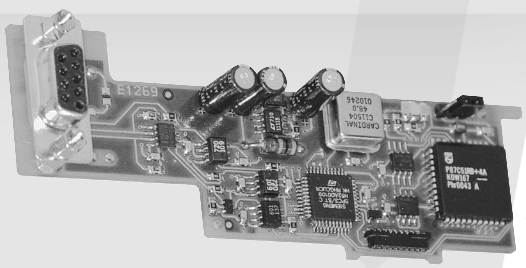
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
CTS	1.75-150 A Split-Core Current Switch, Adjustable	CTSS0000
	1-150 A Fixed-Core Current Switch, Adjustable	CTSF0000
	.75 A Fixed-Core Current Switch, Go-No Go	CTSG0000

I

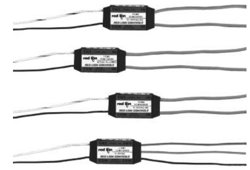
This page intentionally left blank.

ACCESSORIES



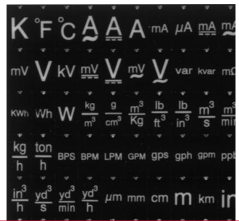
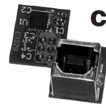
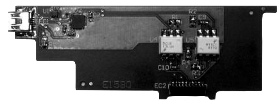
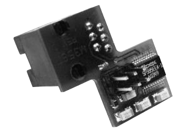
The Trusted Source for
Innovative Control Solutions

Accessories

	POWER SUPPLIES			SIGNAL CONVERSION
	DIN RAIL	APS	MLPS	VCM / TCM / LCM
				
Description	DIN Rail Mounted, 1 Amp, 2 Amp and 4 Amp	Plug-in Socket, 12 VDC and 24 VDC	Micro-line Power Supply	Signal Converter Modules
Dimensions	99 mm (H) x 115 mm (D) 23 mm (W) (1 Amp) 45 mm (W) (2 Amp) 68 mm (W) (4 Amp)	90 mm (H) x 61 mm (W) x 51 mm (D) w/socket	47 mm (H) x 68 mm (W)	12 mm (H) x 18 mm (W) x 39 mm (D) 6" leads
Input	N/A	N/A	N/A	4 to 270 VAC (VCM) 115 VAC (TCM) 3 to 28 VDC (LCM)
Output	24 VDC @ 1, 2 and 4 Amps	Unregulated 12 VDC (APS) Unregulated 24 VDC with 20 mA Current Sources (APSIS)	12 VDC (MLPS1) 24 VDC (MLPS2)	NPN O. C. (VCM, TCM) +3 V Bi-Polar (LCM)
Recommended Application	General Use	General Use	For use with CUB4, CUB5, and DT8 Models, Model Dependent	N/A
Power Source	85 to 264 VAC 90 to 350 VDC	115 VAC 230 VAC	85 to 250 VAC	Powered from signal (VCM, TCM) 5 to 28 VDC (LCM)
Page Number	Page 943	Page 945	Page 949	Page 951

QUICK Specs

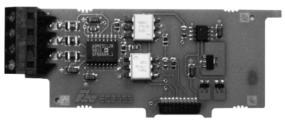
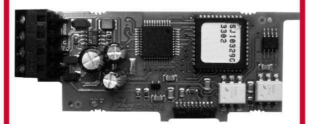
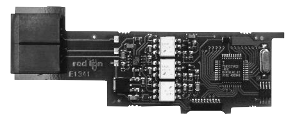
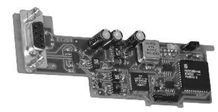
Accessories

	RELAYS	LABEL KITS	OPTION MODULES	
	RLY		USB PROGRAMMING	CUB5 COMMS
			CUB5  PAX 	
Description	Solid State Relays	Label Kits for PAX Analog, PAX Lite, and LPAX Displays	USB Programming Cards for CUB5 and PAX Series	CUB5 Comms Module, RS485
Dimensions	Model Dependent	N/A	N/A	N/A
Input	Control Rating 4 to 28 VDC, Model Dependent	N/A	N/A	N/A
Output	Output Rating 0 to 45 Amp or 48 to 660 VAC, Model Dependent	N/A	N/A	RS485
Recommended Application	Allows low level DC control signal to switch high level AC current or voltage devices	Display engineering units on specific meters	Programming only	Provides communication from the CUB5 Meters
Power Source	N/A	N/A	N/A	N/A
Page Number	Page 954	Page 960	Page 962/968	Page 964

J

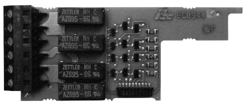
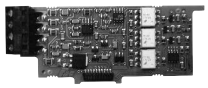
Accessories

OPTION MODULES

	PAX COMMS	PAX DEVICENET	PAX MODBUS	PAX PROFIBUS
				
Description	PAX Comms Module, RS232/485	PAX Comms Module, DeviceNet	PAX Comms Module, Modbus	PAX Comms Module, Profibus
Dimensions	N/A	N/A	N/A	N/A
Input	N/A	N/A	N/A	N/A
Output	RS232/485	DeviceNet	Modbus	Profibus
Recommended Application	Provides communication from the PAX Meters	Provides communication from the PAX Meters	Provides communication from the PAX Meters	Provides communication from the PAX Meters
Power Source	N/A	N/A	N/A	N/A
Page Number	Page 970	Page 975	Page 979	Page 985

Accessories

OPTION MODULES

	PAX SETPOINT	PAX ANALOG
		
Description	PAX Setpoint Module	PAX Analog Output Module
Dimensions	N/A	N/A
Input	N/A	N/A
Output	Dual Form C Quad Form A Quad Sinking Quad Sourcing	4 to 20 mA or 0 to 10 VDC
Recommended Application	Provides setpoint outputs from the PAX Meters	Provides analog retransmitted output from the PAX Meters
Power Source	N/A	N/A
Page Number	Page 989	Page 991

J

This page intentionally left blank.

MODEL PSDR - 24 V POWER SUPPLIES @ 1, 2, or 4 A

DESCRIPTION

The compact PSDR power supplies are industrial input voltage supplies with primary switched-mode regulator technology. They feature low output ripple and adjusted output voltage from 22.5 to 28.5 VDC. The output is electronically protected against overloads and short circuits.

The modules snap onto standard 35 mm flat DIN rails and use removable terminal blocks for easy wiring.

J

SPECIFICATIONS

1. **POWER REQUIREMENTS**:
   Nominal Input Voltage: 100 to 240 VAC
   Input Voltage Range: 85 to 264 VAC or 90 to 350 VDC
   Current Consumption at nominal input voltage:
   PSDR0100: 0.5 A to 0.2 A @ 100 to 240 VAC, 0.4 to 0.1 A @ 90 to 350 VDC
   PSDR0200: 0.82 A to 0.33 A @ 100 to 240 VAC, 0.65 to 0.19 A @ 90 to 350 VDC
   PSDR0400: 1.8 A to 0.7 A @ 100 to 240 VAC, 1.3 to 0.4 A @ 90 to 350 VDC
2. **FREQUENCY**: 50 to 60 Hz
3. **INPUT RECOMMENDED BACKUP FUSE**:
   Power Circuit Breaker: 6 A or 10 A
   Characteristic: B (EN 60898)
4. **SURGE VOLTAGE PROTECTION**: Varistor
5. **POWER OUTPUT**: Nominal value of 24 VDC ±1%. Adjustable from 22.5 to 28.5 VDC via potentiometer
6. **EFFICIENCY AT 230 VAC AND NOMINAL VALUES**: > 80 %
7. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: -25 to 60°C
   Storage Temperature: -40 to 85°C
   Humidity, no moisture condensation: 95 % at 25°C
   Vibration in acc. with IEC 68-2-6: < 15 Hz, amplitude ±2.5 mm; 15 Hz - 150 Hz, 2.3 g
   Shock in all directions acc. with IEC 68-2-27: 30 g
   Contamination in acc. with EN 50178: Degree of pollution 2
8. **STANDARDS AND CERTIFICATIONS**:

Electrical Safety (of information technology equipment)	EN 60950 / VDE 0805 cULus UL Recognized UL 60 950
Industrial regulating devices	cULus LISTED UL 508 listed
Electronic equipment for use in electrical power installations (surge voltage category III)	EN 50178 / VDE 0160
Limitation of output power	NEC Class 2
Safe isolation	VDE 0100-410
Protection against electric shock	DIN VDE 0106-101

CE In conformance with EMC guideline 89/336/EEC and low-voltage directive 73/23/EEC

EMC (Electromagnetic compatibility)
Immunity in accordance with EN 61000-6-2

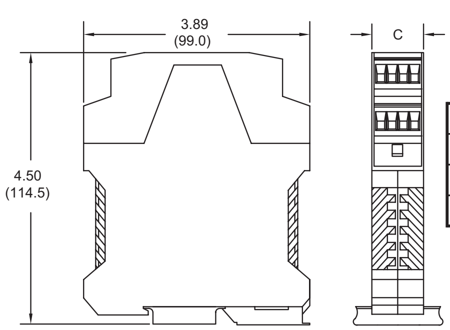
Discharge of static electricity (ESD)	EN 61000-4-2 [2)]	Housing > Level 3 Contact discharge: 8 kV Discharge in air: 8 kV
Electromagnetic HF field	EN 61000-4-3 [1)]	Housing Level 3 Frequency/Field intensity: 80-1000 MHz / 10 V/m
Fast transients (Burst)	EN 61000-4-4 [2)]	Input: 4 kV (Level 4) [4)] Output: 2 kV (Level 3) [4)] Signal: 1 kV (Level 2) [4)]
Surge voltage capacities (Surge)	EN 61000-4-5 [2)]	Input: 4 kV [4)] / 2 kV [4)] (Level 4) Output: 0.5 kV [4)] / 0.5 kV [3)] (Level 1) Signal: 0.5 kV [4)] (Level 1)
Conducted disturbance	EN 61000-4-6 [1)]	I/O/S: Level 3 Frequency/U_0: 0.15-80 MHz / 10 V
Voltage dips	EN 61000-4-11 [2)]	Input: see mains buffering > 20 ms
Simulation mobile phones	ENV 50204	Frequency: 900 MHz, 1800 MHz Field intensity: 20 V/m
Noise emission according to EN 50081-2		
Emitted radio interference		EN 55011 (EN 55022) Class B [5)]
Radio interference voltage		EN 55011 (EN 55022) Class B [5)]

EN 55011 corresponds to CISPR11 / EN 55022 corresponds to CISPR22
EN 61000 corresponds to IEC 1000

[1)] Criterion A:	Normal operating behavior within the defined limits.
[2)] Criterion B:	Temporary impairment to operational behavior, that is corrected by the device itself.
[3)] Symmetrical:	Conductor to conductor.
[4)] Asymmetrical:	Conductor to ground.
[5)] Class B:	Area of application industry and residential.

9. **ISOLATION VOLTAGE**: Input/Output 3 kVAC
10. **INSTALLATION POSITION**: On horizontal mounting rail according to EN 50022-35
11. **CONNECTIONS**: 24 to 14 AWG max. Torque 4.5 to 5.3 inch-lbs (0.5-0.6 Nm).
12. **MOUNTING**: Standard DIN rail top hat (T) profile rail according to EN50022 - 35 X 7.5 and 35 X 15. Can be mounted in rows with vertical Spacing > 5 cm or horizontally with no space.
13. **CONSTRUCTION**: Case body is black, high impact plastic. IP20 touch safe. Protection Class II.
14. **MTBF** (Mean Time Between Failure): >500000 h in acc. with IEC 1709 (SN 29500)
15. **WEIGHT**:
    PSDR0100: 7.4 oz. (210 g)
    PSDR0200: 8.8 oz. (250 g)
    PSDR0400: 14.1 oz. (400 g)

DIMENSIONS In inches (mm)



MODEL	C
PSDR0100	0.87 (22.5)
PSDR0200	1.77 (45)
PSDR0400	2.66 (67.5)

Connection and Operation Instructions

Caution: Danger! Never work on live equipment!
Caution: When the device is opened, a dangerous voltage may remain at the electrolytic capacitors for up to 2 minutes after shutdown!

The installation must be performed by a specialist in accordance with the requirements of EN 60950.

For vertical installations we recommend a minimum spacing of 5 cm (1.97 in.) between other modules and this power supply to ensure sufficient convection.

No minimum spacing is required for horizontal alignment.

The mains feed line must have an appropriate fixing or strain relief outside of the device.

The supply-side installation and the connection via screw terminal blocks must be done in a way that ensures protection against electric shock.

J

PROTECTION

The device must be installed in accordance with the specifications of EN 60950.

It must be possible to switch off the device using a suitable disconnecting device outside the power supply. For example, primary side line protection could be used.

In case of DC applications it is necessary to connect in series an adequate fuse.

RAIL MOUNTING

The power supply unit can be snapped onto all mounting rails in accordance with EN 50022-35. Installation should be made horizontally (input terminal blocks below).

CABLE CONNECTION

The device is equipped with COMBICON plug connectors.

This easy-to assemble connection method allows devices to be exchanged easily and the electrical connection to be visibly isolated.

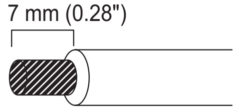
Connecting Cables:

Cable cross sections from 0.2 to 2.5 mm^2 rigid (solid)/flexible (stranded) (AWG 24-14) may be used.

To maintain UL, use copper cable rated for an operating temperature of 75°C/170°F.

For Reliable And Touch-proof Contacts:

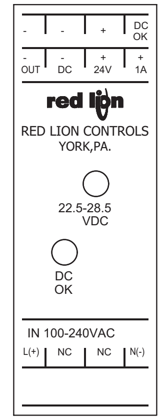
Strip the connection ends (7 mm - See Figure).



ORDERING INFORMATION

MODEL NO.	OUTPUT	PART NUMBER
PSDR1	24 VDC @ 1A	PSDR0100
PSDR2	24 VDC @ 2A	PSDR0200
PSDR4	24 VDC @ 4A	PSDR0400

INPUT



The input connection is made by the screw connections "L(+)" and "N(-)" (torque 0.5 Nm) on the COMBICON plug connection.

For device protection, there is an internal fuse. Additional device protection is not necessary.

Recommended backup fuses are power circuit-breakers 6 A or 10 A, charactistic B (or identical function). In DC applications, a suitable backup fuse must be wired in.

If the internal fuse is triggered, there is most probably a malfunction in the device. In this case, the device must be inspected in the factory!

OUTPUT

The 24 VDC connection is made by the screw connections "+" and "-" (torque 0.5 Nm) on the COMBICON plug connection. At the time of delivery, the output voltage is 24 VDC. The output voltage can be set from 22.5 to 28.5 VDC on the potentiometer.

The device is electronically protected against short circuits and idling. In the event of an error, the output voltage is limited to max 35 VDC.

Function Monitoring

For function monitoring, there is the active DC OK switching output and the DC OK LED.

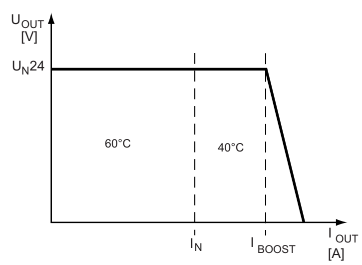
The 24 VDC signal is measured between the "DC OK" and "-" connection terminal blocks and can be loaded with 20 mA maximum. This signal output indicates that the output voltage has fallen below 21.5 VDC when "active high" changes to "low".

The DC OK signal is isolated from the power output.

	STATUS 1	STATUS 2
Green LED " DC OK"	on	off
Active DC OK switching output	U = +24 V (in reference to "-")	U = 0 V (in reference to "-")
Status	Normal operation of the power supply. U_{OUT} > 21.5 V	$U_{OUT} \le 21.5$ V • Secondary consumer short-circuit or overload • No mains voltage or device faulty

Output Characteristic Curve

The device functions following the U-I characteristic curve. Under load, the operating point follows this curve. In the event of a short circuit or overload, the output current is limited to I_{BOOST}. The secondary voltage is reduced until the short circuit on the secondary side has been remedied.



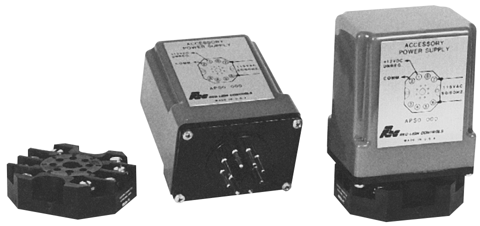
	I_N	I_{BOOST}
PSDR0100	1	1.3
PSDR0200	2	4
PSDR0400	4	6

Thermal Behavior

In the case of ambient temperatures above +60ºC, the output capacity has to be reduced by 2.5% per Kelvin increase in temperature.

From +70°C or a thermal overload, the device reduces the output power for its own protection, and returns to normal operation when it has cooled down.

MODEL APS - OCTAL PLUG-IN ACCESSORY POWER SUPPLY



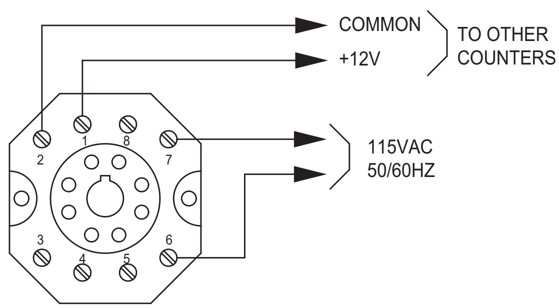
PROVIDES . . .

- *+12 VDC "HELPER" SUPPLY FOR LOAD SHARING WITH UNREGULATED COUNTER SYSTEMS WITH UNUSUAL SENSOR AND ACCESSORY LOADS, OR . . .*
- *"STAND-ALONE" APPLICATIONS FOR POWERING SENSORS AND ACCESSORIES*

DESCRIPTION

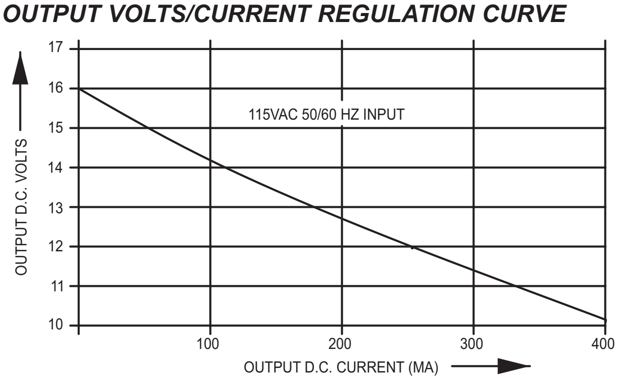
The Model APS is an unregulated +12 VDC supply designed to load share when connected in parallel with internal power supplies of many Red Lion Controls Counters and Rate Indicators. It can also be used as a general purpose "Stand-alone" power supply to power other control circuits, sensors and accessories. The APS is designed for 115 VAC ±10%, 50/60 Hz primary supply. Operating temperature range is -20° to +50°C. Output current is per regulation curve.

TYPICAL CONNECTION DIAGRAM

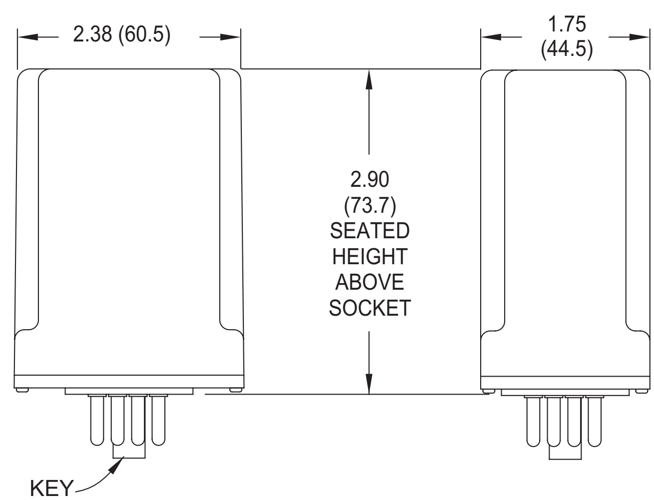


MODEL APS01

OUTPUT VOLTS/CURRENT REGULATION CURVE



DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
APS01	115 VAC Accessory Power Supply	APS01000
SKT1	Base Mount 8-pin Octal Socket	SKT10000
--	DIN Rail 8-pin Socket	SKTDIN00

ACCESSORY PLUG-IN RELAY

PLUG-IN RELAYS PROVIDED FOR EASY SERVICING & MAINTENANCE

ORDERING INFORMATION

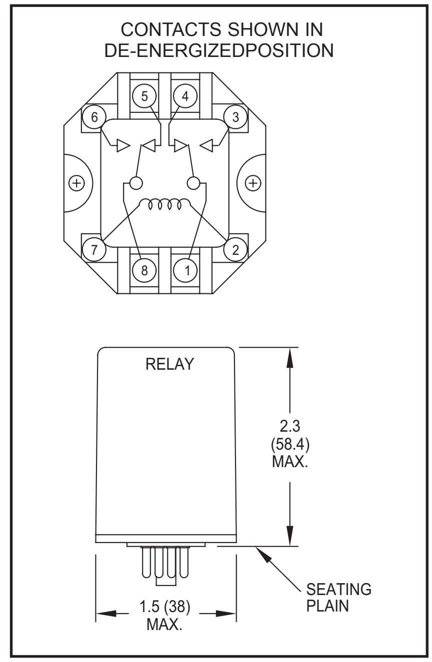
DESCRIPTION	COIL VOLTAGE	PART NUMBER
DPDT Plug-in Relay	12 VDC	RLY10000
	115 VAC	RLY30000
Base Mount 8-pin Octal Socket		SKT10000
DIN Rail 8-pin Socket		SKTDIN00

These industrial relays have a mechanical life expectancy in excess of 10 million cycles, and are both UL and CSA recognized.

RELAY SPECIFICATIONS

COIL: 12 VDC Coil - 120 Ω ±10%,
Rated +12 VDC @ 100 mA.
115 VAC Coil - 2250 Ω ±10%,
Rated 115 VAC @ 52 mA.
CONTACTS: 10 A @ 115 and 230 VAC
(1/6 HP @ 115 V, 1/3 HP @ 230 VAC)
OPERATING TIMES:
Energize - 30 msec max.
De-energize - 30 msec max.
Operating times do not include bounce time *(approx. 3 msec)*.
OPERATING TEMPERATURE RANGE:
-45° to +60°C
ELECTRICAL LIFE: In excess of 100,000 operations @ rated load.
WEIGHT: 3 oz *(85.1 g)*

Mating sockets sold separately. See Ordering Information.



MODEL APSIS - *Octal Plug-in Accessory Power Supply With 20 mA Current Sources*

PROVIDES...

- *24 VDC UNREGULATED "HELPER" SUPPLY FOR LOAD SHARING WITH OTHER 24 VOLT SYSTEMS WITH UNUSUAL SENSOR AND ACCESSORY LOADS OR...*
- *"STAND-ALONE" APPLICATIONS FOR POWERING +24 VDC SENSORS AND ACCESSORIES OR...*
- *TWO 20 mA CURRENT SOURCES, EACH CAPABLE OF SUPPLYING 20 mA OF CURRENT FOR SERIAL COMMUNICATION LOOPS AND POWERING UP TO 16 UNITS PER LOOP.*

DESCRIPTION

The Model APSIS is a convenient plug-in unregulated +24 VDC power supply designed to *"load share"* when connected in parallel with other +24 VDC unregulated systems with unusual power requirements due to sensor or accessory loading *(see Fig.1)*. It can also be used as a general purpose stand-alone supply to power +24 VDC control circuits, sensors and accessories *(see Fig.2)*. In addition, two 20 mA Current Source outputs are available, each capable of powering up to 16 Serial Communications units *(see Fig.3)*. The APSIS is available in 115 and 230 VAC ±10%, 50/60 Hz. primary supply *(see Ordering Information)*. Operating temperature range is -20°C to +50°C.

SPECIFICATIONS

1. **POWER SOURCE**: 2 versions, 115 VAC or 230 VAC ±10%, 50/60 Hz., 11 VA max. *(see Ordering Information)*.
2. **POWER OUTPUT**: +24 VDC unregulated @ 200 mA max. current*, Ripple = 1.5 V P-P max.
3. **OUTPUT**: Two 20 mA current sources, each capable of supplying 20 mA of current for serial communication loops and powering up to 16 units per loop.
4. **OPERATING TEMPERATURE**: -20°C to +50°C (-4°F to +122°F)

* *Maximum available output current derates to 175 mA with 1 source active and 150 mA max. with both sources active.*

TYPICAL LOAD SHARING CONNECTION DIAGRAM

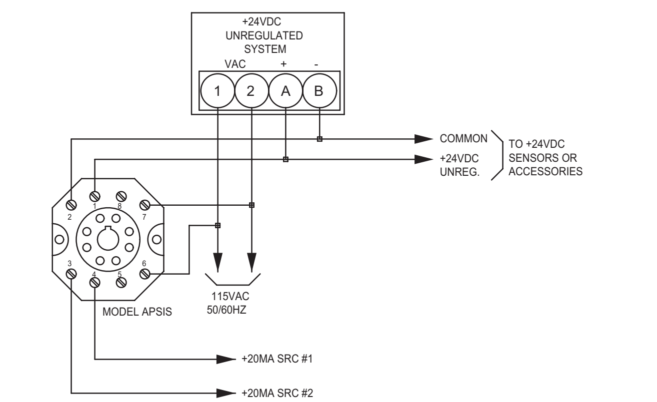
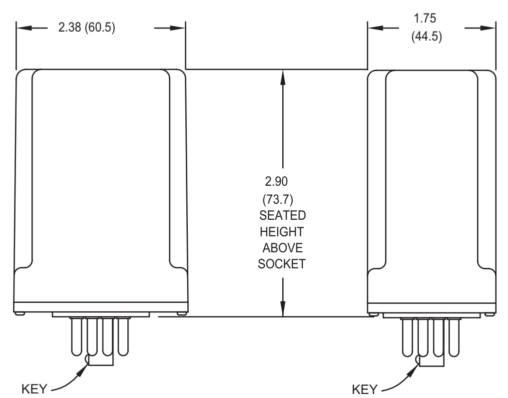


FIGURE 1

DIMENSIONS In inches (mm)



Mating Sockets Sold Separately (See Ordering Information)

TEMPERATURE MONITORING SYSTEM

A temperature monitoring process requires both remote and control room indicators and datalogging capabilities. An RTD *(Resistance Temperature Detector)* to 4 to 20 mA Transmitter, provides a proportional 4 to 20 mA output from the RTD input. Two Red Lion Controls *"Loop Powered Process Indicators" (Model LPPI)* are installed in series in the *"Loop"* and scaled to provide Local and Remote temperature displays. A Datalogger is also placed in the *"Loop"* to provide a hard-copy of process temperatures. Each device in the *"Loop"* has an associated *"voltage drop"* as follows: RTD Transmitter = 9 VDC drop; LPPI = 3 VDC x 2 units = 6 VDC drop; Datalogger = 5 VDC drop. The total voltage drops in the *"Loop"* = 20 VDC. Therefore, RLC's Model APSIS, with its +24 VDC Supply, is used to power this process *"Loop"*.

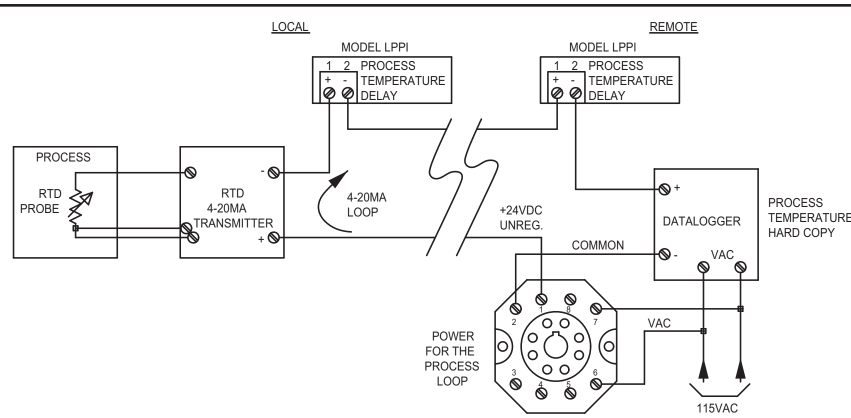


FIGURE 2

PROCESS MONITORING SYSTEM

8 Apollo Thermocouples *(APLTC)* and 8 GEMINIs, all with isolated 20 mA Current Loop Serial Communications, monitor and control processes within a plant. All units, which are located in different areas of the plant, are tied together in series in two *"Loops" (one Transmit Tx, the other Receive Rx)* and are connected to a Central Computer located in another area of the plant. Since there are more than 7, and no more than 16 units in the *"Loop"*, the APSIS +20 mA Current Source Outputs are used to power each *"Loop". (Both Apollo Thermocouple and Gemini units can power up to 7 units in a "Loop" when using their internal 20 mA sources. However, their sources may not be tied together to power more than 7 units.)* Each unit is assigned a different address number and the same Baud rate *(see appropriate APLTC or Gemini data sheet)*. An application program is written which allows the Central Computer to send and retreive data from any APLTC or Gemini.

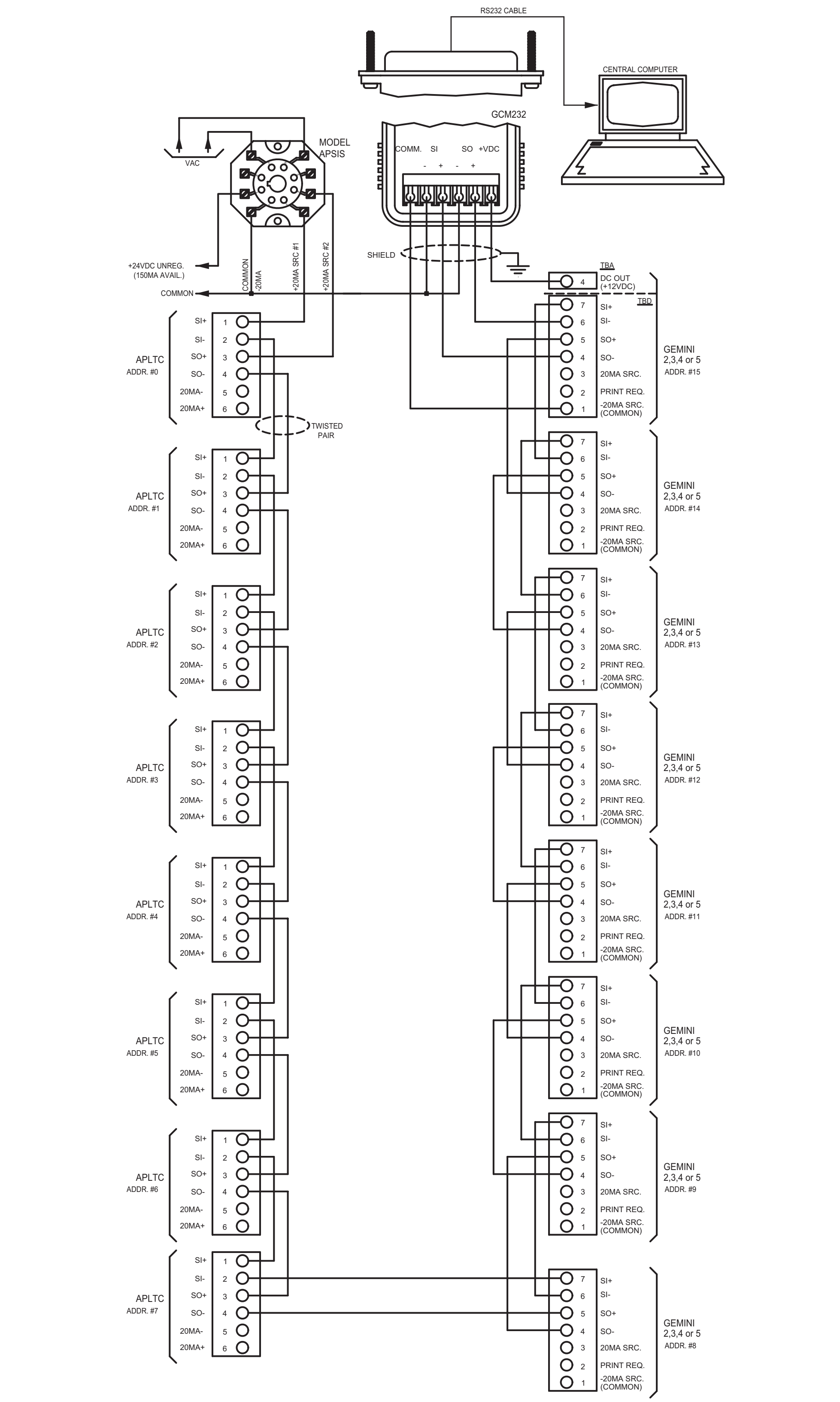
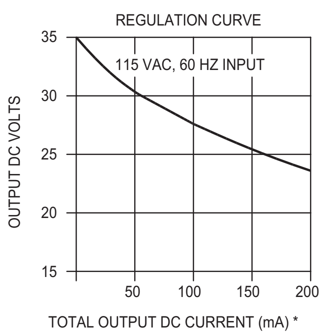


FIGURE 3

OUTPUT VOLTS/CURRENT



*Unregulated output +(2) 20 mA current sources (if used).

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
		230 VAC	115 VAC
APSIS	Accessory Power Supply- Current Source	APSIS010	APSIS000
—	Base Mount, 8-Pin Octal Socket	SKT10000	
—	Din Rail Mount, 8-Pin Octal Socket	SKTDIN00	

MODEL MLPS1 and MLPS2 - MICRO-LINE POWER SUPPLIES

- *PROVIDES POWER FOR THE MICRO-LINE SERIES*
- *MLPS1: 12 VDC OUTPUT @ 400 mA*
- *MLPS2: 24 VDC OUTPUT @ 200 mA*
- *EASILY ATTACHED TO BACK OF DT8, CUB4 AND CUB5*

UL Recognized Component,
File # E179259

J

DESCRIPTION

The Model MLPS power supplies are designed to attach to the rear of the Micro-Line Series. The MLPS1 provides a 12 VDC output, while the MLPS2 provides a 24 VDC output. Both supplies can be powered from an 85-250 VAC source.

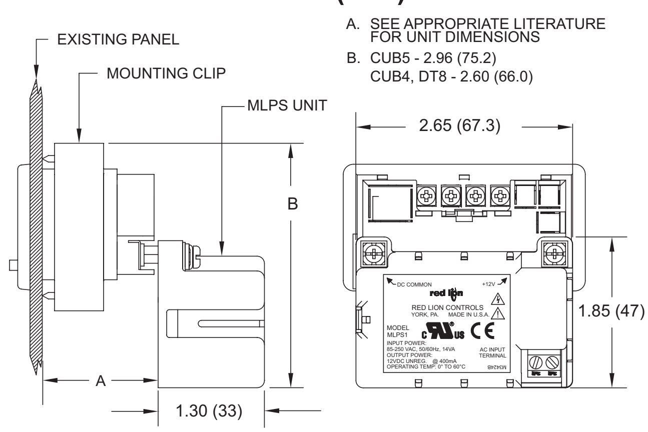
Caution: The maximum output current of the MLPS1 is 400 mA and the MLPS2 is 200 mA. Check the specifications of the specific counter(s)/indicators(s) and sensors(s) being used to ensure that total current requirements do not exceed the respective values of the power supplies.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
MLPS1	+12 VDC Micro Line/Sensor Power Supply	MLPS1000
MLPS2	+24 VDC Micro Line/Sensor Power Supply	MLPS2000

SPECIFICATIONS

1. **POWER REQUIREMENTS:** 85-250 VAC, 50/60 Hz, 14 VA.
2. **POWER OUTPUT:**
   MLPS1: +16 VDC max @ 4 mA; 11.5 VDC min @ 400 mA
   MLPS2: +26 VDC max @ 0 mA; 22 VDC min @ 200 mA
3. **ENVIRONMENTAL CONDITIONS:**
   Operating Temperature: 0 to 60°C
   Storage Temperature: -30 to 75°C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
   Altitude: Up to 2000 meters
4. **CERTIFICATIONS AND COMPLIANCES:**
   SAFETY
   UL Recognized Component, File # E179259, UL61010-1, CAN/CSA-C22.2 No. 61010-1
   Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
   Output meets Class 2 power requirements per UL 1310.
   IECEE CB Scheme Test Report # E179259-V2-S1
   Issued by Underwriters Laboratories, Inc.
   IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.
   ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

Immunity to Industrial Locations:		
Electrostatic discharge	EN 61000-4-2	Criterion A 4 kV contact discharge 8 kV air discharge
Electromagnetic RF fields	EN 61000-4-3	Criterion A 10 V/m
Fast transients (burst)	EN 61000-4-4	Criterion A 2 kV power 1 kV signal
Surge	EN 61000-4-5	Criterion B 1 kV L-L, 2 kV L&N-E power 1 kV signal
RF conducted interference	EN 61000-4-6	Criterion A 3 V/rms
Voltage dip/interruptions	EN 61000-4-11	Criterion A 0.5 cycle
Emissions:		
	EN 55011	Class B

Notes:
1. Criterion A: Normal operation within specified limits.
2. Criterion B: Temporary loss of performance from which the unit self-recovers.

5. **CONSTRUCTION:** High impact black plastic. Mounting hardware included. Installation Category II, Pollution Degree 2.
6. **CONNECTION:** Two position terminal block which accepts one 14 AWG wire (torque terminal screws to 5 inch-lbs. [0.56 N-m]).
7. **WEIGHT:** 2 oz (47 g)

INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

Installation Procedure

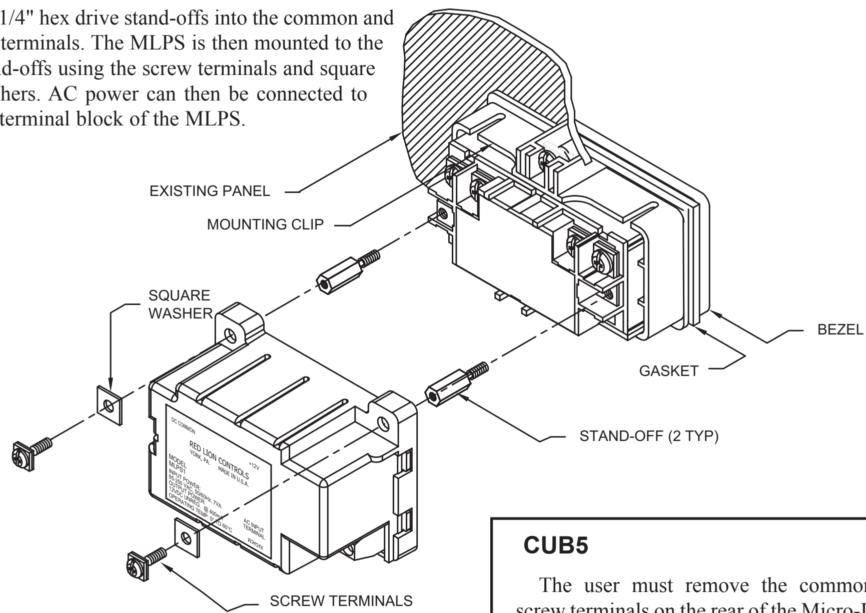
The MLPS is shipped with all the necessary hardware to mount to the rear of an installed Micro-Line unit. Refer to the instructions that correspond to your Micro-Line unit for proper installation.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.

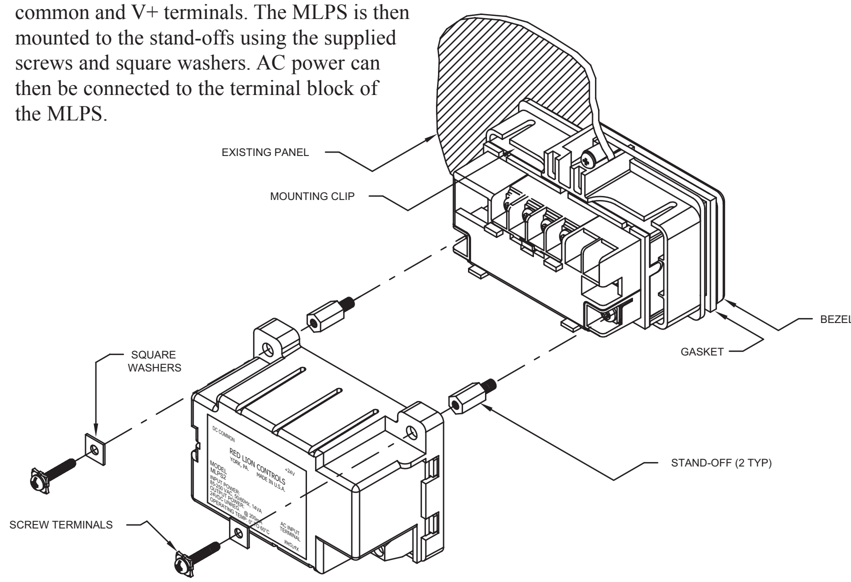
CUB4, DT8

The user must remove the common and V+ screw terminals on the rear of the Micro-Line unit. Install the 1/4" hex drive stand-offs into the common and V+ terminals. The MLPS is then mounted to the stand-offs using the screw terminals and square washers. AC power can then be connected to the terminal block of the MLPS.



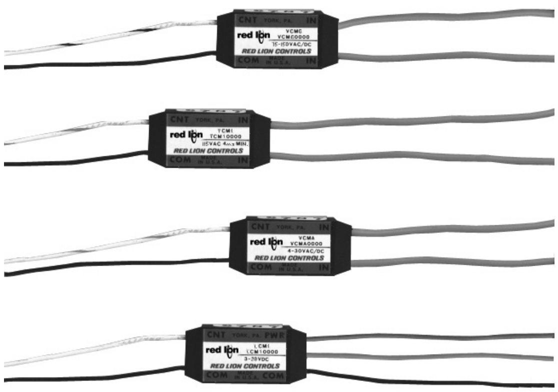
CUB5

The user must remove the common and V+ screw terminals on the rear of the Micro-Line unit. Install the 3/16" hex drive stand-offs into the common and V+ terminals. The MLPS is then mounted to the stand-offs using the supplied screws and square washers. AC power can then be connected to the terminal block of the MLPS.



CONVERTER MODULES

ADAPTS MANY RED LION CONTROLS' COUNTERS AND ACCESSORIES TO A WIDE RANGE OF SIGNAL SOURCES



VCM - VOLTAGE CONVERTER MODULES
Converts AC/DC voltages to an acceptable signal input for many RLC counters and accessories and provides input/output voltage isolation.

TCM - TRIAC CONVERTER MODULE
Accepts unloaded, high off-state leakage triac output from sensors and programmable controllers.

LCM - LOGIC CONVERTER MODULE
Interfaces with CMOS, TTL, and other logic circuits up to +28 VDC, at speeds to 50 KHz. Allows Cub Counters to share sensor outputs with other series counters.

These miniature sized modules are completely encapsulated in PVC, which provides protection against oil, water, dirt, and mechanical damage. They can be quickly and easily mounted to most surfaces by using the self-stick adhesive pad.

VCM - VOLTAGE CONVERTER MODULES

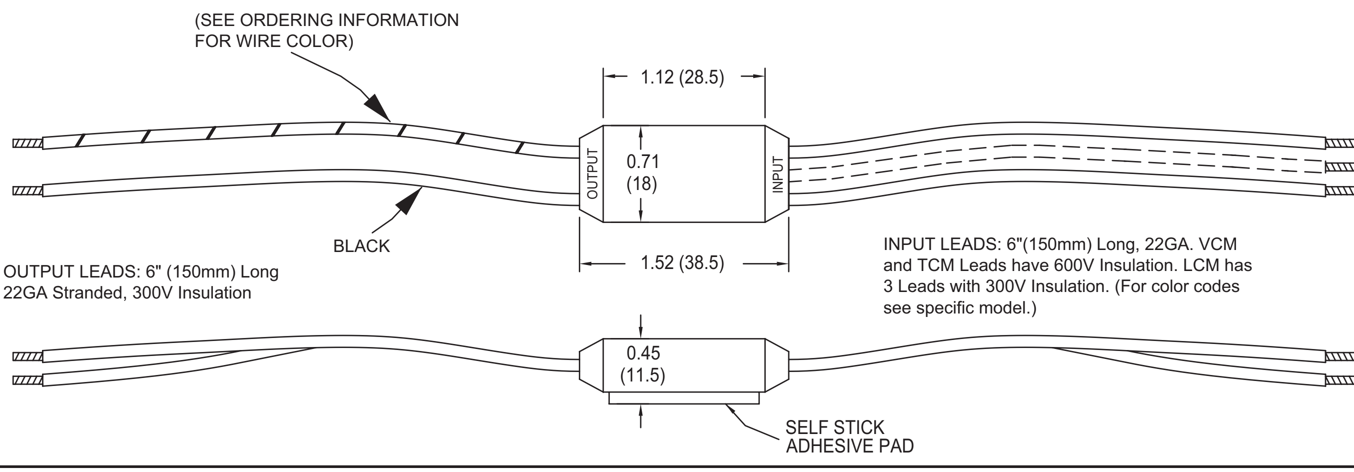
These modules provide a convenient way to adapt RLC Counters to most any machine control voltage signal. They also make it easy to upgrade electro-mechanical counter installations with RLC Counters.

VCM's are available in two input voltage ranges that cover the spectrum from 4-270 V. The non-polarized input of these modules will accept A.C. *(50/60 Hz)* or D.C. voltages at input cycles up to 30 Hz. The output uses MOSFET technology that is compatible with either the L.S. Count or Remote Reset inputs of RLC Counters. Electrical isolation between input and output is achieved by means of an internal opto-isolator rated at 2300 V_{RMS}.

SPECIFICATIONS

1. **INPUT:** VCM1 = 4 to 50 VAC/DC, 50/60 Hz
   VCM2 = 50 to 270 VAC/DC, 50/60 Hz
2. **OUTPUT:** Solid state DC contact closure
   Output rating: 30 VDC at 100 mA max
   Output Isolation: 2300 V_{RMS}
   Off State Leakage: 1 µA max
3. **FREQUENCY:** Max output frequency 20 Hz
4. **ENVIRONMENT:** 0-50 ºC

DIMENSIONS FOR VCM, TCM, & LCM In inches (mm)



TCM - TRIAC CONVERTER MODULE

The TCM is a specialized version of the VCM. It is specifically designed to operate with photo-electric sensors and programmable controllers that have 115 VAC Triac outputs. Due to protective suppression circuits connected in parallel with Triacs, these outputs have a high OFF-State Leakage current, which, if unloaded, is sufficient to keep a VCM in the ON condition continuously.

The TCM incorporates a current bias that offsets output leakage currents up to 4 mA and allows the application of RLC Counters to most unloaded Triac outputs. These modules are available for operation with 115 VAC ±10% 50/60 Hz only. They operate at count rates up to 10 cps, and also provide input/output electrical isolation. Connections for the TCM are the same as those for the VCM.

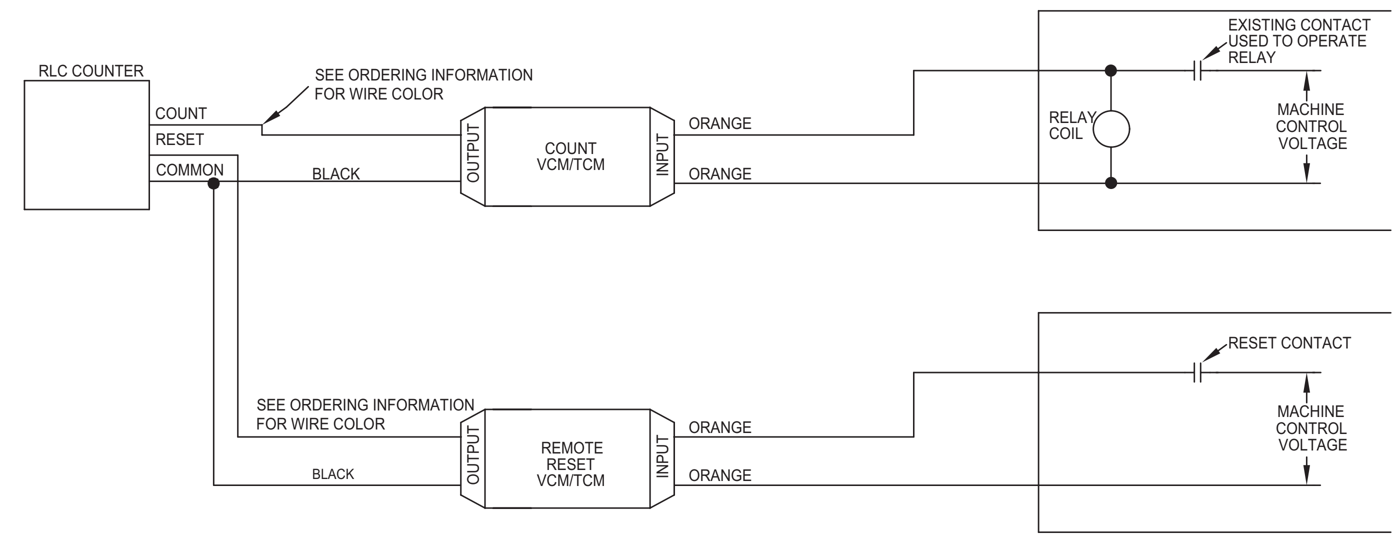
Note: VCM's can be used with Triac outputs that are also driving substantial loads, since the load will shunt the leakage current away from the VCM input.

SPECIFICATIONS

1. **INPUT:** 115 VAC ± 10% (50/60 Hz) 10 mA max current draw
2. **FREQUENCY:** 10 Hz max output
3. **OUTPUT:** Solid state DC contact closure
   Output rating: 30 VDC at 100 mA
   Output Isolation: 2300 V_{RMS}
   Off State Leakage: 1 µA max
4. **ENVIRONMENT:** 0-50 ºC

TYPICAL CONNECTION EXAMPLE FOR VCM & TCM
(Shown with optional VCM for Control Voltage Remote Reset)

Consult Connections and Configurations set up information in counter instruction literature for wiring. Reference switch and contact input information.



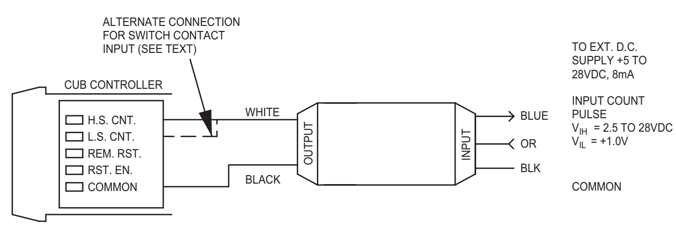
LCM - CONVERTER MODULE

The LCM adapts CUB* Counters to practically any type of logic and sensor output, and to any count signal voltage from +3 to +28 VDC. The module accepts input count pulses from NPN Open-Collector Transistor outputs, Bi-Polar outputs, or sourcing outputs such as Emitter-Follower or PNP Open-Collector Transistors *(Sourcing outputs must be externally loaded with a load of 10 Kohms or less)*. The LCM output is a Bi-Polar drive that is compatible with either the Low-Speed or High-Speed Counter inputs as well as the Remote Reset input** of the CUB Counters. The output is inverted with respect to the input which causes the CUB Counter to increment on the leading *(positive going)* edge of a count pulse. Power for operation of the LCM can be normally obtained from the existing D.C. power supply used to operate the sensor or other logic circuitry. When count pulse signals are generated by switch contacts the LCM output can be applied to the L.S. input of the CUB to de-bounce these pulses. Minimum pulse width when driving the L.S. input is 10 msec and maximum count rate is 50 cps.

* *LCM intended for use with CUB1,2,3,and 7.*
** *When used to operate Remote Reset input, the LCM will reset counter when input to LCM goes high due to signal inversion.*

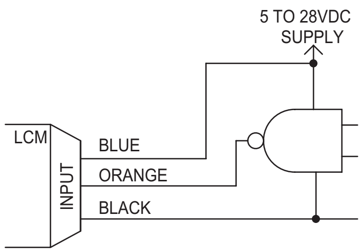
SPECIFICATIONS

1. **POWER:** 5 to 28 VDC, 8 mA max
2. **INPUT:** V_{IH} = +2.5 to 28 VDC, 500 µA max source
   V_{IL} = +1.0 VDC, 50 µA max sink
3. **OUTPUT:** Bipolar 3 VDC with 1 mA sink/source (output should not be connected to voltage levels above 3.5 VDC)
4. **FREQUENCY:** MAX input/output frequency = 50 KHz (see counter input for frequency limitations)
5. **ENVIRONMENT:** 0-50 ºC

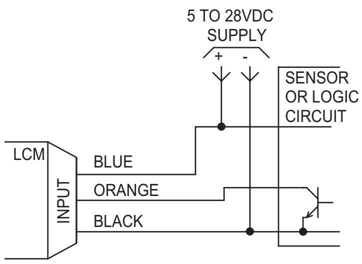


TYPICAL INPUTS TO LCM

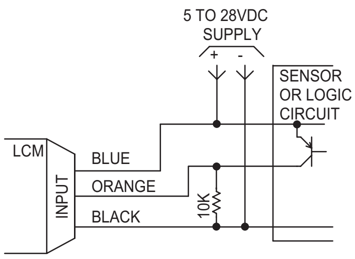
CMOS OR TTL



NPN OPEN COLLECTOR (SINK OUTPUT)



PNP OPEN COLLECTOR (SOURCE OUTPUT)



J

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	INPUT VOLTAGE	OUTPUT WIRE COLOR	PART NUMBER
VCM	Voltage Converter Module	4 - 50 V AC/DC	yellow	VCM10000
		50 - 270 V AC/DC	white	VCM20000
TCM	Triac Converter Module	115 VAC ±10%	white/green trace	TCM10000
LCM	Logic Converter Module	+3 to +28 VDC (signal) +5 to +28 VDC (supply)	white	LCM10000

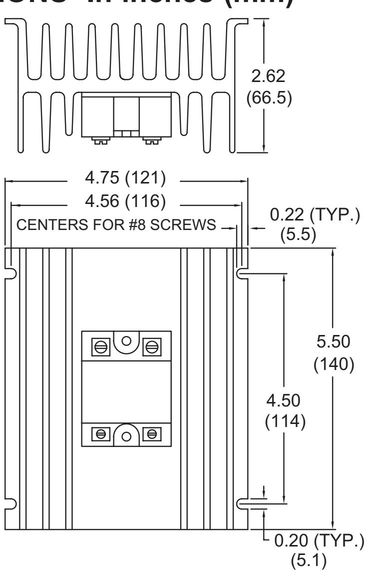
MODEL RLY5 - SOLID STATE POWER UNIT

- *SWITCHES UP TO 45 AMPERES @ 240 VAC*
- *LOW LEVEL DC INPUT CONTROL SIGNAL (3-32 VDC)*
- *OPTICALLY-ISOLATED OUTPUT*
- *ZERO VOLTAGE TURN-ON, ZERO CURRENT TURN-OFF FOR REDUCED RFI*
- *INTERNAL SNUBBERS TO REDUCE FALSE TRIGGERING RELATED TO HIGH dv/dt APPLICATIONS*
- *SUPPLIED WITH HIGH EFFICIENCY HEATSINK FOR SUPERIOR THERMAL and SURGE CURRENT RATINGS*

GENERAL DESCRIPTION

The SSR Power Unit is a solid state relay which can switch load currents up to 45 Amperes @ 240 VAC. The unit interfaces directly with a SSR Drive Module (OMD00003). The input and output terminals are isolated from each other to eliminate ground loops and noise problems. The unit features a zero voltage turn-on and a zero current turn-off detector to minimize radiated RFI when switching. An internal snubber minimizes inrush currents and guards against false triggering of the output; related to high dv/dt applications. A low DC control signal of +3 to +32 VDC is all that is needed for the switching operation. The solid state switch, highlighted by the inverse-parallel SCR output, provides a greatly increased operational life over a mechanical relay by avoiding the usual relay contact problems: arcing, bouncing, mechanical failure, etc. The solid state relay is shipped mounted to the high efficiency heatsink for immediate installation.

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL	DESCRIPTION	PART NUMBER
RLY5	SSR Power Unit	RLY50000

Do not dispose of unit in trash - Recycle

SPECIFICATIONS

OUTPUT SPECIFICATIONS

1. **Operating Voltage Range**: 50-280 VAC RMS
2. **Operating Frequency Range**: 47-63 Hz
3. **Maximum Continuous Load Current**: See Thermal Rating Code
4. **Maximum Surge Load Current**: See Peak Surge Current Curve
5. **Minimum Load Current**: 40 mA RMS
6. **Maximum Off-State Leakage Current**: 10 mA RMS
7. **Maximum Transient Voltage**: 600 V peak
8. **Maximum Output Voltage Drop**: 1.6 V peak
9. **Power Dissipation at Full Load**: 50 Watts
10. **Maximum I^2T**: 1600A^2sec
 (For Fusing Purposes, t = 8.3 msec)
11. **Minimum Off-State dv/dt protection**: 500 V/usec

INPUT SPECIFICATIONS
(Use with RLC SSR Drive Module, OMD00003)

1. **Control Voltage Range**: 3 to 32 VDC
2. **Maximum Turn-on Voltage**: 3 VDC
3. **Minimum Turn-off Voltage**: 1 VDC
4. **Maximum Reverse Voltage**: -32 VDC
5. **Minimum Input Impedance**: 1500 Ω
6. **Maximum Turn-on/Turn-off time**: 8.3 msec

GENERAL SPECIFICATIONS

1. **Isolation (Input to Output to Base)**: 4000 V RMS
2. **Insulation Resistance**: 10 GΩ
3. **Operating Temperature Range**: -30° to +75°C
4. **Storage Temperature Range**: -40° to +120°C

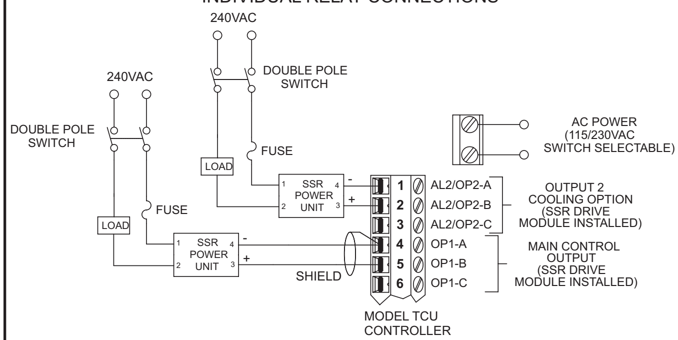
INSTALLATION

It is recommended to mount the unit outside of an enclosure in an area where there is unrestricted air flow. The unit should always be mounted with the fins in a vertical position to maximize heat dissipation. If mounting the unit inside an enclosure, the internal temperature of the enclosure will normally be higher than the surrounding area and must be accounted for. At full rated load, the unit will dissipate 50 watts and achieve a case temperature in excess of 90°C. In all installations, it is important to allow at least two inches around the power unit for proper ventilation.

CONNECTIONS

Separate power feed lines should be run to the load side of the relay. The controller unit and the load should NEVER share the same power feed. It is recommended to install the SSR Power Unit as close to the load as possible to keep the power cable runs short. This will help reduce noise from radiating into other equipment. The input control signal cable can be run over distances in excess of 200 ft. with shielded cable from the controller to the SSR power unit. Connect the shield to the minus "-" terminal of the control signal, on the SSR Power Unit and at only one end.

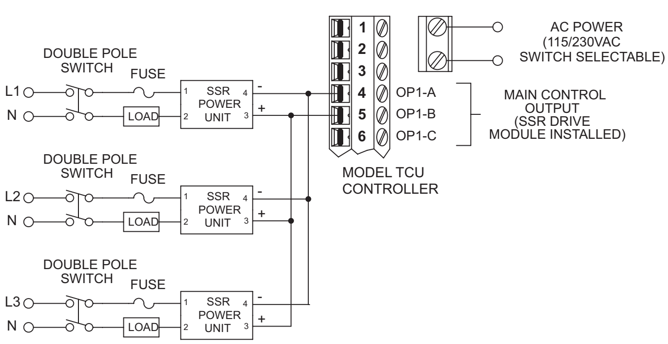
INDIVIDUAL RELAY CONNECTIONS



MULTIPLE UNITS

For increased power handling, up to four SSR Power Units may be parallel connected, and all controlled by a single output of an SSR Drive Module (OMD00003). The output of the SSR Power Units must NOT be parallel connected to the same load because of unequal current sharing among the devices. The outputs should be wired to individual heaters, but they may share the same supply. If five or more SSR Power Units are required, a Relay Output Module (OMD00000) may be used in conjunction with an external +12 VDC power source (RLC Model APS01000) to switch the SSR Power Units.

MULTIPLE RELAY CONNECTION



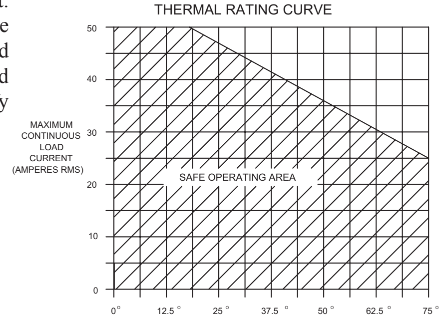
OPERATION

The following are important aspects of operation of the SSR power unit which must be considered. Adhering to these guidelines will ensure reliable and trouble free operation.

THERMAL RATING CURVES

The Thermal Rating Curve will determine the maximum allowable ambient operating temperature for the maximum continuous load current. The two parameters must intersect in the Safe Operating Area of the graph. Operation outside the safe operating area will shorten the life of or cause permanent damage to the SSR Power Unit. The ambient temperature of the power unit should be measured with all of the associated equipment operating to verify the Thermal Ratings.

THERMAL RATING CURVE

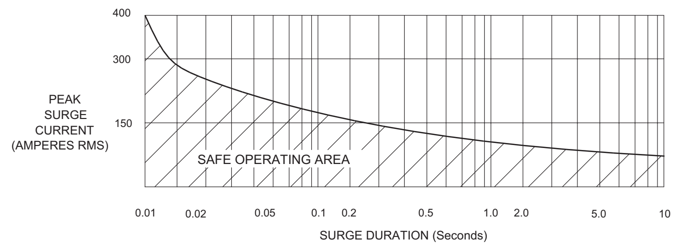


SURGE CURRENT

When the SSR Power Unit switches a load on, an in-rush (surge) current that is higher than the continuous load current will flow. The surge current can be estimated from the table below which outlines the ratio of surge to steady state current for various load devices. The surge current duration must be within the Safe Operating Area of the Peak Surge Current vs. Time Figure. Surge currents outside the safe operating area will shorten the life of or cause permanent damage to the power unit.

Load Device	Ratio Surge Current to Steady State Current
Incandescent Bulbs (cold)	5
Quartz Heaters (cold)	7
Motors (motionless)	10
Compressors	10

PEAK SURGE CURRENT vs. DURATION



FUSING

The output of the SSR Power Unit should be protected by a fast blow I^2t fuse (Bussman KAX-30 or equivalent). This guards against long duration surge currents, short circuits, etc., which may damage the SSR Power Unit.

MECHANICAL INTERRUPT SWITCH

The off-state output leakage current of the power unit is 10 mA maximum. The voltage level of the output will rise proportional to the resistance of the load due to this leakage current. Full line voltage can be measured when the output is connected to a high resistance load and the power unit is in the off-state.

A mechanical interrupt switch (double pole) should be placed between both sides of the line voltage and the load. The switch should be opened when servicing any part of the output wiring. When measuring the off-state output voltage of the unit for correct operation, load the output of the SSR Power Unit with a small resistance (approximately 100 ohms).

SNUBBING

The power unit has internal snubbers to guard against transients generated by most loads. Loads with low power factors (ie. motors) may require additional external snubbing network.

MODEL RLY6/RLY6A - SINGLE PHASE DIN RAIL MOUNT SOLID STATE RELAY

- *INTEGRATED HEAT SINK*
- *OPTICALLY ISOLATED*
- *SOLID STATE SWITCHING*
- *SINGLE PHASE OUTPUT RATING: 25 A (RLY6) or 40 A (RLY6A)*
- *SWITCHING: 24 TO 660 VAC*
- *CONTROL SIGNAL: 4 TO 32 VDC*
- *ZERO VOLTAGE TURN-ON*
- *MOUNTS ON DIN RAIL OR DIRECTLY TO PANEL*
- *4000 VOLT ISOLATION*
- *BUILT-IN SNUBBER*
- *LED "ON" INDICATOR*
- *CAGE CLAMP TERMINATIONS*

UL Recognized Component, File #E191578

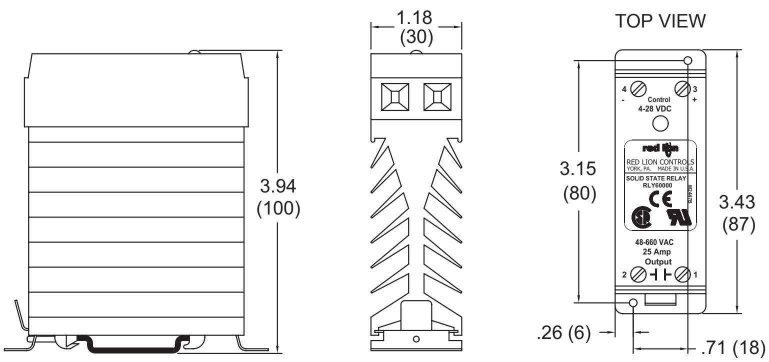
LR 702877

GENERAL DESCRIPTION

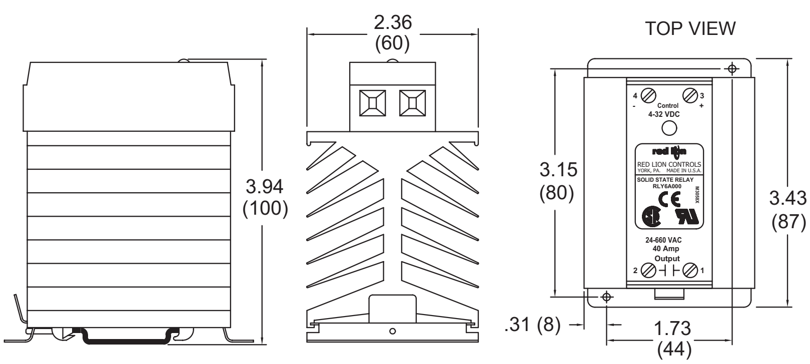
The RLY60000 is a solid state relay that switches load currents up to 25 A; the RLY6A000 switches load currents up to 40 A. These units feature a zero voltage turn-on detector to minimize radiated RFI when switching. An internal snubber guards against false triggering of the output related to high dv/dt applications. A low level DC control signal of 4 to 32 VDC is all that is needed for the switching operation. These units, highlighted by the inverse-parallel SCR output, provide a greatly increased operational life over mechanical relays by avoiding the usual relay contact problems such as: arcing, bouncing, and mechanical failure.

The RLY6/RLY6A can be directly controlled by logic/SSR drive output or sourcing output of Red Lion Controls products.

RLY6, 25 Amp DIMENSIONS In inches (mm)



RLY6A, 40 Amp DIMENSIONS In inches (mm)



SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

SPECIFICATIONS

OUTPUT SPECIFICATIONS

1. **OPERATING VOLTAGE RANGE**: 24 to 660 VAC
2. **OPERATING FREQUENCY RANGE**: 47 to 63 Hz
3. **MAXIMUM CONTINUOUS LOAD CURRENT**:
   (See Safe Operating Conditions)
   RLY6: 25 A_{RMS}
   RLY6A: 40 A_{RMS}
4. **SURGE CURRENT**:
   RLY6:
   Non-Repetitive 1 Cycle: 250 A_{PEAK}
   Non-Repetitive 1 Second: 100 A_{PEAK}
   RLY6A:
   Non-Repetitive 1 Cycle: 250 A_{PEAK}
   Non-Repetitive 1 Second: 150 A_{PEAK}
5. **MIN. LOAD CURRENT**: 100 mA
6. **LEAKAGE CURRENT @ V_{OUT} (Max.)**: 8 mA
7. **OVER VOLTAGE RATING**: 1400 PIV
8. **VOLTAGE DROP @ I_{OUT}**: 1.5 VAC
9. **POWER DISSIPATION AT FULL LOAD**:
   RLY6: 25.0 Watts
   RLY6A: 48.0 Watts

SPECIFICATIONS (Cont'd)

10. **I^2T FUSING**: 1035 A^2S
(For Fusing Purposes, T = 8.3 msec.)
11. **Dv/Dt @ V_{OUT} (Max.)**: 500 V/μsec

INPUT SPECIFICATIONS

1. **CONTROL VOLTAGE RANGE**: 4 to 32 VDC
2. **TURN-ON VOLTAGE (MIN.)**: 4 VDC
3. **TURN-OFF VOLTAGE (MAX.)**: 1 VDC
4. **REVERSE VOLTAGE PROTECTION**: -75 VDC
5. **INPUT CURRENT (MAX.)**: 8 mA

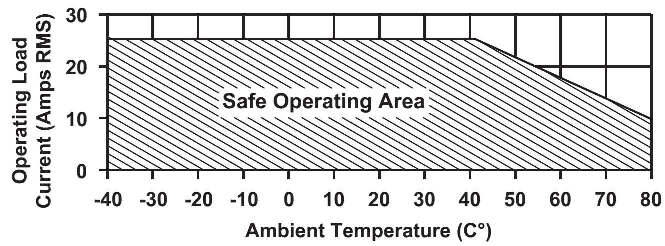
GENERAL SPECIFICATIONS

1. **ISOLATION (INPUT TO OUTPUT TO BASE)**: 4000 V_{RMS}
2. **CAPACITANCE INPUT TO OUTPUT**: 3 pf
3. **OPERATING TEMPERATURE RANGE**: -40°C to +80°C

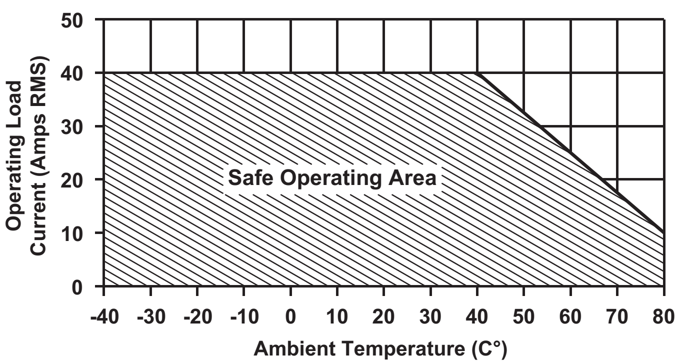
SAFE OPERATING CONDITIONS

The relay must always operate within the "Safe Operating Area" of the Derating Curve Figure. Operations outside the Safe Operating Area will shorten the life of, or cause permanent damage to, the relay. The ambient temperature should be measured 1" (25 mm) below the relay (when mounted to a vertical surface) and with all of the associated equipment operating.

RLY6 25 A Derating Curve



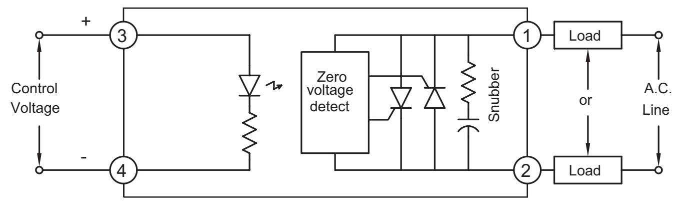
RLY6A 40 A Derating Curve



It is strongly recommended that a 0.18" (4.6 mm) clearance is maintained on all four sides of the relay. If the relays are mounted against each other, then the end relays must be derated by additional 10% (of the Derating Curve) and the middle relays by 20%.

In small enclosures, adequate ventilation must be provided to assure proper safe operating temperature. Accumulation of dust and dirt on the heat sink fins will also affect heat dissipation. In extreme dust and dirt conditions, the relay must be derated by additional 20%.

SCHEMATIC



FUSING

Devices such as electromechanical circuit breakers and slow blow fuses cannot react quickly enough to protect this relay in a shorted condition. Fast "semiconductor fuses" with appropriate I^2T ratings are strongly recommended.

MECHANICAL INTERRUPT SWITCH

The off-state leakage current of the power unit is 8 mA maximum. The voltage level of the output will rise proportional to the resistance of the load due to this leakage current. Full line voltage can be measured when the output is connected to a high resistance load and the power unit is in the off-state.

A mechanical interrupt switch is recommended between both sides of the line voltage and the load. The switch should be opened when servicing any part of the output wiring. When measuring the off-state output voltage of the unit for correct operation, load the output of the RLY6/RLY6A with a small resistance (approximately 100 ohms).

WIRING GUIDELINES

The controlling device and the relay load should NEVER share the same power feed. It is recommended that this relay be installed as close as possible to the load to keep the power cable runs short. The control voltage can run over distances in excess of 200 feet with shielded cable. If using shielded cable, connect the shield to the minus "-" terminal of the control signal at one end only.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
RLY6	25 A Single Phase Din Rail Mount Solid State Relay	RLY60000
RLY6A	40 A Single Phase Din Rail Mount Solid State Relay	RLY6A000

Do not dispose of unit in trash - Recycle

MODEL RLY7 - THREE PHASE DIN RAIL MOUNT SOLID STATE RELAY

- *INTEGRATED HEAT SINK*
- *OPTICALLY ISOLATED*
- *SOLID STATE SWITCHING*
- *25 A THREE PHASE OUTPUT RATING*
- *24 TO 660 VAC SWITCHING*
- *4 TO 32 VDC CONTROL SIGNAL*
- *ZERO VOLTAGE TURN-ON*
- *MOUNTS ON DIN RAIL OR DIRECTLY TO PANEL*
- *4000 VOLT ISOLATION*
- *BUILT-IN SNUBBER*
- *LED "ON" INDICATOR*
- *CAGE CLAMP TERMINATIONS*

J

UL Recognized Component,
File #E191578

GENERAL DESCRIPTION

The RLY7 is a three phase solid state relay that switches load currents up to 25 A. The unit features a zero voltage turn-on detector to minimize radiated RFI when switching. An internal snubber guards against false triggering of the output related to high dv/dt applications. A low level DC control signal of 4 to 32 VDC is all that is needed for the switching operation. This unit, highlighted by the inverse-parallel SCR output, provides a greatly increased operational life over a mechanical relay by avoiding the usual relay contact problems such as: arcing, bouncing, and mechanical failure.

The RLY7 can be directly controlled by logic/SSR drive output or sourcing output of Red Lion Controls products.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so, can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.

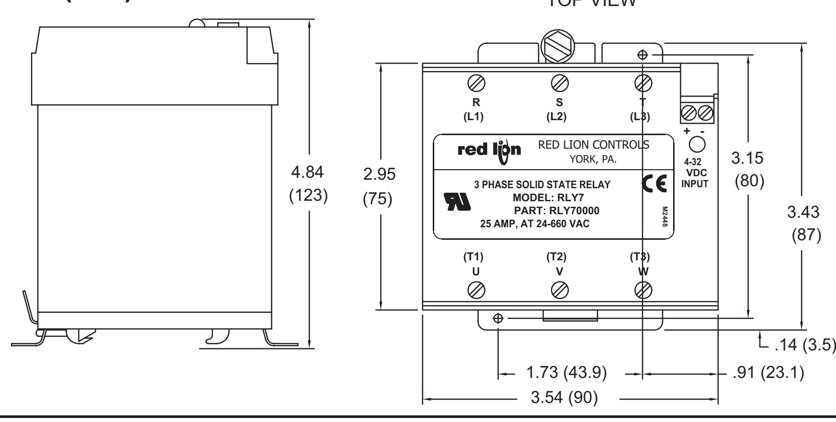
CAUTION: Risk of electric shock.

SPECIFICATIONS

OUTPUT SPECIFICATIONS

1. Operating Voltage Range: 24 to 660 VAC
2. Operating Frequency Range: 47 to 63 Hz
3. Maximum Continuous Load Current: 25 Amps (3 pole), 35 Amps (2 pole) (See Safe Operating Conditions)
5. Min. Load Current: 100 mA
6. Leakage Current @ V_{OUT} (Max.): 10 mA
7. Peak Blocking Voltage: 1400 VAC
8. Voltage Drop @ I_{OUT}: 3 VAC
9. I^2T Fusing: 1350 A^2sec (For Fusing Purposes, T = 8.3 msec.)
10. Dv/Dt @ V_{OUT} (Max.): 1000 V/µsec

DIMENSIONS In inches (mm)



INPUT SPECIFICATIONS

1. Control Voltage Range: 4 to 32 VDC
2. Turn-on Voltage (Min.): 4 VDC
3. Turn-off Voltage (Max.): 1 VDC
4. Input Current (Max.): 15 mA

GENERAL SPECIFICATIONS

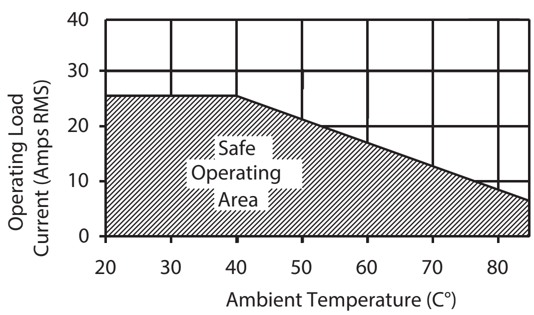
1. Isolation (Input to Output to Base): 4000 V_{RMS}
2. Operating Temperature Range: 0°C to 40°C

SAFE OPERATING CONDITIONS

The relay must always operate within the “Safe Operating Area” of the Derating Curve Figure. Operations outside the Safe Operating Area will shorten the life of, or cause permanent damage to, the relay. The ambient temperature should be measured 1" (25 mm) below the relay (when mounted to a vertical surface) and with all of the associated equipment operating.

It is strongly recommended that a 1" (25 mm) clearance is maintained on all four sides of the relay. If the relays are mounted against each other, then the end relays must be derated by an additional 10% (of the Derating Curve) and the middle relays by 20%.

Derating Curve



In small enclosures, adequate ventilation must be provided to assure proper safe operating temperature. Accumulation of dust and dirt on the heat sink fins will also affect heat dissipation. In extreme dust and dirt conditions, the relay must be derated by an additional 20%.

FUSING

Devices such as electromechanical circuit breakers and slow blow fuses cannot react quickly enough to protect this relay in a shorted condition. Fast “semiconductor fuses” with appropriate I^2T ratings are strongly recommended.

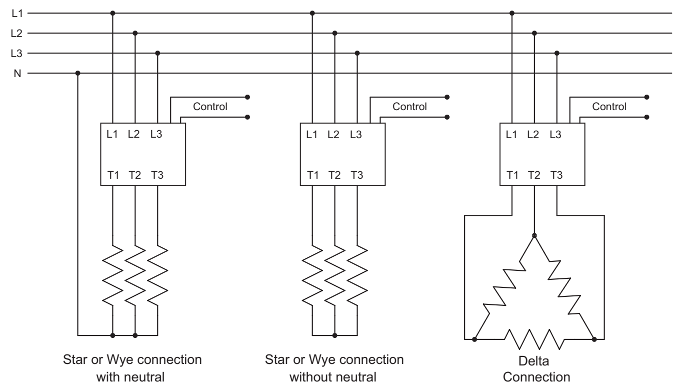
MECHANICAL INTERRUPT SWITCH

The off-state leakage current of the power unit is 10 mA maximum. The voltage level of the output will rise proportional to the resistance of the load due to this leakage current. Full line voltage can be measured when the output is connected to a high resistance load and the power unit is in the off-state.

A mechanical interrupt switch is recommended between the line voltage and the load. The switch should be opened when servicing any part of the output wiring. When measuring the off-state output voltage of the unit for correct operation, load the output of the RLY7 with a small resistance (approximately 100 ohms).

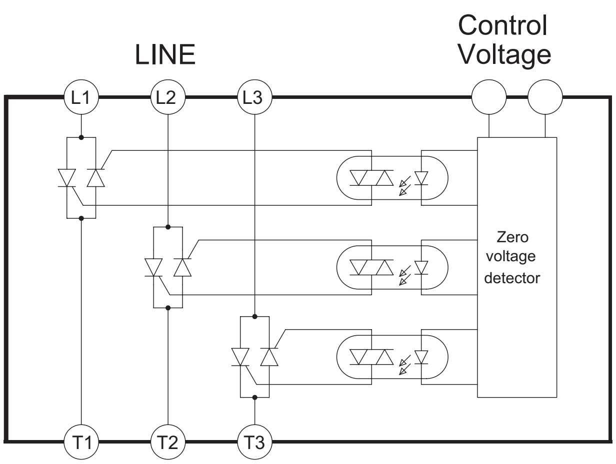
WIRING GUIDELINES

The controlling device and the relay load should NEVER share the same power feed. It is recommended that this relay be installed as close as possible to the load to keep the power cable runs short. The control voltage can run over distances in excess of 200 feet with shielded cable. If using shielded cable, connect the shield to the minus “-” terminal of the control signal at one end only.



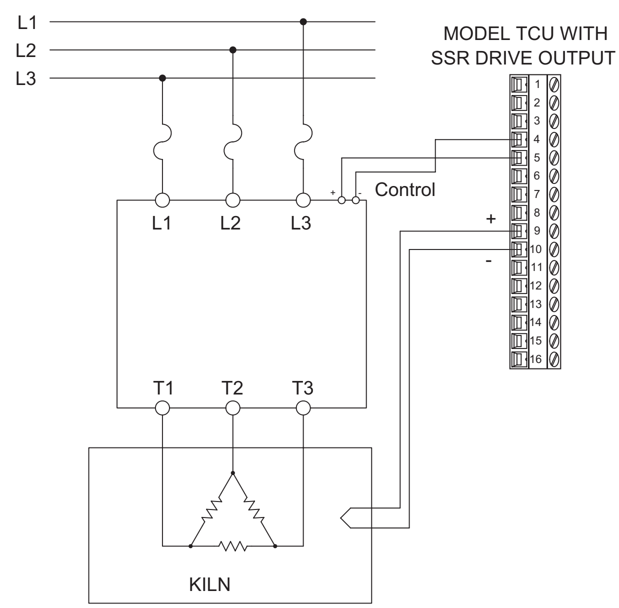
J

SCHEMATIC



THREE PHASE HEATING APPLICATION

This application shows a Model TCU Temperature Controller regulating the temperature of a drying kiln. The TCU has an SSR Drive Output Module installed. This module controls the three phase relay directly.



ORDERING INFORMATION

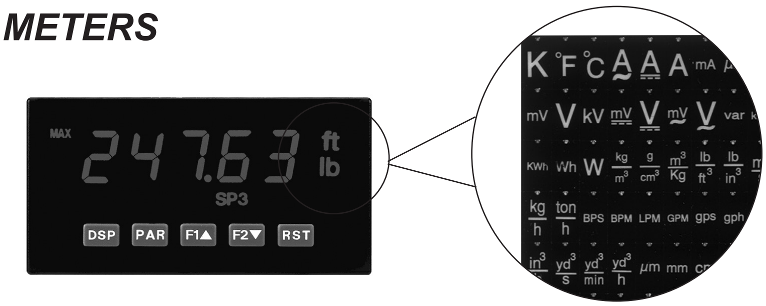
MODEL NO.	DESCRIPTION	PART NUMBER
RLY7	Three Phase Din Rail Mount Solid State Relay	RLY70000

Do not dispose of unit in trash - Recycle

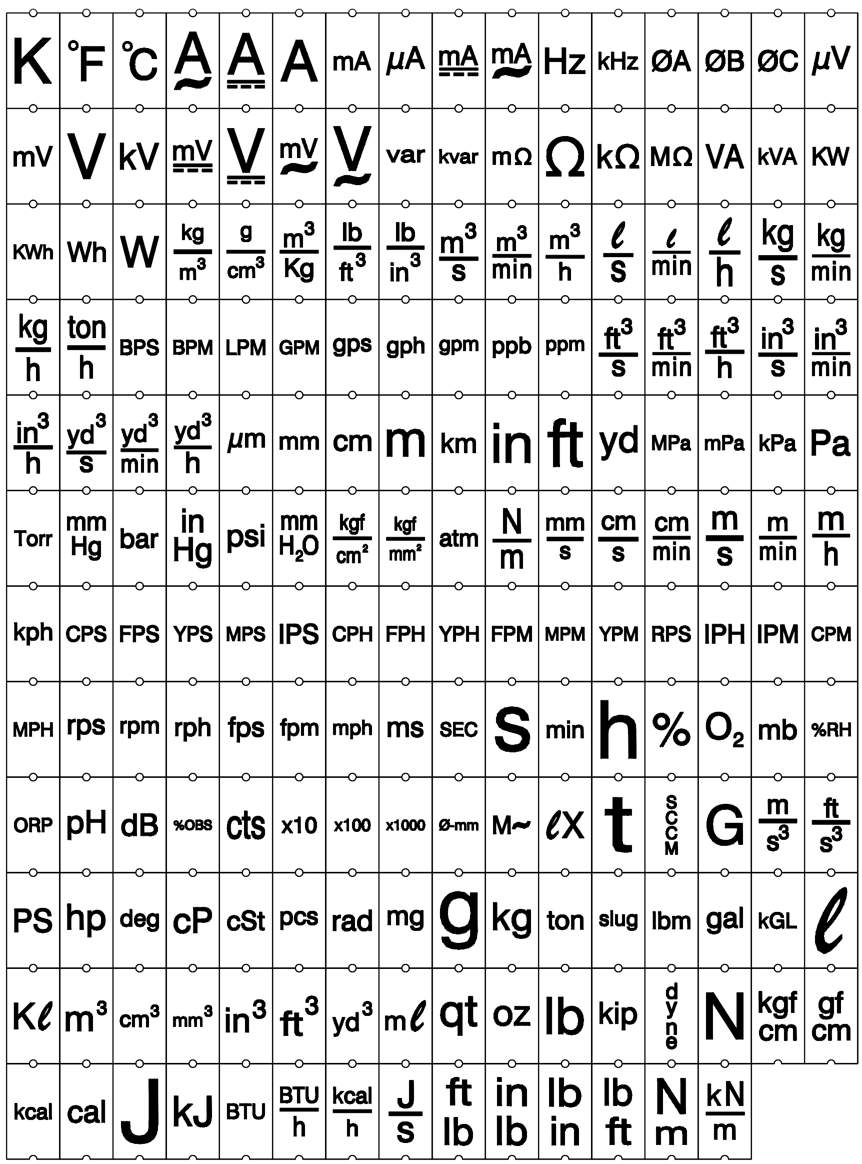
MODEL PAXLBK - LABEL KITS FOR 5 DIGIT ANALOG PAX AND PAX LITE METERS

DESCRIPTION

These label kits provide a unique way to identify your display with one of 189 different engineering units. The label lights up from inside the PAX or PAX Lite Meters where it is protected from washdown and dirty environments. Simply select the appropriate label from the kit and apply it to the plastic frame. The frame then installs into holes in the PC board on the right side of the display. Activating the backlight is controlled in the meter program.



J



ORDERING INFORMATION

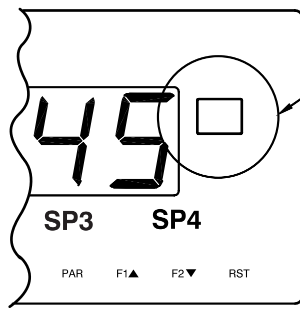
MODEL NO.	DESCRIPTION	PART NUMBERS
PAXLBK	Units Label Kit for 5 Digit PAX Meters	PAXLBK10
	Units Label Kit for 5 Digit PAX Lite Meters	PAXLBK30

LPAX ENCLOSURE, MOUNTING AND LABEL ACCESSORIES

- *ENGINEERING UNIT LABELS*
- *BRACKETS FOR BASE, CEILING, OR WALL MOUNTING*
- *NEMA 4/IP65 ENCLOSURE FOR WASHDOWN ENVIRONMENTS*
- *FRONT PANEL SHROUD FOR ENHANCED VIEWING*

LX LABEL ACCESSORY

The LX label accessories allow the 5 digit LPAX display to be customized with an engineering unit. The label is affixed to the embossed area on the bezel of the LPAX. The LPAX module is then programmed to turn on its backlighting, which illuminates the label from behind.



INSTALLATION

Before applying the label, ensure that the embossed area is clean, dry, and free of dirt. Remove the backing and center the label in the embossed area and attach. Take extra care to seat the edges of the label.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
LX	Custom Units Label for 5 Digit LPAX	Listed Below

(blank)		K	A	mA	µA	Hz	kHz	kV	VA	kVA	VAC	mV	V
LXBLANK0 *		LXK00000	LXA00000	LXMA0000	LXUA0000	LXHZ0000	LXKHZ000	LXKV0000	LXVA0000	LXKVA000	LXVAC000	LXMV0000	LXV00000
mΩ	Ω	KΩ	MΩ	W	KW	KWh	kg	ton	gal	ℓ	mℓ	Kℓ	m^3
LXMOHM10	LXOHM000	LXKOHM00	LXMOHM20	LXW00000	LXKW0000	LXKWH000	LXKG0000	LXTON000	LXGAL000	LXL00000	LXML0000	LXKL0000	LXM30000
cm^3	mm^3	in^3	ft^3	yd^3	$\frac{\ell}{h}$	$\frac{kg}{s}$	$\frac{kg}{min}$	$\frac{m^3}{s}$	$\frac{m^3}{min}$	$\frac{m^3}{h}$	$\frac{\ell}{s}$	$\frac{\ell}{min}$	$\frac{kg}{h}$
LXCM3000	LXMM3000	LXIN3000	LXFT3000	LXYD3000	LXL/H000	LXKG/S00	LXKG/MIN	LXM3/S00	LXM3/MIN	LXM3/H00	LXL/S000	LXL/MIN0	LXKG/H00
$\frac{ton}{h}$	$\frac{ft^3}{s}$	$\frac{ft^3}{min}$	$\frac{ft^3}{h}$	BPS	BPM	LPM	gps	GPM	gpm	gph	FPS	FPM	FPH
LXTON/H0	LXFT3/S0	LXFT3/MN	LXFT3/H0	LXBPS000	LXBPM000	LXLPM000	LXGPS000	LXGPM100	LXGPM200	LXGPH000	LXFPS100	LXFPM100	LXFPH000
fps	fpm	YPS	YPM	YPH	IPS	IPM	IPH	CPS	CPM	CPH	MPS	MPM	MPH
LXFPS200	LXFPM200	LXYPS000	LXYPM000	LXYPH000	LXIPS000	LXIPM000	LXIPH000	LXCPS000	LXCPM000	LXCPH000	LXMPS000	LXMPM000	LXMPH000
kph	RPS	rps	rpm	rph	ppb	ppm	$\frac{mm}{s}$	$\frac{cm}{s}$	$\frac{cm}{min}$	$\frac{m}{s}$	$\frac{m}{min}$	$\frac{m}{h}$	$\frac{t}{min}$
LXKPH000	LXRPS100	LXRPS200	LXRPM000	LXRPH000	LXPPB000	LXPPM000	LXMM/S00	LXCM/S00	LXCM/MIN	LXM/S000	LXM/MIN0	LXM/H000	LXT/MIN0
$\frac{u}{min}$	$\frac{lb}{min}$	$\frac{lb}{h}$	T	t	%RH	pH	deg	G	oz	lb	x10	x100	x1000
LXU/MIN0	LXLB/MIN	LXLB/H00	LXT10000	LXT20000	LX%RH000	LXPH0000	LXDEG000	LXG00000	LXOZ0000	LXLB0000	LX10X000	LX100X00	LX1000X0
ØA	ØB	ØC	bar	in Hg	psi	kPa	%	in	ft	yd	mm	cm	m
LXPHA000	LXPHB000	LXPHC000	LXBAR000	LXINHG00	LXPSI000	LXKPA000	LX%00000	LXIN0000	LXFT0000	LXYD0000	LXMM0000	LXCM0000	LXM00000
km	N	hp	in lb	ft lb	min	h	S	SEC	VDC		°F	°C	
LXKM0000	LXN00000	LXHP0000	LXINLB00	LXFTLB00	LXMIN000	LXH00000	LXS00000	LXSEC000	LXVDC000		LXDF0000 **	LXDC0000 **	

* Blank label included with each LPAX

** These labels included with MPAXT units

MODEL CUB5USB - USB PROGRAMMING OPTION CARD

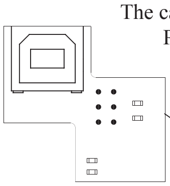
DESCRIPTION

This bulletin serves as a guide for the installation, configuration and operation of the CUB5 USB Programming plug-in card for the CUB5. The plug-in card is a separately purchased option card that plugs into the main circuit board of the meter. The CUB5USB card in conjunction with the Crimson® programming software enables the user to configure CUB5 on a PC. The CUB5USB requires installation of drivers which are included with the Crimson Programming software. Following installation of the drivers, the card appears as a Virtual communications port.

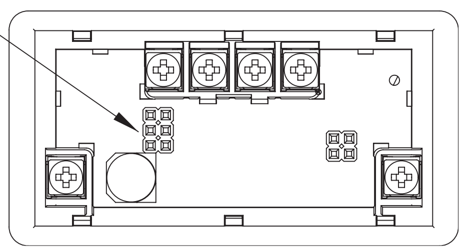
Crimson is a Windows® based program that allows configuration of the CUB® 5 meters from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the CUB5 meters. The CUB5 program can then be saved in a PC file for future use. A CUB5 serial plug-in card is required to program the meter using the software.

INSTALLING PLUG-IN CARDS

The card plugs into the main circuit board of the meter as shown. Perform USB driver installation below prior to powering the CUB5 and connecting CUB5USB to a PC USB port.



USB Card



WARNING: Disconnect all power to the unit before installing Plug-in card.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

USB DRIVER INSTALLATION

1. Download and install the latest Crimson 2 build on your Windows® compatible PC. Earlier builds may not have the RLC Virtual Comm port drivers. Crimson software is available as a free download at http://www.redlion.net.
2. Install CUB5USB card into CUB5 meter and apply power to the CUB5.
3. Connect Type A USB cable to computer and CUB5USB option card. Windows will prompt you for the location of the drivers for the device. The default location for these drivers is "C:\Program Files\Red Lion controls\Crimson 2.0\Device." When the hardware setup appears, choose "Install from a list or Specific location," click Next, and then check "Include this location..." and click the Browse button. Point the Wizard at the location specified above or whatever other location you specified during installation of the software. It is important that you perform this step correctly, or you may have to manually remove the drivers using the Device Manager, and repeat the installation once more.
   Note: Crimson's USB drivers have not been digitally signed by Microsoft®, and you will therefore see a dialog offering you the chance to stop the installation. You should be sure to select the Continue option to indicate that you do indeed wish to install the drivers.
4. Windows will automatically assign a comms port to the CUB5USB. To determine the port assigned, open "System Properties" from within Windows® Control Panel. Select the Hardware tab, and click the "Device Manager" button. Expand the "Ports" line. Take note of which Comms port is assigned to "RLC Virtual Comm port". It must be Com4 or lower to operate with Crimson 2. If higher, right-click on the entry and select "Properties," "Port Settings" tab, and then "Advanced" button. Select a Coms port that is COM4 or lower and is not physically being used.

SPECIFICATIONS

CUB5USB PROGRAMMING CARD

Type: USB Virtual Comms Port
Baud Rate: 300 to 38.4k
Unit Address: 0 to 99

CRIMSON 2 SYSTEM REQUIREMENTS

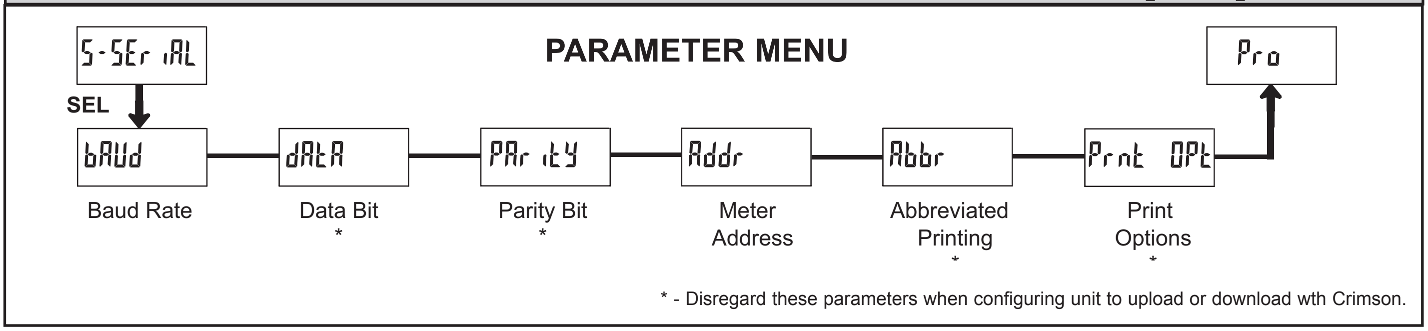
- Windows 2000, XP, or Vista
- RAM and free disk space as required by the chosen operating system.
- An additional 50 MB of disk space for software installation.
- A display of at least 800 by 600 pixels
- A USB port for downloading to the CUB5

ORDERING INFORMATION

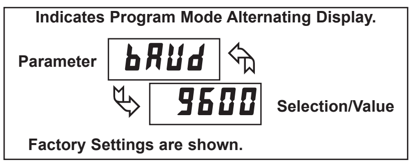
MODEL NO.	DESCRIPTION	PART NUMBER
CUB5USB	CUB5 USB Programming Card	CUB5USB0
CBLUSB	Type A to B USB Cable	CBLUSB00
SFCRUSB*	USB Programming Kit containing USB Card, USB Cable and Crimson software	SFCRUSB0
SFCRD*	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200

* Crimson software is available for download from http://www.redlion.net/

MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SEr)



Module 5 is the programming module for the Serial Communications Parameters. The only paramters of concern when utilizing the CUB5USB programming option card to communicate with Crimson 2 programming software is the Baud Rate and Meter Address. The Parameters are only accessible when an optional CUB5USB, RS232 or RS485 serial communications card is installed in the meter.



BAUD RATE

bAUd
9600

300 1200 4800 19200
600 2400 9600 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT *

dAtA
7-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT*

PAr
Odd

nO Odd EUEn

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to nO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr
00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING *

Abbr
nO

nO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select nO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

PRINT OPTIONS *

OPt
nO

nO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as nO will not be sent.

The “Print All” (P-ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, the Setpoint value(s) will not be sent unless an optional setpoint card is installed in the meter.

* - Disregard these parameters when configuring unit to upload or download wth Crimson software.

J

MODEL CUB5COM -SERIAL COMMUNICATIONS PLUG-IN OPTION CARDS

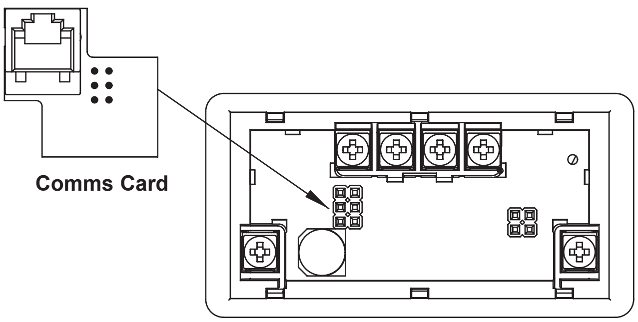
DESCRIPTION

This bulletin serves as a guide for the installation, configuration and operation of the RS232 and RS485 serial communications plug-in cards for the CUB5. The plug-in cards are separately purchased option cards that plug into the main circuit board of the meter. Only one communication card can be used at a time.

Crimson is a Windows® based program that allows configuration of the CUB5 meters from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the CUB5 meters. The CUB5 program can then be saved in a PC file for future use. A CUB5 serial plug-in card is required to program the meter using the software.

INSTALLING PLUG-IN CARDS

The cards plug into the main circuit board of the meter as shown.



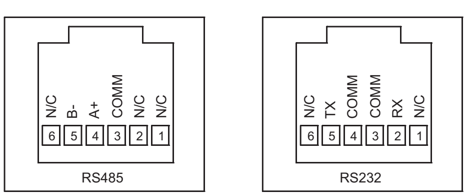
WARNING: Disconnect all power to the unit before installing Plug-in card.

CAUTION: The Plug-in cards and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

WIRING CONNECTIONS

Connections to the serial communications cards are made through an RJ11 modular connector. Connector pin-outs for the RS485 and RS232 cards are shown below.

RJ11 CONNECTOR PIN OUTS



SPECIFICATIONS

RS485 SERIAL COMMUNICATIONS CARD

Type: RS485 multi-point balanced interface (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity
Bus Address: 0 to 99; max 32 meters per line
Transmit Delay: Selectable, 2 msec min. or 50 msec min.

RS232 SERIAL COMMUNICATIONS CARD

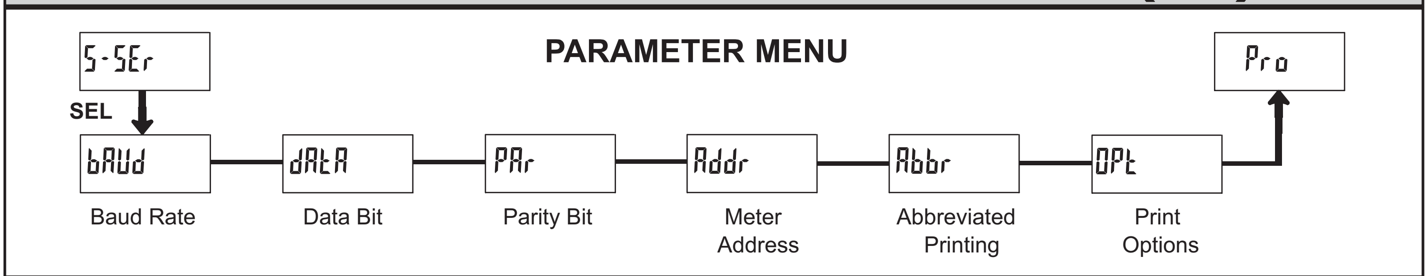
Type: RS232 half duplex (non-isolated)
Baud Rate: 300 to 38.4k
Data Format: 7/8 bits; odd, even, or no parity

ORDERING INFORMATION

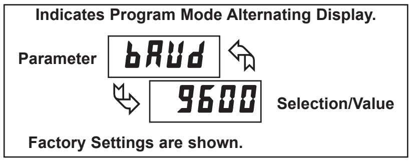
MODEL NO.	DESCRIPTION	PART NUMBER
CUB5COM	RS485 Serial Communications Card	CUB5COM1
	RS232 Serial Communications Card	CUB5COM2
CBL	RS232 Programming Cable (DB9-RJ11)	CBLPROG0
	RS485 Programming Cable (DB9-RJ11)	CBPRO007
SFCRD*	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP	SFCRD200

* Crimson software is available for download from http://www.redlion.net/

MODULE 5 - SERIAL COMMUNICATIONS PARAMETERS (5-SEr)



Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the CUB5 with those of the host computer or other serial device. The Serial Setup Parameters are only accessible when an optional RS232 or RS485 serial communications module is installed in the meter.



BAUD RATE

bAUd
9600

300 600 1200 2400 4800 9600 19200 38400

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting and receiving.

DATA BIT

dAtA
7-bit

7-bit 8-bit

Select either 7- or 8-bit data word length. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PAr
Odd

NO Odd EVEN

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to NO, an additional stop bit is used to force the frame size to 10 bits.

METER ADDRESS

Addr
00

0 to 99

Enter the serial node address. With a single unit, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abbr
NO

NO YES

This parameter determines the formatting of data transmitted from the meter in response to a Transmit Value command or a Block Print Request. Select NO for a full print transmission, consisting of the meter address, mnemonics, and parameter data. Select YES for abbreviated print transmissions, consisting of the parameter data only. This setting is applied to all the parameters selected in the PRINT OPTIONS. (Note: If the meter address is 0, the address will not be sent during a full transmission.)

J

PRINT OPTIONS

OPt
NO

NO YES

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block.

Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as NO will not be sent.

The "Print All" (P-ALL) option selects all meter values for transmitting (YES), without having to individually select each parameter in the sublist.

Note: Inactive parameters will not be sent regardless of the print option setting. For example, the Setpoint value(s) will not be sent unless an optional setpoint card is installed in the meter.

ANALOG MODELS - CUB5V, CUB5I, CUB5P, CUB5TC, CUB5RT

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INP	Input	YES	INP
HI	Maximum	NO	MAX
LO	Minimum	NO	MIN
SPt-1	Setpoint 1	NO	SP1
SPt-2	Setpoint 2	NO	SP2

Sending Serial Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

Command	Description	Notes
N	Node (meter) Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by a register ID character.
V	Value Change (write)	Write to register of the meter. Must be followed by a register ID character and numeric data.
R	Reset	Reset a register value or setpoint output. Must be followed by a register ID character
P	Block Print Request (read)	Initiates a block print output. Registers in the print block are selected in Print Options.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Command Response Time section for differences in meter response time when using the * and $ terminator.

Register Identification Chart

Analog Models - CUB5V, CUB5I, CUB5P, CUB5TC, CUB5RT

ID	Value Description	MNEMONIC	Applicable Commands	Transmit Details (T and V)
A	Input	INP	T	5 digit
B	Maximum	MAX	T, R	5 digit
C	Minimum	MIN	T, R	5 digit
D	Setpoint 1 (Reset output 1)	SP1	T, R, V	5 digit positive/4 digit negative
E	Setpoint 2 (Reset output 2)	SP2	T, R, V,	5 digit positive/4 digit negative

Command String Examples:

1. Node address = 17, Write 350 to the setpoint 1 value
   String: N17VD350*
2. Node address = 5, Read input, response time of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 1 output
   String: RD*
4. Node address = 31, Request a Block Print Output, response time of 2 msec min
   String: N31P$

Transmitting Data to the Meter

Numeric data sent to the meter must be limited to transmit details listed in the Register Identification Chart. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: The meter's scaled decimal point position is set for 0.0 and 25 is written to a register. The value of the register is now 2.5. In this case, write a value of 250 to equal 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data From The Meter

Data is transmitted from the meter in response to either a transmit command (T), a block print request command (P) or a User Input print request. The response from the meter is either a full field transmission or an abbreviated transmission, depending on the selection chosen in Module 5.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-15	9 byte data field; 7 bytes for number, one byte for sign, one byte for decimal point
16	<CR> (carriage return)
17	<LF> (line feed)
18	<SP>* (Space)
19	<CR>* (carriage return)
20	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 15) is 9 characters long. When a requested display value exceeds the meter's display limits, decimal points are sent in place of numerical data to indicate a display overrange.

The remaining 7 positions of this field consist of a minus sign (for negative values), a floating decimal point (if applicable), and five positions for the requested value. The data within bytes 9 to 15 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with a <CR> and <LF>. After the last line of a block print, an extra <SP>, <CR> and <LF> are added to provide separation between the print blocks.

Abbreviated Transmission

Byte	Description
1-9	9 byte data field, 7 bytes for number, one byte for sign, one byte for decimal point
10	<CR> (carriage return)
11	<LF> (line feed)
12	<SP>* (Space)
13	<CR>* (carriage return)
14	<LF>* (line feed)

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and the register mnemonic, leaving only the numeric part of the response.

Meter Response Examples (Analog models):

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 1 = -250.5
   SP1 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print 250<CR><LF><SP><CR><LF>

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). During RS232 transmissions, the meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (* or $) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

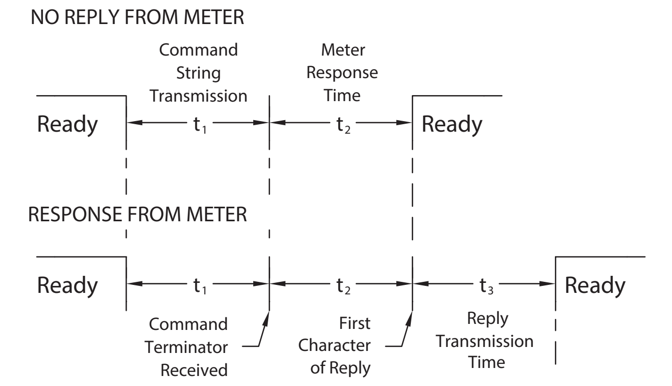
At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The ‘*’ terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with ‘$’ results in a response time (t_2) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. At the end of t_3, the meter is ready to receive the next command.

$$t_3 = (10 \text{ times the \# of characters}) / \text{baud rate}$$

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.



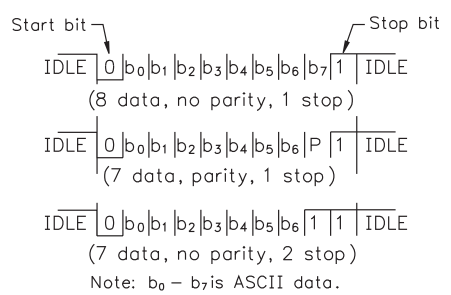
Timing Diagram Figure

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character. The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.



Character Frame Figure

Start Bit and Data Bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted.

Parity Bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The CUB5 meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop Bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the meter.

MODEL PAXUSB - USB PROGRAMMING OPTION CARD

DESCRIPTION

This bulletin serves as a guide for the installation of the PAX USB Programming plug-in card. The plug-in card is a separately purchased option card that plugs into the main circuit board of the unit. The PAX USB card in conjunction with the Crimson® programming software enables the user to configure a PAX from a PC. The PAXUSB requires the installation of drivers that are included with the Crimson Programming software.

Following installation of the drivers, the card appears as a Virtual communications port.

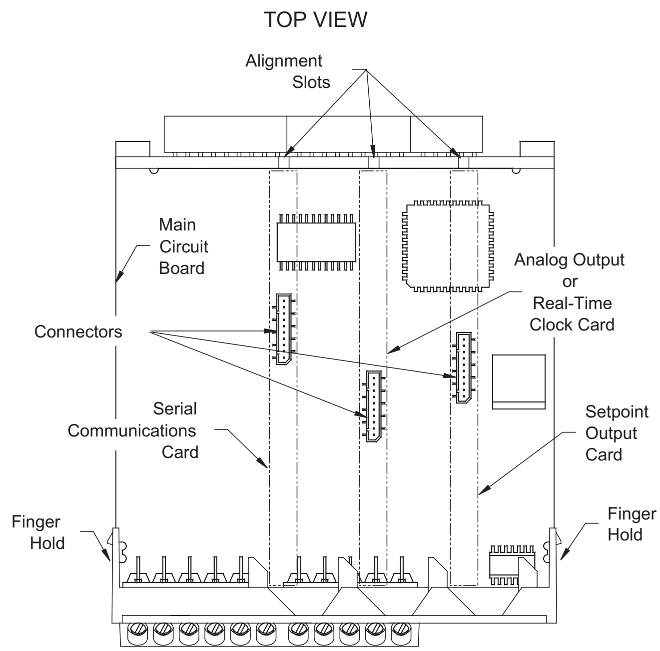
Crimson is a Windows® based program that allows configuration of the PAX® units from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the PAX units. The PAX program can then be saved in a PC file for future use.

INSTALLING AN OPTION CARD

***CAUTION**: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, handle the cards by the edges only. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

***WARNING**: Exposed line voltage may be present on the circuit boards when power is applied. Remove all power to the unit AND load circuits before accessing the unit.*

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot bay in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Perform USB driver installation below prior to powering the PAX and connecting PAXUSB to PC USB port.



COMMUNICATIONS

It is necessary to match the PAX unit's serial communications parameters to the host's parameters before communications can be established. This is accomplished by using the PAX front panel keys to enter the Serial Communications Parameters Module.

CRIMSON 2 SYSTEM REQUIREMENTS

- Windows 2000, XP, or Vista
- RAM and free disk space as required by the chosen operating system.
- An additional 50 MB of disk space for software installation.
- A display of at least 800 by 600 pixels
- A USB port for downloading to the PAX

SPECIFICATIONS

PAXUSB PROGRAMMING CARD

Type: USB Virtual Comms Port

Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.

PAXH Isolation:

Isolation To Sensor Common: 1400 Vrms for 1 min.
Working Voltage: 125 V

Isolation To User Input Common: 500 Vrms for 1 min.
Working Voltage: 50 V

Baud Rate: 300 to 19.2k

Unit Address: 0 to 99; only 1 unit can be configured at a time

USB DRIVER INSTALLATION

1. Download and install the latest Crimson 2 build on your Windows® compatible PC. Earlier builds may not have the RLC Virtual Comm port drivers. Crimson software is available as a free download at http://www.redlion.net.
2. Install PAXUSB card into the unit and apply power to the PAX.
3. Connect Type A to mini B USB cable to computer and PAX option card. Windows will prompt you for the location of the drivers for the device. The default location for these drivers is "C:\Program Files\Red Lion controls\Crimson 2.0\Device." When the hardware setup appears, choose "Install from a list or Specific location," click Next, and then check "Include this location..." and click the Browse button. Point the Wizard at the location specified above or whatever other location you specified during installation of the software. It is important that you perform this step correctly, or you may have to manually remove the drivers using the Device Manager, and repeat the installation once more.
   Note: Crimson's USB drivers have not been digitally signed by Microsoft®, and you will therefore see a dialog offering you the chance to stop the installation. You should be sure to select the Continue option to indicate that you do indeed wish to install the drivers.
4. Windows will automatically assign a comms port to the PAXUSB. To determine the port assigned, open "System Properties" from within Windows® Control Panel. Select the Hardware tab, and click the "Device Manager" button. Expand the "Ports" line. Take note of which Comms port is assigned to "RLC Virtual Comm port". It must be Com4 or lower to operate with Crimson 2. If higher, right-click on the entry and select "Properties," "Port Settings" tab, and then "Advanced" button. Select a Coms port that is COM4 or lower and is not physically being used.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXUSB	PAX USB Programming Card	PAXUSB00
CBLUSB	Type A to mini B USB Cable	CBLUSB01
SFCRUSB*	USB Programming Kit containing USB Card, USB Cable, and Crimson Software	SFCRUSB1

* Crimson software is available for download from http://www.redlion.net/

MODEL PAXCDC -SERIAL COMMUNICATIONS PLUG-IN OPTION CARDS

DESCRIPTION

This bulletin serves as a guide for the installation, configuration and operation of the RS232 and RS485 cards for the PAX family of meters. Only one communication card can be used at a time.

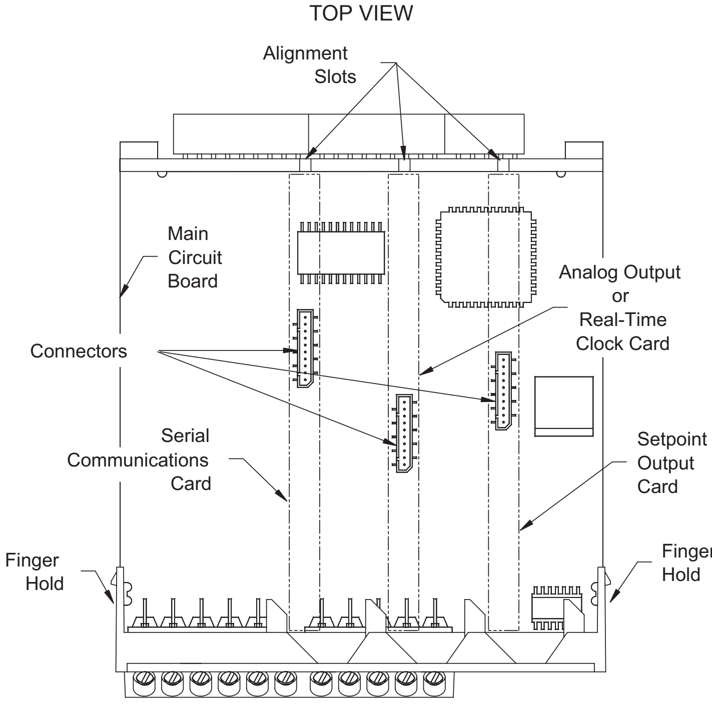
The PAX meter can be fitted with up to three different option cards. The slot bays of the option cards are dedicated to a particular card function. The option card functions are: serial communications, analog output and setpoint output. Only one card from each function category can be installed into the meter.

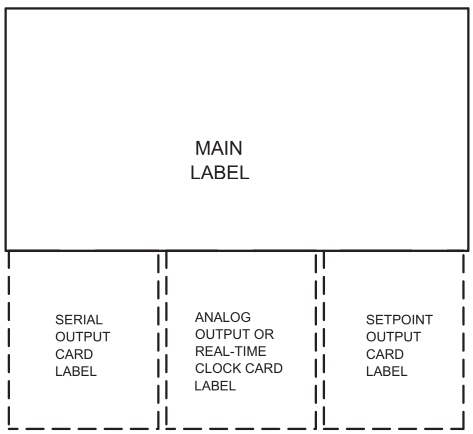
INSTALLING AN OPTION CARD

***Caution**: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, handle the cards by the edges only. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

***Warning**: Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.*

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot bay in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Apply the option card label to the bottom side of the meter. **Do not cover the vents on the top surface of the meter.** The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.





ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXCDC	RS485 Serial Communications Output Card with Terminal Block	PAXCDC10
	Extended RS485 Serial Communications Output Card with Dual RJ11 Connector	PAXCDC1C
	RS232 Serial Communications Output Card with Terminal Block	PAXCDC20
	Extended RS232 Serial Communications Output Card with 9 Pin D Connector	PAXCDC2C

SPECIFICATIONS

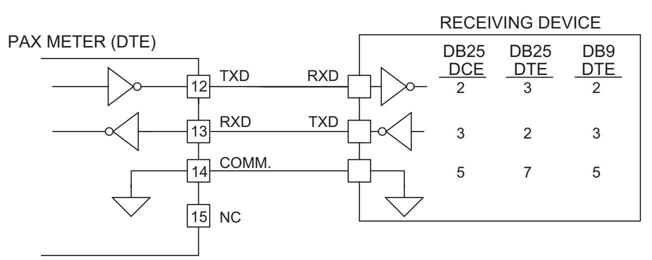
PAXH Isolation For Both Cards:
- **Isolation To Sensor Common**: 1400 Vrms for 1 min.
  Working Voltage: 125 V
- **Isolation To User Input Common**: 500 Vrms for 1 min.
  Working Voltage: 50 V

RS485 Communication Card
- **Type**: RS485 multi-point balanced interface
- **Isolation To Sensor & User Input Commons**: 500 Vrms for 1 min.
  Working Voltage: 50 V. Not Isolated from all other commons.
- **Baud Rate**: 300 to 19.2k
- **Data Format**: 7/8 bits; odd, even, or no parity
- **Bus Address**: 0 to 99, max 32 meters per line
- **Transmit Delay**: Selectable; 2 - 50 msec or 50 - 100 msec

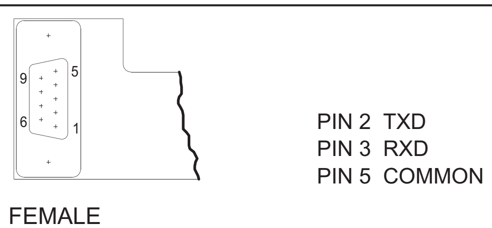
RS232 Communication Card
- **Type**: RS232 half duplex
- **Isolation To Sensor & User Input Commons**: 500 Vrms for 1 min.
  Working Voltage: 50 V. Not Isolated from all other commons.
- **Baud Rate**: 300 to 19.2k
- **Data Format**: 7/8 bits; odd, even or no parity

WIRING CONNECTIONS

RS232 Communications



Terminal Block Connection Figure



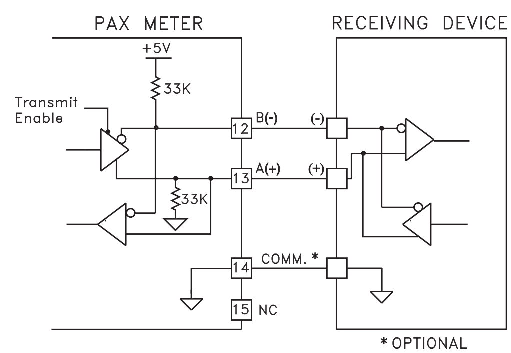
Extended Comms Connection Figure

RS232 is intended to allow only two devices to communicate over distances up to 50 feet. Data Terminal Equipment (DTE) transmits data on the Transmitted Data (TXD) line and receives data on the Received Data (RXD) line. Data Computer Equipment (DCE) receives data on the TXD line and transmits data on the RXD line. The PAX emulates a DTE. If the other device connected to the meter also emulates a DTE, the TXD and RXD lines must be interchanged for communications to take place. This is known as a null modem connection. Most printers emulate a DCE device while most computers emulate a DTE device.

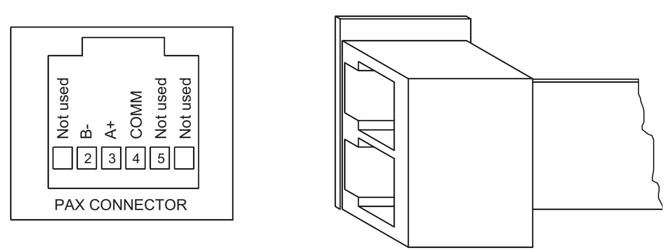
Some devices cannot accept more than two or three characters in succession without a pause in between. In these cases, the meter employs a busy function. As the meter begins to transmit data, the RXD line (RS232) is monitored to determine if the receiving device is “busy”. The receiving device asserts that it is busy by setting the RXD line into a space condition (logic 0). The meter then suspends transmission until the RXD line is released by the receiving device.

RS485 Communications

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the PAX is limited to 19.2k baud). The same pair of wires is used to both transmit and receive data. An RS485 bus is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.

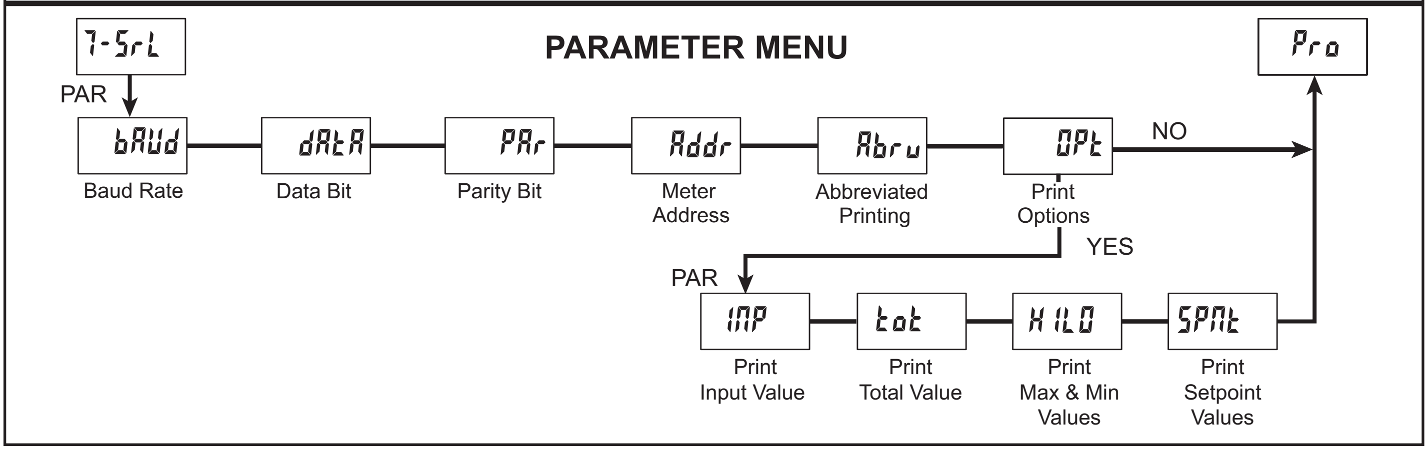


Terminal Block Connection Figure

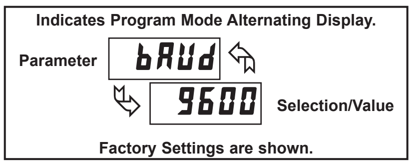


Extended Comms Connection Figure

MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SrL)



It is necessary to match the PAX meter's serial communications parameters to the host's parameters before communications can be established. This is accomplished by using the PAX front panel keys to enter 7-SrL.



BAUD RATE

bAUd
9600

300 1200 4800 19200
600 2400 9600

Set the baud rate to match that of other serial communications equipment. Normally, the baud rate is set to the highest value that all of the serial communications equipment is capable of transmitting.

DATA BIT

dAtA
7

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match that of other serial communication equipment. Since the meter receives and transmits 7-bit ASCII encoded data, 7 bit word length is sufficient to request and receive data from the meter.

PARITY BIT

PAr
Odd

Odd EVEN NO

Set the parity bit to match that of the other serial communications equipment used. The meter ignores the parity when receiving data, and sets the parity bit for outgoing data. If no parity is selected with 7-bit word length the meter transmits and receives data with 2 stop bits. (For example: 10 bit frame with mark parity)

METER ADDRESS

Addr
0

0 to 99

Enter the serial node address. With a single unit on a bus, an address is not needed and a value of zero can be used (RS232 applications). Otherwise, with multiple bussed units, a unique address number must be assigned to each meter. The node address applies specifically to RS485 applications.

ABBREVIATED PRINTING

Abru
YES

YES NO

Select abbreviated transmissions (numeric only) or full field transmission. When the data from the meter is sent directly to a terminal for display, the extra characters that are sent identify the nature of the meter parameter displayed. In this case, select NO. When the data from the meter goes to a computer, it may be desirable to suppress the node address and mnemonic when transmitting. In this case, set this parameter to YES.

PRINT OPTIONS

OPt
NO

YES NO

YES - Enters the sub-menu to select those meter parameters to appear in the block print. For each parameter in the sub-menu select YES for the parameter to appear with the block print, and NO to disable the parameter.

*Setpoints 1-4 are setpoint plug-in card dependent.

Input Value	INP	YES	NO
Max and Min Values	h ILO	YES	NO
Total Value	tot	YES	NO
Setpoint values*	SPNt	YES	NO

J

Sending Commands and Data

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a the command terminator character * or $.

Command Chart

Command	Description	Notes
N	Node Address Specifier	Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character.
V	Value change (write)	Write to register of the meter. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character
P	Block Print Request (read)	Initiates a block print output. Registers are defined in programming.

Register Identification Chart

ID	Value Description	Register ID	Applicable Commands/Comments	
A	Input	INP	T, P, R	(Reset command [Ver2.5+] zeros the input ["REL" or Tare])
B	Total	TOT	T, P, R	(Reset command resets total to zero)
C	Max Input	MAX	T, P, R	(Reset command resets total to zero)
D	Min Input	MIN	T, P, R	(Reset command resets MIN to current reading)
E	Setpoint 1	SP1	T, P, V, R	(Reset command resets the setpoint output)
F	Setpoint 2	SP2	T, P, V, R	(Reset command resets the setpoint output)
G	Setpoint 3	SP3	T, P, V, R	(Reset command resets the setpoint output)
H	Setpoint 4	SP4	T, P, V, R	(Reset command resets the setpoint output)
I	Analog Output Register	AOR	T, V	(Applies to manual mode)
J	Control Status Register	CSR	T, V	
L	Absolute (gross) input display value	ABS GRS †	T, P	
Q	Offset/Tare (PAXS)	OFS TAR †	T, P, V	(Ver 2.5+)

† -Register ID for the PAXS.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to illegal commands. The following procedure details construction of a command string:

1. The first 2 or 3 characters consist of the Node Address Specifier (N) followed by a 1 or 2 character node address number. The node address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the optional address specifier, the next character is the command character.
3. The next character is the register ID. This identifies the register that the command affects. The P command does not require a register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences of * and $ terminating characters.

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1, response delay of 2 msec min
   String: N17VE350$
2. Node address = 5, Read Input value, response delay of 50 msec min
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output, response delay of 50 msec min
   String: RH*

Sending Numeric Data

Numeric data sent to the meter must be limited to 5 digits (-19,999 to 99,999). If more than 5 digits are sent, the meter accepts the last 5. Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5 In this case, write a value = 25.0).

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

Receiving Data

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. In this case, the response contains only the numeric field. The meter response mode is established in programming.

Full Field Transmission

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	12 byte data field; 10 bytes for number, one byte for sign, one byte for decimal point (The T command may be a different byte length)
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned =0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register ID (Serial Mnemonic).

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative value have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

The abbreviated response suppresses the node address and register ID, leaving only the numeric part of the response.

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

(CSR) Control Status Register

The Control Status Register is used to both directly control the meter's outputs (setpoints and analog output), and interrogate the state of the setpoint outputs. The register is bit mapped with each bit position within the register assigned to a particular control function. The control function are invoked by writing to each bit position. The bit position definitions are:

bit 0: Setpoint 1 Output Status
- 0 = output off
- 1 = output on

bit 1: Setpoint 2 Output Status
- 0 = output off
- 1 = output on

bit 2: Setpoint 3 Output Status
- 0 = output off
- 1 = output on

bit 3: Setpoint 4 Output Status
- 0 = output off
- 1 = output on

bit 4: Manual Mode
- 0 = automatic mode
- 1 = manual mode

bit 5: Always stays 0, even if 1 is sent.

bit 6: Sensor Status (PAXT only)
- 0 = sensor normal
- 1 = sensor fail

bit 7: Always stays 0, even if 1 is sent.

Although the register is bit mapped starting with bit 7, HEX < > characters are sent in the command string. Bits 7 and 5 always stay a zero, even if a "1" is sent. This allows ASCII characters to be used with terminals that may not have extended character capabilities.

Writing a "1" to bit 4 of CSR selects manual mode. In this mode, the setpoint outputs are defined by the values written to the bits b0, b1, b2, b3; and the analog output is defined by the value written to the AOR. Internal control of these outputs is then overridden.

In automatic mode, the setpoint outputs can only be reset off. Writing to the setpoint output bits of the CSR has the same effect as a Reset command (R). The contents of the CSR may be read to interrogate the state of the setpoint outputs and to check the status of the temperature sensor (PAXT only).

Examples:

1. Set manual mode, turn all setpoints off:

		7	6	5	4	3	2	1	0:bit location	
VJ<30>* or VJ0*	ASCII 0 =	0	0	1	1	0	0	0	0	or <30>

V is command write, J is CSR and * is terminator.

2. Turn SP1, SP3 outputs on and SP2, SP4 outputs off:

		7	6	5	4	3	2	1	0:bit location	
VJ<35>* or VJ5*	ASCII 5 =	0	0	1	1	0	1	0	1	or <35>

3. Select Automatic mode:

		7	6	5	4	3	2	1	0:bit location	
VJ<40>* or VJ@*	ASCII @ =	0	1	0	0	0	0	0	0	or <40>

Note: Avoid writing values <0A> (LF), <0D> (CR), <24> ($) and <2E> (*) to the CSR. These values are interpreted by the meter as end of command control codes and will prematurely end the write operation.

(AOR) Analog Output Register

The Analog Output Register controls the analog output of the meter. The manual mode must first be engaged by setting bit 4 of the Control Status Register. The range of values of this register is 0 to 4095, which corresponds to 0 mA, 0 V and 20 mA, 10 V; respectively. The table lists correspondence of the output signal with the register value.

Register Value	Output Signal*	
	I (mA)	V (V)
0	0.000	0.000
1	0.005	0.0025
2047	10.000	5.000
4094	19.995	9.9975
4095	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (20 mA or 10 V).*

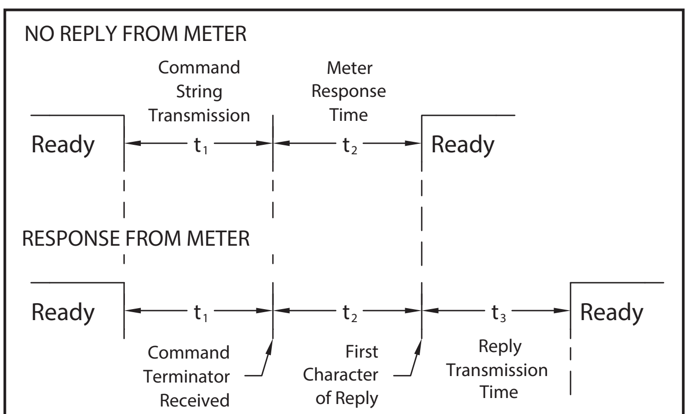
Writing to this register while the meter is in the manual mode causes the output signal to update immediately. While in the automatic mode, this register may be written to, but the output will not update until the meter is placed in manual mode.

Examples:

1. Set output to full scale:
   VI4095*
2. Set output to zero scale:
   VI0*

Command Response Time

The meter can only receive data or transmit data at any one time (half-duplex operation). The meter ignores commands while transmitting data, but instead uses RXD as a busy signal. When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.



Timing Diagram Figure

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

t_1 = (10 * # of characters) / baud rate

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 50 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character. The standard command line terminating character is '*'. This terminating character results in a response time window of 50 msec minimum and 100 msec maximum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with '$' results in a response time window (t_2) of 2 msec minimum and 50 msec maximum. The faster response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel. t_3 = (10 * # of characters) / baud rate. At the end of t_3, the meter is ready to receive the next command.

The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Communication Format

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

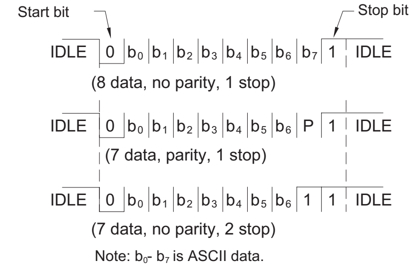
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is “framed” with a beginning start bit, an optional error detection parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit.

MODEL PAXCDC -DEVICENET™ OUTPUT OPTION CARD

DESCRIPTION

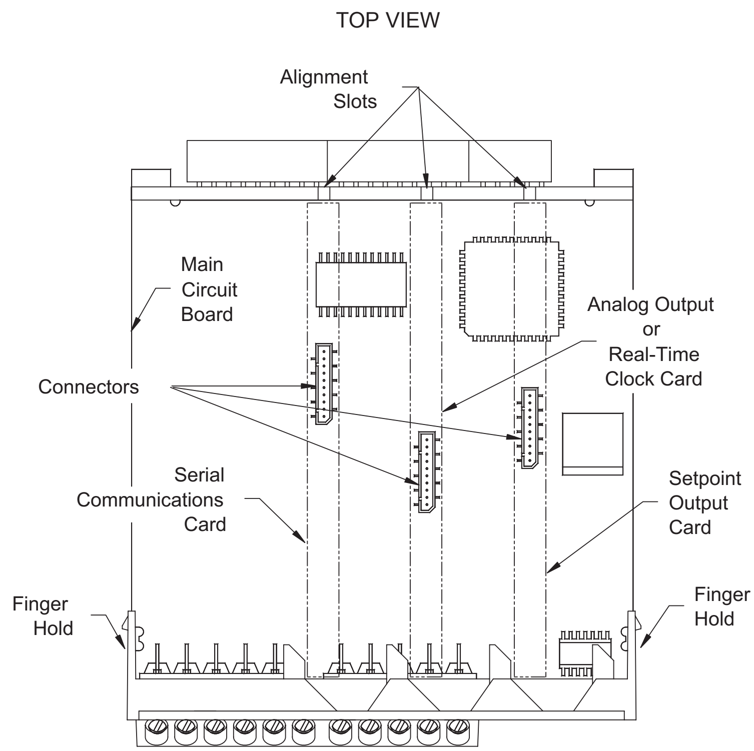
The DeviceNet Option Card (PAXCDC30) is designed for the PAX series of meters. It fits into the Comms slot of any PAX meter and allows the meter to communicate with a DeviceNet bus. The card supports Polling, Bit Strobe, and Explicit Message Commands. The MAC ID and the Baud Rate are switch adjustable via a DIP switch. A bicolor LED is used to indicate the meter's status in relationship to the bus.

INSTALLING AN OPTION CARD

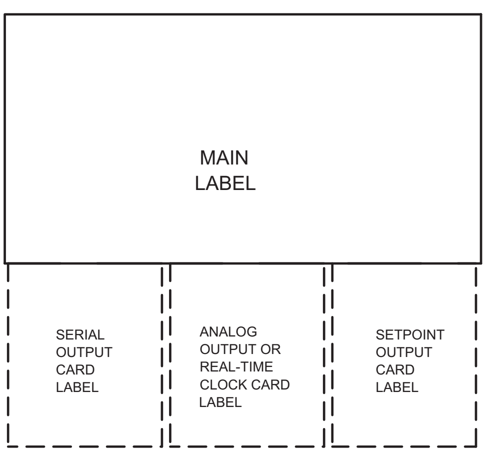
***Caution**: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

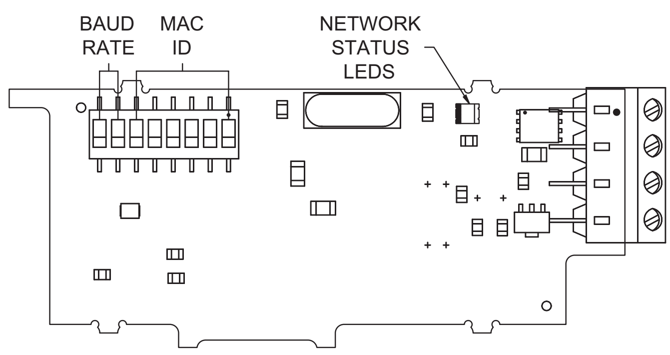
***Warning**: Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.*

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Apply the option card label to the bottom side of the meter. Do not cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.
6. See manual for wiring connections and programming procedures.



J





DIP SWITCHES

Both MAC ID and baud rate are set via DIP switches on the DeviceNet™ option card. See the DIP switch setting table for more details on these DIP switches. Configuration of MAC ID and baud rate is not supported over DeviceNet™.

NETWORK STATUS LEDs

The network status LEDs provide visual indication to the operator of the DeviceNet™ card's current status.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXCDC	PAX DeviceNet™ Output Card	PAXCDC30

DeviceNet™ SPECIFICATIONS

POWER SUPPLY

Source: Supplied by DeviceNet™ bus.
The bus does not power the host.

Voltage: 11 to 25 VDC.

Current:
Nominal: 40 mA at 25 VDC.
Inrush: 550 mA for 5 msec at 25 VDC.

*Power must be applied to the PAX meter before bus power is applied to the card.

NETWORK SPECIFICS

Compatibility: Group 2 Server Only, not UCMM capable.

Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud.

Bus Interface: Phillips 82C250 or equivalent with mis-wiring protection per DeviceNet™ Volume 1 Section 10.2.2.

Node Isolation: Bus powered, isolated node.

Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

Bus Connection:
12 V+
13 CAN_H
14 CAN_L
15 V-
Shield: No Connection

INSTALLATION INFORMATION

Factory Settings:
Baud rate: 125 KBs.
MAC ID: 63
Strobe Register: 07h
Polling flags: All on.
Swap data flag: Off.
Store Flags: All on.

DIP SWITCH SETTING TABLE

SWITCH #	SETTING
1 - 6	MAC ID (all off = 0, all on = 63) Switch 1 is LSB (1), switch 6 is MSB (32).
7 off, 8 off	125 K baud
7 on, 8 off	250 K baud
7 off, 8 on	500 K baud
7 on, 8 on	N/A

CONNECTION SIZES

Device Profile: This product conforms to the DeviceNet™ specification Volumes I and II of version 2.0.

Device Configuration: No DeviceNet™ configuration is supported.

MESSAGE	PRODUCED	CONSUMED
Explicit	4 Bytes	4 Bytes
Polled	4 Bytes	6 Bytes
Bit Strobe	4 Bytes	8 Bytes

However, some meter configuration is supported.

NETWORK STATUS LEDs

Flashing Red LED:
This device is the only device on the network (waiting for an acknowledgment to its duplicate MAC ID check), or an I/O connection has timed out, or a recoverable error has occurred.

Flashing Green LED:
The device is functioning correctly and is waiting to be commissioned by a bus master.

Solid Red LED:
The device has encountered a non-recoverable fault, such as a duplicate MAC ID response, and has removed itself from the bus, or the device is in a power up reset state and is attempting to come on line.

Solid Green LED:
The device is on line, functioning correctly and has been commissioned by a bus master.

SUPPORTED CONNECTIONS

Polled Command: The Polled Command consumes 6 bytes of data, and is used to get, set, or reset attributes. The meter attribute is determined by the value in byte 0 of the data field. Refer to the Attribute Identification Chart for the appropriate value. Byte 1 determines the action: 0 = get, 1 = set, 2 = reset. The next 4 bytes are the new attribute value for the set command. For get or reset commands, enter 4 zeros. The data response from the Polled Command is in the format of a 4 byte hexadecimal number. For the get command (0), the response is the attribute value. For the set command (1), the response is an echo of the data input. For the reset command (2), all 0s are returned.

Bit Strobe Command: The Bit Strobe Command consumes eight bytes of data, or less. This is a read only predetermined meter attribute. The data response from the Bit Strobe Command is in the format of a 4 byte hexadecimal number. The register that will be read using the Bit Strobe command is determined by setting Attribute 2, Instance 1, Class 100* (decimal) with a value that represents the desired attribute. Refer to the Attribute Identification Chart for the appropriate value.

**Class 100 (decimal) is a vendor specific class.*

EXPLICIT MESSAGE COMMAND

Get Attribute: The attribute that will be read using the Get Attribute command is determined by setting Service Code 14, Instance 1, Class 100* (decimal), and the attribute with a value that represents the desired meter attribute. Refer to the Attribute Identification Chart for the appropriate value. The data response from the Get Attribute Command is in the format of a 4 byte hexadecimal number.

Set Attribute: The attribute that will be set using the Set Attribute command is determined by setting Service Code 16, Instance 1, Class 100* (decimal), and the attribute with a value that represents the desired meter attribute. Refer to the Attribute Identification Chart for the appropriate value. The data field for the Set Attribute Command is entered as a 4 byte hexadecimal number.

Reset Attribute: The attribute that will be reset using the Reset Attribute command is determined by setting Service Code 5, Instance 1, Class 100* (decimal), and the attribute with a value that represents the desired meter attribute. Refer to the Attribute Identification Chart for the appropriate value.

**Class 100 (decimal) is a vendor specific class.*

Note: Not all meter attributes respond to a Set or Reset Attribute command. Refer to the Attribute Identification Chart for details.

Vendor Specific Error Responses

CODE ERROR #	ERROR CODE MEANING
1F (General Code)	Vendor Specific Error
1 (Additional Code)	Meter Response Time-out
2 (Additional Code)	Vendor Service Not Supported
3 (Additional Code)	Command String Syntax Error

Attribute Identification Chart

VALUE	DESCRIPTION						SERVICE CODES SUPPORTED						POLLING	STORE
	PAX	PAXI	PAXCK	PAXDP	PAX2A	PAXDR	PAX	PAXI	PAXCK	PAXDP	PAX2A	PAXDR		
1	Data Swapping Flag ①						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
2	Bit Strobe Attribute						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
3	Polling Flags 1 ②						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
4	Polling Flags 2 ②						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
5	Polling Flags 3 ②						N/A	G, S	G, S	G, S	G, S	G, S	N/A	N/A
6	DIP Switch ③						G	G	G	G	G, S	G, S	N/A	N/A
7	Input	Count A	Timer	Input A (rel)	Input (rel)	Rate A	G	G, S, R	G, S, R	G, R	G, R	G	Attr 3, bit 0	Attr 26, bit 0
8	Total	Count B	Count	Input B (rel)	Total	Rate B	G, R	G, S, R	G, S, R	G, R	G, R	G	Attr 3, bit 1	Attr 26, bit 1
9	Max	Count C	RTC Time	Calc	Max. Input	Rate C	G, R	G, S, R	G, S	G	G, R	G	Attr 3, bit 2	Attr 26, bit 2
10	Min	Rate	RTC Date	Total	Min. Input	Total A	G, R	G, S	G, S	G, R	G, R	G, S, R	Attr 3, bit 3	Attr 26, bit 3
11	SP 1	Min	SP 1	Min Input	Setpoint 1	Total B	G, S, R	G, S, R	G, S, R	G, R	G, S, R	G, S, R	Attr 3, bit 4	Attr 26, bit 4
12	SP 2	Max	SP 2	Max Input	Setpoint 2	Total C	G, S, R	G, S, R	G, S, R	G, R	G, S, R	G, R	Attr 3, bit 5	Attr 26, bit 5
13	SP 3	Scale A	SP 3	Input A (abs)	Setpoint 3	Scale A	G, S, R	G, S	G, S, R	G	G, S, R	G, S	Attr 3, bit 6	Attr 26, bit 6
14	SP 4	Scale B	SP 4	Input B (abs)	Setpoint 4	Scale B	G, S, R	G, S	G, S, R	G	G, S, R	G, S	Attr 3, bit 7	Attr 26, bit 7
15	AOR ④	Scale C	SP 1 Off	Input A (offset)	Band/Dev 1	Scale C	G, S	G, S	G, S	G, S	G, S	G, S	Attr 4, bit 0	Attr 27, bit 0
16	CSR ④	Load A	SP 2 Off	Input B (offset)	Band/Dev 2	Load A	G, S	G, S	G, S	G, S	G, S	G, S	Attr 4, bit 1	Attr 27, bit 1
17	-----	Load B	SP 3 Off	-----	Band/Dev 3	Load B	-----	G, S	G, S	-----	G, S	G, S	Attr 4, bit 2	Attr 27, bit 2
18	-----	Load C	SP 4 Off	-----	Band/Dev 4	-----	-----	G, S	G, S	-----	G, S	----	Attr 4, bit 3	Attr 27, bit 3
19	-----	SP 1	Timer Start	SP 1	Input (abs)	Setpoint 1	-----	G, S, R	G, S	G, S, R	G	G, S, R	Attr 4, bit 4	Attr 27, bit 4
20	-----	SP 2	Count Start	SP 2	Input Offset	Setpoint 2	-----	G, S, R	G, S	G, S, R	G, S	G, S, R	Attr 4, bit 5	Attr 27, bit 5
21	-----	SP 3	Timer Stop	SP 3	-----	Setpoint 3	-----	G, S, R	G, S	G, S, R	----	G, S, R	Attr 4, bit 6	Attr 27, bit 6
22	-----	SP 4	Count Stop	SP 4	-----	Setpoint 4	-----	G, S, R	G, S	G, S, R	----	G, S, R	Attr 4, bit 7	Attr 27, bit 7
23	-----	MMR ④	MMR ④	MMR ④	MMR ④	MMR ④	-----	G, S	G, S	G, S	G, S	G, S	Attr 5, bit 0	Attr 28, bit 0
24	-----	AOR ④	RTC Day	AOR ④	AOR ④	AOR ④	-----	G, S	G, S	G, S	G, S	G, S	Attr 5, bit 1	Attr 28, bit 1
25	-----	SOR ④	SOR ④	SOR ④	SOR ④	SOR ④	-----	G, S	G, S	G, S	G, S	G, S	Attr 5, bit 2	Attr 28, bit 2
26	Store Flags 1 ⑤						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
27	Store Flags 2 ⑤						G, S	G, S	G, S	G, S	G, S	G, S	N/A	N/A
28	Store Flags 3 ⑤						N/A	G, S	G, S	G, S	G, S	G, S	N/A	N/A

① Data Swap: (1 byte), Attribute 1, Instance 1, Class 100 (decimal). Data is normally sent and entered as follows: Pax display value = 500000 (7A120h). 4 byte value sent would be 20 A1 07 00. Setting the data swap value to 1 would result in the data being sent as 00 07 A1 20. This attribute can only be set to 0 or 1, all other values are ignored. The factory setting value is 0. Data Byte is saved in EEPROM memory.

② Polling Flags: (3 bytes) Attribute 3 - 5, Instance 1, Class 100 (decimal). The DeviceNet card is continually requesting values from the PAX unit. The polling flags determine what values are requested during each loop. Setting the flags to "1" enables the card to poll that particular value. A "0" value disables it. Turning polling flags off allows the card to request fewer values and therefore decreases the internal loop time, which allows the values that are polled to be updated more often.

TYPICAL UPDATE TIMES

PAX	PAXI/PAXCK/PAXDP
All values (10) – 1.00 sec	All values (19) – 750 msec
5 values – 500 msec	10 values – 430 msec
1 value – 100 msec	5 values – 230 msec
	1 value – 52 msec

If a Set Attribute is executed for any value, that value is automatically updated to the latest value, regardless of whether the polling flag is on or off. On power up, all values are updated regardless of Polling flag settings. Polling flag values are saved in EEPROM memory. Factory settings is "on" for all Polling flags.
See Meter Attribute Identification Chart for polling flags.

③ DIP Switch Values: (1 byte), Attribute 6, Instance 1, Class 100 (decimal). Returns the dip switch setting. Switch 1 = LSB, 1 = on.

④ Indicates PAX Manual Mode Registers. See next section for descriptions of these registers.

⑤ Store Flags: (3 bytes) Attribute 26 - 28, Instance 1, Class 100 (decimal). This set of flags determines whether the attribute is stored to EEPROM when a Set or Reset service code is executed. If the flag is 0, the value is not saved to EEPROM memory in the PAX. If the flag is 1, the value is saved immediately to EEPROM memory in the PAX. Factory setting is "on" for all Store Flags. The attributes are grouped in blocks. Storing one attribute may cause others to be stored. If an attribute is SET frequently, its store flag should be set to 0 to increase EEPROM life.

MANUAL MODE DESCRIPTION

(CSR) Control Status Register [16] (PAX)

The Control Status Register is used to directly control the meter's outputs (setpoints and analog output), or view the state of the setpoint outputs and the status of the temperature sensor (PAXT only). The attribute is bit mapped with each bit position within the attribute assigned to a particular control function. The control functions are invoked by writing to each bit position. The bit position definitions are:

bit 0: SP1 Output
bit 1: SP2 Output
bit 2: SP3 Output
bit 3: SP4 Output
0 = output off
1 = output on
bit 4: Manual Mode
0 = automatic mode
1 = manual mode
bit 5: Always stays 0, even if 1 is sent.
bit 6: Sensor Status (PAXT only)
0 = sensor normal
1 = sensor fail
bit 7: Always stays 0, even if 1 is sent.

In Manual Mode, the setpoint outputs are defined by the values written to bits b0, b1, b2, b3; and the analog output is defined by the value written to the AOR. Internal control of these outputs is then overridden. In automatic mode, the setpoint outputs can only be reset off.

Example:
1. Select manual mode for all outputs:
Value to write to attribute 16: 0010h

(MMR) Auto/Manual Mode Register [23] (PAXI/PAXCK/PAXDP/PAX2A/PAXDR)

This attribute sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint output. In Manual Mode (1) the outputs are defined by the attribute SOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the attribute is changed by a write). Each output may be independently changed to auto or manual. Select values to place in manual mode by writing appropriate value to attribute 23. The bit position definitions are:

PAXI/PAXDP/PAX2A/PAXDR

bit 0: Analog Output
bit 1: SP4
bit 2: SP3
bit 3: SP2
bit 4: SP1

0 = Auto Mode
1 = Manual Mode

PAXCK

bit 0: SP4
bit 1: SP3
bit 2: SP2
bit 3: SP1

0 = Auto Mode
1 = Manual Mode

Example:

1. Select manual mode for all outputs and AOR (PAXI/PAXDP/PAX2A/PAXDR):
   Value to write to attribute 23: 001Fh

(SOR) Setpoint Output Register [25] (PAXI/PAXCK/PAXDP/PAX2A/PAXDR)

This attribute is used to view or change the states of the setpoint outputs. Reading from this attribute will show the present state of all the setpoint outputs. A “0” in the setpoint location means the output is inactive and a “1” means the output is active.

In Automatic Mode (See MMR Description), the meter controls the setpoint output state. In Manual Mode, writing to this attribute will change the output state. The bit position definitions are:

bit 0: SP1
bit 1: SP2
bit 2: SP3
bit 3: SP4

0 = Output off
1 = Output on

Examples:

1. Turn all outputs on:
   Value to write to attribute 25 - 000Fh.
2. Turn outputs 1, 3 on:
   Value to write to attribute 25 - 0005h.
3. Turn all outputs off:
   Value to write to attribute 25 - 0000h.

(AOR) Analog Output Register (Not PAXCK)

The Analog Output Register controls the analog output of the meter. The manual mode must first be engaged by setting bit 4 of the CSR (PAX) or bit 0 of the MMR (PAXI). The range of values of this attribute is 0 to 4095, which corresponds to 0 mA, 0 V and 20 mA, 10 V; respectively. If a value larger than 4095 is written to the AOR Attribute, 4095 will be loaded. The table lists correspondence of the output signal with the attribute value.

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (20 mA or 10 V).*

Attribute Value	Output Signal*	
	I (mA)	V (V)
0	0.000	0.000
1	0.005	0.0025
2047	10.000	5.000
4094	19.995	9.9975
4095	20.000	10.000

Writing to this attribute while the meter is in the manual mode causes the output signal to update immediately. While in the automatic mode, this attribute may be written to, but the output will not update until the meter is placed in manual mode.

Examples:

1. Set output to full scale:
   Value to write to attribute 15 (PAX) or attribute 24 (PAXI) - 0FFFh (4095).
2. Set output to zero scale:
   Value to write to attribute 15 (PAX) or attribute 24 (PAXI) - 0000h (0).

MODEL PAXCDC -MODBUS OUTPUT OPTION CARD

DESCRIPTION

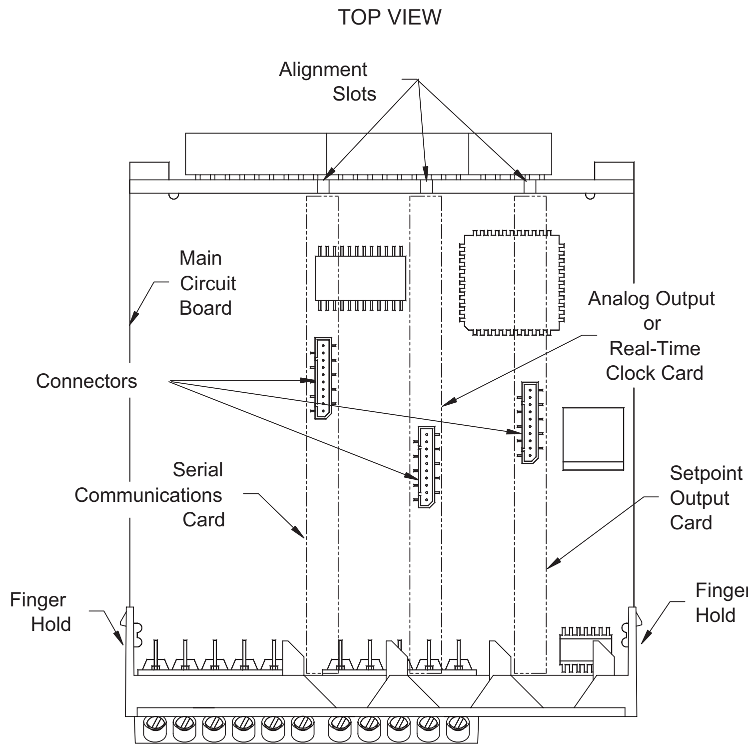
This product bulletin covers the MODBUS Communication Card for the PAX Meters. The card will allow the PAX Meter to transmit Display Values, Setpoints and Reset Values via MODBUS RS485 communication, in the RTU and ASCII modes.

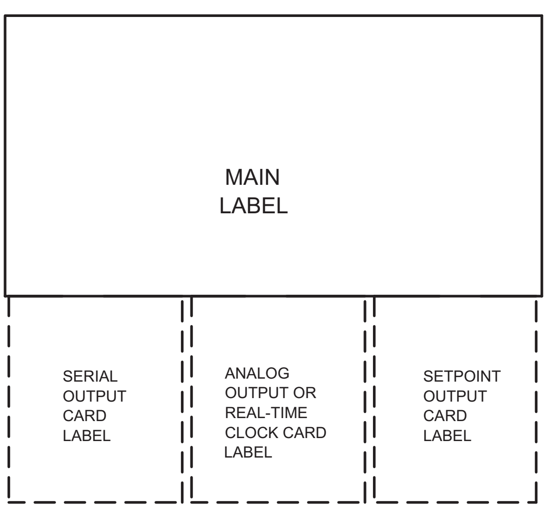
INSTALLING AN OPTION CARD

***Caution**: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

***Warning**: Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.*

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small scewdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Apply the option card label to the bottom side of the meter. Do not cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.
6. See manual for wiring connections and programming procedures.





MODBUS SPECIFICATIONS

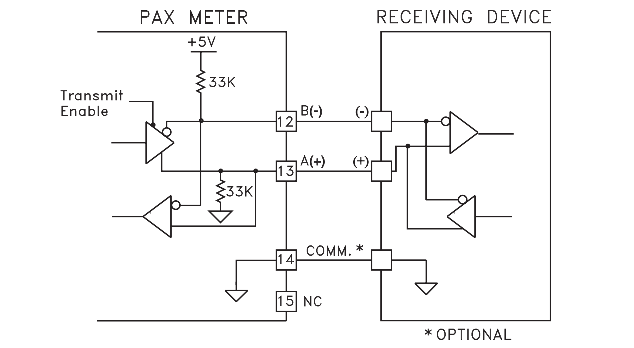
1. **Type**: RS485; RTU and ASCII MODBUS modes
2. **Isolation To Sensor & User Input Commons**: 500 Vrms for 1 minute. Working Voltage: 50 V. Not isolated from all other commons.
3. **Baud Rates**: 300 to 38400.
4. **Data**: 7/8 bits
5. **Parity**: No, Odd, or Even
6. **Addresses**: 1 to 247.
7. **Transmit Delay**: Programmable; See Transmit Delay explanation.

ORDERING INFORMATION

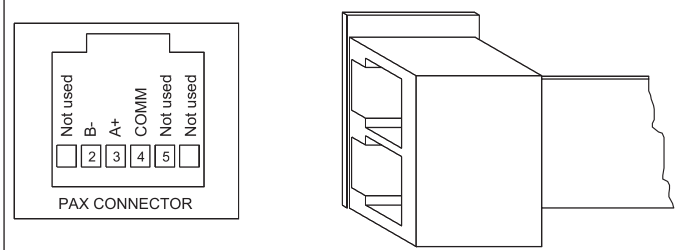
MODEL	DESCRIPTION	PART NUMBER
PAXCDC	PAX MODBUS Output Card	PAXCDC40
	PAX MODBUS Output Card with RJ11 Connector	PAXCDC4C

RS485 COMMUNICATIONS

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the PAX is limited to 19.2k baud). The same pair of wires is used to both transmit and receive data. RS485 is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



Terminal Block Connection Figure

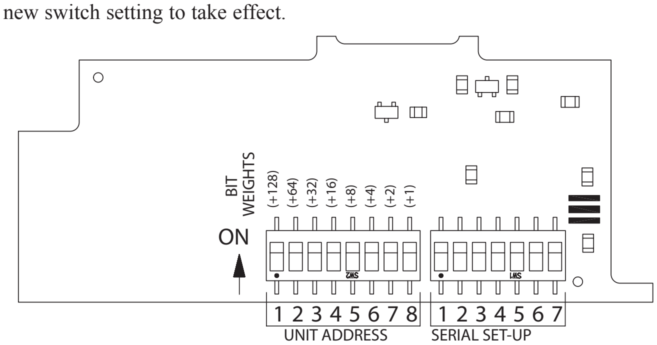


Extended Comms Connection Figure

J

SERIAL SET-UP DIP SWITCH OPERATION

Serial port configuration is accomplished through two banks of DIP switches on the MODBUS card. The bank of 8 switches sets the Unit Address, the bank of 7 switches sets the Serial port parameters (ASCII/RTU, 7/8 bits, Parity, and Baud rate). Changes to the switch settings are only detected on power-up of the unit. After changing a switch setting, power to the unit must be cycled for the new switch setting to take effect.



Both unit address and serial set-up are set via DIP switches on the MODBUS option card. See the DIP switch setting table for more details on these DIP switches.

For the Unit Address bank, the high order bit is switch 1, and the ON position is a ‘1’, the OFF position is a ‘0’. Legal unit addresses are 1 to 247. When a Unit Address of 0 is selected, the card responds to Unit Address 1. When a Unit Address of 248 through 255 is selected, the card responds to Unit Address 247.

For the serial bank, the following settings apply:

SWITCH	SETTINGS AVAILABLE		FACTORY SETTINGS
1	OFF: ASCII	ON: RTU	RTU
2	OFF: 7 Bits	ON: 8 Bits	8 Bits
3	OFF: None	ON: Parity	No Parity
4	OFF: Even	ON: Odd	OFF
5	Baud Rate	(See Baud Rate Switch Selections)	9600
6	Baud Rate		
7	Baud Rate		

BAUD RATE SWITCH SELECTIONS

	5	6	7
38400:	ON	ON	ON
19200:	ON	ON	OFF
9600:	ON	OFF	ON
4800:	ON	OFF	OFF
2400:	OFF	ON	ON
1200:	OFF	ON	OFF
600:	OFF	OFF	ON
300:	OFF	OFF	OFF

MODBUS SUPPORTED FUNCTION CODES

COIL FUNCTIONS

FC01: Read Coils

FC05: Force Single Coil, FC15: Force Multiple Coils.

1. Valid coil addresses are 1-49.
2. Block starting point can not exceed coil 49.

HOLD REGISTER FUNCTIONS

FC03: Read Holding Registers.

FC06: Preset Single Register, FC16: Preset Multiple Registers.

1. Valid register address are 40001 – 40039, 40041, 40042, 41001 – 41010.
2. Up to 16 registers can be requested at one time.
3. Block starting point can not exceed the register boundaries.
4. Holding registers are a mirror of Input registers (FC04).
5. Unused registers will return a value of HEX <8000>.
6. If a register is implemented, but does not exist for a particular unit configuration (such as SP3, SP4) a value of HEX <0000> will be returned.
7. Registers 41001 – 41010 contain the slave ID. See FC17.
8. Broadcast write is supported for FC06 & FC16. Register writes using address "0" will be recognized by the MODBUS card, regardless of address DIP switch setting.

OTHER SUPPORTED FUNCTIONS

FC04:

Returns the same values as FC03, except the register number starts with "3" (Ex: Pax Input Hi is 30001)

FC08 – Fetch Comm. Event Counter.

The MODBUS response breaks down as follows:

":010804"<TOT HI><TOT LO><GOOD HI><GOOD LO>XX<CR><LF>

The "TOT HI" and "TOT LO" values are the total number of messages that were received, that started with the card's address. The "GOOD HI" and "GOOD LO" are "good" messages (correct address, parity, and checksum). The values are reset on power up and every time the FC08 function is requested.

FC17 - Report Slave ID.

The following is sent upon FC17 request:

Unit Address, 17 (FC code), RLC-PAX(I or ?) 00?0, 0100 (for code version 1.00), 16 (number of read supported registers), 16 (number of write supported registers), 00 (number of registers available for GUID/Scratch pad memory), checksum of the string.

The following is the HEX of a PAXI (with unit address of 247):

:<F7><11><14><52><4C><43><2D><50><41><58><49><30><30><3F>
<30><01><00><00><10><00><10><00><00><XX><CR><LF>

XX is the LRC Checksum

PAX MANUAL MODE DESCRIPTION

(CSR) Control Status Register [40021]

The Control Status Register is used to directly control the meter's outputs (setpoints and analog output), or view the state of the setpoint outputs and the status of the temperature sensor (PAXT only). The register is bit mapped with each bit position within the register assigned to a particular control function. The control functions are invoked by writing to each bit position. The bit position definitions are:

bit 0: SP1 Output
bit 1: SP2 Output
bit 2: SP3 Output
bit 3: SP4 Output
} 0 = output off, 1 = output on

bit 4: Manual Mode
0 = automatic mode
1 = manual mode

bit 5: Always stays 0, even if 1 is sent.
bit 6: Sensor Status (PAXT only)
0 = sensor normal
1 = sensor fail
bit 7: Always stays 0, even if 1 is sent.

In Manual Mode, the setpoint outputs are defined by the values written to bits b0, b1, b2, b3; and the analog output is defined by the value written to the AOR. Internal control of these outputs is then overridden. In automatic mode, the setpoint outputs can only be reset off.

(MMR) Auto/Manual Mode Register [40036] (PAXI/DR/CK/TM)

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint output. In Manual Mode (1) the outputs are defined by the registers SOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. Select values to place in manual mode by writing appropriate value to holding register 40036. The bit position definitions are:

PAXI/PAXDR

bit 0: Analog Output
bit 1: SP4
bit 2: SP3
bit 3: SP2
bit 4: SP1
} 0 = Auto Mode, 1 = Manual Mode

PAXCK/PAXTM

bit 0: SP4
bit 1: SP3
bit 2: SP2
bit 3: SP1
} 0 = Auto Mode, 1 = Manual Mode

Examples:

1. Select manual mode for all outputs (PAX):
   Value to write to holding register 40021: 0010h
2. Select manual mode for all outputs and AOR (PAXI, PAXDR):
   Value to write to holding register 40036: 001Fh

(SOR) Setpoint Output Register [40038] (PAXI/DR/CK/TM)

This register is used to view or change the states of the setpoint outputs. Reading from this register will show the present state of all the setpoint outputs. A "0" in the setpoint location means the output is inactive and a "1" means the output is active.

In Automatic Mode (See MMR Description), the meter controls the setpoint output state. In Manual Mode, writing to this register will change the output state. The bit position definitions are:

bit 0: SP1
bit 1: SP2
bit 2: SP3
bit 3: SP4
} 0 = Output off, 1 = Output on

Examples:

1. Turn all outputs on:
   Value to write to holding register 40038: 000Fh.
2. Turn outputs 1, 3 on:
   Value to write to holding register 40038: 0005h.
3. Turn all outputs off:
   Value to write to holding register 40038: 0000h.

(AOR) Analog Output Register (Not Applicable to PAXCK/TM)

The Analog Output Register controls the analog output of the meter. The manual mode must first be engaged by setting bit 4 of the CSR (PAX) or bit 0 of the MMR (PAXI/DR). The range of values of this register is 0 to 4095, which corresponds to 0 mA, 0 V and 20 mA, 10 V; respectively. If a value larger than 4095 is written to the AOR register, 4095 will be loaded. The table lists correspondence of the output signal with the register value.

Register Value	Output Signal* I (mA)	Output Signal* V (V)
0	0.000	0.000
1	0.005	0.0025
2047	10.000	5.000
4094	19.995	9.9975
4095	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (20 mA or 10 V).*

Writing to this register while the meter is in the manual mode causes the output signal to update immediately. While in the automatic mode, this register may be written to, but the output will not update until the meter is placed in manual mode.

Examples:

1. Set output to full scale:
   Value to write to holding register 40020 (PAX) or 40037 (PAXI/DR): 0FFFh (4095).
2. Set output to zero scale:
   Value to write to holding register 40020 (PAX) or 40037 (PAXI/DR): 0000h (0).

HOLDING REGISTERS

Values less than 65,535 will be in (LO word). Values greater than 65,535 will continue into (HI word). Negative values are represented by two's complement of the combined (HI word) and (LO word).

HOLDING REGISTER	PAX [4]		PAXI [5]	PAXCK/PAXTM [5]		PAXDR [5]	
		ACCESS			ACCESS		ACCESS
40001:	Input (HI)	Read Only	CTA (HI)	Timer (HI)	Read/Write	Rate A (HI)	Read Only
40002:	Input (LO)	Read Only	CTA (LO)	Timer (LO)	Read/Write	Rate A (LO)	Read Only
40003:	Total (HI)	Read Only	CTB (HI)	Counter (HI)	Read/Write	Rate B (HI)	Read Only
40004:	Total (LO)	Read Only	CTB (LO)	Counter (LO)	Read/Write	Rate B (LO)	Read Only
40005:	Min (HI)	Read Only	CTC (HI)	RTC Time (HI)	Read/Write	Rate C (HI)	Read Only
40006:	Min (LO)	Read Only	CTC (LO)	RTC Time (LO)	Read/Write	Rate C (LO)	Read Only
40007:	Max (HI)	Read Only	RTE (HI)	RTC Date (HI)	Read/Write	Total A (HI)	Read/Write
40008:	Max (LO)	Read Only	RTE (LO)	RTC Date (LO)	Read/Write	Total A (LO)	Read/Write
40009:	SP1 (HI)	Read/Write	Min (HI)	SP1 (HI)	Read/Write	Total B (HI)	Read/Write
40010:	SP1 (LO)	Read/Write	Min (LO)	SP1 (LO)	Read/Write	Total B (LO)	Read/Write
40011:	SP2 (HI)	Read/Write	Max (HI)	SP2 (HI)	Read/Write	Total C (HI)	Read/Reset
40012:	SP2 (LO)	Read/Write	Max (LO)	SP2 (LO)	Read/Write	Total C (LO)	Read/Reset
40013:	SP3 (HI)	Read/Write	SFA (HI)	SP3 (HI)	Read/Write	SFA (HI)	Read/Write
40014:	SP3 (LO)	Read/Write	SFA (LO)	SP3 (LO)	Read/Write	SFA (LO)	Read/Write
40015:	SP4 (HI)	Read/Write	SFB (HI)	SP4 (HI)	Read/Write	SFB (HI)	Read/Write
40016:	SP4 (LO)	Read/Write	SFB (LO)	SP4 (LO)	Read/Write	SFB (LO)	Read/Write
40017:	Polling1 *	Read/Write	SFC (HI)	SP1 Off (HI)	Read/Write	SFC (HI)	Read/Write
40018:	Reset *	Read/Write	SFC (LO)	SP1 Off (LO)	Read/Write	SFC (LO)	Read/Write
40019:	TRX Delay [3]	Read/Write	LDA (HI)	SP2 Off (HI)	Read/Write	LDA (HI)	Read/Write
40020:	AOR [2]	Read/Write	LDA (LO)	SP2 Off (LO)	Read/Write	LDA (LO)	Read/Write
40021:	CSR	Read/Write	LDB (HI)	SP3 Off (HI)	Read/Write	LDB (HI)	Read/Write
40022:	Terminate1	Read/Write	LDB (LO)	SP3 Off (LO)	Read/Write	LDB (LO)	Read/Write
40023:			LDC (HI)	SP4 Off (HI)	Read/Write		
40024:			LDC (LO)	SP4 Off (LO)	Read/Write		
40025:			SP1 (HI)	Timer Start (HI)	Read/Write	SP1 (HI)	Read/Write
40026:			SP1 (LO)	Timer Start (LO)	Read/Write	SP1 (LO)	Read/Write
40027:			SP2 (HI)	Counter Start (HI)	Read/Write	SP2 (HI)	Read/Write
40028:			SP2 (LO)	Counter Start (LO)	Read/Write	SP2 (LO)	Read/Write
40029:			SP3 (HI)	Timer Stop (HI)	Read/Write	SP3 (HI)	Read/Write
40030:			SP3 (LO)	Timer Stop (LO)	Read/Write	SP3 (LO)	Read/Write
40031:			SP4 (HI)	Counter Stop (HI)	Read/Write	SP4 (HI)	Read/Write
40032:			SP4 (LO)	Counter Stop (LO)	Read/Write	SP4 (LO)	Read/Write
40033:			Polling1 *	Polling1 *	Read/Write	Polling1 *	Read/Write
40034:			Polling2 *	Polling2 *	Read/Write	Polling2 *	Read/Write
40035:			TRX Delay [3]	TRX Delay [3]	Read/Write	TRX Delay [3]	Read/Write
40036:			MMR	MMR	Read/Write	MMR	Read/Write
40037:			AOR [2]	RTC Day	Read/Write	AOR [2]	Read/Write
40038:			SOR	SOR	Read/Write	SOR	Read/Write
40039:			Reset *	Reset *	Read/Write	Reset *	Read/Write
40040:							
40041:			Terminate1	Terminate1	Read/Write	Terminate1	Read/Write
40042:			Terminate2	Terminate2	Read/Write	Terminate2	Read/Write

* See Coil Table for register mapping and Coil Descriptions for functionality.

Notes:

1. Any registers marked with "——" are unused and will return a value of HEX <8000>.
2. If a value larger than 4095 is written to the AOR register, 4095 will be loaded.
3. TRX delay is the minimum time from the reception of the last character in the MODBUS Query until the response is started. The minimum delay value is equal to 2 character times (2 msec min.). The user can increase the delay time by writing to the TRX Delay register. Any value written to the TRX Delay register that is less than the value calculated at power up will be ignored. The TRX Delay value is stored in E^2PROM memory. On power-up, the calculated value is compared to the value read back from the E^2PROM. The greater of the 2 values will be used as the TRX Delay value and will be written to the TRX Delay register.
4. Numeric data is limited to value -19999 to 99999.
5. Numeric data is limited to the value listed for that parameter according to the meter's literature.

COIL TABLE

COIL ADDRESS	COIL NUMBER	PAX		PAXI		PAXCK		PAXDR	
		COIL NAME	MIRROR REGISTER	COIL NAME	MIRROR REGISTER	COIL NAME	MIRROR REGISTER	COIL NAME	MIRROR REGISTER
01	0	SP1 Output	40021 (bit 0)	SP1 Output	40038 (bit 0)	SP1 Output	40038 (bit 0)	SP1 Output	40038 (bit 0)
02	1	SP2 Output	40021 (bit 1)	SP2 Output	40038 (bit 1)	SP2 Output	40038 (bit 1)	SP2 Output	40038 (bit 1)
03	2	SP3 Output	40021 (bit 2)	SP3 Output	40038 (bit 2)	SP3 Output	40038 (bit 2)	SP3 Output	40038 (bit 2)
04	3	SP4 Output	40021 (bit 3)	SP4 Output	40038 (bit 3)	SP4 Output	40038 (bit 3)	SP4 Output	40038 (bit 3)
05	4	Reset Max	40018 (bit 2)	Reset Max	40039 (bit 2)	———	———	Reset Total C	40039 (bit 2)
06	5	Reset Min	40018 (bit 3)	Reset Min	40039 (bit 3)	———	———	Reset Total B	40039 (bit 3)
07	6	———	———	Reset CNT A	40039 (bit 7)	Reset Timer	40039 (bit 7)	———	———
08	7	———	———	Reset CNT B	40039 (bit 6)	Reset Counter	40039 (bit 6)	———	———
09	8	———	———	Reset CNT C	40039 (bit 5)	———	———	———	———
10	9	Reset Total	40018 (bit 4)	———	———	———	———	———	———
11	10	Poll Input	40017 (bit 0)	Poll CNT A	40033 (bit 0)	Poll Timer	40033 (bit 0)	Poll Rate A	40033 (bit 0)
12	11	Poll Total	40017 (bit 1)	Poll CNT B	40033 (bit 1)	Poll Counter	40033 (bit 1)	Poll Rate B	40033 (bit 1)
13	12	Poll Max	40017 (bit 2)	Poll MAX	40033 (bit 2)	Poll SP2	40033 (bit 2)	Poll Total C	40033 (bit 2)
14	13	Poll Min	40017 (bit 3)	Poll MIN	40033 (bit 3)	Poll SP1	40033 (bit 3)	Poll Total B	40033 (bit 3)
15	14	Poll SP1	40017 (bit 4)	Poll SP1	40033 (bit 4)	Poll Timer Start	40033 (bit 4)	Poll SP1	40033 (bit 4)
16	15	Poll SP2	40017 (bit 5)	Poll SP2	40033 (bit 5)	Poll Counter Start	40033 (bit 5)	Poll SP2	40033 (bit 5)
17	16	Poll SP3	40017 (bit 6)	Poll SP3	40033 (bit 6)	Poll Timer Stop	40033 (bit 6)	Poll SP3	40033 (bit 6)
18	17	Poll SP4	40017 (bit 7)	Poll SP4	40033 (bit 7)	Poll Counter Stop	40033 (bit 7)	Poll SP4	40033 (bit 7)
19	18	Poll AOR	40017 (bit 8)	Poll AOR	40033 (bit 8)	Poll Day	40033 (bit 8)	Poll AOR	40033 (bit 8)
20	19	Poll CSR	40017 (bit 9)	Poll SOR	40033 (bit 9)	Poll SOR	40033 (bit 9)	Poll SOR	40033 (bit 9)
21	20	Term Total	40022 (bit 0)	Poll CNT C	40033 (bit 10)	Poll RTC Time	40033 (bit 10)	Poll Rate C	40033 (bit 10)
22	21	Term Max	40022 (bit 1)	Poll RATE	40033 (bit 11)	Poll RTC Date	40033 (bit 11)	Poll Total A	40033 (bit 11)
23	22	Term Min	40022 (bit 2)	Poll SFA	40033 (bit 12)	Poll SP3	40033 (bit 12)	Poll SFA	40033 (bit 12)
24	23	Term SP1	40022 (bit 3)	Poll SFB	40033 (bit 13)	Poll SP4	40033 (bit 13)	Poll SFB	40033 (bit 13)
25	24	Term SP2	40022 (bit 4)	Poll SFC	40033 (bit 14)	Poll SP1 Off	40033 (bit 14)	Poll SFC	40033 (bit 14)
26	25	Term SP3	40022 (bit 5)	Poll LDA	40033 (bit 15)	Poll SP2 Off	40033 (bit 15)	Poll LDA	40033 (bit 15)
27	26	Term SP4	40022 (bit 6)	Poll LDB	40034 (bit 0)	Poll SP3 Off	40034 (bit 0)	Poll LDB	40034 (bit 0)
28	27	Term AOR	40022 (bit 7)	Poll LDC	40034 (bit 1)	Poll SP4 Off	40034 (bit 1)	———	———
29	28	Term CSR	40022 (bit 8)	Poll MMR	40034 (bit 2)	Poll MMR	40034 (bit 2)	Poll MMR	40034 (bit 2)
30	29	Response Delay	40017 (bit 10)	Response Delay	40034 (bit 3)	Response Delay	40034 (bit 3)	Response Delay	40034 (bit 3)
31	30	———	———	Term CNT A	40041 (bit 0)	Term Timer	40041 (bit 0)	Term CNT A	40041 (bit 0)
32	31	———	———	Term CNT B	40041 (bit 1)	Term Count	40041 (bit 1)	Term CNT B	40041 (bit 1)
33	32	———	———	Term CNT C	40041 (bit 2)	Term RTC Time	40041 (bit 2)	Term CNT C	40041 (bit 2)
34	33	———	———	Term Rate	40041 (bit 3)	Term RTC Date	40041 (bit 3)	Term Total A	40041 (bit 3)
35	34	———	———	Term Min	40041 (bit 4)	Term SP1	40041 (bit 4)	Term Total B	40041 (bit 4)
36	35	———	———	Term Max	40041 (bit 5)	Term SP2	40041 (bit 5)	Term Total C	40041 (bit 5)
37	36	———	———	Term SFA	40041 (bit 6)	Term SP3	40041 (bit 6)	Term SFA	40041 (bit 6)
38	37	———	———	Term SFB	40041 (bit 7)	Term SP4	40041 (bit 7)	Term SFB	40041 (bit 7)
39	38	———	———	Term SFC	40041 (bit 8)	Term SP1 Off	40041 (bit 8)	Term SFC	40041 (bit 8)
40	39	———	———	Term LDA	40041 (bit 9)	Term SP2 Off	40041 (bit 9)	Term LDA	40041 (bit 9)
41	40	———	———	Term LDB	40041 (bit 10)	Term SP3 Off	40041 (bit 10)	Term LDB	40041 (bit 10)
42	41	———	———	Term LDC	40041 (bit 11)	Term SP4 Off	40041 (bit 11)	———	———
43	42	———	———	Term SP1	40041 (bit 12)	Term Time Start	40041 (bit 12)	Term SP1	40041 (bit 12)
44	43	———	———	Term SP2	40041 (bit 13)	Term Count Start	40041 (bit 13)	Term SP2	40041 (bit 13)
45	44	———	———	Term SP3	40041 (bit 14)	Term Time Stop	40041 (bit 14)	Term SP3	40041 (bit 14)
46	45	———	———	Term SP4	40041 (bit 15)	Term Count Stop	40041 (bit 15)	Term SP4	40041 (bit 15)
47	46	———	———	Term AOR	40042 (bit 0)	Term MMR	40042 (bit 0)	Term AOR	40042 (bit 0)
48	47	———	———	Term MMR	40042 (bit 1)	Term Day	40042 (bit 1)	Term MMR	40042 (bit 1)
49	48	———	———	Term SOR	40042 (bit 2)	Term SOR	40042 (bit 2)	Term SOR	40042 (bit 2)

COIL DESCRIPTIONS

Coils 1-4: Output Coils

These coils are used to read or change the states of the Setpoint Outputs. To change the state of the output(s), the output(s) must be in manual mode. Refer to the CSR or MMR/SOR registers in the Manual Mode Description section.

Coils 5-10: Reset Coils

These coils are used to perform the Reset command for the values listed. Forcing the coil "on" causes the appropriate value in the unit to be reset. The coil is cleared after the command is executed, therefore, the coil value read will always be 0 (zero).

Coils 11-29: Polling Coils

The MODBUS card is continually requesting values from the PAX unit. The polling bit coils determine what values are requested during each loop. Setting the coils to "1" enables the card to poll that particular value. A "0" value disables it. Turning polling coils off allows the user to request fewer values and therefore decreases the internal loop time, which allows the values that are polled to be updated more often.

If a MODBUS read is issued for any value, that value is automatically updated to the latest value, regardless of whether the polling bit is on or off. On power up, all values are updated regardless of Polling bit settings. Polling coil values are saved in E^2PROM memory. Factory settings is "on" for all Polling coils.

TYPICAL UPDATE TIMES**	
PAX	PAXI/DR/CK/TM
All values (10) - 1.15 sec	All values (19) - 900 msec
5 values - 500 msec	10 values - 480 msec
1 value - 100 msec	5 values - 230 msec
	1 value - 52 msec

***Update time is the typical time to update the internal memory provided no MODBUS requests are incoming.*

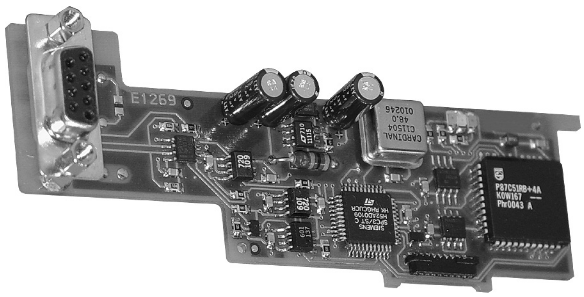
Coils 21-29 (PAX), Coils 31-49 (PAXI/DR/CK/TM): Terminating Coils

This set of coils determines what terminating character is sent to the PAX meter when a write command is executed. If the flag is 0, a $ is used as the terminating character and the value is not saved to E^2PROM memory in the PAX. If the flag is 1, an * is used as the terminating character and the value is saved to E^2PROM memory in the PAX.

Coil 30: Response Delay

When a write command is issued, the new value is written to the PAX. If the coil is off, the MODBUS write response is not issued until the value is read back from the PAX. For MODBUS reads, if a polling coil is off, the response is not issued until the latest value is read back from the PAX. If the coil is set "on" the MODBUS response is issued as soon the received command is complete. The write coil is saved in E^2PROM memory. Factory setting is on.

MODEL PAXCDC - PROFIBUS-DP COMMUNICATIONS OPTION CARD



- *CONNECTS PAX METER TO PROFIBUS-DP NETWORK*
- *STANDARD 9-PIN D-SUB CONNECTOR INTERFACE*
- *CYCLIC I/O DATA TRANSMISSION, UP TO 84 BYTES IN/OUT*
- *OPERATING RANGE FROM 9.6 KBAUD TO 12 MBAUD WITH AUTOMATIC BAUD RATE DETECTION*
- *STATION ADDRESS SET THROUGH ROTARY SWITCHES*
- *CONFIGURATION VIA SELECTION OF PRE-CONFIGURED MODULES FOR THE SPECIFIC PAX METER TYPE*
- *FREEZE MODE AND SYNC MODE SUPPORTED*
- *DIAGNOSTIC LEDs INDICATE CARD STATUS*
- *PNO CERTIFIED, CONFORMANCE TESTED SLAVE DEVICE*

DESCRIPTION

The PAX PROFIBUS-DP Communications Option Card provides a direct connection for a PAX panel meter to a PROFIBUS-DP Network. This allows a PROFIBUS Master device, such as a PLC, to control and monitor the operation of the PAX meter. The meter functions as an intelligent PROFIBUS-DP Slave device on the Network.

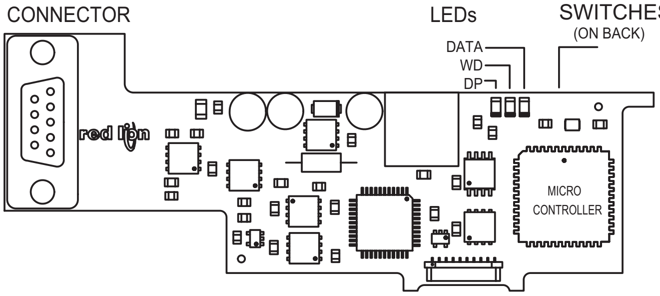
The PROFIBUS-DP Network connects through a 9-pin D-subminiature female connector on the rear of the card. The card is installed in the PAX meter using a slotted rear cover, allowing the PROFIBUS-DP Connector to extend beyond the rear of the PAX case. Power for the card is provided internally from the power supply of the PAX meter. The PROFIBUS-DP Network is isolated from the control electronics on the card using high-speed optocouplers.

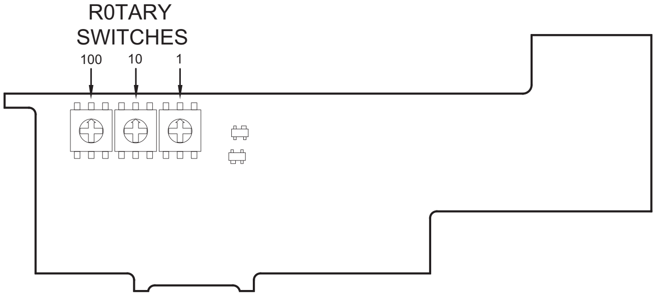
This fully featured communications card supports Automatic Baud Rate Detection, with an operating range of 9.6 Kbaud up to 12 Mbaud. The Station Address is set via rotary switches. The card's address is read at power up.

Data Exchange with the Master device occurs through cyclic I/O data transmission. The size of the I/O data block is determined by the selection of pre-configured Modules for the specific PAX meter type. All data values are in 32-bit integer format, Motorola byte ordering. The PROFIBUS-DP protocol per EN 50170 is implemented using the Siemens SPC3 ASIC. Three on-board Diagnostic LEDs indicate the status of Data Exchange (DATA), the SPC3 Watchdog (WD) and DP State Machine (DP).

PNO Conformance and GSD File

The PAX PROFIBUS-DP Card is PNO certified, having passed the conformance test for PROFIBUS-DP Slave devices, Certificate No. Z01170. The PNO Identifier for this PROFIBUS device is 0x09D0. The functional characteristics are described in GSD file REDL09D0.GSD. The GSD file and PAX bitmap can be downloaded from the Red Lion Controls website.





SPECIFICATIONS

1. **FIELDBUS TYPE**: PROFIBUS-DP per standard EN 50170, implemented with Siemens SPC3 ASIC
2. **BUS INTERFACE**: Isolated RS485 through 9-Pin D-Sub connector
3. **NETWORK ISOLATION**: 500 Vrms for 1 minute (50 V working) between PROFIBUS-DP network and PAX Sensor & User Input commons. Not isolated from other PAX option card commons.
4. **POWER**: Card powered internally by the PAX meter
5. **OUTPUT POWER**: +5 VDC @ 90 mA max. available on the D-Sub connector pins 5 (GND) and 6 (+5 V)
6. **BAUD RATES**: 9.6 Kbaud to 12 Mbaud, Auto Baud Rate Detection
7. **STATION ADDRESS**: 0 to 125, set by rotary switches
8. **SUPPORTED FUNCTIONS**:
   FREEZE Mode: Supported
   SYNC Mode: Supported
   FAIL SAFE Mode: Not Supported
   EXTERNAL DIAGNOSTIC DATA: Not Supported
9. **INSTALLATION REQUIREMENTS**:
   Installed Depth: 4.88" (124 mm) from the rear of the PAX bezel
   Additional Height: 0.35" (9 mm) above the PAX case surface

ORDERING INFORMATION

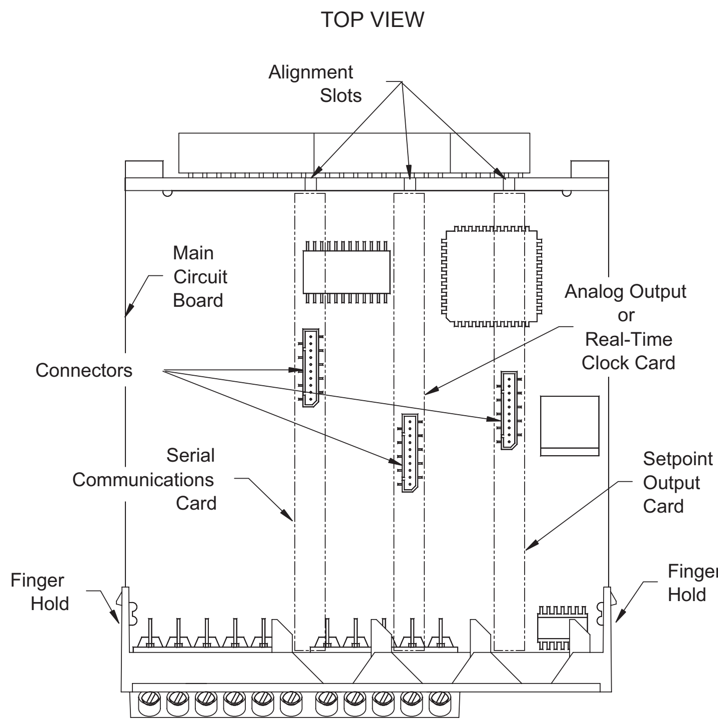
MODEL NO.	DESCRIPTION	PART NUMBER
PAXCDC	PAX PROFIBUS-DP Communications Card	PAXCDC50

INSTALLING AN OPTION CARD

Caution: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the serial communication card. Hold the unit by the rear cover, not the display board, when installing an option card.
3. Install the option card by aligning the option card with the slot in the rear cover. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.



J

PRINCIPLE OF OPERATION

The PAX PROFIBUS-DP Card provides the PROFIBUS Network with access to an Input Data Block (data written to the PROFIBUS Network from the PAX) and an Output Data Block (data read from the PROFIBUS Network by the PAX). Using an internal high speed protocol, the card scans each PAX register in turn, continuously reading Input Data and only writing Output Data on demand. The PAX registers are mapped into each Input and Output Data Block, allowing the PROFIBUS Network read/write access to all the registers in the PAX. The structure of these Data Blocks is described in more detail in section **Data Block Structure**.

The Input Data and Output Data Blocks are updated at the end of each scan of the host PAX Meter. In order to increase the rate that new data is made available to the PROFIBUS Network, a scheme is employed that reduces the number of registers polled by the card in each scan to only those that are required in the application. This Polled Read Mask maps each bit to a PAX register index which, when set, will force that register to be read from the PAX Meter. This Polled Read Mask is defined as User Parameter Data and is described in more detail in section **Parameterization**.

Due to the cyclic nature of data exchange in the PROFIBUS network changing Output Data in a slave device, a scheme is employed that indicates which registers need to be written to the PAX Meter. This Demand Write Mask maps each bit to a register index which when set, will perform a "once only" write from the Output Data Block to the PAX Meter. Clearing and re-setting the bit in the Demand Write Mask will cause the value to be written again. The Demand Write Mask is part of the Data Block structure and is described in detail in section **Demand Write and Store Request Masks**.

STATION ADDRESS

The station address is set using three rotary switches allowing the ID to be set in standard decimal notation (e.g. address = 123 - SWC = 1, SWB = 2, SWA = 3). Valid addresses range from 0 to 125. If an address greater than 125 is set, the card will default to a station address of 125.

Note: The card will not default to 125 if set for 999, this number is a special test mode.

DIAGNOSTIC LEDs

Three LEDs indicate the status of the SPC3 DP Control State Machine (DP), the Watchdog State Machine (WD) and the PROFIBUS-DP Data Exchange State (DATA) as shown in Table 1. The LEDs are viewable through the vents on the top of the PAX case.

Table 1 - LED Indication of PROFIBUS-DP Card Status

LED STATE			CARD STATUS
DP (Red)	WD (Green)	DATA (Red)	
FLASHING	FLASHING	OFF	Bus Not Connected
OFF	FLASHING	OFF	Baud Rate Search
OFF	ON	OFF	Baud Control
FLASHING	ON	OFF	Waiting for Parameterization
ON	ON	OFF	Waiting for Configuration
OFF	OFF	ON	Data Exchange

PARAMETERIZATION

The Polled Read Mask defines which PAX registers will be polled by the card and therefore updated in the Input Data Block. The Polled Read Mask is a 32-bit integer with each bit mapped to a PAX register index. The Polled Read Mask is configured in the card by the Master sending a Parameterization telegram with 4 bytes of User Parameter Data representing the Polled Read Mask, in Motorola byte ordering.

Table 2 shows the User Parameter bytes representing the Polled Read Mask and gives the default value and a typical example. The default Polled Read Mask indicates PAX register index 0 will be updated in the Input Block. The example Polled Read Mask indicates that PAX registers 0 and 8 will be updated in the Input Block.

Table 2 - User Parameter Data

BYTE	0	1	2	3	4
DESCRIPTION	-	Polled Read Mask			
DEFAULT	0x00	0x00	0x00	0x00	0x01
EXAMPLE	0x00	0x00	0x00	0x01	0x01

CONFIGURATION

Configuration of the Data Block is by the selection of pre-configured modules, identified in the GSD file as “PAX Digital (6-digit)” and “PAX Analog (5-digit)”. They differ in the number of registers available and therefore the size of the Data Block required to map all the registers completely. Each PAX register is represented as a 32-bit Integer requiring 2, 16-bit words or 4 bytes.

DATA EXCHANGE

Demand Write and Store Request Masks

The Demand Write Mask defines how data is written to the PAX. The Demand Write Mask is a 32-bit integer with each bit mapped to a PAX register index. Setting a bit in the Demand Write Mask of the Output Data Block will force the corresponding register to be written “once only” to the PAX. Clearing and re-setting the bit will cause the value to be written again. The Demand Write Mask is part of the Data Block structure.

The Write Service Status register in the Input Data Block reports when the register has been written to the PAX by setting the corresponding bit. By monitoring this register a PLC program can detect when the Output Data has been serviced. The bit will be cleared in the Service Status register when the corresponding bit is cleared in the Demand Write Mask.

The Store Mask defines how the written value is to be stored in the PAX. The PAX meters have some values stored in EEPROM so they may power up in the last saved state. For values that change often it is possible to exceed the life of an EEPROM with repeated writes to the same address location - this method inhibits writes to EEPROM. The Store Mask is a 32-bit integer with each bit mapped to a PAX register index. Setting a bit will inhibit the corresponding register from being saved to EEPROM.

Data Block Structure

Table 3 shows the Data Block Structure, consisting of the Write and Store Masks and the individual PAX Data Registers. Each Data Register value is a 32-bit Integer, with Motorola byte ordering. For the Analog PAX meters, the Data Block size is 48 bytes Input, 48 bytes Output. For the PAXDP and PAX2A Analog meters, and the Digital PAX meters, the Data Block size is 84 bytes Input, 84 bytes Output.

J

Table 3 - Data Block Structure

REGISTER INDEX (Mask Bit)	DATA BLOCK BYTES	PAX ANALOG INPUT METER (5-Digit)	PAXDP ANALOG INPUT METER (5-Digit) ****	PAX2A ANALOG INPUT METER (6-Digit) ****	PAXI DIGITAL COUNT / RATE (6-Digit)	PAXDR DIGITAL DUAL RATE (6-Digit)	PAXCK DIGITAL CLOCK / TIMER (6-Digit)
-	1 - 4	Demand Write Mask (Output) / Service Status (Input)					
-	5 - 8	Store Mask (Output) / Unused (Input)					
0	9 - 12	Input *	Input A (relative) *	Input (relative) *	Count A	Rate A *	Timer
1	13 - 16	Total *	Input B (relative) *	Total *	Count B	Rate B *	Counter
2	17 - 20	Max. Input *	Calculation *	Max. Input *	Count C	Rate C *	RTC Time
3	21 - 24	Min. Input *	Total *	Min. Input *	Rate	Total A	RTC Date
4	25 - 28	Setpoint 1	Min Input *	Setpoint 1	Min. Rate	Total B	Setpoint 1
5	29 - 32	Setpoint 2	Max Input *	Setpoint 2	Max. Rate	Total C *	Setpoint 2
6	33 - 36	Setpoint 3	Input A (absolute) *	Setpoint 3	Scale Factor A	Scale Factor A	Setpoint 3
7	37 - 40	Setpoint 4	Input B (absolute) *	Setpoint 4	Scale Factor B	Scale Factor B	Setpoint 4
8	41 - 44	AOR **	Input A (offset)	Band/Deviation 1	Scale Factor C	Scale Factor C	Setpoint Off 1
9	45 - 48	CSR **	Input B (offset)	Band/Deviation 2	Count Load A	Count Load A	Setpoint Off 2
10	49 - 52	----	***	Band/Deviation 3	Count Load B	Count Load B	Setpoint Off 3
11	53 - 56	----	***	Band/Deviation 4	Count Load C	***	Setpoint Off 4
12	57 - 60	----	Setpoint 1	Input (absolute) *	Setpoint 1	Setpoint 1	Timer Start
13	61 - 64	----	Setpoint 2	Input Offset	Setpoint 2	Setpoint 2	Counter Start
14	65 - 68	----	Setpoint 3	***	Setpoint 3	Setpoint 3	Timer Stop
15	69 - 72	----	Setpoint 4	***	Setpoint 4	Setpoint 4	Counter Stop
16	73 - 76	----	MMR **	MMR **	MMR **	MMR **	MMR **
17	77 - 80	----	AOR **	AOR **	AOR **	AOR **	RTC Day
18	81 - 84	----	SOR **	SOR **	SOR **	SOR **	SOR **

* Indicates Read-Only parameters. All other parameters are Read/Write.
** Indicates PAX Manual Mode Registers. See next section for description.
*** Indicates bit value must not be set in the Parameterization polled read mask.
**** Select “PAX Digital (6-digit)” module for full mapping of the available registers.

PAX MANUAL MODE REGISTERS

CSR - Control Status Register (PAX Analog Only)

The Control Status Register is used to directly control the meter's outputs (setpoints and analog output), or view the state of the setpoint outputs and the status of the temperature sensor (PAXT only). The CSR register is bit mapped, with the bit positions of the least-significant byte assigned to specific control functions. The control functions are invoked by writing to the appropriate bit position. The bit position definitions are:

bit 0: Setpoint 1 Output
bit 1: Setpoint 2 Output
bit 2: Setpoint 3 Output
bit 3: Setpoint 4 Output
(bits 0–3: 0 = output off, 1 = output on)
bit 4: Auto/Manual Mode
  0 = automatic mode
  1 = manual mode
bit 5: Unused (always stays 0)
bit 6: Sensor Status (PAXT only)
  0 = sensor normal
  1 = sensor fail
bit 7: Unused (always stays 0)

Setting bit 4 of the CSR selects Manual Mode. In this mode, the setpoint outputs are defined by the values written to bits b0, b1, b2, b3; and the analog output is defined by the value written to the Analog Output Register (AOR). Internal control of these outputs is then overridden.

In Automatic Mode, the setpoint outputs can only be Reset off. The contents of the CSR may be read to interrogate the state of the setpoint outputs and to check the status of the temperature sensor (PAXT only).

MMR - Auto/Manual Mode Register (PAXDP/PAX2A/PAXI/PAXDR/PAXCK)

This register sets the controlling mode for each output in the PAX meters. Each output may be independently changed to Auto or Manual mode. The MMR register is bit mapped, with the bit positions of the least-significant byte assigned to specific outputs. Auto or Manual mode is selected by writing to the appropriate bit position. The bit position definitions are:

PAXDP/PAX2A/PAXI/PAXDR	PAXCK
bit 0: Analog Output	bit 0: Setpoint 4 Output
bit 1: Setpoint 4 Output	bit 1: Setpoint 3 Output
bit 2: Setpoint 3 Output	bit 2: Setpoint 2 Output
bit 3: Setpoint 2 Output	bit 3: Setpoint 1 Output
bit 4: Setpoint 1 Output	

0 = Auto Mode, 1 = Manual Mode

In Auto Mode (0) the meter controls the setpoint output state and the Analog Output (PAXDP/PAX2A/PAXI/PAXDR only). In Manual Mode (1) the setpoint outputs are defined by the value in the Setpoint Output Register (SOR); and the Analog Output is defined by the value written to the Analog Output Register (AOR). When transferring from Auto Mode to Manual Mode, the meter holds the last output value (until the register is changed by a write).

SOR - Setpoint Output Register (PAXDP/PAX2A/PAXI/PAXDR/PAXCK)

The Setpoint Output Register is used to view or change the states of the setpoint outputs in the PAX meters. Reading this register will show the present state of all the setpoint outputs. A "0" means the output is inactive and a "1" means the output is active.

In Auto Mode (see MMR description), the meter controls the setpoint output state. In Manual Mode, the four least-significant bits of the SOR are assigned to specific outputs. Writing to the appropriate bit position defines the state of the setpoint output. The bit position definitions are:

bit 0: Setpoint 4 Output Status
bit 1: Setpoint 3 Output Status
bit 2: Setpoint 2 Output Status
bit 3: Setpoint 1 Output Status
(0 = Output Off, 1 = Output On)

(AOR) Analog Output Register (Not applicable to PAXCK)

The Analog Output Register value defines the signal level of the meter's analog output. The range of values for this register is 0 to 4095 (0FFFh), which corresponds to the analog output signal ranges shown in Table 4.

Table 4 - Analog Output Signal Ranges

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.000	4.000	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

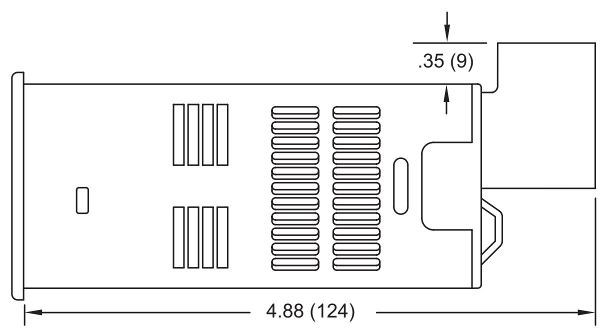
**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA or 0-10 V).*

In Automatic mode, the meter controls the analog output signal level. Reading the AOR will show the present value of the analog output signal. While in Automatic mode, this register may be written to, but it has no effect until the analog output is placed in the Manual mode.

In Manual mode, writing to the AOR causes the analog output signal level to update per the value written. Manual mode is engaged by setting bit 4 of the CSR (PAX Analog meter) or bit 0 of the MMR (PAXDP/PAX2A/PAXI/PAXDR). If a value larger than 4095 is written to the AOR, 4095 will be loaded.

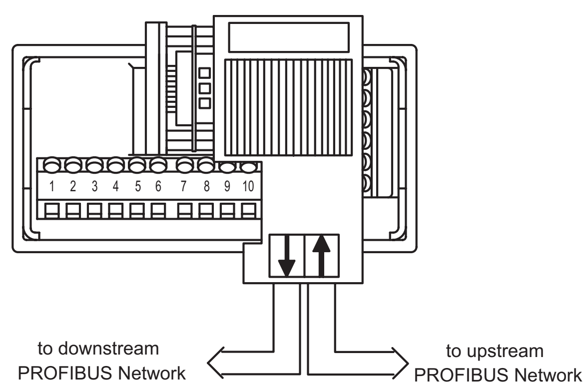
INSTALLATION AND CONNECTION

Installation Clearance Required - In Inches (mm)



PROFIBUS-DP Network Connection

PROFIBUS plug connectors such as Siemens 6ES7 972-0BA10-0XA0 are recommended. When wiring the connector, be sure to observe the proper direction for data flows, indicated by the arrows on the connector. When the PAX meter is the last device on the network, set the terminating resistor switch on the connector to the "ON" position.



MODEL PAXCDS -SETPOINT OUTPUT PLUG-IN OPTION CARDS

DESCRIPTION

This bulletin serves as a guide for the installation of PAX Setpoint cards. The setpoint cards are available as dual relay, quad relay, quad sinking transistor, quad sourcing transistor/SSR drive, or dual triac/dual SSR drive outputs.

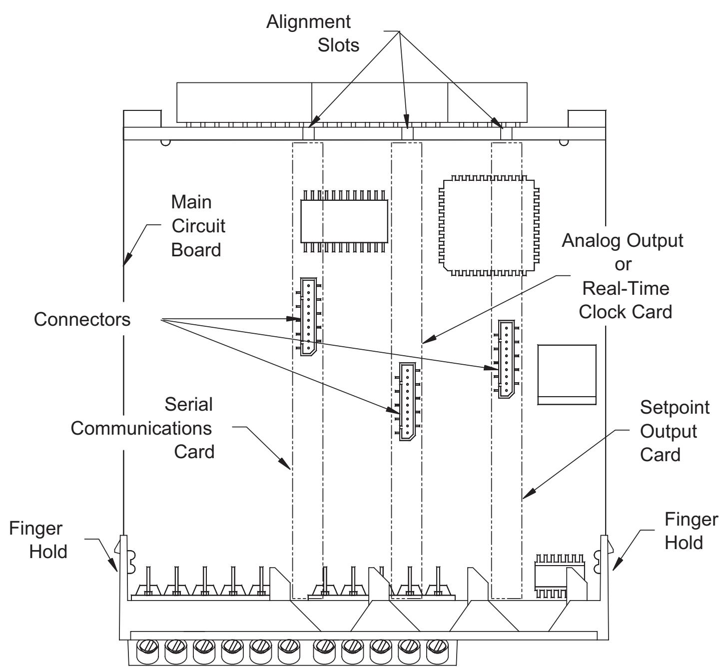
INSTALLING AN OPTION CARD

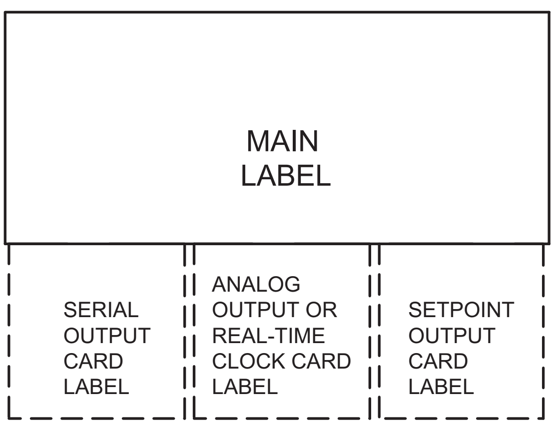
***Caution**: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

***Warning**: Exposed line voltage may be present on the circuit boards when power is applied. Remove all power to the unit AND load circuits before accessing the unit.*

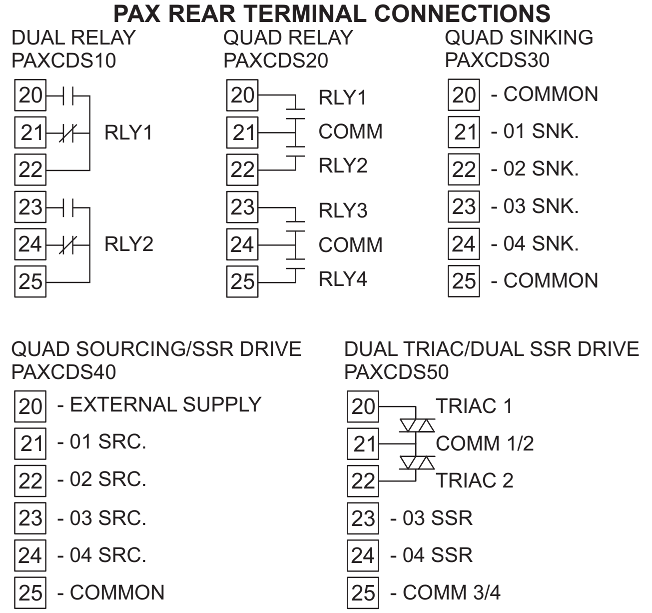
1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Apply the option card label to the bottom side of the unit. **Do not cover the vents on the top surface of the unit.** The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.

TOP VIEW





PAX REAR TERMINAL CONNECTIONS



SPECIFICATIONS

Setpoint Output Cards: Five types of field installable cards

Response Time: 200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled)700 msec. max. (digital filter disabled, internal zero correction enabled)

PAXH only: 1 sec. max. to within 99% of final readout value (digital filter disabled)

PAXT only: 200 msec. typ.; 700 msec max. (digital filter disabled)

PAXH Isolation For All Four Cards:

Isolation To Sensor Common: 1400 Vrms for 1 min.
Working Voltage: 125 V

Isolation To User Input Common: 500 Vrms for 1 min.
Working Voltage: 50 V

Dual Relay Card: PAXCDS10

Type: Two FORM-C relays

Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 250 V

Contact Rating:

One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @120 VAC, inductive load

Total Current With Both Relays Energized not to exceed 5 amps

Life expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

Quad Relay Card: PAXCDS20

Type: Four FORM-A relays

Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 V

Contact Rating:

One Relay Energized: 3 amps @ 250 VAC or 30 VDC (resistive load), 1/10 HP @120 VAC, inductive load

Total Current With All Four Relays Energized not to exceed 4 amps

Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

Quad Sinking Open Collector Card: PAXCDS30

Type: Four isolated sinking NPN transistors.

Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.

Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

Quad Sourcing Open Collector/SSR Drive Card: PAXCDS40

Type: Four isolated sourcing PNP transistors.

Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.

Rating:

Internal supply: 18/24 VDC (unit dependent) ± 10%, 30 mA max. total all four outputs

External supply: 30 VDC max., 100 mA max each output

Dual Triac/Dual SSR Drive Card: PAXCDS50

Triac:

Type: Isolated, zero crossing detection

Voltage: 260 VAC max., 20 VAC min.

Max Load Current: 1 Amp @ 25°C
0.75 Amp @ 50°C

Total load current with both triacs ON not to exceed 1.5 Amps

Min Load Current: 5 mA

Off State Leakage Current: 1 mA max @ 60 Hz

Operating Frequency: 20-400 Hz

SSR Drive:

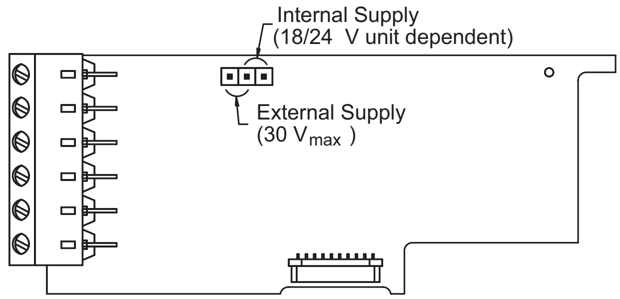
Type: Two isolated sourcing PNP Transistors.

Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.

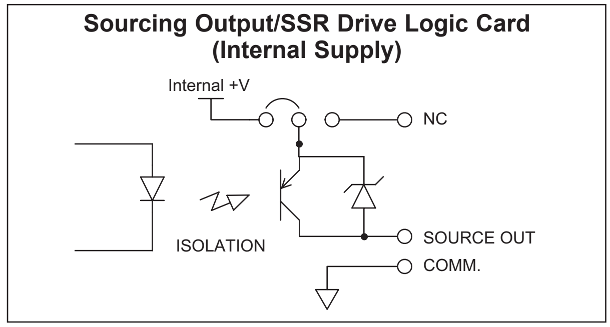
Rating:

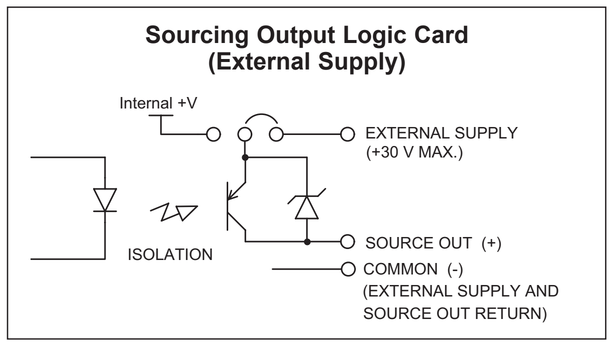
Output Voltage: 18/24 VDC (unit dependent) ± 10%, 30 mA max. total both outputs

Quad Sourcing Open Collector Output Card Supply Select



For Quad Sourcing/SSR Drive Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before applying power.





ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXCDS	Dual Relay Output Card	PAXCDS10
	Quad Relay Output Card	PAXCDS20
	Quad Sinking Open Collector Output Card	PAXCDS30
	Quad Sourcing Open Collector/SSR Drive Output Card	PAXCDS40
	Dual Triac/Dual SSR Drive Output Card	PAXCDS50

MODEL PAXCDL -ANALOG OUTPUT PLUG-IN OPTION CARD

DESCRIPTION

This bulletin serves as a guide for the installation, configuration and operation of the PAX® Analog Output card. The analog output can be configured for 0 to 20 mA, 4 to 20 mA or 0-10 VDC. Only one range can be used at a time.

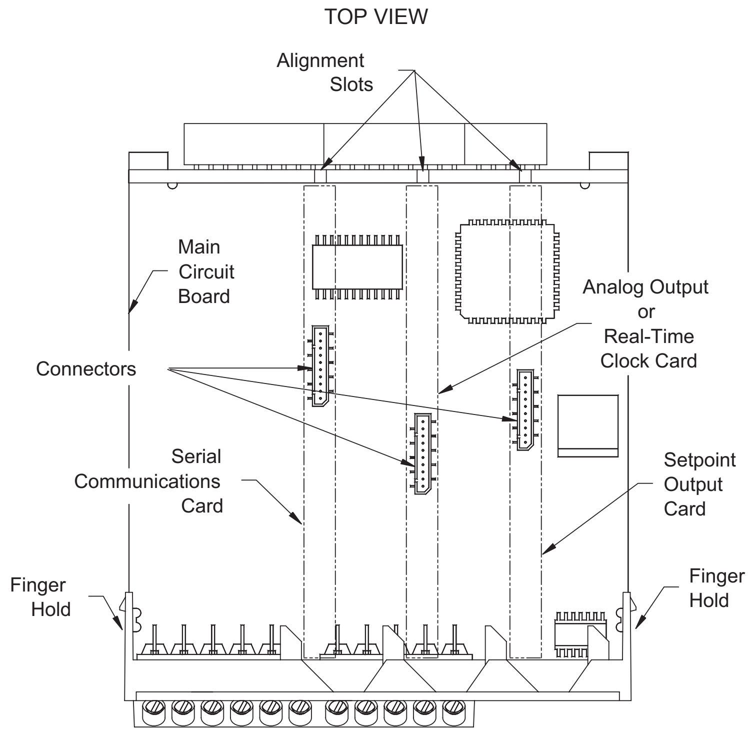
The PAX® meter can be fitted with up to three optional plug-in cards. The slot bays of the plug-in cards are dedicated to a particular card function. The plug-in card functions are: serial communications, analog output and setpoint output. Only one card from each function category can be installed.

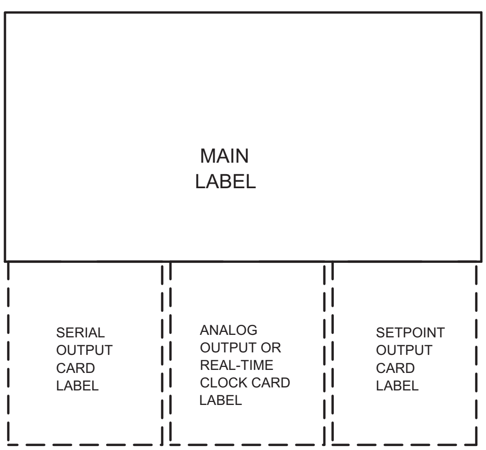
INSTALLING AN OPTION CARD

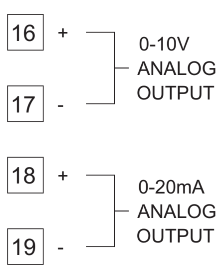
Caution*: The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.*

Warning*: Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.*

1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the type of option card to be installed. Hold the unit by the rear connector, not the display board, when installing an option card.
3. Install the option card by aligning the option card connector with the slot bay in the rear cover. The cards are keyed by position with different main board connector locations. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.
5. Apply the option card label to the bottom side of the meter. **Do not cover the vents on the top surface of the meter.** The surface of the case must be clean for the label to adhere properly. Apply the label to the area designated by the large case label.







SPECIFICATIONS

Analog Output Card

Types: 0 to 20 mA, 4 to 20 mA and 0 to 10 VDC

Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not isolated from all other commons.

PAXH Only:
Isolation To Sensor Common: 1400 Vrms for 1 min.
Working Voltage: 125 V
Isolation To User Input Common: 500 Vrms for 1 min.
Working Voltage: 50 V

Accuracy: 0.17% of FS (18 to 28°C); 0.4% of FS (0 to 50°C)

Resolution: 1/3500

Compliance:
10 VDC: 10 KΩ load min.
20 mA: 500 Ω load max. (self-powered)

Update Time: 200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled)
700 msec. max. (digital filter disabled, internal zero correction enabled)
PAXH only: 1 sec. max. to within 99% of final readout value (digital filter disabled)

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PAXCDL	Analog Output Card	PAXCDL10

MODULE 8 - Analog Output Parameters (8-Out)

PARAMETER MENU

8-Out → PAR → tYPE — ASIN — AN-LO — AN-HI — udt — burn (PAXT ONLY) → Pro

tYPE	ASIN	AN-LO	AN-HI	udt	burn
Analog Type	Analog Assignment	Analog Low Scale Value	Analog High Scale Value	Analog Update Time	Burn-out Action

Indicates Program Mode Alternating Display.

Parameter: tYPE
Selection/Value: 4-20

Factory Settings are shown.

ANALOG TYPE

tYPE / 4-20

SELECTION	RANGE
0-20	0 to 20 mA
4-20	4 to 20 mA
0-10	0 to 10 V

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG ASSIGNMENT

ASIN / InP

InP HI LO tot

Enter the source for the analog output to retransmit:
InP = Display Input Value
HI = Maximum Display Input Value
LO = Minimum Display Input Value
tot = Totalize Display Value

ANALOG LOW SCALE VALUE

AN-LO / 0.00

-19999 to 99999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

AN-HI / 100.00

-19999 to 99999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

udt / 0.0

0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at a rate of 20/sec.

PROBE BURN-OUT ACTION (PAXT ONLY)

burn / LO

LO HI

Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

J

INSTALLATION CONSIDERATIONS OF ELECTRONIC INSTRUMENTS & CONTROLS, IN INDUSTRIAL ENVIRONMENTS

Most electronic equipment designed for use in industrial environments has a high degree of noise immunity and protection against damage. But even the best can experience difficulties in operation if certain minimal considerations are not adhered to when installing the equipment. When relay contacts are used to switch inductive loads, such as auxiliary relays or solenoids, extremely large voltage spikes can be generated when the relay contact opens, these voltage spikes can cause pitting of the relay's contacts, thereby reducing its usable life.

The internal functioning components of an electronic instrument operate on a low DC voltage, generally 5 V, and respond to signals as low as 1 V or less. In contrast, stray voltage spikes in excess of 100 V and sometimes thousands of volts can be detected in the industrial environment. These voltage spikes can be coupled from power lines that are powering equipment that contains S.C.R. circuitry, or in other ways causes rapid load changes on the AC line. These spikes can also be coupled from lines that are actuating AC or DC solenoids or actuators. In other words, any wiring in an industrial application should be considered a potential noise source.

How can these noise spikes get into the instrument? There are three major ways that noise spikes can enter the instrument.

1. Noise can enter directly, via the AC power input. It is recommended that electronic instruments be connected to a relatively clean source of power. If this cannot be accomplished, there are means of suppressing noise or isolating the instrument from the noise. These consist of everything from simple inductive load suppressors (M.O.V.'s) to constant voltage isolation transformers, depending on the severity of power line disturbance.
2. Noise can enter via the input leads. Here, there are two modes (See Fig. 1) by which the noise can enter. Normal mode, which means the noise enters on the input lead, with respect to the instrument common; and common mode, which means the noise enters on both the input and the instrument common with respect to earth ground (power line neutral). It is recommended that sensor input and control input wiring not be run in the same conduit or raceways with power lines or current carrying control lines. It is also recommended that these lines be kept away from inductive loads such as motors, solenoids, relays and contactors. For best results, it is recommended that two-conductor shielded cable be used to connect these inputs. The shield should be connected to the input common at the instrument only. In addition, the input common should only be connected to machine ground (earth) at one point, preferably a direct connection to the input common terminal.
3. The third way noise can enter the instrument is via the output lines. This is one of the most overlooked sources of trouble. When an output is driving an inductive load, such as solenoids, contactors, or relays; a large noise spike, several times the supply voltage, is generated every time the output is turned off. This noise spike, in addition to physically degrading the relay contact, can radiate off the output lines and into more sensitive areas of the instrument. The surest way to alleviate this situation is to suppress the noise spike. It is best to do it at the noise source (See Fig. 2), to prevent noise currents from flowing in the output lines. There are several ways to do this. If it is a DC device, then either a diode or a M.O.V. (Metal Oxide Varistor) can be placed across the device to suppress it. The greater the current load of the device, the higher wattage diode required. If it is an AC load, then a M.O.V. or capacitor and resistor in series can be used. It can be seen that the output lines can be noise sources and as such should be kept away from the instrument's own input lines, as well as the input lines of other instruments.

In addition to the foregoing considerations, care should be taken when connecting input and output returns to the instrument's common. When separate input and output commons are provided, they should not be mixed. When an output device return is connected to an input common (See Fig. 4), the output current will flow in the input common line. This will cause a noise voltage to be present, which can affect the operation of the instrument.

In summary, it is much easier to eliminate problems when building up a system than after it is installed.

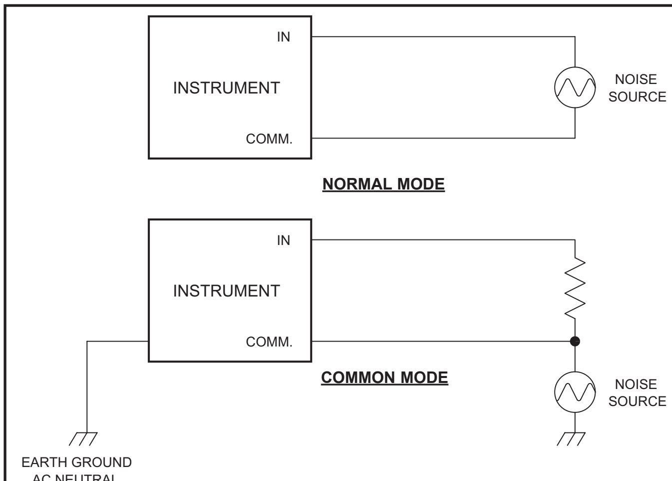


Figure 1

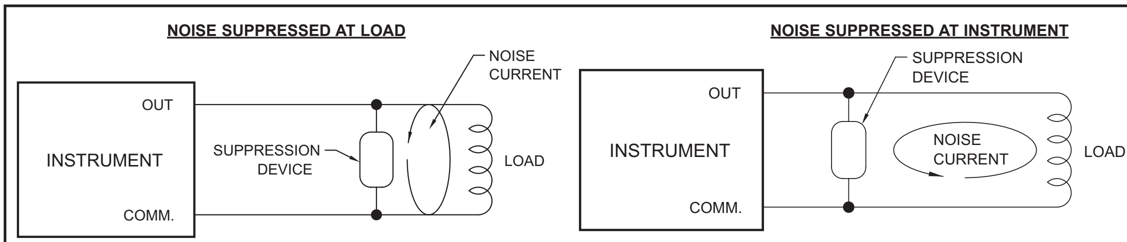


Figure 2

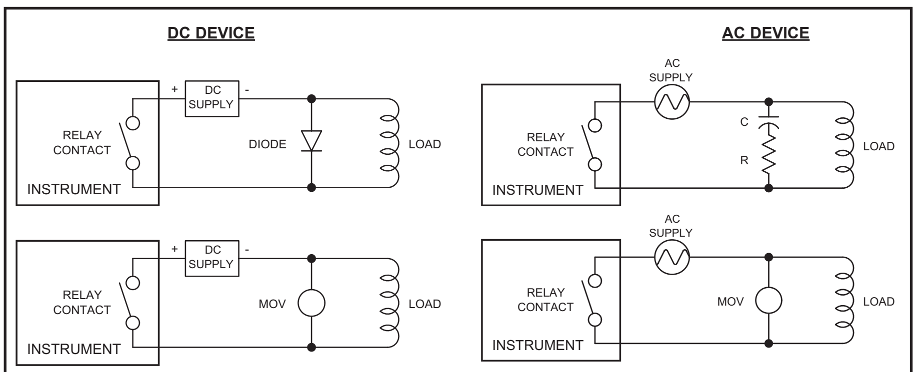


Figure 3

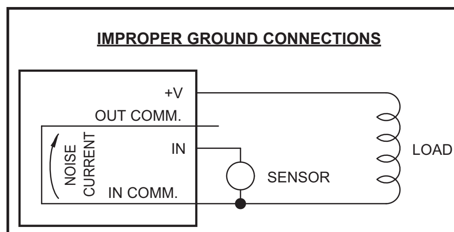


Figure 4

MODEL FCOR - FERRITE SUPPRESSION CORE

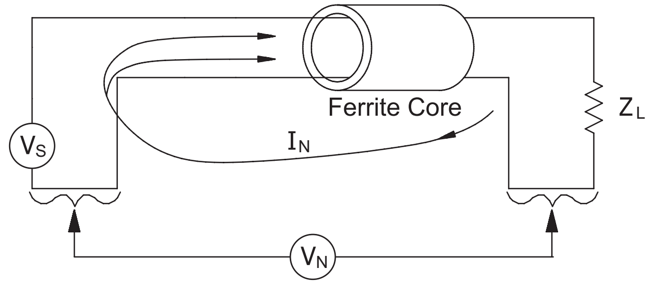
DESCRIPTION

This Ferrite suppression core is packaged in a nylon case ready to clamp on a single cable or several cables connecting to electronic equipment. The purpose of the core is to attenuate conducted Electro-Magnetic Interference (EMI) in the 25 MHz to 200 MHz range. Increasing the number of cable turns through the core increases the impedance of the core. A higher impedance results in greater EMI attenuation.

Placing more than one core on a cable increases the impedance at a slower rate than adding turns to one core. The impedance for multiple cores is equal to the sum of each core's impedance. For a given application, start with a single core using 2 turns. Add additional turns or additional cores as necessary.

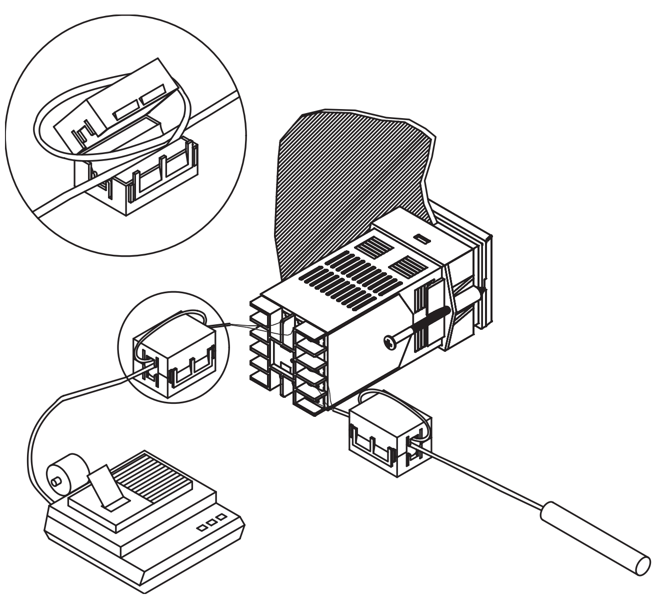
Note: Increasing the number of turns beyond two will tend to degrade performance at higher frequencies (see Specifications).

Place the cores on the cables as close to the equipment as possible unless the equipment is mounted in a shielded enclosure and the source of the EMI is from outside the enclosure. In this case, place the cores on the cable just inside or outside the entry point of the enclosure.



Ferrite core used for suppressing common--mode noise.
I_N = Common-mode Noise Current
Z_L = Load Impedance
V_S = Signal Voltage
V_N = Common-mode Noise Voltage

APPLICATION



SPECIFICATIONS

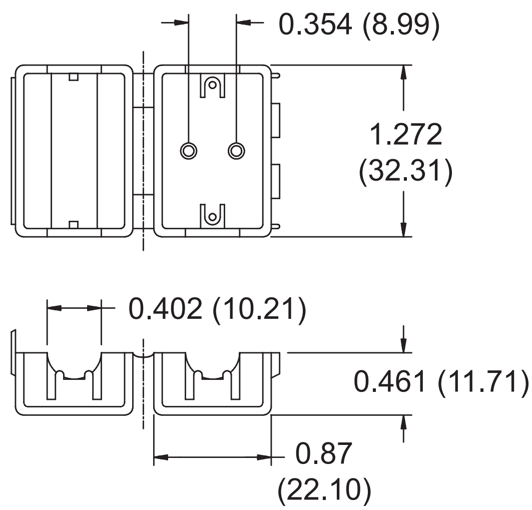
1. **MAX. CABLE DIAMETER:** 0.390" (9.9 mm)
2. **IMPEDANCE (OHMS):**

# OF TURNS	25 MHz MIN.	100 MHz ±20%
1	110	225
2	440	900
4	1760	1000

 # OF TURNS = The number of times the cable passes through the core.

3. **WEIGHT:** 0.63 oz. (18 g)

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
FCOR	Ferrite Suppression Core	FCOR0000

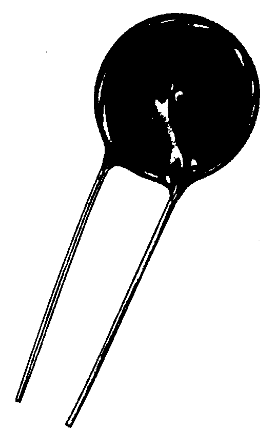
Do not dispose of unit in trash - Recycle

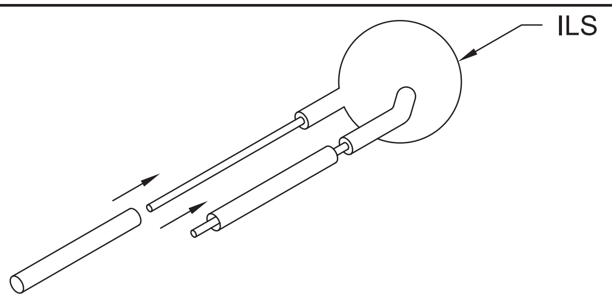
INDUCTIVE LOAD SUPPRESSOR

DESCRIPTION

These devices, when installed across an inductive load, such as a contactor, solenoid or relay, will suppress transient surges during a switching. This will enhance relay life and provide increased reliability of operation.

There are two devices available, one for use in 115 volt circuits and one for use in 230 volt circuits.





Fully slide PVC insulating tubing over Model ILS leads, as shown.
Caution: Ensure VAC is "OFF" before installing Model ILS.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ILS1	115 VAC Inductive Load Suppressor	ILS11500
ILS2	230 VAC Inductive Load Suppressor	ILS23000

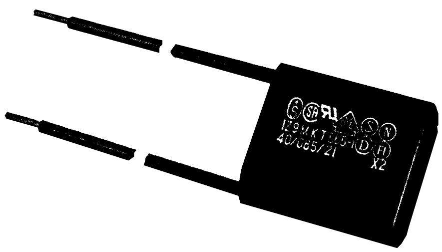
ILS SPECIFICATIONS *

DEVICE MODEL NUMBER	RATED VOLTAGE		RATED PEAK SINGLE PULSE TRANSIENT CURRENT (AMPS)	SINGLE PULSE TRANSIENT ENERGY JOULES	POWER DISSIPATION WATTS	CLAMPING VOLTAGE VOLTS
	AC VOLTS	DC VOLTS				
ILS1	130	175	6500	80	1.0	340 V @ 100 A
ILS2	275	370	6500	150	1.0	710 V @ 100 A

*NOTE: These devices will suppress most transient surges. However, if the device heats up or stops functioning after a short period of time a higher joules rated device may be required.

Do not dispose of unit in trash - Recycle

R-C SNUBBER NOISE AND ARC SUPPRESSOR



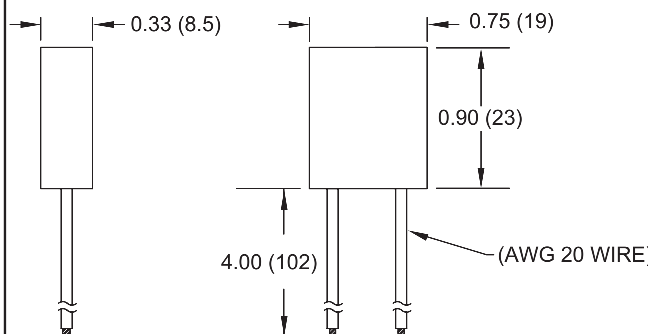
GENERAL DESCRIPTION

The R-C Snubber is intended to suppress the "inductive kick" from motors, solenoids or relay coils. High energy noise spikes are generated whenever current is interrupted through an inductive load. These noise spikes may interfere with associated equipment causing erratic operation and may also accelerate relay contact wear. Applied across an inductive load, the R-C snubber suppresses the noise spikes and extends contact life.

J

DIMENSIONS In inches (mm)

[All Dimensions are nominal]



SPECIFICATIONS

1. **R-C Value:** 0.1 µf, 47 Ω 1/2 Watt (±30%)
2. **Max. Line Voltage:** 250 V rms or 250 VDC
3. **Frequency:** DC to 62 Hz
4. **Peak Pulse Voltage:** 1200 V max.

UL recognized component
(Okaya Electric America, Inc. PN# XEB0471, UL-1414, File # E47474)

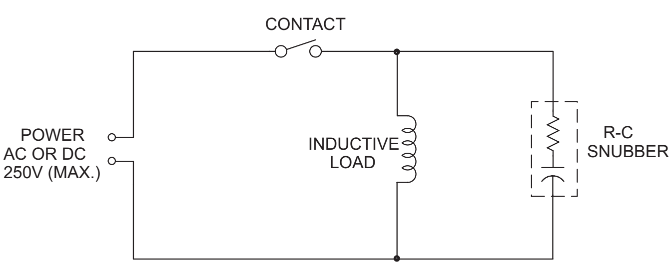
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
SNUB	R-C Snubber Inductive Load Suppressor	SNUB0000

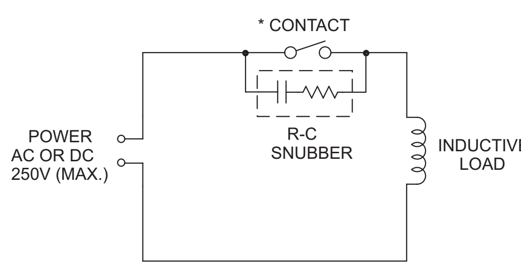
Do not dispose of unit in trash - Recycle

APPLICATION

The R-C snubber inductive load suppressor should be applied as shown below. Placing the suppressor across the contact in many cases can work as well, but for maximum effect, it is best to place the suppressor directly across the load. All inductive loads in a system should be suppressed in this manner to avoid mutual interference. The suppressors are effective in both AC and DC circuits.



Preferred Application



Alternate Application

** Use a snubber across all contacts in the load circuit.*

MODEL LFIL - GENERAL PURPOSE LINE FILTER

DESCRIPTION

This line filter can be used in AC or DC power supply lines to attenuate conducted Electro-Magnetic Interference (EMI). EMI is the most common cause of erratic operation in electronic equipment. Line filters should be installed close to electronic equipment and mounted directly to a metal enclosure that is connected to earth ground (protective earth).

Note: Always connect the earth lead of the filter to the power line ground (protective earth).

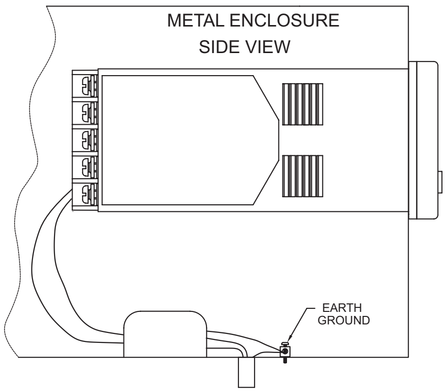


Figure 1

The ideal location for the line filter is directly inside the metal enclosure in which the unit is mounted when the source of EMI is external to the enclosure (See Figure 1). Mount the filter where the power enters the enclosure. If the enclosure contains many different types of equipment or EMI generating devices, such as motors or contactors, then the EMI source may be inside the enclosure. In this case, mount the line filter as close to the unit as possible (See Figure 2).

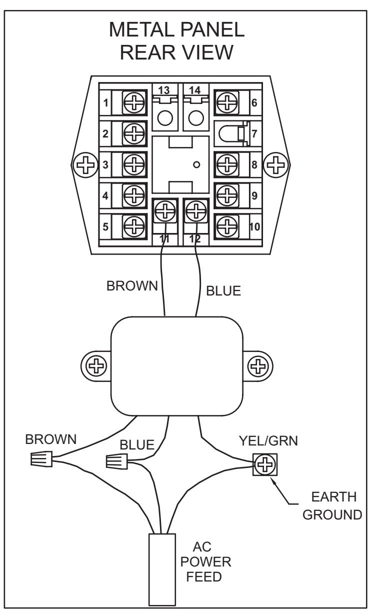
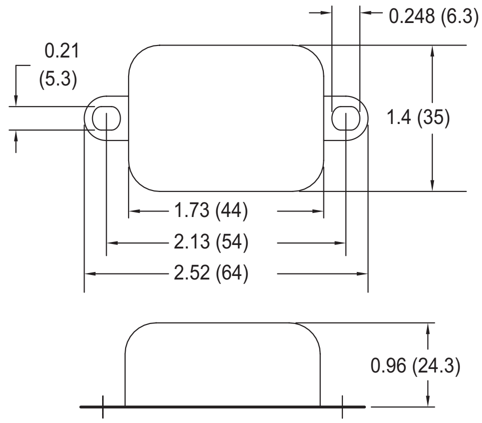


Figure 2

If the panel and enclosure are non-conductive, then the power feed ground is the only earth ground connection. Connecting only the earth lead of the filter to the earth ground without mounting the filter directly to a metal enclosure will not be as effective.

DIMENSIONS In inches (mm)

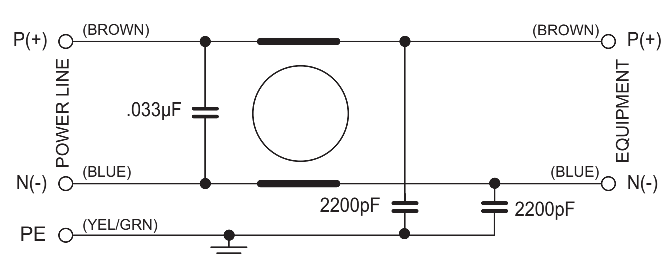


SPECIFICATIONS

1. **CURRENT RATING:** 1.15 A @ 25°C ; 1 A @ 40°C
2. **LEAKAGE CURRENT:** 0.74 mA/Lead @ 230 V, 50 Hz
3. **INDUCTANCE:** 12 mH
4. **CONNECTIONS:** Flexible wires 20 AWG
5. **HIPOT TEST VOLTAGE:** P→E: 2 KV for 2 sec
   P→N: 760 VAC for 2 sec
6. **MAX OPERATING VOLTAGE:** 250 VAC, 50/60 Hz
7. **OPERATING FREQUENCY:** DC to 400 Hz
8. **TEMPERATURE RANGE:** -25°C to +100°C
9. **WEIGHT:** 2.29 oz. (65 g)

UL recognized component
(Schaffner, PN# FN2010-1/07, File # E64388)

BLOCK DIAGRAM



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
LFIL	General Purpose Line Filter	LFIL0000

Do not dispose of unit in trash - Recycle

J

This page intentionally left blank.

ENCLOSURES
& PANELS

The Trusted Source for
Innovative Control Solutions

K

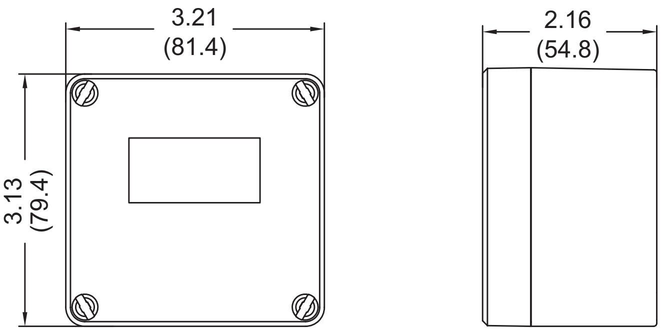
This page intentionally left blank.

MODEL ENC13 - NEMA 4 ENCLOSURES FOR CUB7

DESCRIPTION

This enclosure is designed for applications requiring a water resistant instrument enclosure. The enclosure is fabricated of polycarbonate and is designed to withstand NEMA 4X/IP65 wash-down applications. The enclosure must be drilled to accept conduit fittings or other types of wiring connectors. The enclosure can be used free-standing, or it can be securely fastened to a mounting surface.

ENC13 DIMENSIONS In inches (mm)



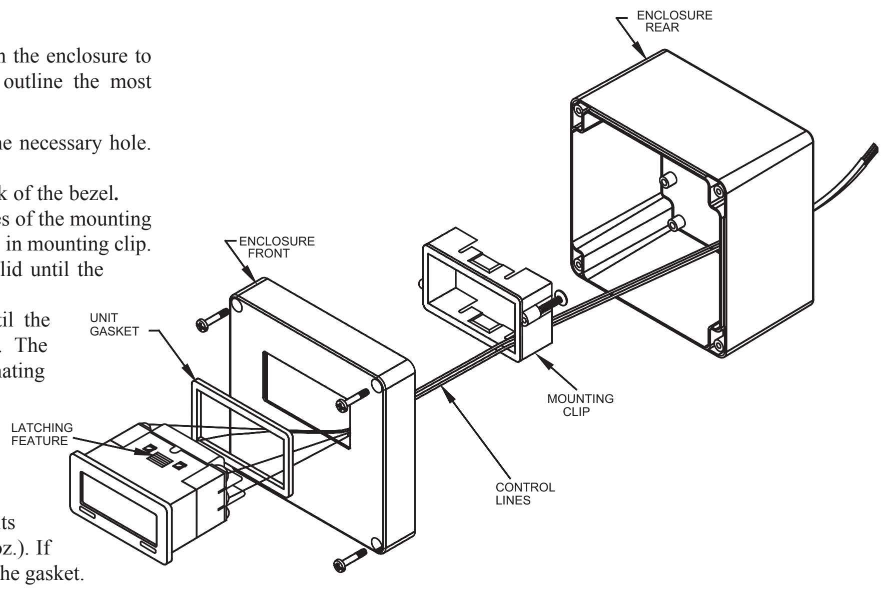
ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
ENC13	Plastic Enclosure for CUB7 units	ENC13000

ENC13 INSTALLATION

It is recommended to wire the unit before mounting it in the enclosure to ensure good electrical connections. The following steps outline the most common sequence for installing a unit.

1. Determine the location of the conduit fitting and drill the necessary hole. Install the fitting and bring the wiring into the enclosure.
2. Slide the panel gasket over the rear of the unit to the back of the bezel**.**
3. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
4. Install the unit through the opening in the front of the lid until the bezel flange contacts the panel.
5. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
6. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness (Recommended torque is 28 to 36 in-oz.). If not, gradually turn mounting screws to further compress the gasket.
7. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.

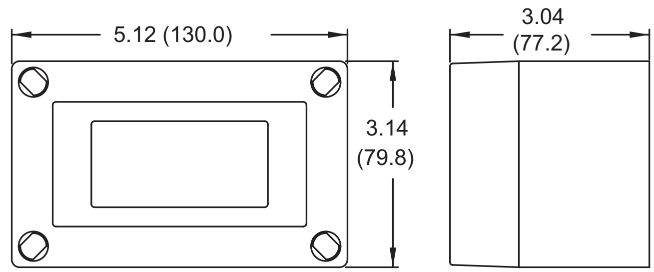


8. Connect the necessary wires to the unit for the application desired.
9. Assemble the enclosure with the screws provided. Alternately tighten each screw to ensure uniform gasket pressure.

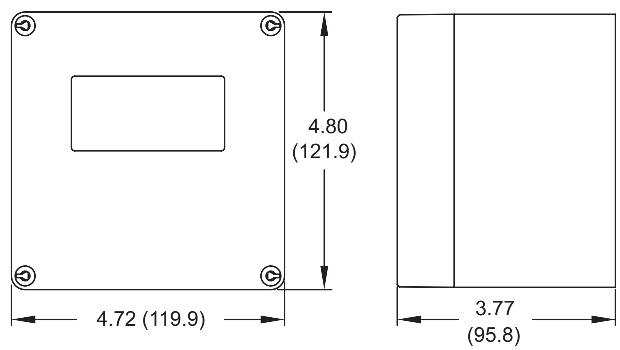
MODEL ENC8 - NEMA 4 ENCLOSURES FOR CUB4, CUB5, DT8 & DT9 UNITS

ENC8A & ENC8B - PLASTIC ENCLOSURES

ENC8A DIMENSIONS In inches (mm)



ENC8B DIMENSIONS In inches (mm)



K

DESCRIPTION

These enclosures are designed for applications requiring a water resistant instrument enclosure. The enclosures are fabricated of polycarbonate and are designed to withstand NEMA 4X/IP65 wash-down applications. The enclosures must be drilled to accept conduit fittings or other types of wiring connectors. The enclosures can be used free-standing, or securely fastened to a mounting surface.

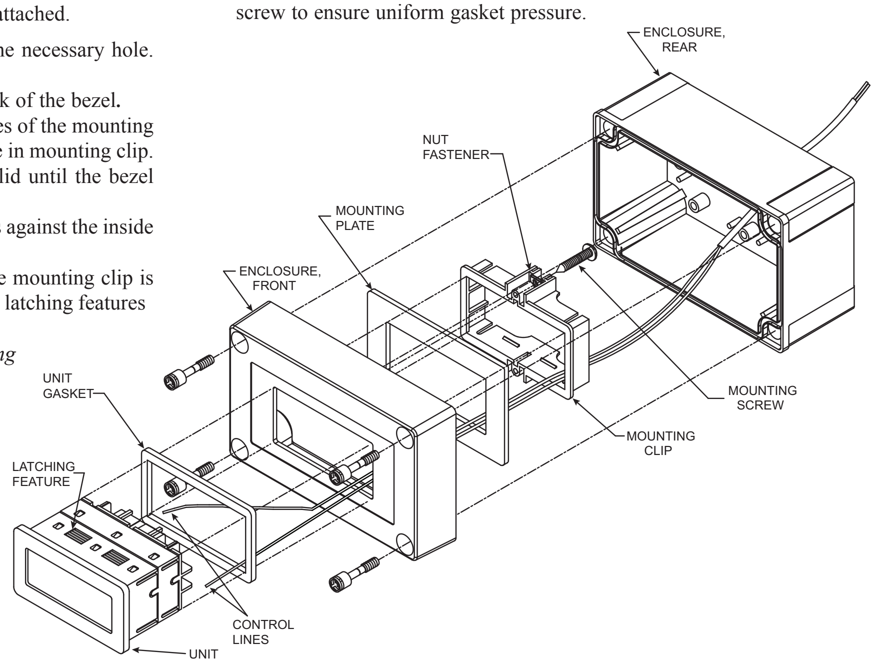
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ENC8A	Plastic Enclosure for single units	ENC8A000
ENC8B	Plastic Enclosure for units with an MLPS1 attached	ENC8B000
For More information on Pricing, Enclosures & Panel Mount Kits, refer to the RLC Catalog or contact your local RLC Distributor.		

ENC8A INSTALLATION

It is recommended to wire the unit before mounting it in the enclosure to ensure good electrical connections. The following steps outline the most common sequence for installing a unit without an MLPS1 attached.

1. Determine the location of the conduit fitting and drill the necessary hole. Install the fitting and bring the wiring into the enclosure.
2. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
4. Install the unit through the opening in the front of the lid until the bezel flange contacts the panel.
5. Slide the mounting plate over the rear of the unit until it is against the inside front of the enclosure.
6. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
7. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness (Recommended torque is 28 to 36 in-oz.). If not, gradually turn mounting screws to further compress the gasket.
8. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.
9. Connect the necessary wires to the unit for the application desired.
10. Assemble the enclosure with the screws provided. Alternately tighten each screw to ensure uniform gasket pressure.

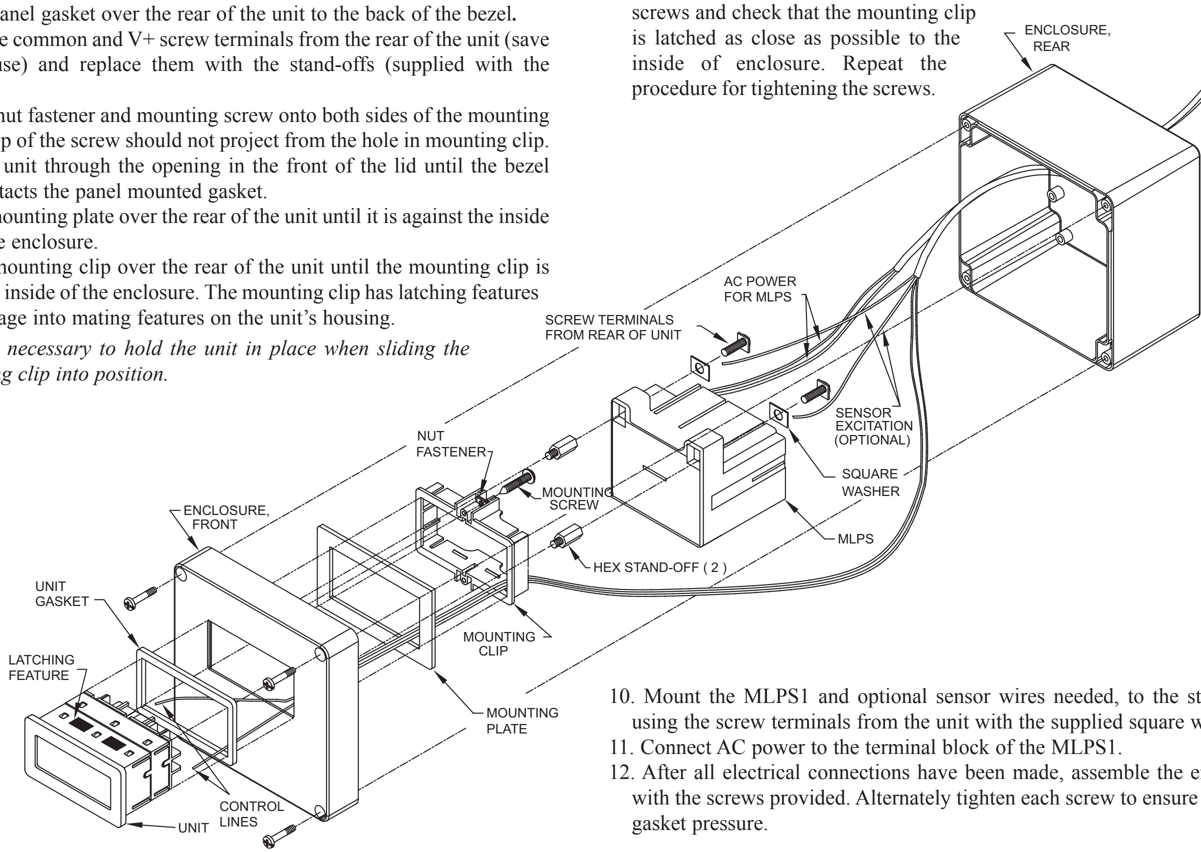


ENC8B w/ MLPS1 Installation

Installing a unit with an MLPS1 attached requires some planning. It is recommended that the unit with the MLPS1 attached be temporarily installed in the enclosure to determine the best location for the conduit fitting to avoid interference with the MLPS1.

1. Determine the location of the conduit fitting and drill the necessary hole. Install the fitting and bring the wiring into the enclosure.
2. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Remove the common and V+ screw terminals from the rear of the unit (save for later use) and replace them with the stand-offs (supplied with the MLPS1).
4. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
5. Install the unit through the opening in the front of the lid until the bezel flange contacts the panel mounted gasket.
6. Slide the mounting plate over the rear of the unit until it is against the inside front of the enclosure.
7. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.

   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
8. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness (Recommended torque is 28 to 36 in-oz.). If not, gradually turn mounting screws to further compress the gasket.
9. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.



10. Mount the MLPS1 and optional sensor wires needed, to the stand-offs using the screw terminals from the unit with the supplied square washers.
11. Connect AC power to the terminal block of the MLPS1.
12. After all electrical connections have been made, assemble the enclosure with the screws provided. Alternately tighten each screw to ensure uniform gasket pressure.

ENC8 - STEEL ENCLOSURE

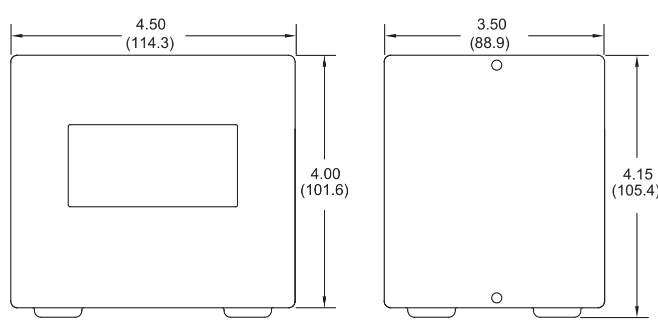
DESCRIPTION

This enclosure is designed for use with the CUB4, CUB5, DT8 & DT9 units. The enclosures are large enough to accommodate a Micro-line Power Supply (MLPS1) attached to the unit. These rugged enclosures are fabricated of formed steel with all seams welded to withstand NEMA 4/IP65 wash-down applications. The kits are coated with a durable black polyurethane finish.

The holes for conduit fittings or other types of wiring connectors can be drilled through the removable rear access panel, or through the enclosure itself.

The enclosures can be free standing or securely fastened to a mounting surface with the brackets and hardware found in the mounting kit (provided with the enclosure). The brackets also allow the enclosure to be raised and/or tilted from the mounting surface in order to achieve the most favorable operating position. Provided are four self-stick foot pads that can be applied to the bottom of the enclosure to protect the mounting surface. The foot pads are particularly useful for free standing installations.

DIMENSIONS In inches (mm)



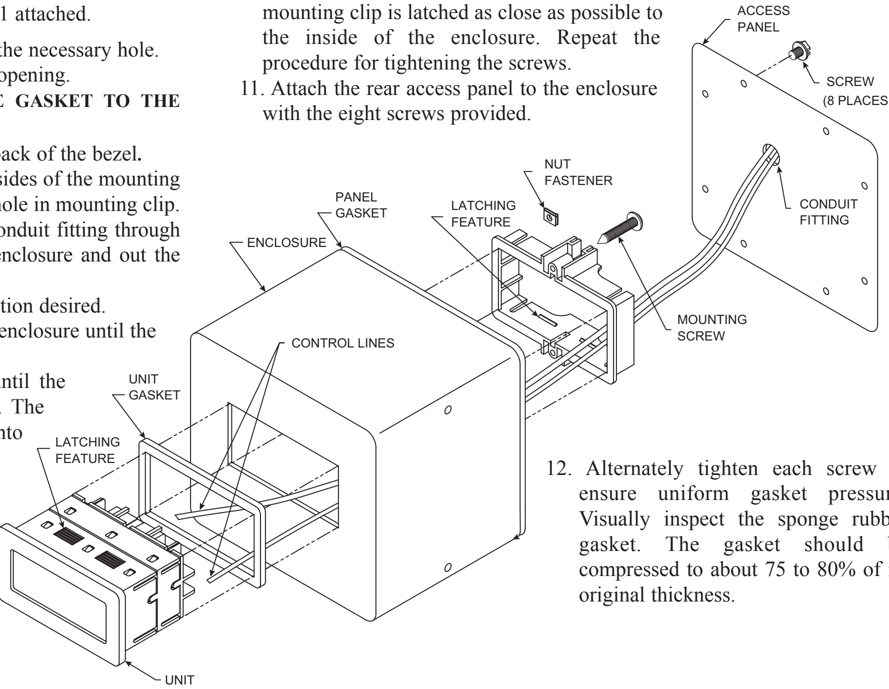
ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
ENC8	NEMA 4/IP65 ENCLOSURE	ENC80000
For More information on Pricing, Enclosures & Panel Mount Kits, refer to the RLC Catalog or contact your local RLC Distributor.		

ENC8 INSTALLATION

It is recommended to wire the unit before mounting it in the enclosure to ensure good electrical connections. The following steps outline the most common sequence for installing a unit without an MLPS1 attached.

1. Determine the location of the conduit fitting and drill the necessary hole.
2. Apply adhesive side of panel gasket to rear enclosure opening.
   DO NOT APPLY THE ADHESIVE SIDE OF THE GASKET TO THE ACCESS PANEL.
3. Slide the panel gasket over the rear of the unit to the back of the bezel.
4. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
5. Route the wire to be connected to the unit from the conduit fitting through the mounting clip, and then through the rear of the enclosure and out the front.
6. Connect the necessary wires to the unit for the application desired.
7. Install the unit through the opening in the front of the enclosure until the bezel flange contacts the panel.
8. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
9. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness (Recommended torque is 28 to 36 in-oz.). If not, gradually turn mounting screws to further compress the gasket.
10. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of the enclosure. Repeat the procedure for tightening the screws.
11. Attach the rear access panel to the enclosure with the eight screws provided.



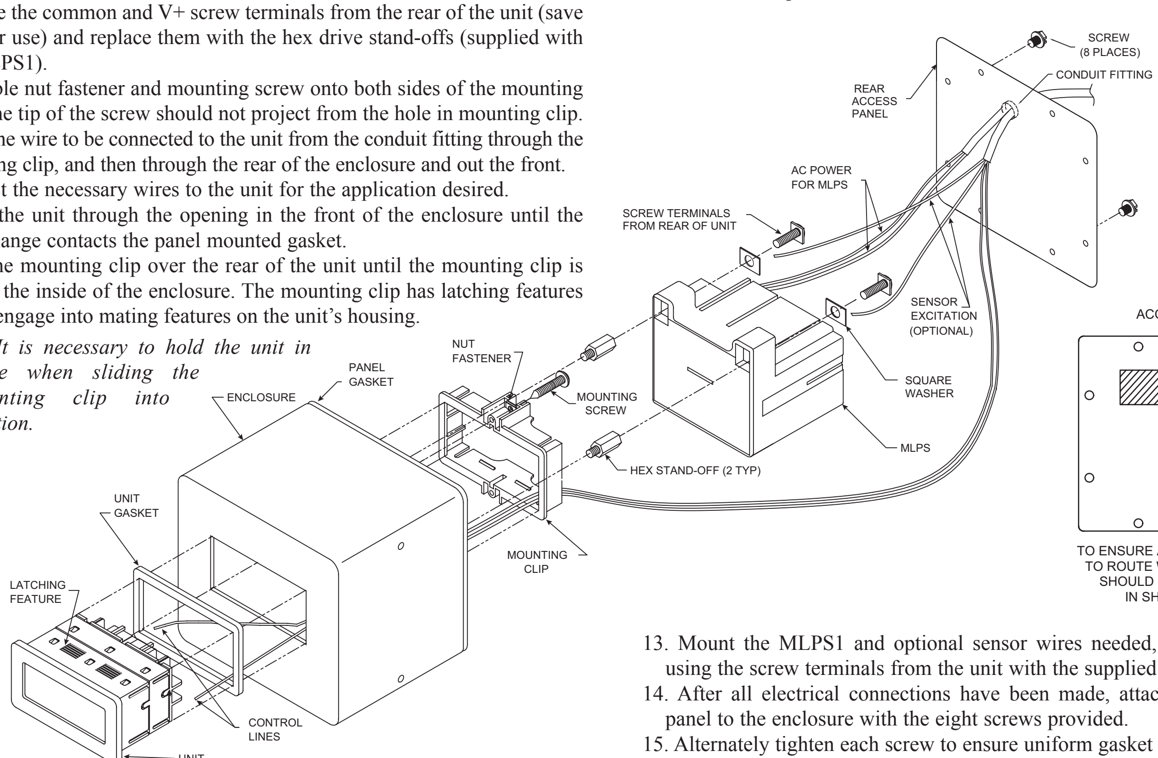
12. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the sponge rubber gasket. The gasket should be compressed to about 75 to 80% of its original thickness.

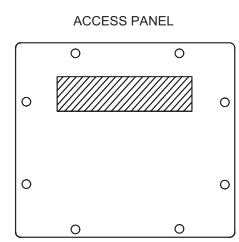
K

ENC8 w/ MLPS1 Installation

Installing a unit with an MLPS1 attached requires some planning. It is recommended that the unit with the MLPS1 attached be temporarily installed in the enclosure to determine the best location for the conduit fitting to avoid interference with the MLPS1.

1. Mark the location of the conduit fitting and drill the necessary hole.
2. Apply adhesive side of panel gasket to rear enclosure opening.
   DO NOT APPLY THE ADHESIVE SIDE OF THE GASKET TO THE ACCESS PANEL.
3. Slide the panel gasket over the rear of the unit to the back of the bezel.
4. Remove the common and V+ screw terminals from the rear of the unit (save for later use) and replace them with the hex drive stand-offs (supplied with the MLPS1).
5. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
6. Route the wire to be connected to the unit from the conduit fitting through the mounting clip, and then through the rear of the enclosure and out the front.
7. Connect the necessary wires to the unit for the application desired.
8. Install the unit through the opening in the front of the enclosure until the bezel flange contacts the panel mounted gasket.
9. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
10. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the front panel gasket. The gasket should be compressed to about 75 to 80% of its original thickness (Recommended torque is 28 to 36 in-oz.). If not, gradually turn mounting screws to further compress the gasket.
11. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.
12. Connect AC power to the terminal block of the MLPS1.



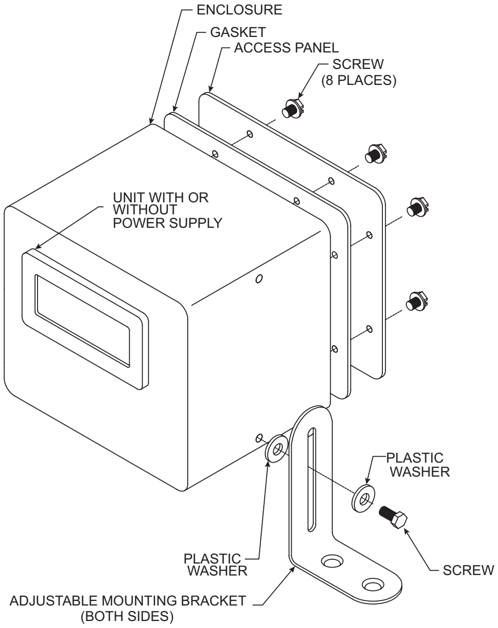


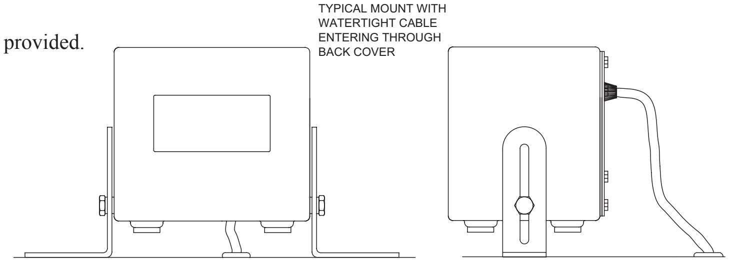
TO ENSURE ADEQUATE ROOM TO ROUTE WIRES, CONDUIT SHOULD BE CONNECTED IN SHADED AREA

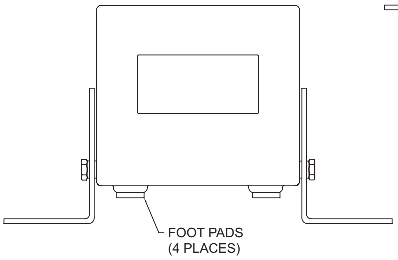
13. Mount the MLPS1 and optional sensor wires needed, to the stand-offs using the screw terminals from the unit with the supplied square washers.
14. After all electrical connections have been made, attach the rear access panel to the enclosure with the eight screws provided.
15. Alternately tighten each screw to ensure uniform gasket pressure. Visually inspect the sponge rubber gasket. The gasket should be compressed to about 75 to 80% of its original thickness.

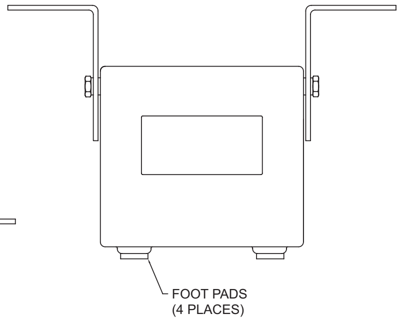
MOUNTING THE ENCLOSURE

1. Self-stick foot pads may be applied to the features on the bottom of the enclosure to protect the mounting surface.
2. To securely mount the enclosure, attach the adjustable mounting brackets to the enclosure using the plastic washers and screws. Mounting brackets may be attached to the top or bottom of the enclosure.
3. Secure the adjustable mounting brackets to mounting location with the screws provided.









K

NEMA 4 1/16 DIN SERIES ENCLOSURES

ENC11A & ENC11B - PLASTIC ENCLOSURES

- *RUGGED POLYCARBONATE CONSTRUCTION*
- *COMPLETELY SEALED FOR NEMA 4X/IP65 WASH-DOWN*
- *EASY MOUNTING OPTIONS*

DESCRIPTION

These enclosures are designed for applications requiring a water resistant instrument enclosure. The ENC11A and ENC11B enclosures are fabricated of polycarbonate and when properly installed, the meter and the enclosures are designed to withstand NEMA 4X/IP65 wash-down applications. The enclosures can be used free-standing, or securely fastened to a mounting surface. The enclosures are precut for either one or two meters.

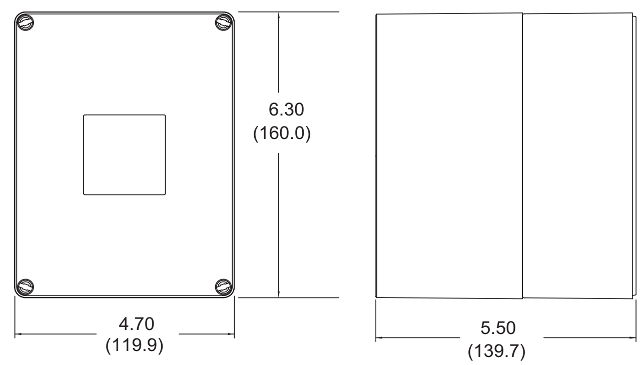
Electrical connections to the enclosed instrument are easily made by drilling the desired location on the back or side of the enclosure. Select the proper drill size to accommodate the conduit fitting or other wire connector. To maintain the enclosure NEMA 4X rating, sealed connectors must be used.

ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
ENC11A	NEMA 4X/IP65 Enclosure for One 1/16 DIN Meter	ENC11A00
ENC11B	NEMA 4X/IP65 Enclosure for Two 1/16 DIN Meters	ENC11B00

K

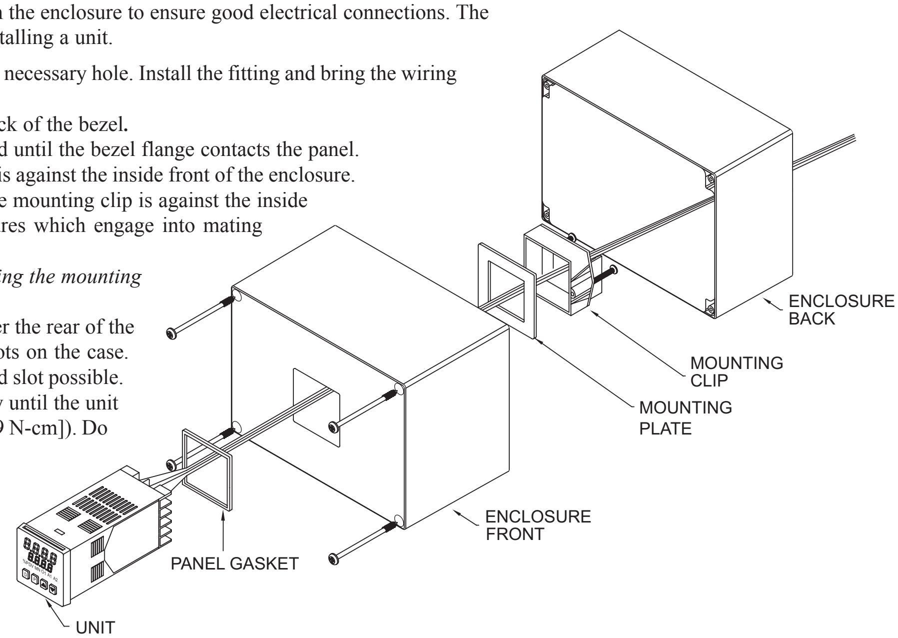
DIMENSIONS In inches (mm)



ENC11A AND ENC11B INSTALLATION

It is recommended to wire the unit before mounting it in the enclosure to ensure good electrical connections. The following steps outline the most common sequence for installing a unit.

1. Determine the location of the conduit fitting and drill the necessary hole. Install the fitting and bring the wiring into the enclosure.
2. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Install the unit through the opening in the front of the lid until the bezel flange contacts the panel.
4. Slide the mounting plate over the rear of the unit until it is against the inside front of the enclosure.
5. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the enclosure. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
6. While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79 N-cm]). Do not over-tighten the screws.
7. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.
8. Connect the necessary wires to the unit for the application desired.
9. Assemble the enclosure with the screws provided. Alternately tighten each screw to ensure uniform gasket pressure.



ENC11 - STEEL ENCLOSURE

- *RUGGED STEEL CONSTRUCTION*
- *COMPLETELY SEALED FOR WASH-DOWN*
- *VERSATILE MOUNTING OPTIONS FOR MACHINE OR DESKTOP*

DESCRIPTION

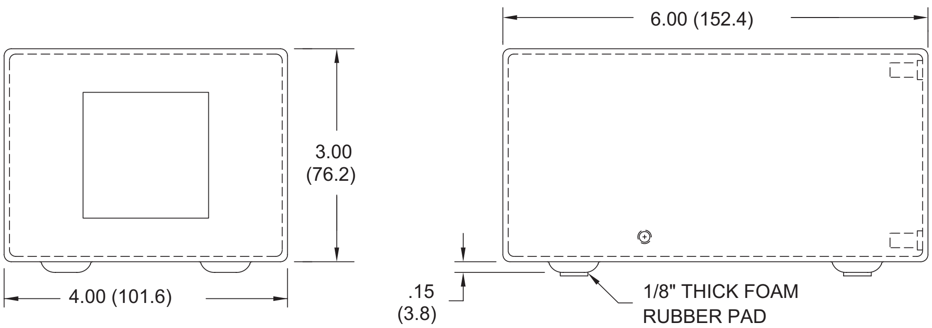
This enclosure is designed for applications requiring a water resistant instrument enclosure. The enclosure is fabricated of formed steel with all seams welded to withstand NEMA 4/IP65 wash-down applications. The kit is coated with a durable flat black polyurethane finish.

Electrical connections to the enclosed instrument are easily made through a removable access panel at the rear of the enclosure. The panel must be drilled to accept conduit fittings or other types of wiring connectors.

The enclosure can be used free-standing or securely fastened to a mounting surface with brackets which are provided with each enclosure. The brackets also allow the enclosure to be raised and/or tilted from the mounting surface in order to achieve the most favorable operating position. Self-adhering rubber pads are provided which can be applied to the bottom of the enclosure. These rubber pads will protect the mounting surface and are particularly useful for free-standing installations.

K

DIMENSIONS In inches (mm)



ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
ENC11	NEMA 4 Enclosure for 1/16 DIN Units	ENC11000

NEMA 4 1/8 DIN SERIES ENCLOSURES

ENC5B & ENC5C - PLASTIC ENCLOSURES

- *RUGGED POLYCARBONATE CONSTRUCTION*
- *COMPLETELY SEALED FOR NEMA 4X/IP65 WASH-DOWN*
- *EASY MOUNTING OPTIONS*

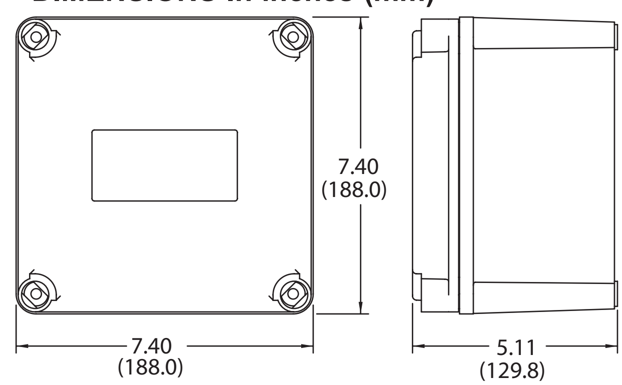
DESCRIPTION

These enclosures are designed for applications requiring a water resistant instrument enclosure and are precut for either one or two meters. The ENC5B and ENC5C enclosures are fabricated of polycarbonate and when properly installed, the meter and the enclosures are designed to withstand NEMA 4X/IP65 wash-down applications. The enclosures can be used free-standing, or securely fastened to a mounting surface.

Electrical connections to the enclosed instrument(s) are easily made by drilling the desired location on the back or side of the enclosure. Select the proper drill size to accommodate the conduit fitting or other wire connector. To maintain the enclosure NEMA 4X rating, sealed connectors must be used.

K

DIMENSIONS In inches (mm)



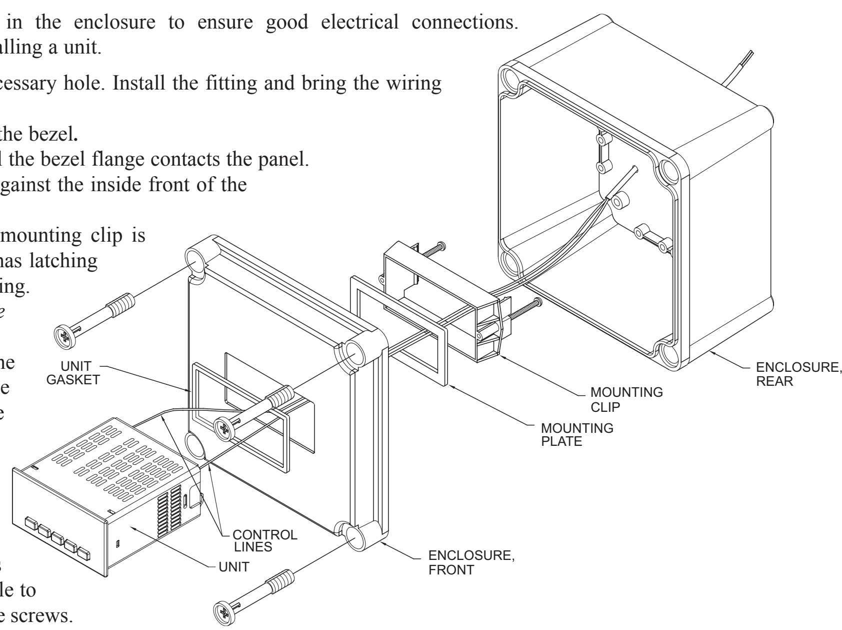
ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
ENC5B	NEMA 4X/IP65 Enclosure for One 1/8 DIN Meter	ENC5B000
ENC5C	NEMA 4X/IP65 Enclosure for Two 1/8 DIN Meters	ENC5C000

ENC5B AND ENC5C INSTALLATION

It is recommended to wire the unit before mounting it in the enclosure to ensure good electrical connections. The following steps outline the most common sequence for installing a unit.

1. Determine the location of the conduit fitting and drill the necessary hole. Install the fitting and bring the wiring into the enclosure.
2. Slide the panel gasket over the rear of the unit to the back of the bezel**.**
3. Install the unit through the opening in the front of the lid until the bezel flange contacts the panel.
4. Slide the mounting plate over the rear of the unit until it is against the inside front of the enclosure.
5. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the mounting plate. The mounting clip has latching features which engage into mating features on the unit's housing. *Note: It is necessary to hold the unit in place when sliding the mounting clip into position.*
6. While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79 N-cm]). Do not over-tighten the screws.
7. If the gasket is not adequately compressed, and the mounting screws can no longer be turned, loosen the mounting screws and check that the mounting clip is latched as close as possible to the inside of enclosure. Repeat the procedure for tightening the screws.
8. Connect the necessary wires to the unit for the application desired.
9. Assemble the enclosure with the screws provided. Alternately tighten each screw to ensure uniform gasket pressure.



ENC5A - STEEL ENCLOSURE

- *RUGGED STEEL CONSTRUCTION*
- *COMPLETELY SEALED FOR NEMA 4/IP65 WASH-DOWN*
- *VERSATILE MOUNTING OPTIONS FOR MACHINE OR DESKTOP*

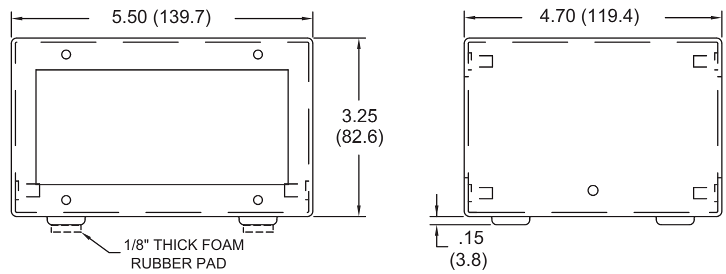
DESCRIPTION

The ENC5A enclosure is fabricated of formed steel with all seams welded to withstand NEMA 4/IP65 wash-down applications. The kit is coated with a durable flat black polyurethane finish.

Electrical connections to the enclosed instrument are easily made through a removable access panel at the rear of the enclosure. The panel must be drilled to accept conduit fittings or other types of wiring connectors.

The enclosure can be used free-standing or securely fastened to a mounting surface with brackets which are provided with each enclosure. The brackets also allow the enclosure to be raised and/or tilted from the mounting surface in order to achieve the most favorable operating position. Self-stick rubber pads are provided which can be applied to the bottom of the enclosure. These rubber pads will protect the mounting surface and are particularly useful for free-standing installations.

DIMENSIONS In inches (mm)



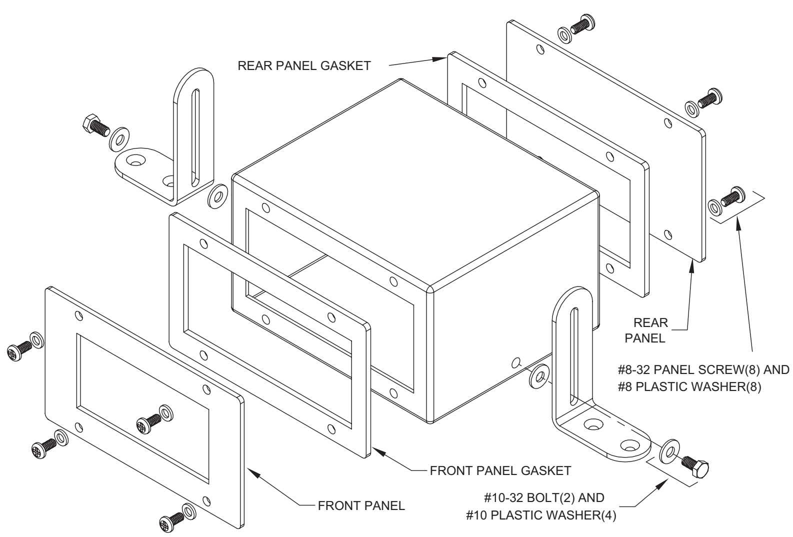
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
ENC5A	NEMA 4/IP65 Enclosure for 1/8 DIN Meter	ENC5A000

K

ENC5A INSTALLATION

1. Mark the location on the rear panel for your wire connector or conduit fitting, and drill the necessary hole. Connect your wire connector or fitting to the rear panel.
2. Remove the center sections of the front and rear panel gaskets. These centers contain the optional foam rubber feet for the enclosure.
3. Apply the adhesive side of the panel gasket to the front and rear openings of the enclosure. DO NOT APPLY THE ADHESIVE SIDE OF THE GASKET TO THE FRONT OR REAR PANELS.
4. Install the unit to the front panel according to the standard panel installation instructions found in the product literature.
5. Route the wires to be connected to the unit from the conduit fitting through the rear of the enclosure and out the front.
6. Connect the necessary wires to the unit for the application desired.
7. Attach the front and rear panels to the enclosure with the screws and washers provided. Alternately tighten each screw to ensure uniform gasket compression. Visually inspect the sponge rubber gasket. The gasket should be compressed to about 75 to 80% of its original thickness.



8. For a free-standing enclosure, apply the self-stick foam rubber pads to the features on the bottom of the enclosure to protect the mounting surface.
9. To securely mount the enclosure, attach the adjustable mounting brackets to the enclosure using the washers and bolts provided. Secure the mounting brackets to the desired mounting location. The mounting screws to attach the brackets to your surface are not provided due to the variety of installation options available.

LPAX ENCLOSURE, MOUNTING AND LABEL ACCESSORIES

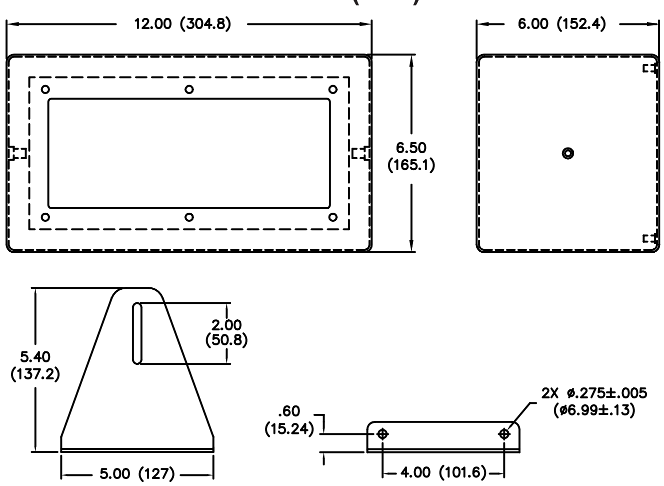
- *ENGINEERING UNIT LABELS*
- *BRACKETS FOR BASE, CEILING, OR WALL MOUNTING*
- *NEMA 4/IP65 ENCLOSURE FOR WASHDOWN ENVIRONMENTS*
- *FRONT PANEL SHROUD FOR ENHANCED VIEWING*

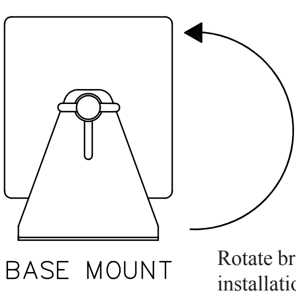
ENC9-NEMA 4/IP65 LPAX ENCLOSURE

The ENC90000 NEMA 4/IP65 enclosure provides a means of mounting the LPAX display in dirty or washdown environments. The enclosure comes with all the gaskets, hardware (except the mounting screws), and brackets required to base, ceiling, or wall mount the LPAX display. The mounting screws to attach the brackets to your surface are not provided due to the variety of installation options available.

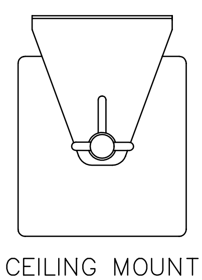
K

DIMENSIONS In inches (mm)



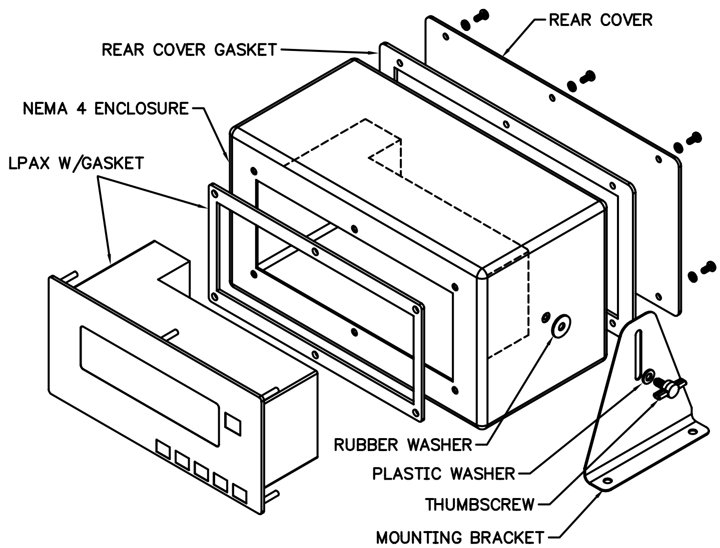


Rotate bracket for other installation choices.



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
ENC9	NEMA 4 Enclosure for LPAX	ENC90000

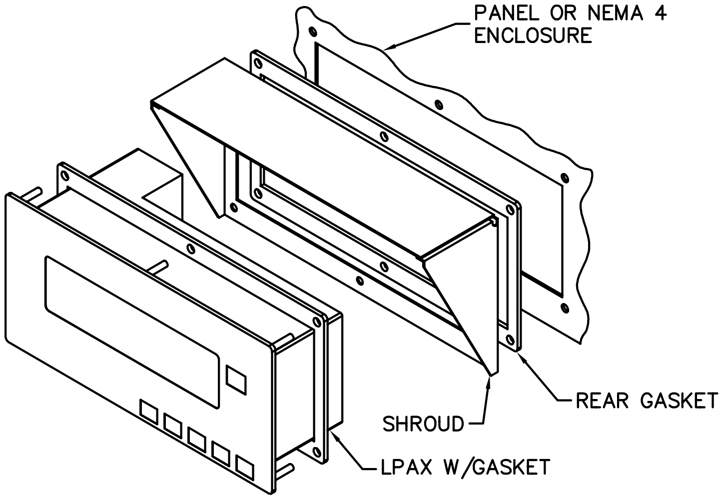


ENCLOSURE ASSEMBLY

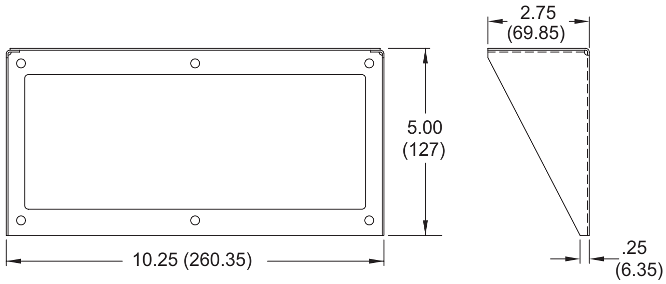
1. Before drilling a hole in the enclosure for your wire connector or fitting, ensure that the location you have chosen allows enough clearance around the MPAX module.
2. Remove the center section of the gasket provided with the LPAX, and slide it over the rear of the display and onto the mounting studs.
3. Insert the LPAX into the enclosure as illustrated. Install six #10-32 keps nuts (supplied with the LPAX) and tighten evenly for uniform gasket compression. The gasket should be compressed to about 75 to 80% of its original thickness. Do not overtighten the nuts.
4. Run the wires through the hole that was drilled in the enclosure, and attach them to the LPAX. Wiring instructions are provided in the appropriate PAX bulletin shipped with the MPAX Module.
5. Remove the center section of the rear cover gasket. Apply the gasket to the rear panel of the enclosure by inserting the screws through the panel and into the holes in the gasket. Position the panel on the enclosure and start all of the screws. Alternately tighten each screw to ensure uniform gasket compression. The gasket should be compressed to about 75 to 80% of its original thickness.
6. To securely mount the enclosure, attach the adjustable mounting brackets to the enclosure using the washers and screws provided.
7. Secure the mounting brackets to the desired mounting location.

SHROUD

The optional shroud enhances the readability of the LPAX unit in areas with high intensity overhead light sources. The shroud can be used in conjunction with any installation (panel mount, enclosure, or mounting brackets). When properly installed, the shroud will not affect the integrity of a NEMA 4 installation.



DIMENSIONS In inches (mm)



INSTALLATION

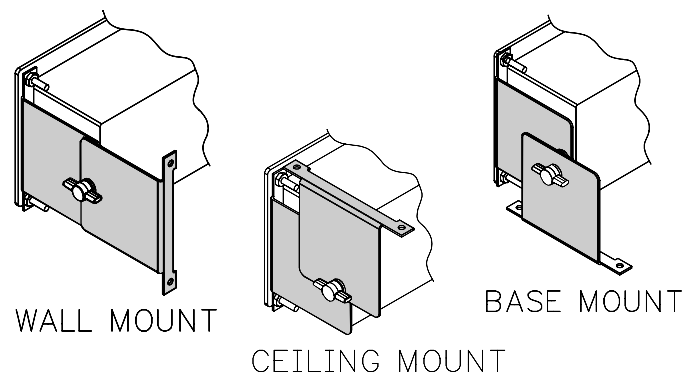
1. Remove the center section of the gasket provided with the LPAX, and slide it over the rear of the display and onto the mounting studs.
2. Orient the shroud and gasket as shown in the assembly figure, and place it over the LPAX. The studs of the LPAX should now be protruding through the rear of the shroud.
3. Follow the remaining installation instructions for panel mounting, bracket mounting or enclosure mounting as appropriate.

ORDERING INFORMATION

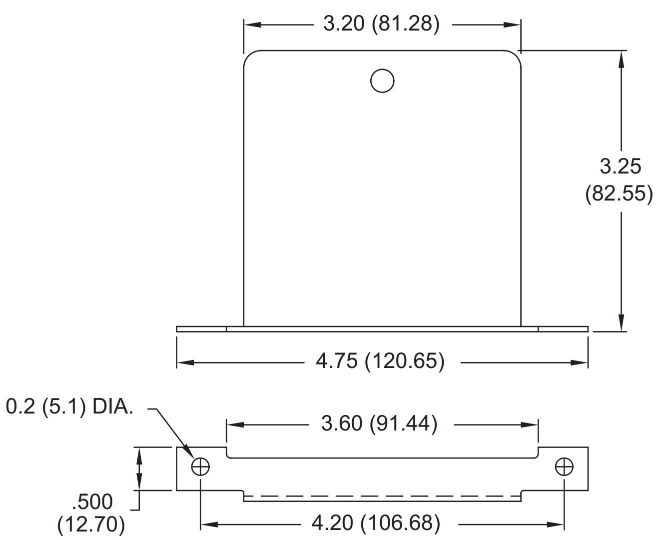
MODEL NO.	DESCRIPTION	PART NUMBERS
SHR	Shroud for LPAX	SHRLPAX0

MBLPAX-MOUNTING BRACKETS

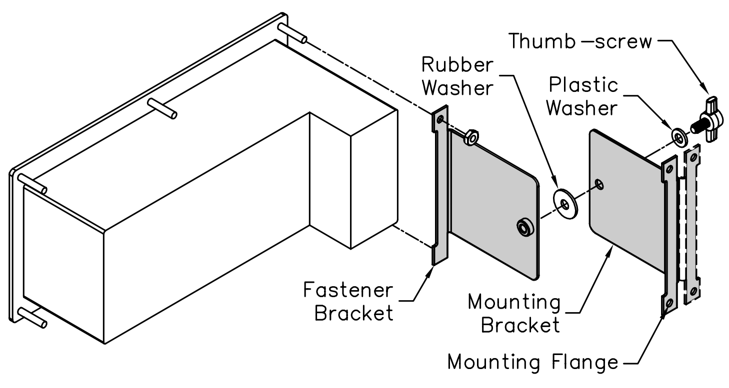
The MBLPAX mounting brackets provide an easy way to base, wall, or ceiling mount the LPAX display. The MBLPAX kit comes with two sets of brackets, and most of the hardware to mount the LPAX at virtually any angle. The screws to attach the brackets to your surface are not provided due to the variety of installation options available.



DIMENSIONS In inches (mm)



ASSEMBLY



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
MB	Mounting Bracket for LPAX	MBLPAX00

Notes:

1. When installing the brackets, the fastener bracket must be installed on the studs of the LPAX as shown.
2. The mounting bracket may be installed with the flange facing in or out.
3. The rubber washers provided must be installed between the two mounting brackets during assembly.
4. The screws for fastening the brackets to a surface are not provided in the MBLPAX kit. The holes are 0.2" in diameter and will accept size #10 screws and smaller.

K

NEMA 4/IP65 LARGE DISPLAY ENCLOSURE & SHROUD FOR EPAX

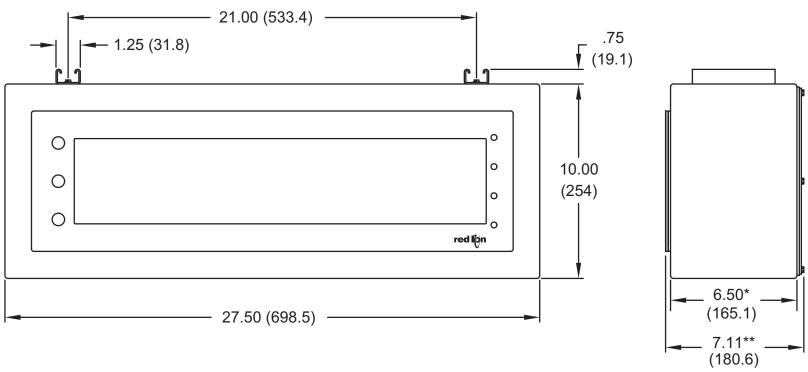
Picture includes the EPAX, Nema Enclosure, and Shroud

- *LIGHT-WEIGHT ALUMINUM CONSTRUCTION*
- *COMPLETELY SEALED FOR WASH-DOWN*
- *MOUNTING CHANNELS FOR VERSATILE INSTALLATION*

DESCRIPTION

The NEMA 4/IP65 Large Display Enclosure is designed to protect the EPAX from dust and hose directed water, when properly installed. This light-weight all aluminum unit utilizes welded seams and neoprene gaskets to meet NEMA 4/IP65 requirements. A textured, polyurethane coating protects against corrosion and is scratch resistant. Figure 1 below shows the overall dimensions of the Enclosure. The Display Enclosure with Mounting Channels weighs 9 pounds (4.1 Kg).

DIMENSIONS In inches (mm)



* Housing Only ** Overall Including Screwheads

Figure 1

MOUNTING

Provided with the enclosure are two ¼-20 UNC x 1" hex bolts, two ¼-20 UNC *"strut nuts"*, and two ¼" washers. The *"strut nuts"* can be installed anywhere in the channel by inserting them, spring side down, into the channels, then rotating them 90 degrees clockwise until the notches engage with the lips of the channel. The bolts and washers provided allow mounting to surfaces ¼" to ½" thick *(6.4 to 12.7 mm)*. Use longer bolts for mounting to thicker surfaces. Bolts fabricated from materials other than steel are not recommended.

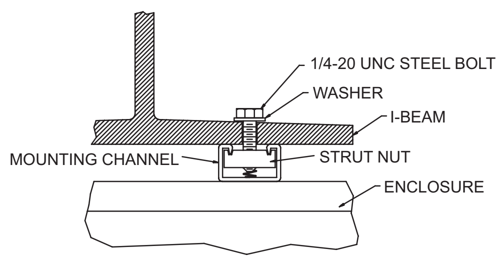
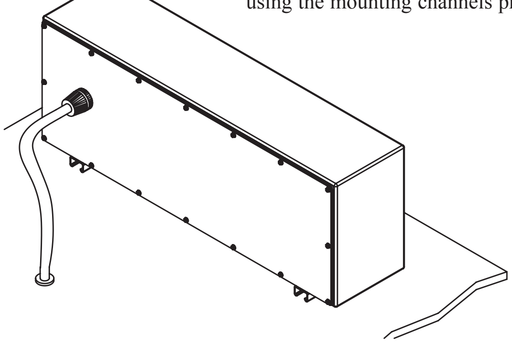


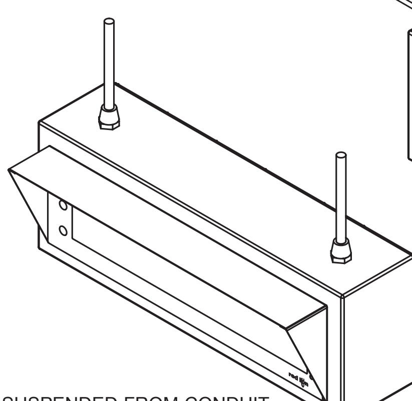
Figure 3

TYPICAL INSTALLATIONS FOR NEMA 4/IP65 ENCLOSURE

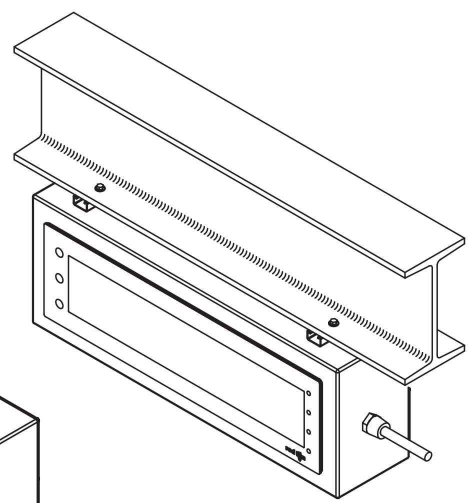
Removing the rear panel of the enclosure allows access to the Display for service. Either the rear panel or housing may be drilled to accept sealed conduit fittings, liquid-tight cable fittings or other types of wiring connectors. The enclosure may be attached to horizontal surfaces located above or below it, using the mounting channels provided.



BASEMOUNT WITH WATERTIGHT CABLE CONNECTOR ENTERING THROUGH REAR PANEL.



SUSPENDED FROM CONDUIT WITH SEALED FITTINGS. (SHOWN WITH SHROUD).

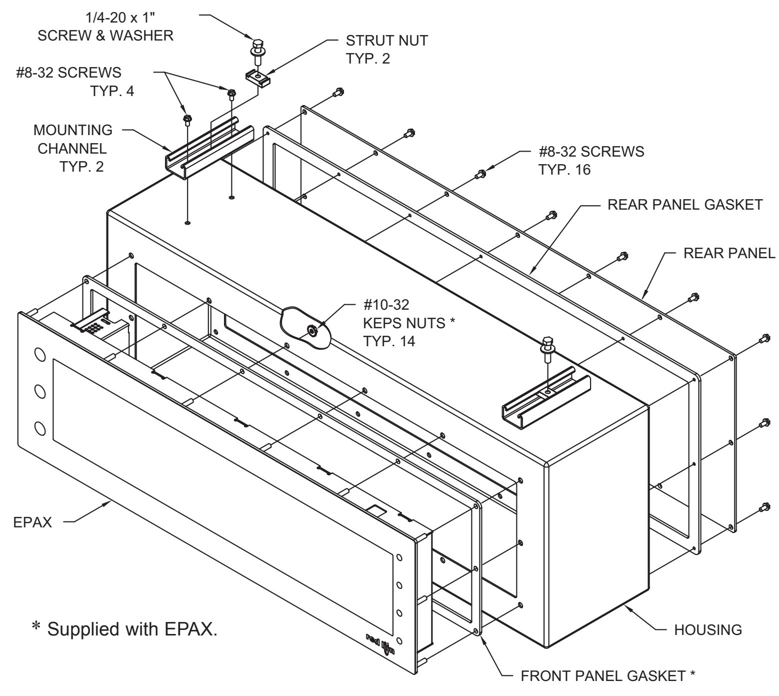


BEAM MOUNT WITH SEALED CONDUIT ENTERING FROM RIGHT SIDE.

Figure 2

ASSEMBLY AND INSTALLATION PROCEDURE

1. Install the two mounting channels on the enclosure housing using the four #8-32 screws provided and then insert the strut nuts *(provided)*. Invert enclosure if base mounting.
2. If the wiring is to be routed through the housing, make sure that the mounting channels are oriented properly before drilling, so the Display will be readable. Wiring is generally brought into the right side of the housing or rear panel, closest to the terminals of the MPAX module. Drill the proper size hole in the housing or rear panel for the wiring connector or sealed conduit fitting and attach the fitting*(s)*
3. Before installing the Display into the housing, be sure that the mounting channels are oriented properly for the type of installation planned. Place the gasket that is supplied with the Display over the studs extending from the front panel of the display.
4. If using the shroud, refer to the Shroud Installation Procedure. Place the Display with gasket through the holes in the housing as shown at right. Working back and forth across the stud pattern, install the #10-32 keps nuts supplied with the Display on the studs. Tighten firmly.
5. Mount the housing, using the strut nuts and steel ¼-20 UNC bolts and washers, as shown in figure 4.
6. Connect the wires to the Display per the instructions included with the personality board.
7. Remove the center section of the rear panel gasket. Apply the gasket to the rear panel of the enclosure by inserting the #8-32 screws through the panel and into the holes in the gasket. Position the panel on the housing, start all of the screws, then firmly tighten them in a pattern working back and forth across the rear panel.



* Supplied with EPAX.

Figure 4

DIMENSIONS FOR THE EPAX DISPLAY SHROUD

The optional EPAX Display Shroud enhances the readability of the Displays that are installed in areas with high intensity overhead light sources. The Shroud can be used with the EPAX Display in any installation, (panel mount, NEMA 4/IP65 Enclosure, or Universal Mounting Bracket). When properly assembled, the Shroud will not affect the integrity of a NEMA 4/IP65 installation. The Shroud weighs 1.0 pound (0.45 Kg).

DIMENSIONS In inches (mm)

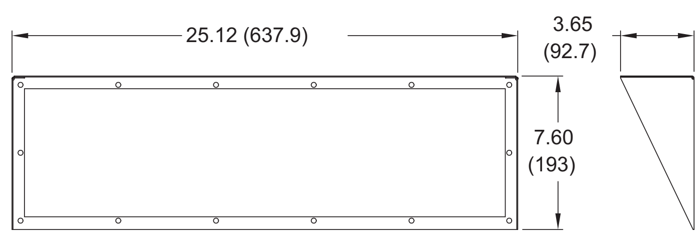
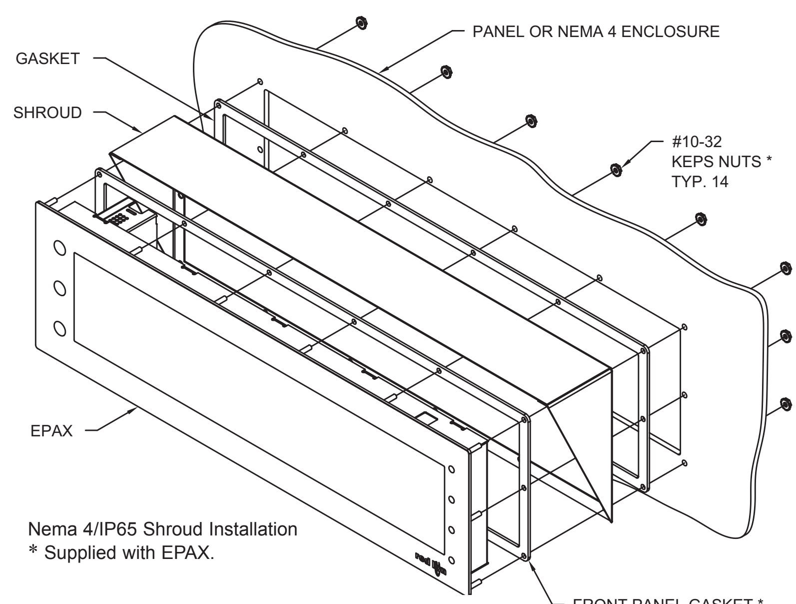


Figure 5

SHROUD INSTALLATION PROCEDURE

Installing The Shroud On An EPAX Display In A NEMA 4/IP65 Enclosure Or Panel

1. Place a gasket over the studs extending from the rear of the front panel of the Display.
2. Orient the shroud as shown in Figure 6, and place it over the display. The studs of the display should now be protruding through the rear of the shroud.
3. Place the other gasket over the studs.
4. Install the unit into the panel or enclosure using the #10-32 keps nuts that are supplied with the Display. Tighten the nuts firmly.



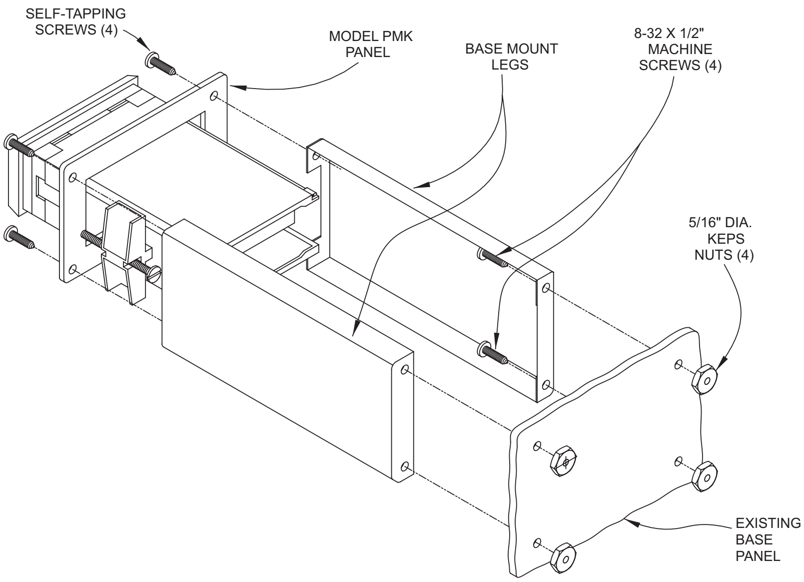
Nema 4/IP65 Shroud Installation
* Supplied with EPAX.

Figure 6

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS
ENC12	NEMA 4/IP65 Enclosure for EPAX	ENC12000
SHR	Shroud for EPAX	SHREPAX0
EN/SH	EPAX NEMA 4/IP65 Enclosure and Shroud	EPAXENSH

MODEL BMK3 & BMK4 - BASE MOUNT KITS



DESCRIPTION

The Model BMK3 and 4 Base Mount Kits provide the necessary equipment for base mounting various units. The kits are coated with a durable flat black polyurethane finish and consist of two mounting legs which attach to the customer's base panel, using the hardware provided.

Model PMK3 and 4 are separate front panels, available for different sized units. After mounting the units to the appropriate PMK panel, the entire assembly is then attached to the mounting legs.

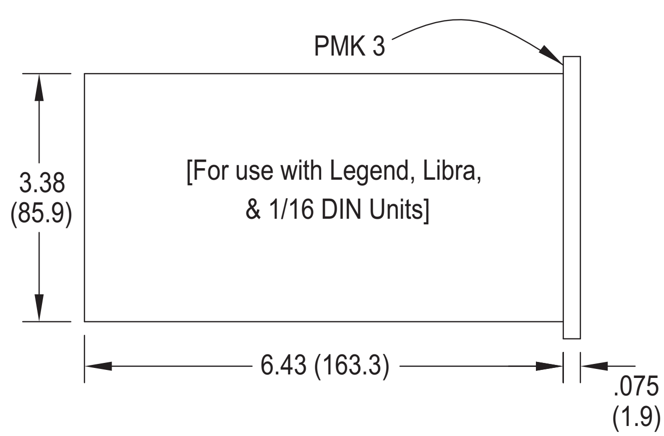
K

MOUNTING PROCEDURE

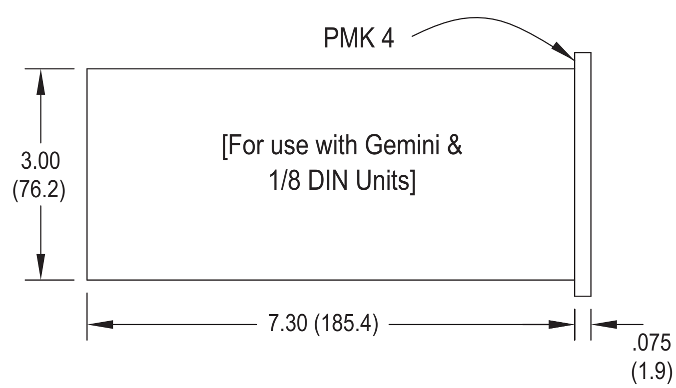
1. Mark and drill holes *(3/16" Dia.)* in base panel for attaching the base mount legs. Use the appropriate Model PMK panel as a template for marking the mounting hole locations. NOTE: RECOMMENDED MINIMUM BASE PANEL THICKNESS IS 1/8" TO SUPPORT THE WEIGHT OF THE INDICATOR WITHOUT PANEL DISTORTION.
2. Attach the base mount legs to the base panel using the machine screws and nuts provided or user supplied hardware if panel thickness exceeds 1/4".
3. Mount the indicator to the Model PMK panel, utilizing the mounting clips provided, in accordance with the panel mounting instructions supplied with the individual unit.
4. Attach the PMK panel and unit assembly to the base mount legs by using the self-tapping screws provided.

BASE MOUNT DIMENSIONS In inches (mm)

BMK3

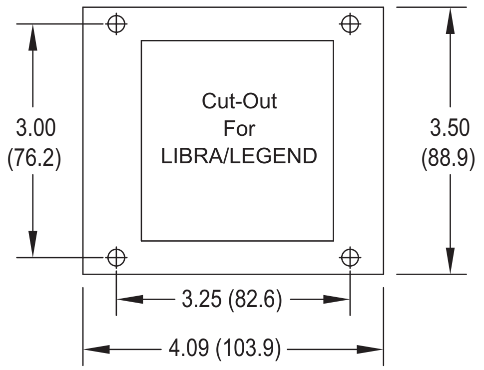


BMK4

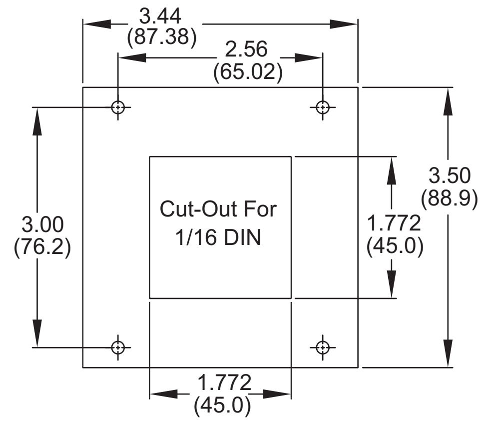


PANEL DIMENSIONS In inches (mm)

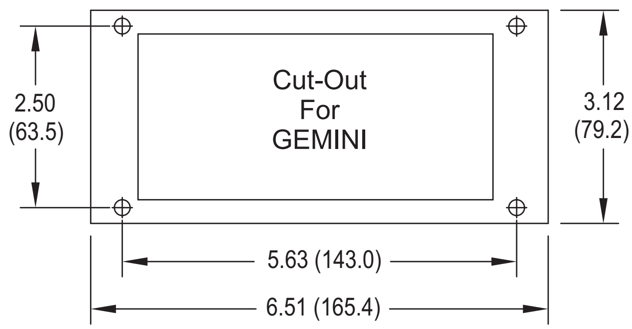
PMK3B



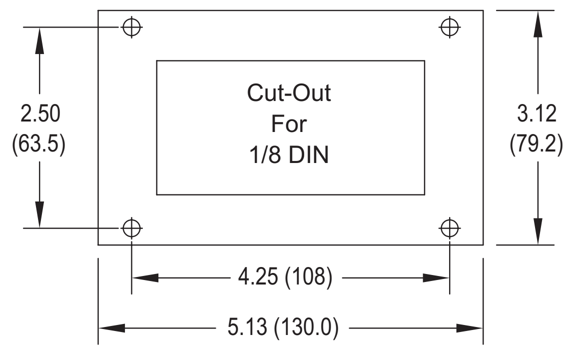
PMK3C



PMK4A



PMK4B



ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
BMK 3	Base Mount Kit For Legend And Libra	BMK30000
BMK 4	Base Mount Kit For Gemini and 1/8 DIN Units	BMK40000
PMK 3B	Mounting Panel For Libra And Legend	PMK3B000
PMK 3C	Mounting Panel For 1/16 DIN Units	PMK3C000
PMK 4A	Mounting Panel For Gemini	PMK4A000
PMK 4B	Mounting Panel For 1/8 DIN Units	PMK4B000

MODEL BMK6, BMK7 & BMK7A - BASE MOUNT KIT FOR CUB4, CUB5 & DT8 UNITS

DESCRIPTION

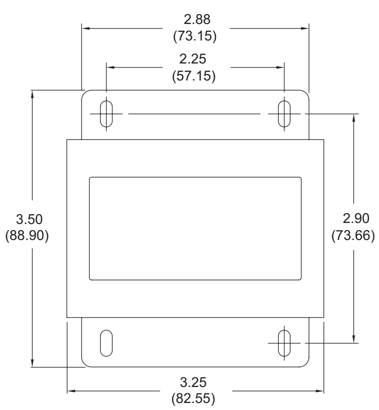
The BMK6, BMK7 and BMK7A base mounts are designed for use with the CUB4, CUB5, and DT8 units. The BMK7 is large enough to accommodate a Micro-line Power Supply (MLPS) attached to a CUB4 or DT8. The BMK7A will accommodate a Micro-line Power Supply (MLPS) attached to a CUB5.

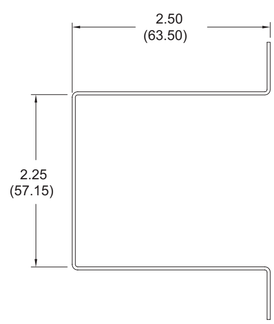
The wires can either be brought through the panel on which the unit is mounted, or through the hole(s) in the enclosure itself. Grommets are provided to insert in the hole(s) on the base mount (where applicable) when wires are routed through it. The grommets are in the accessory bag with each base mount unit, along with four nuts and bolts for mounting.

The base mounts are constructed of steel with a textured black finish.

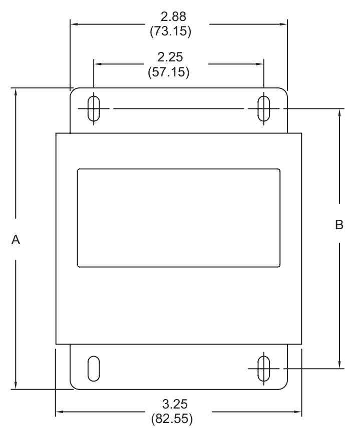
DIMENSIONS In inches (mm)

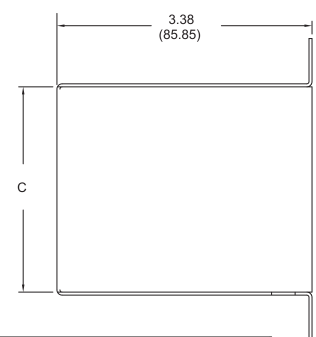
BMK6 - OPEN BASE MOUNT KIT (Without MLPS)





BMK7/BMK7A - CLOSED BASE MOUNT KIT (With or Without MLPS)





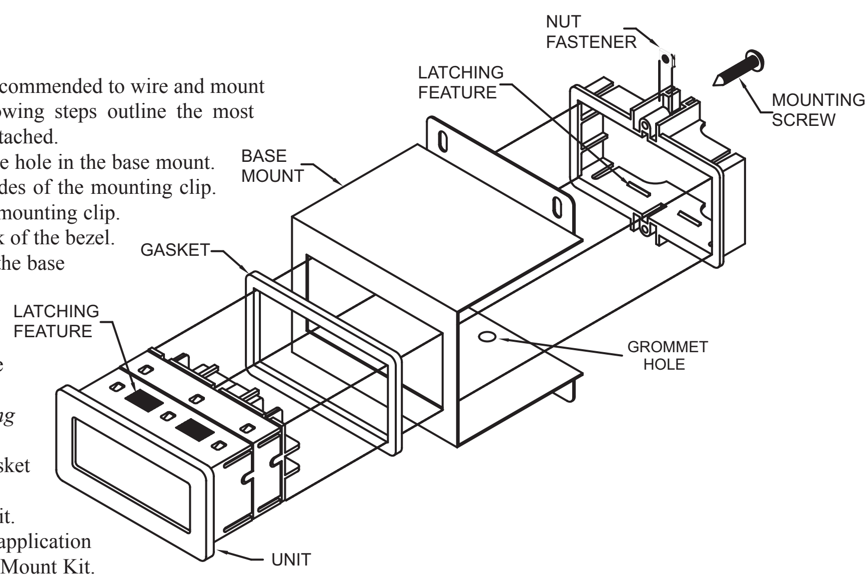
MODEL	A	B	C
BMK7	4.00 (101.50)	3.45 (87.63)	2.80 (71.12)
BMK7A	4.62 (117.35)	4.00 (101.50)	3.50 (88.90)

INSTALLATION

BMK6 - Open Base Mount

Before attaching the BMK6 to the panel or frame, it is recommended to wire and mount the unit to ensure good electrical connections. The following steps outline the most common sequence for installing a unit without an MLPS attached.

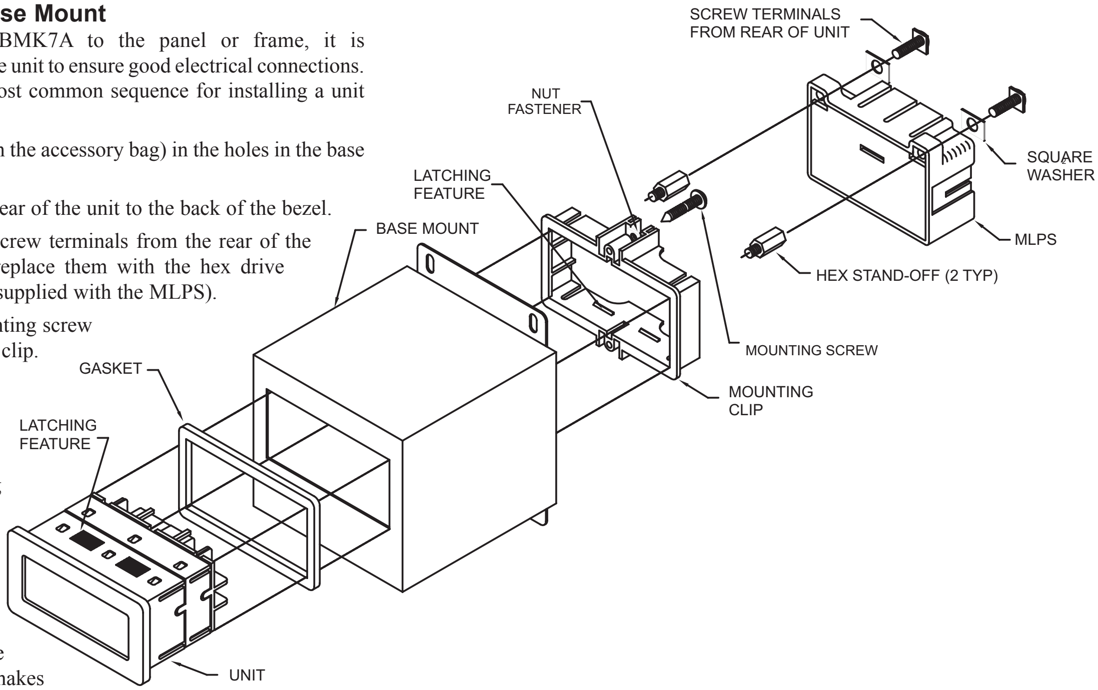
1. Install the grommet (provided in the accessory bag) in the hole in the base mount.
2. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
3. Slide the panel gasket over the rear of the unit to the back of the bezel. Then install the unit through the opening in the front of the base mount until the bezel flange makes contact.
4. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the base mount. The mounting clip has latching features which engage into mating features on the unit's housing.
   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
5. Alternately tighten each screw to ensure uniform gasket compression.
6. Connect the necessary wires from the grommet to the unit.
7. Mount the base mount enclosure to the panel or frame as application requires. Four bolts and nuts are provided with the Base Mount Kit.



INSTALLATION

BMK7/BMK7A - Closed Base Mount

Before attaching the BMK7/BMK7A to the panel or frame, it is recommended to wire and mount the unit to ensure good electrical connections. The following steps outline the most common sequence for installing a unit with an MLPS attached.



1. Install the grommets (provided in the accessory bag) in the holes in the base mount.
2. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Remove the common and V+ screw terminals from the rear of the unit (save for later use), and replace them with the hex drive stand-offs with round washers (supplied with the MLPS).
4. Assemble nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in mounting clip.
5. Route the wires from the grommets, through the mounting clip, into the rear of the base mount and out the front.
6. Connect the wires necessary for the application to the unit.
7. Install the unit through the opening in the front of the base mount until the bezel flange makes contact.
8. Slide the mounting clip over the rear of the unit until the mounting clip is against the inside of the base mount. The mounting clip has latching features which engage into mating features on the unit's housing.

   Note: It is necessary to hold the unit in place when sliding the mounting clip into position.
9. Alternately tighten each screw to ensure uniform gasket compression.
10. Connect AC power to the terminal block of the MLPS.

    Note: Make sure the AC selector switch is set to the appropriate position before applying power to the unit.
11. Mount the MLPS and optional sensor wires needed to the stand-offs using the screw terminal from the unit with the supplied square washers.
12. Mount the base mount enclosure to the panel or frame as application requires. Four bolts and nuts are provided with the Base Mount Kit.

K

ORDERING INFORMATION

MODEL NO	DESCRIPTION	PART NUMBER
BMK	OPEN BASE MOUNT KIT	BMK60000
	CLOSED BASE MOUNT KIT (DT8, CUB4)	BMK70000
	CLOSED BASE MOUNT KIT (CUB5)	BMK7A000
For More information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC Distributor.		

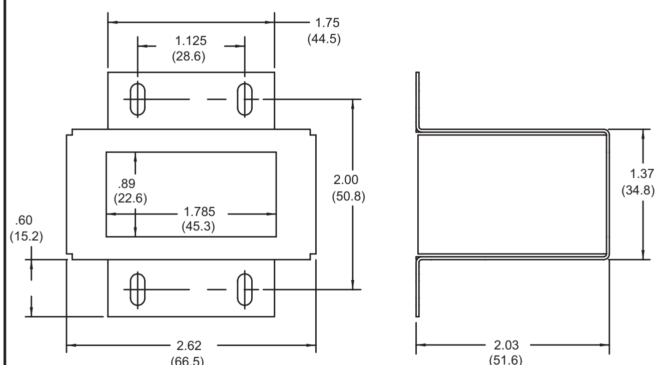
MODEL BMK8 - BASE MOUNT KIT FOR CUB7

DESCRIPTION

The BMK8 base mount is designed for use with the CUB7 series products. Wire feed to the CUB7 unit may be through the existing panel/frame or through the hole in the BMK8 itself.

The base mount is constructed of steel with a textured black finish and includes four mounting bolts and nuts.

DIMENSIONS In inches (mm)

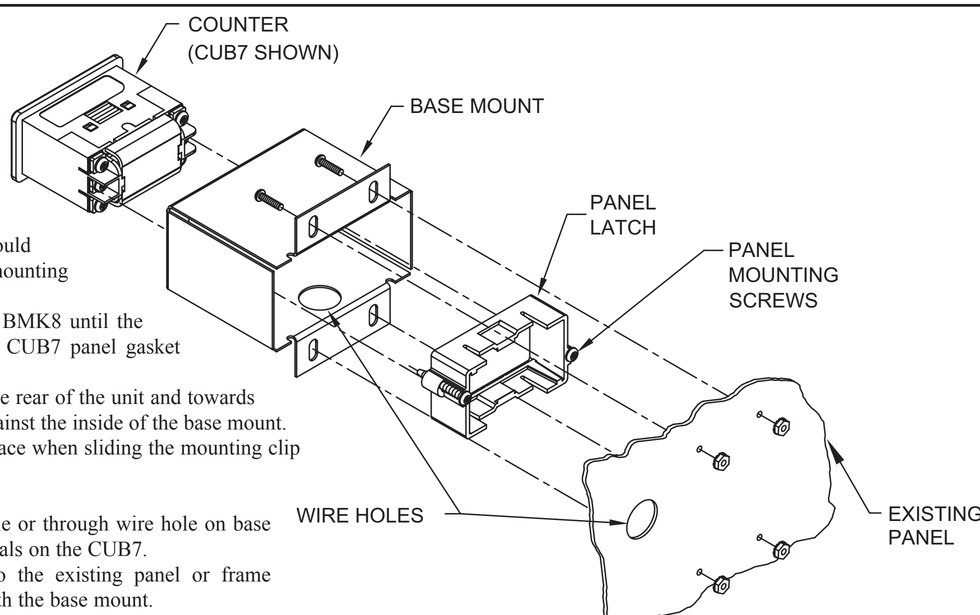


ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
BMK8	CUB7 BASE MOUNT KIT	BMK80000

INSTALLATION

1. Mark and drill holes (5/32") in existing panel using the BMK8 as a template. An addition hole may be cut in the existing panel for wire feed.
2. Remove the panel latch (mounting clip) from the CUB7 unit and insert the mounting screws (supplied with the CUB7) on both sides of panel latch. The tip of the screw should not project from the hole in the panel latch (mounting clip).
3. Slide the CUB7 through the cut out in the BMK8 until the bezel flange contacts the base mount. The CUB7 panel gasket is optional.
4. Slide the panel latch (mounting clip) over the rear of the unit and towards the front of the unit until it latches firmly against the inside of the base mount. Note: It is necessary to hold the CUB7 in place when sliding the mounting clip into position.
5. Alternately tighten mounting screws.
6. Route wires through existing panel wire hole or through wire hole on base mount and connect to the appropriate terminals on the CUB7.
7. Mount the CUB7/base mount assembly to the existing panel or frame utilizing the four bolts and nuts provided with the base mount.



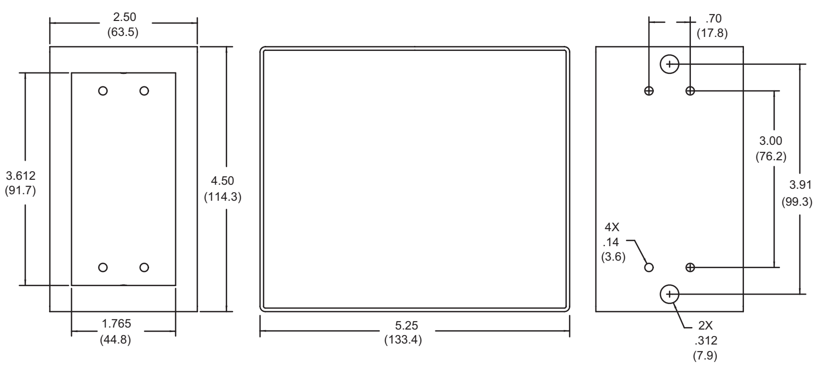
MODEL BMK9 - DIN RAIL MOUNT ADAPTER KIT FOR PAX

DESCRIPTION

The BMK9 DIN rail mount kit is designed to adapt any PAX panel mount meter to DIN rail mount requirements. Wire feed to the PAX unit may be through the top or bottom of the adapter kit.

The DIN rail adapter frame is constructed of steel with a textured black finish and includes two plastic DIN rail mounting feet for attachment to a top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15.

DIMENSIONS In inches (mm)



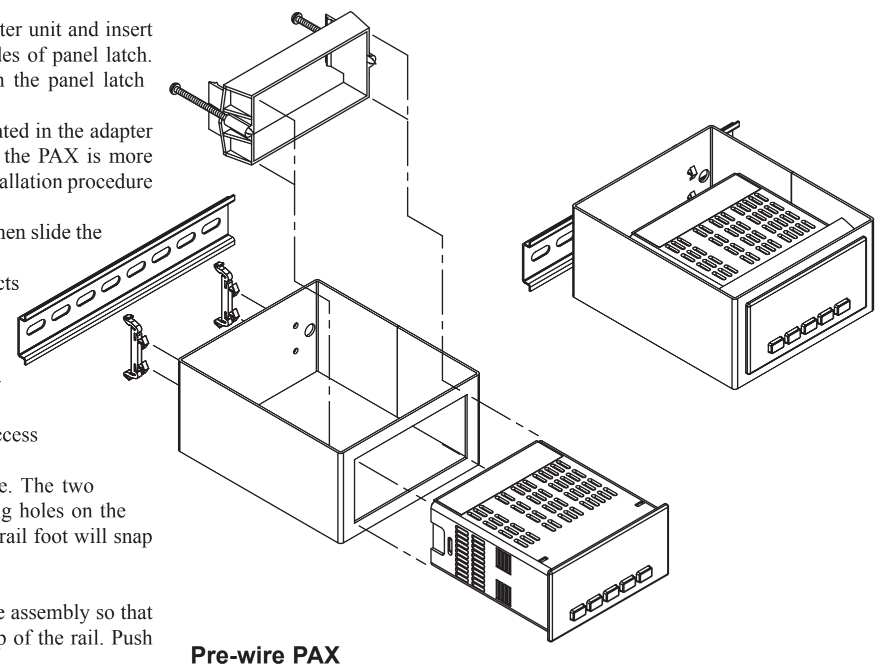
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
BMK9	DIN Rail PAX Base Mount Kit	BMK90000
For More information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC Distributor.		

K

INSTALLATION

1. Remove the panel latch (mounting clip) from the PAX meter unit and insert the mounting screws (supplied with the PAX) on both sides of panel latch. The tip of the screw should not project from the hole in the panel latch (mounting clip).
2. The PAX meter may be wired after the unit has been mounted in the adapter frame, in which case continue with Step 3. If pre-wiring the PAX is more convenient, skip to the pre-wiring step at the end of this installation procedure before returning to Step 3.
3. Slide the PAX meter through the cut out in the BMK9 and then slide the panel latch (mounting clip) over the rear of the PAX.
4. Continue sliding the PAX meter until the bezel flange contacts the adapter frame. The PAX panel gasket is optional.
5. Slide the panel latch (mounting clip) towards the front of the unit until it latches firmly against the inside of the adapter frame. Note: It is necessary to hold the PAX meter in place when sliding the mounting clip into position.
6. Alternately tighten mounting screws through the rear access holes of the adapter frame.
7. Apply both DIN rail feet to the rear of the adapter frame. The two latching pins of the rail foot are positioned into the mating holes on the adapter frame. Slight pressure applied to the center of the rail foot will snap foot into locking position.
8. Wire PAX meter appropriately.
9. To install the complete assembly on a T style rail, angle the assembly so that the top groove of both rail feet are located over the top lip of the rail. Push the assembly towards the rail until it snaps into place.
10. To remove the assembly from the rail, place a screwdriver behind the bottom groove of the foot rail and slightly pry upwards to release first rail foot. Apply same procedure to second rail foot and remove complete assembly.



Pre-wire PAX

2a. Route wires through the panel latch (mounting clip) and then through the front cut out of the adapter frame from the inside to the outside. Wire PAX meter appropriately. Continue with installation at Step 3 above.

MODEL BMK11 – CUB5 OR MLPS DIN RAIL BASE MOUNT ADAPTER KIT

DESCRIPTION

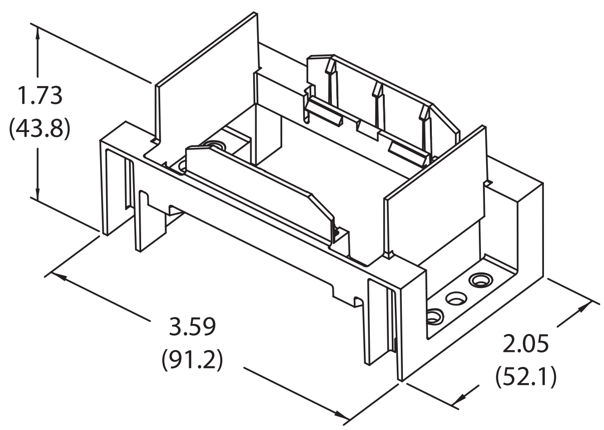
The model BMK11 can be used to mount a CUB5 meter or a Micro Line Power Supply (MLPS) in various applications. Need a DIN rail mounted display? Simply add the DIN rail clips to the back of the BMK11, install your meter and snap it on the rail. If your application requires an inexpensive power supply, simply mount an MLPS to the BMK11 and snap it to the rail. For base mount application, just use the appropriate mounting screws to securely fasten the BMK11. Nothing could be easier.

ORDERING INFORMATION

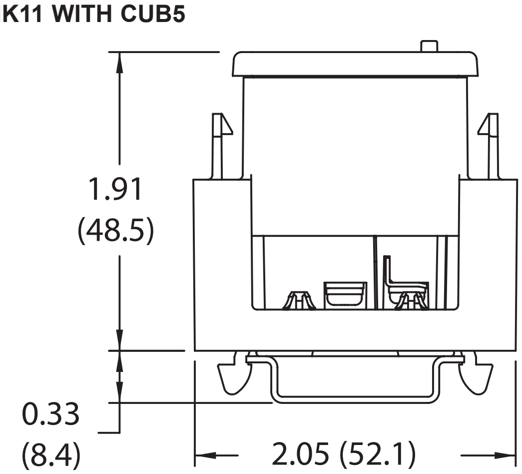
MODEL NO.	DESCRIPTION	PART NUMBER
BMK11	CUB5 or MLPS DIN Rail Base Mount Kit	BMK11000

DIMENSIONS In inches (mm)

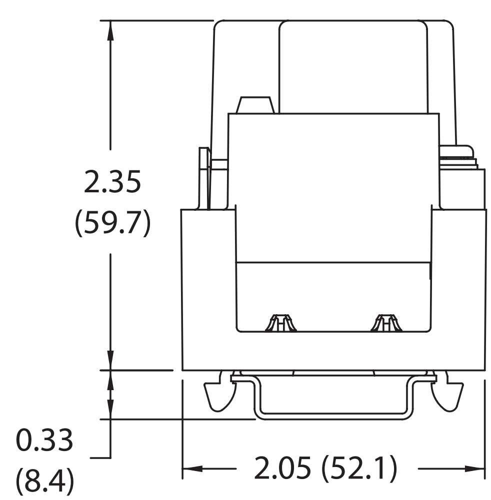
BMK11 WITHOUT UNIT



BMK11 WITH CUB5

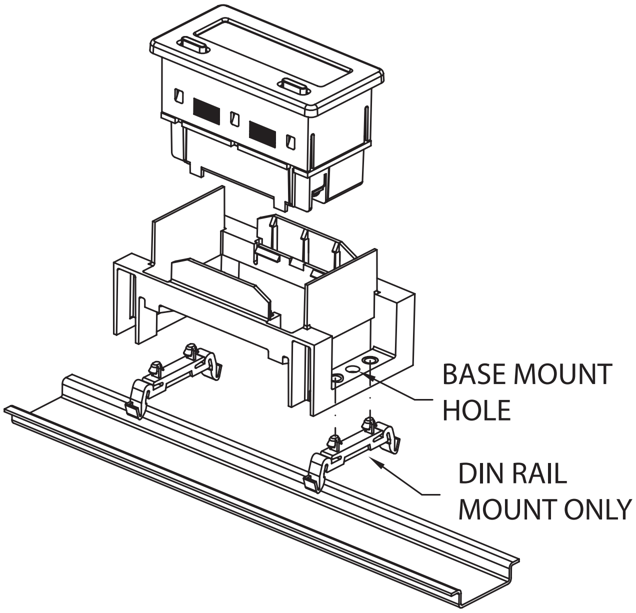


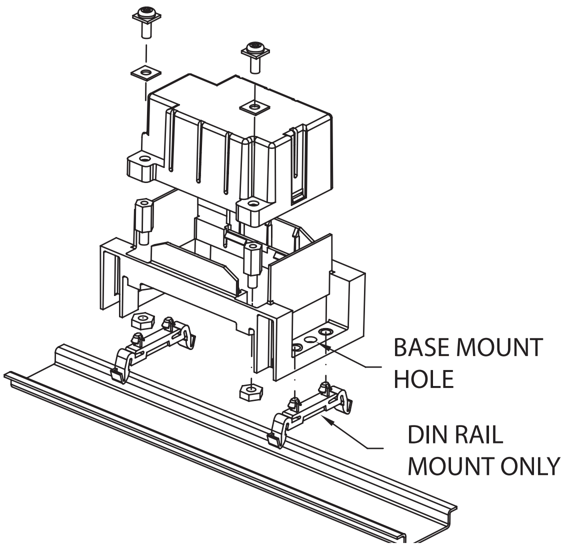
BMK11 WITH MLPS



CUB5 INSTALLATION

1. Remove the panel latch (mounting clip) from the indicator. Insert the indicator into the BMK11 per diagram at right. Verify indicator is fully seated and latches have engaged. With latches properly engaged the indicator will not pull out of the BMK11.
2. Wire the indicator.
3. For **DIN RAIL** mounting, insert the two plastic feet as shown in the diagram at right. Angle the assembly so that the top groove of both rail feet are located over the top lip of the rail. Rotate the assembly towards the rail until it snaps into place.
4. To remove the assembly from the rail, place a screwdriver behind one of the rail feet and draw the rail foot away from the rail disengaging it from the rail. Apply the same procedure to the second rail foot and remove the complete assembly from the rail.
5. For **Base Mount**, use the holes indicated in the diagram at right, and screw or bolt the assembly to the desired mounting surface. User is responsible for selecting the appropriate screw or bolt to provide mounting to the desired surface. Base mount holes in the BMK11 are designed for #8 hardware.
6. To remove the indicator from the BMK11, slide a small screwdriver into the slot provided in the latch. Draw the latch away from the indicator until disengaged. Repeat the procedure on the other side. Once the latches are released, remove the indicator from the BMK11.





MLPS INSTALLATION

1. Using the two nuts supplied with the BMK11, affix standoffs from MLPS hardware pack as indicated in the diagram at left.
2. Snap the MLPS over the standoffs into the BMK11 as indicated in the diagram.
3. Attach the MLPS to the standoffs using the square washers and SEMS terminal screws included with MLPS hardware pack.
4. Assembly can be wired at this time, or after the mounting is completed.
5. For **DIN RAIL** mounting, insert the two plastic feet as shown in the diagram. Angle the assembly so that the top groove of both rail feet are located over the top lip of the rail. Rotate the assembly towards the rail until it snaps into place.
6. For **Base Mount**, use the holes indicated in the diagram at left, and screw or bolt the assembly to the desired mounting surface. User is responsible for selecting the appropriate screw or bolt to provide mounting to the desired surface. Base mount holes in BMK11 are designed for #8 hardware.
7. To remove the MLPS from the BMK11, slide a small screwdriver between the MLPS and the latch wall. Draw the latch away from the MLPS until disengaged. Repeat procedure on the other side. Once latches are released remove the MLPS from the BMK11.

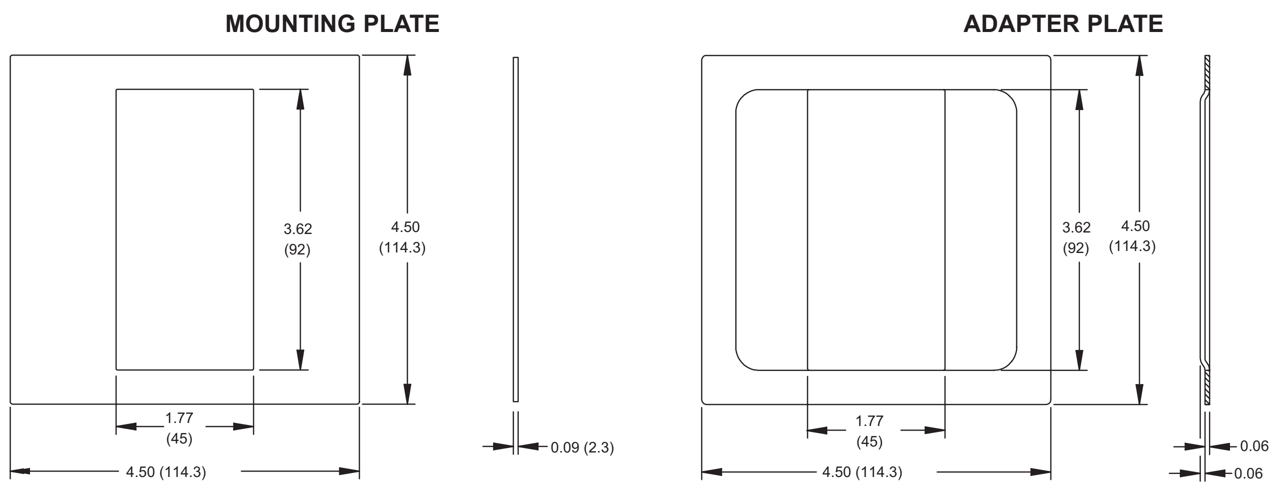
K

MODELS PMK5, PMK7, and PMK7A - PANEL MOUNT ADAPTER KITS

PMK5 - 1/4 DIN TO 1/8 DIN ADAPTER

This panel mount adapter kit is used to mount 1/8 DIN instruments, vertically or horizontally into an existing 1/4 DIN panel cut-out. The kit includes two durable steel mounting plates painted black and a neoprene gasket. The Adapter Kit, when used with a unit which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed. Red Lion Controls 1/8 DIN products include Temperature and Process Control Units (*Models TCU, TSC, PCU, and PSC*), and PAX Series.

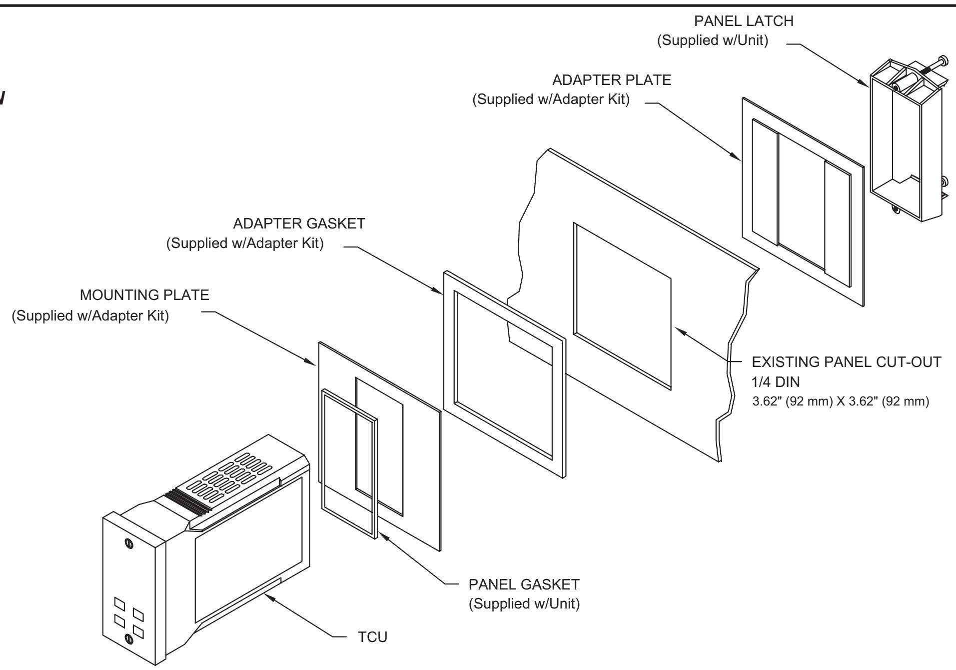
DIMENSIONS In inches (mm)



INSTALLATION

TYPICAL VERTICAL MOUNT INSTALLATION

1. Remove the paper backing from the adhesive side of the adapter gasket *(included with adapter kit)* and carefully apply the gasket to the front of the existing panel cut-out.
2. Apply the panel gasket (*provided with the unit*) to one side of the mounting plate. Slide the mounting plate over the unit with the gasket facing the Bezel of the unit.
3. Insert the unit with mounting plate into the panel cut-out from the front. Slide the adapter plate over the rear of the unit. The protrusion on the adapter plate is designed to fit into the existing 1/4 DIN panel cut-out to properly position the unit.
4. Refer to the installation section of the manual, supplied with the instrument, to complete the installation.



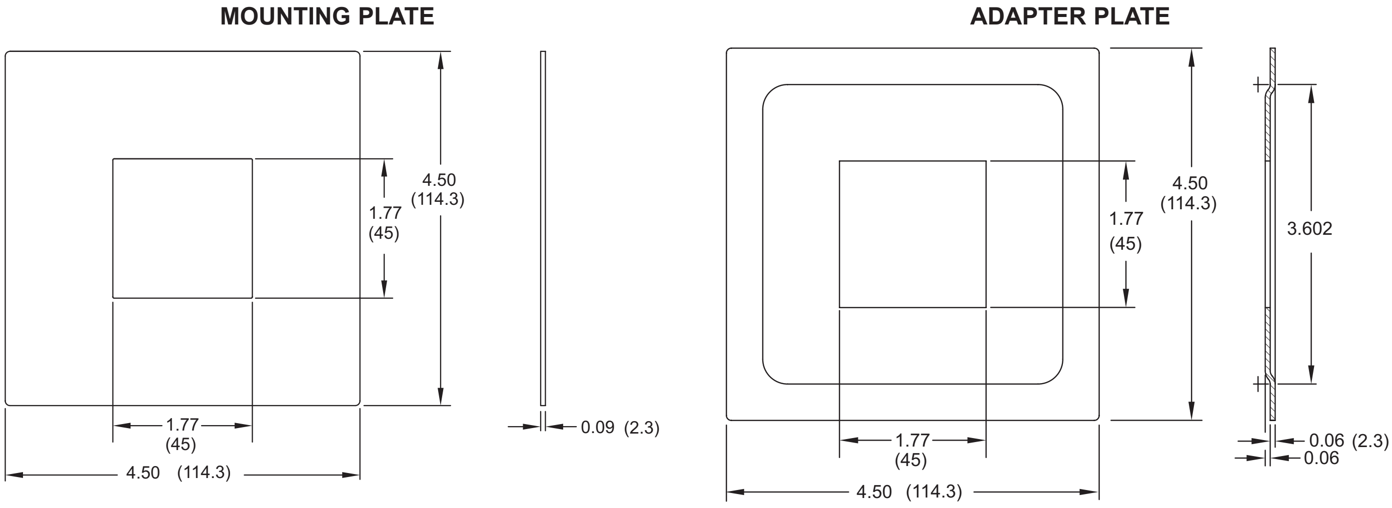
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PMK5	Panel Mount Adapter Kit (1/4 DIN TO 1/8 DIN)	PMK50000
PMK7	Panel Mount Adapter Kit (1/4 DIN TO 1/16 DIN)	PMK70000
PMK7A	Panel Mount Adapter Kit (1/4 DIN TO CUB)	PMK7A000

PMK7 - 1/4 DIN TO 1/16 DIN ADAPTER

This panel mount adapter kit is used to mount 1/16 DIN instruments, into an existing 1/4 DIN panel cut-out. The kit includes two durable steel mounting plates painted black and a neoprene gasket. The Adapter Kit, when used with a unit which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed. Red Lion Controls 1/16 DIN products include Temperature and Process Control Units (*Models T48, T16, P48, and P16*), and Model C48 Counters and Timers.

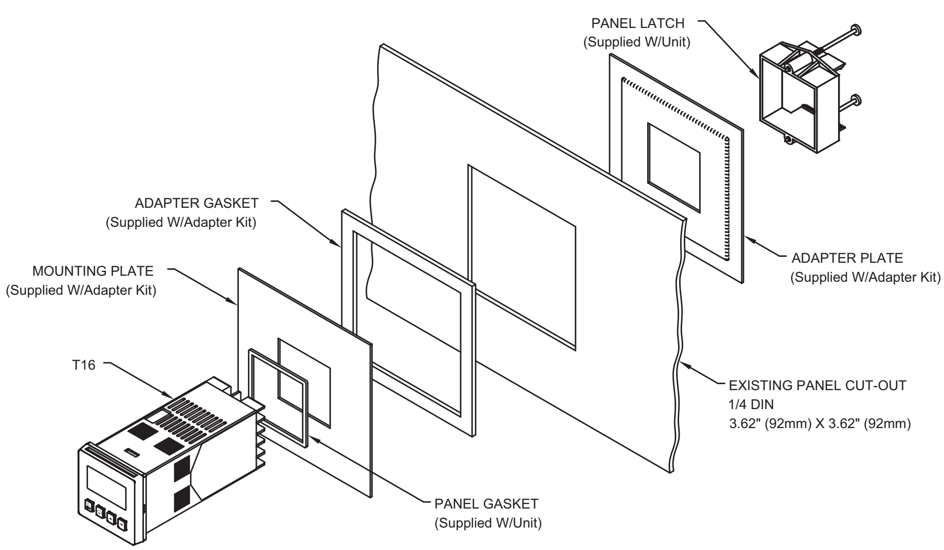
DIMENSIONS In inches (mm)



INSTALLATION

TYPICAL INSTALLATION

1. Remove the paper backing from the adhesive side of the adapter gasket *(included with adapter kit)* and carefully apply the gasket to the front of the existing panel cut-out.
2. Apply the panel gasket (*provided with the unit*) to one side of the mounting plate. Slide the mounting plate over the unit with the gasket facing the Bezel of the unit.
3. Insert the unit with mounting plate into the panel cut-out from the front. Slide the adapter plate over the rear of the unit. The protrusion on the adapter plate is designed to fit into the existing 1/4 DIN panel cut-out to properly position the unit.
4. Refer to the installation section of the manual, supplied with the instrument, to complete the installation.

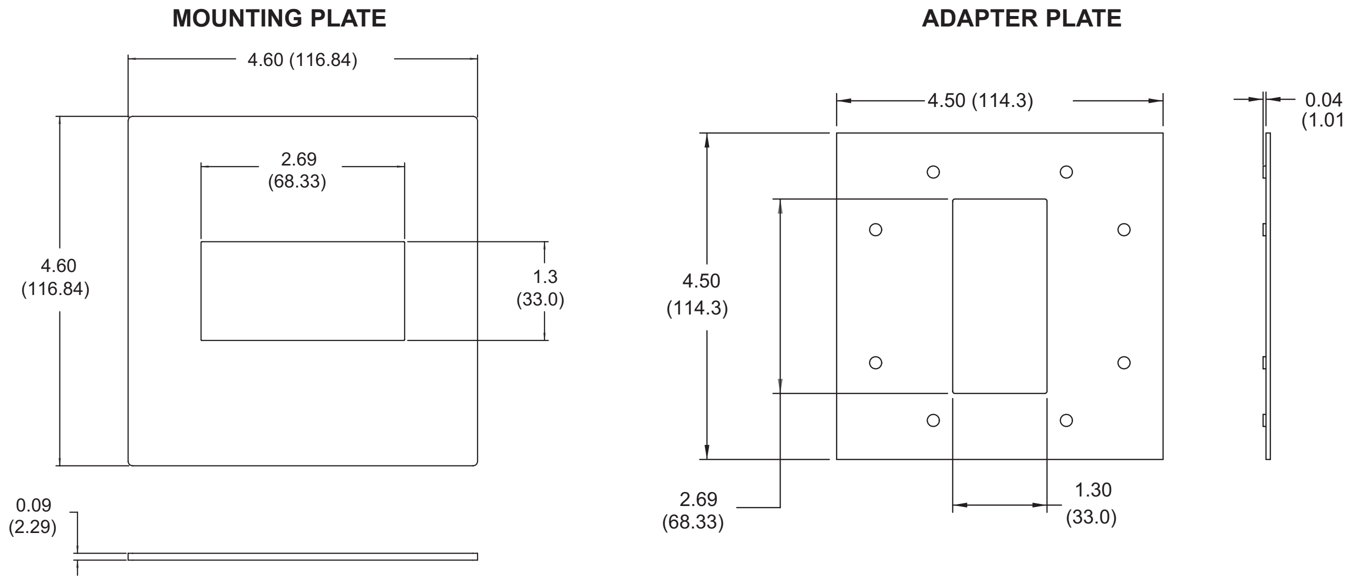


K

PMK7A - 1/4 DIN TO CUB ADAPTER

This panel mount adapter kit is used to mount CUB4, CUB5, DT8 and DT9 instruments, into an existing 1/4 DIN panel cut-out. The kit includes two durable steel mounting plates painted black and a neoprene gasket. The Adapter Kit, when used with a unit which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed.

DIMENSIONS In inches (mm)

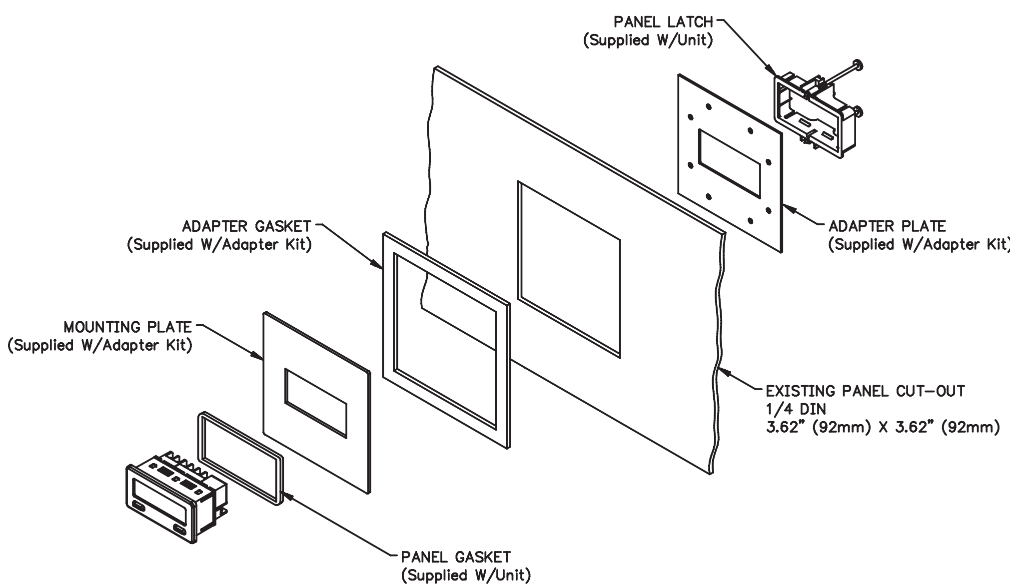


K

INSTALLATION

TYPICAL INSTALLATION

1. Remove the paper backing from the adhesive side of the adapter gasket *(included with adapter kit)* and carefully apply the gasket to the front of the existing panel cut-out.
2. Apply the panel gasket (*provided with the unit*) to one side of the mounting plate. Slide the mounting plate over the unit with the gasket facing the Bezel of the unit.
3. Insert the unit with mounting plate into the panel cut-out from the front. Slide the adapter plate over the rear of the unit. The protrusion on the adapter plate is designed to fit into the existing 1/4 DIN panel cut-out to properly position the unit.
4. Refer to the installation section of the manual, supplied with the instrument, to complete the installation.



PANEL MOUNT ADAPTER KIT - 1/8 DIN TO 1/16 DIN

The panel mount adapter kit is used to mount 1/16 DIN instruments into existing vertical or horizontal 1/8 DIN panel cut-outs. The kit includes two black painted durable steel mounting plates and a sponge rubber gasket. The Adapter Kit, when used with a unit which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed. Red Lion Controls 1/16 DIN products include Temperature and Process Control Units (Models T48, and P48), and the C48 units.

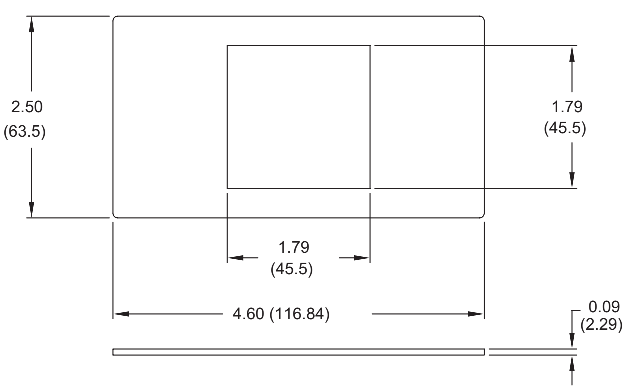
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PMK6	Panel Mount Adapter Kit (1/8 DIN to 1/16 DIN)	PMK60000

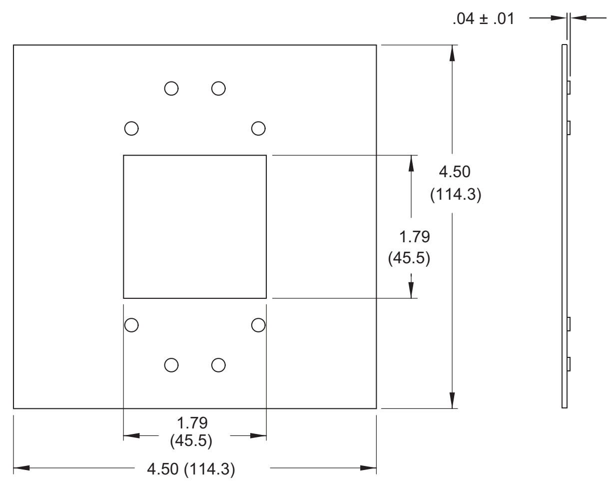
K

DIMENSIONS In inches (mm)

MOUNTING PLATE



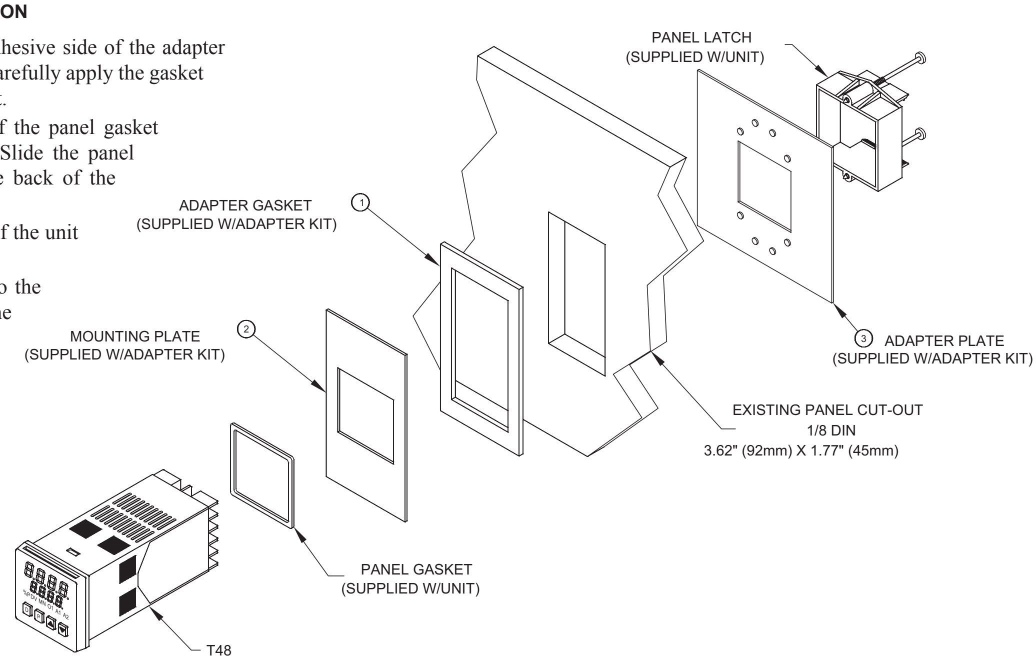
ADAPTER PLATE



INSTALLATION

TYPICAL VERTICAL MOUNT INSTALLATION

1. Remove the paper backing from the adhesive side of the adapter gasket *(included with adapter kit)* and carefully apply the gasket to the front of the existing panel cut-out.
2. Carefully remove the center section of the panel gasket (provided with the unit) and discard. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Slide the mounting plate over the rear of the unit to the back of the unit bezel.
4. Insert the unit with mounting plate into the panel cut-out from the front. Slide the adapter plate over the rear of the unit. The protrusion on the adapter plate is designed to fit into the existing 1/8 DIN panel cut-out to properly position the unit.
5. Refer to the installation section of the manual, supplied with the unit, to complete the installation.



PANEL MOUNT ADAPTER KIT - 1/8 DIN TO CUB5

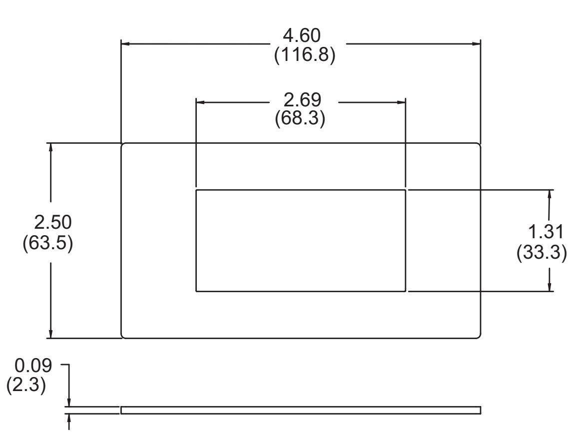
The panel mount adapter kit is used to mount CUB5 units into existing 1/8 DIN panel cut-outs. The kit includes two black painted durable steel mounting plates and a sponge rubber gasket. The Adapter Kit, when used with a unit which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed. Red Lion Controls CUB5 products include Counters, Timers, Temperature, Process and Rate units.

ORDERING INFORMATION

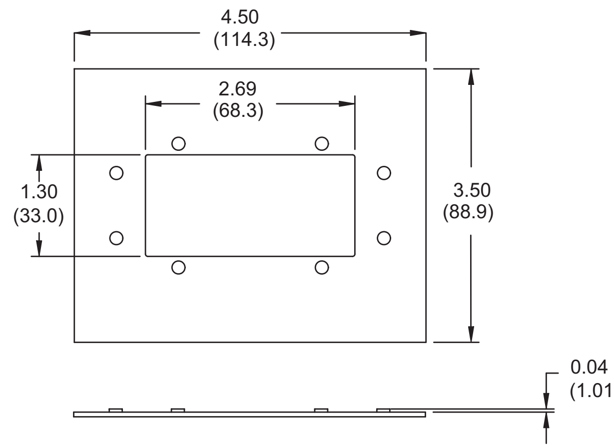
MODEL NO.	DESCRIPTION	PART NUMBER
PMK6A	Panel Mount Adapter Kit (1/8 DIN to CUB5)	PMK6A000

DIMENSIONS In inches (mm)

MOUNTING PLATE



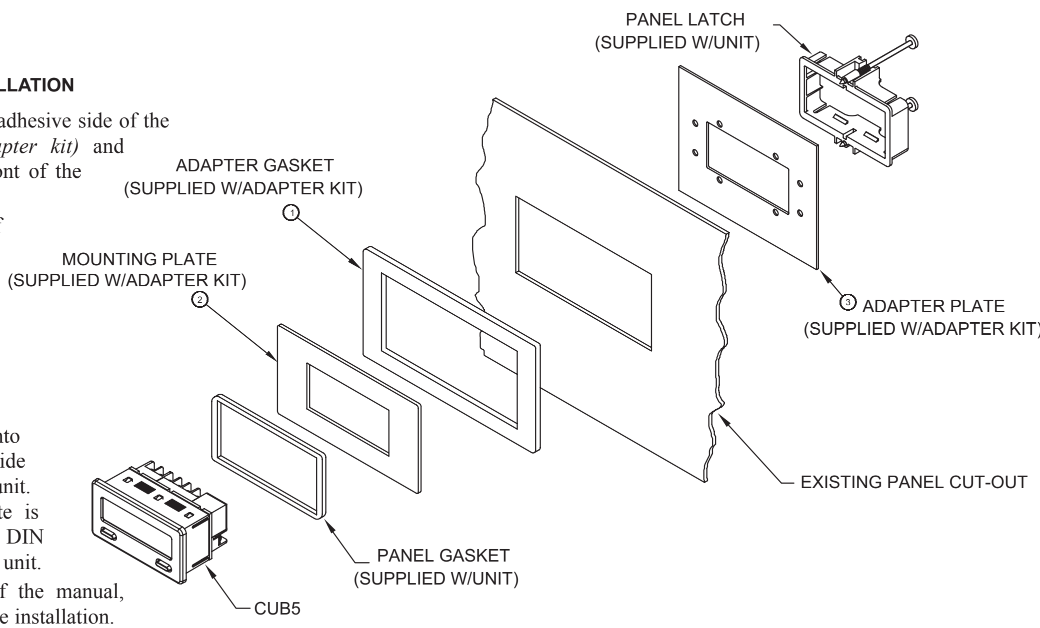
ADAPTER PLATE



INSTALLATION

TYPICAL HORIZONTAL MOUNT INSTALLATION

1. Remove the paper backing from the adhesive side of the adapter gasket *(included with adapter kit)* and carefully apply the gasket to the front of the existing panel cut-out.
2. Carefully remove the center section of the panel gasket (provided with the unit) and discard. Slide the panel gasket over the rear of the unit to the back of the bezel.
3. Slide the mounting plate over the rear of the unit to the back of the unit bezel.
4. Insert the unit with mounting plate into the panel cut-out from the front. Slide the adapter plate over the rear of the unit. The protrusion on the adapter plate is designed to fit into the existing 1/8 DIN panel cut-out to properly position the unit.
5. Refer to the installation section of the manual, supplied with the unit, to complete the installation.



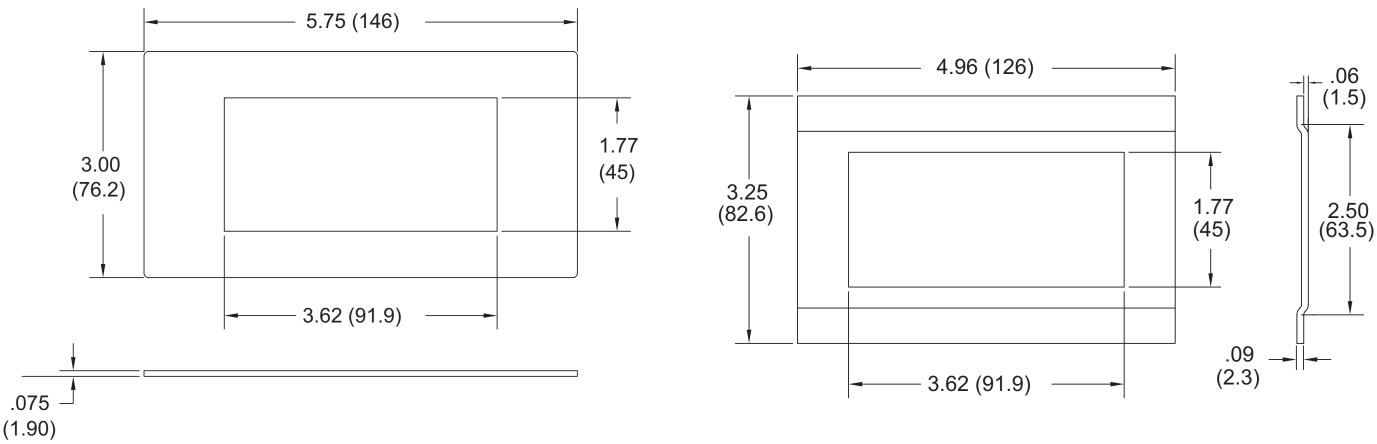
MODEL PMK8 - PANEL MOUNT ADAPTER KIT FOR PAX TO GEMINI CUT-OUT

The **PMK8** panel mount adapter kit is used to mount a PAX meter into an existing GEMINI panel cut-out. The kit includes two durable steel mounting plates painted black and a neoprene gasket. The Adapter Kit, when used with a meter which has NEMA 4/IP65 specifications, will meet NEMA 4/IP65 requirements when properly installed.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PMK8	Panel Mount Adapter Kit (PAX to Gemini)	PMK80000

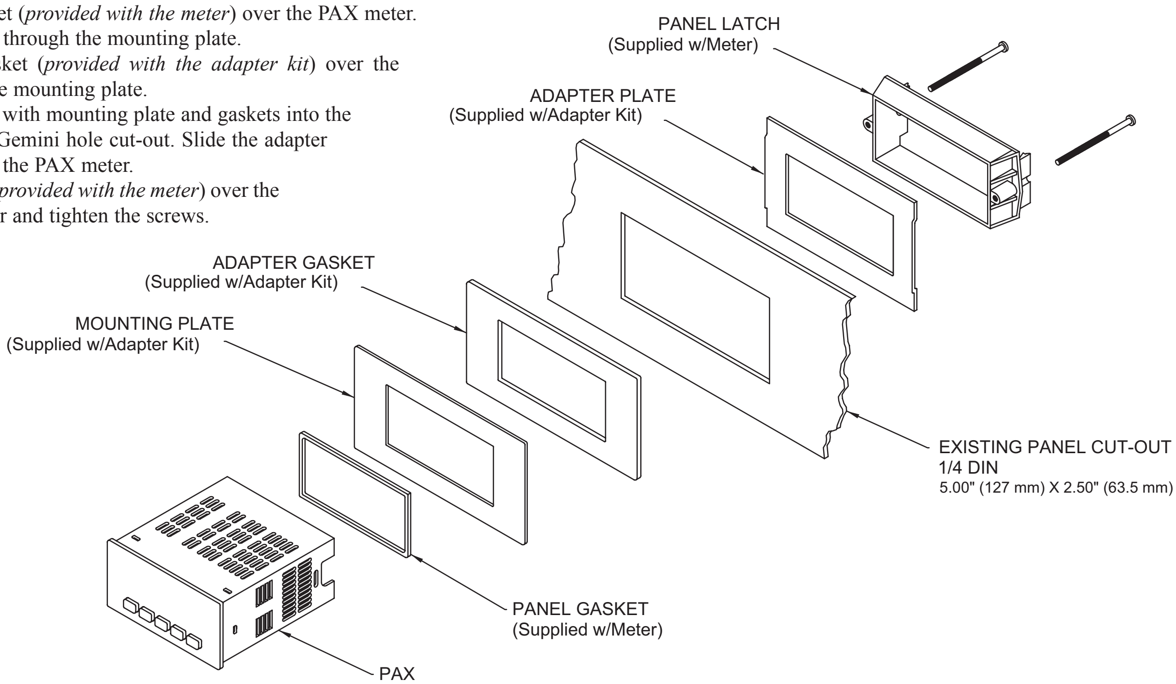
PMK8 DIMENSIONS In inches (mm)



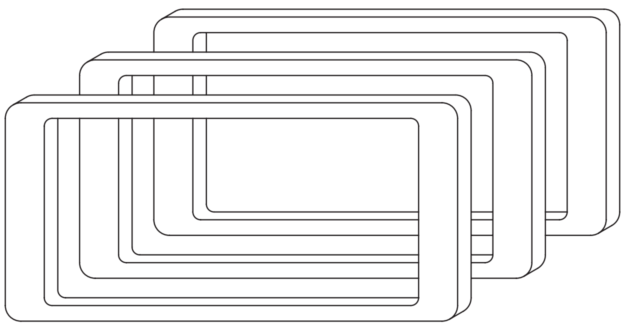
K

PMK8 INSTALLATION

1. Apply the panel gasket (*provided with the meter*) over the PAX meter.
2. Insert the PAX meter through the mounting plate.
3. Apply the panel gasket (*provided with the adapter kit*) over the PAX meter behind the mounting plate.
4. Insert the PAX meter with mounting plate and gaskets into the front of the existing Gemini hole cut-out. Slide the adapter plate over the rear of the PAX meter.
5. Slide the panel latch (*provided with the meter*) over the rear of the PAX meter and tighten the screws.

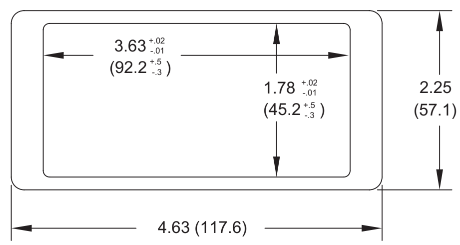


1/8 DIN PANEL ADAPTER KIT
FOR DT3A, DT3D, SCT, & SCP PANEL CUT-OUTS



The 1/8 DIN panel adapter kit permits the mounting of the PAX and Apollo units into an existing 1.8" (*45.7 mm*) x 3.88" (*98.5 mm*) (DT3A, DT3D, SCT, & SCP) panel cut-out. The kit consists of two metal adapter plates coated with a durable flat black polyurethane finish, and a neoprene gasket, which provides a sealed front panel that meets NEMA 4/IP65 specifications when properly installed.

DIMENSIONS In Inches (mm)



NOTE:
An overall panel area of 2.25" (57.1 mm) x 4.63" (117.6 mm) is required for proper mounting.

K

INSTALLATION

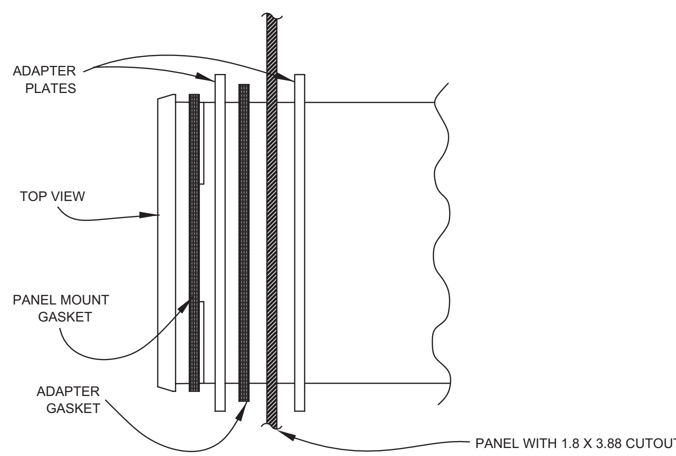
1. Remove the backing from the adhesive side of the adapter gasket (*included with adapter kit*) and carefully stick the gasket to the front of the existing panel cut-out.

2. Place the standard panel mount gasket (*provided with the unit*) over the unit. Then slide one of the plates over the unit. If the gasket has adhesive, apply the gasket to the plate, then slide the plate over the unit. (*Gasket must be facing the bezel.*)

3. Insert the unit into the panel cut-out from the front and slide the remaining adapter plate over the unit from the rear.

4. Install the mounting clip(s) as per the unit instructions. Tighten the mounting screws evenly to apply uniform compression and to provide a water-tight seal.

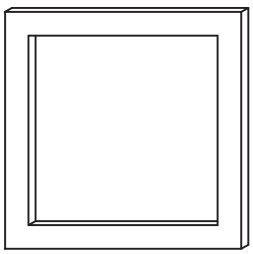
CAUTION: Only minimum pressure is required to seal the panel. Do NOT overtighten the mounting screws.



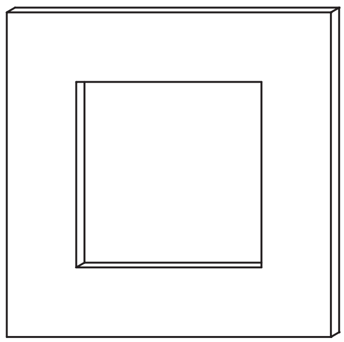
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PMKA1	3-PIECE KIT permits mounting to existing 1.8" x 3.88" (45.7 x98.4 mm) Panel cut-out, O.A. DIM. 2.25" x 4.63" (57.1 x 117.6 mm)	PMKA1000

INSTALLATION FOR 1/16 DIN PANEL MOUNT KITS



PMKCC1



PMKCC2

These panel mount kits for 1/16 DIN products are available to aid in replacing many products on the market today. Kits come complete with adapter plates coated with a durable flat black polyurethane finish and gaskets.

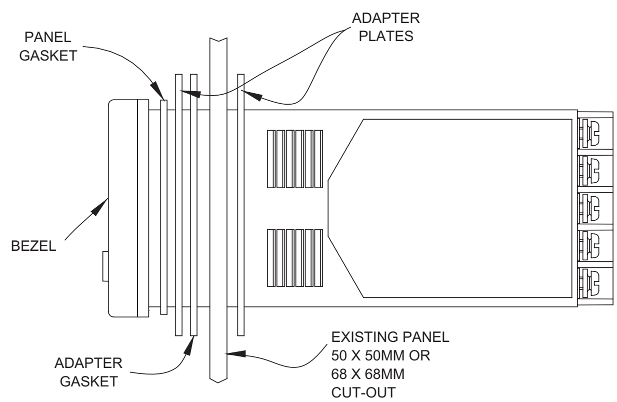
K

PMKCC1 & PMKCC2

These panel mount kits adapt 1/16 DIN products to either a 50 mm x 50 mm or a 68 mm x 68 mm panel cut-out. The kit consists of two metal panel adaptors and one neoprene gasket. The adapter plates and gasket are pinched between the front bezel of the 1/16 DIN unit and the unit's mounting clip.

Note: If room permits, make the wiring connections after the unit is mounted. If there is not enough room, pull the wires through before installing as described below:

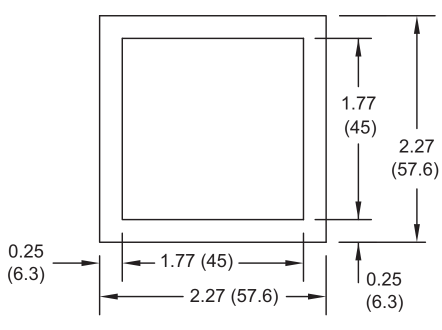
1. Slide the following items onto the 1/16 DIN unit.
   a. Panel gasket supplied with 1/16 DIN unit.
   b. One PMKCC adapter plate.
   c. Adapter gasket supplied with PMKCC.
2. If wiring connections can be made after the unit is mounted, skip to Step 3.
   a. Pull wires through mounting clip.
   b. Pull wires through one PMKCC adapter plate.
   c. Pull wires through existing panel opening.
   d. Wire unit.
3. Slide unit through panel cut-out from the front, and center in the panel opening.
4. Slide PMKCC adapter plate onto back of unit.
5. Install the mounting clip and tighten to moderately "pinch" the gaskets between the front bezel and the mounting clip.



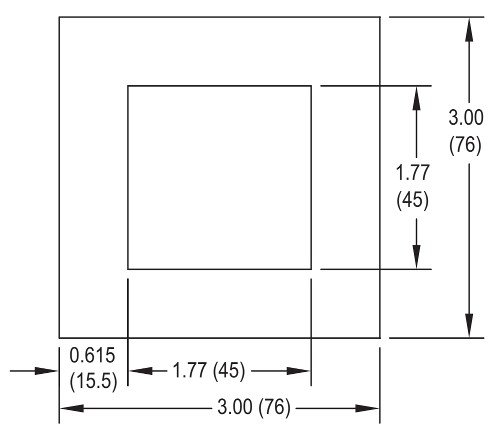
ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
PMKCC1	3-PIECE KIT permits mounting in existing 1.97" X 1.97" (50 mm x 50 mm) panel cut-outs	PMKCC100
PMKCC2	3-PIECE KIT permits mounting in existing 1.97" X 1.97" (50 mm x 50 mm) or 2.68" X 2.68" (68 mm x 68 mm) panel cut-outs	PMKCC200

DIMENSIONS In inches (mm)



PMKCC1

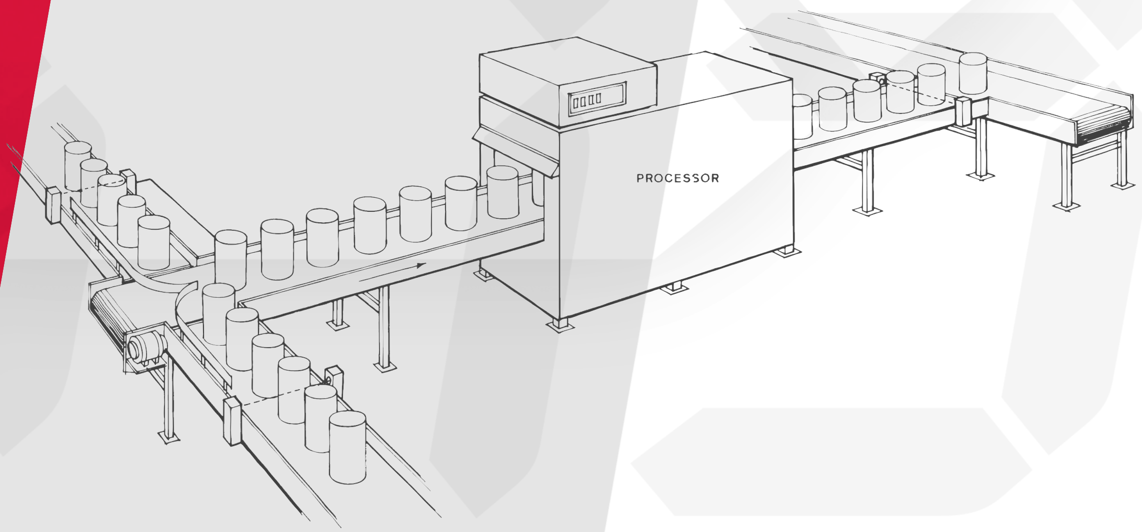


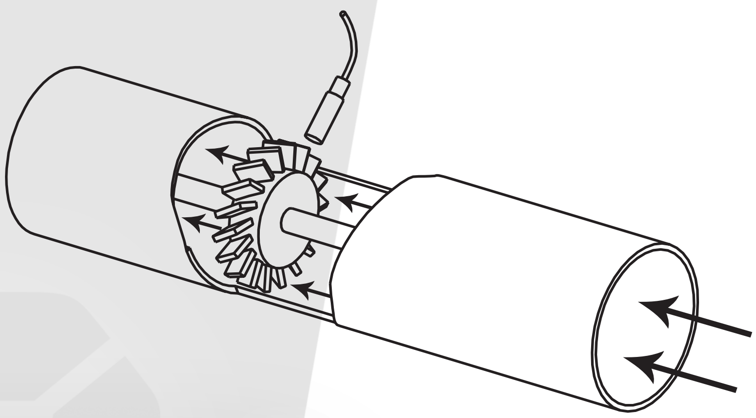
PMKCC2

K

This page intentionally left blank.

SENSOR WIRING GUIDE





L

The Trusted Source for

Innovative Control Solutions

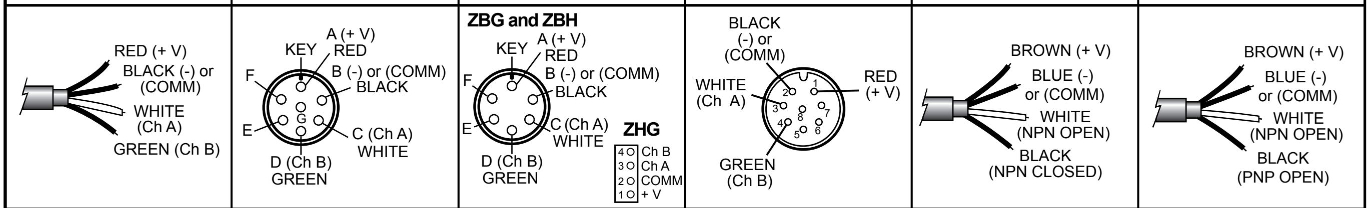
L

SENSOR MODEL	ASTC, LMPC, ZFG, ZCG, HESS, PSAH	PSA1B PSA2B	PSA6B PSA7B PSA8B PSAFP PSAC	MP25TA MP37TA MP37CA MP62TA MP75TX	LMPEC	LMPCC
OLD MODEL	LSC RPGC					
OUTPUT CONNECTIONS	RED (+ V) BLACK (-) or (COMM) WHITE (Ch A)	BLACK OR BROWN (+ V) BLUE (Ch A)	BROWN (+ V) BLUE (-) or (COMM) BLACK (Ch A)	WHITE OR BLUE BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK
APLR/APLRI/APLPT	RED (+ V) — 3 (DC OUT) BLK (-) — 4 (COMM.) WHT (Ch A) — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BLK or BRN (+ V) — 3 (DC OUT) 1.5 K — 4 (COMM.) BLUE (Ch A) — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BRN (+ V) — 3 (DC OUT) BLUE (-) — 4 (COMM.) BLK (Ch A) — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BLK — 4 (COMM.) BLUE or WHT — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	A (+ V) — 3 (DC OUT) B (-) — 4 (COMM.) C (Ch A) — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	A (+ V) — 3 (DC OUT) B (-) — 4 (COMM.) C (Ch A) — 5 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC
C48C	WHT (Ch A) — 7 (INPUT A) BLK (-) — 9 (COMM.) RED (+ V) — 10 (DC OUT) SWITCH SETTINGS: SRC LO FRQ LO BIAS / SNK HI FRQ HI BIAS	BLUE (Ch A) — 7 (INPUT A) BLK or BRN (+ V) — 10 (DC OUT) SWITCH SETTINGS: SRC LO FRQ LO BIAS / SNK HI FRQ HI BIAS	BLK (Ch A) — 7 (INPUT A) BLUE (-) — 9 (COMM.) BRN (+ V) — 10 (DC OUT) SWITCH SETTINGS: SRC LO FRQ LO BIAS / SNK HI FRQ HI BIAS	*NOT APPLICABLE*	C (Ch A) — 7 (INPUT A) B (-) — 9 (COMM.) A (+ V) — 10 (DC OUT) SWITCH SETTINGS: SRC LO FRQ LO BIAS / SNK HI FRQ HI BIAS	A (Ch A) — 7 (INPUT A) B (-) — 9 (COMM.) C (+ V) — 10 (DC OUT) SWITCH SETTINGS: SRC LO FRQ LO BIAS / SNK HI FRQ HI BIAS
CUB7	WHT (Ch A) BLK (-) RED (+ V) 1 (COMM) 6 (H.S. IN) PSMA 1 2 3 4 5	*NOT APPLICABLE*	BLK (Ch A) BLUE (-) BRN (+ V) 1 (COMM) 6 (H.S. IN) PSMA 1 2 3 4 5	*NOT APPLICABLE*	*NOT APPLICABLE*	C (Ch A) B (-) A (+ V) 1 (COMM) 6 (H.S. IN) PSMA 1 2 3 4 5
CUB1, CUB2	WHT (Ch A) BLK (-) RED (+ V) BLK * (COMM) WHT * (H.S. IN) PSMA 1 2 3 4 5	*NOT APPLICABLE*	BLK (Ch A) BLUE (-) BRN (+ V) BLK * (COMM) WHT * (H.S. IN) PSMA 1 2 3 4 5	*NOT APPLICABLE*	*NOT APPLICABLE*	C (Ch A) B (-) A (+ V) BLK * (COMM) WHT * (H.S. IN) PSMA 1 2 3 4 5
CUB2LQ	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*
CUB2LU	APS 1 (+) 2 (-) RED (+ V) BLK * (COMM.) BLK (COMM) WHT (Ch A) — WHT * (CNT.)	*NOT APPLICABLE*	APS 1 (+) 2 (-) BRN (+ V) BLK * (COMM) BLUE (-) BLK (Ch A) — WHT * (CNT.)	*NOT APPLICABLE*	*NOT APPLICABLE*	APS 1 (+) 2 (-) A (+ V) BLK * (COMM) B (-) C (Ch A) — WHT * (CNT.)
CUB3	APS 1 (+) 2 (-) RED (+ V) BLK * (COMM.) BLK (COMM) WHT (Ch A) — WHT * (CNT.)	*NOT APPLICABLE*	APS 1 (+) 2 (-) BRN (+ V) BLK * (COMM) BLUE (-) BLK (Ch A) — WHT * (CNT.)	*NOT APPLICABLE*	*NOT APPLICABLE*	APS 1 (+) 2 (-) A (+ V) BLK * (COMM.) B (-) C (Ch A) — WHT * (CNT.)

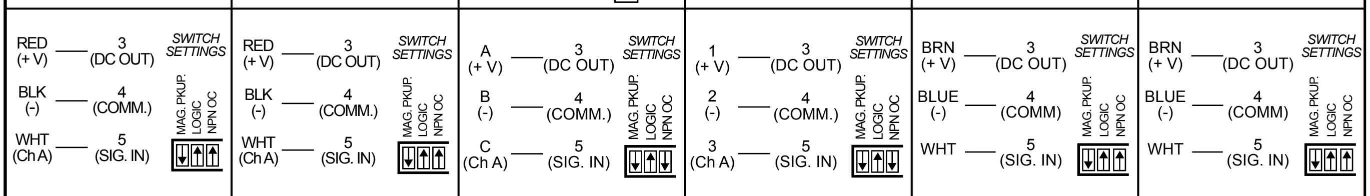
* Designates wires from the listed counter.

SENSOR MODEL	ZCH, ZFH, ZGH, ZMD, ZOD, ZOH, ZPJ, ZRJ, ZRL, ZSD, RPGD	ZDH ZLZ ZNH ZUK	ZBG ZBH ZHG	ZBG ZBH (M12 Connector)	PRMDC RCMDC RRMDC	PRDC RCDC RRDC
OLD MODEL	ARJ, LSM, LSQ, RPGO, RPGQ,	LE, RPGN	RPGB RPGH	RPGB		

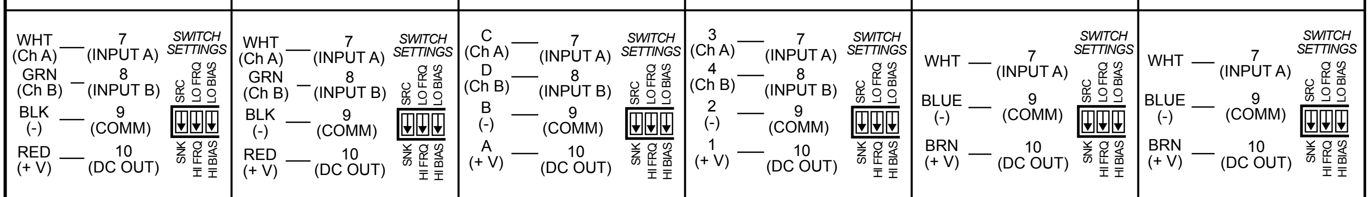
OUTPUT CONNECTIONS



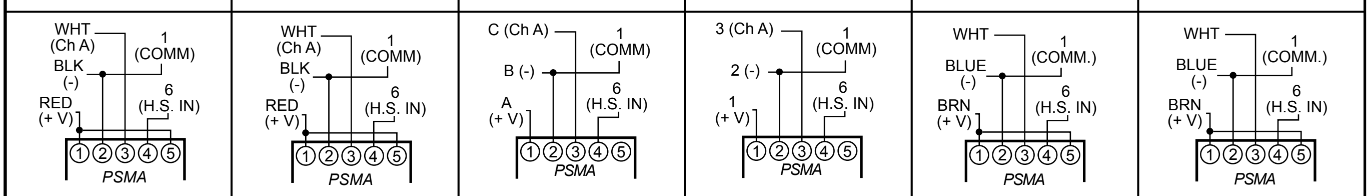
APLR/APLRI/APLPT



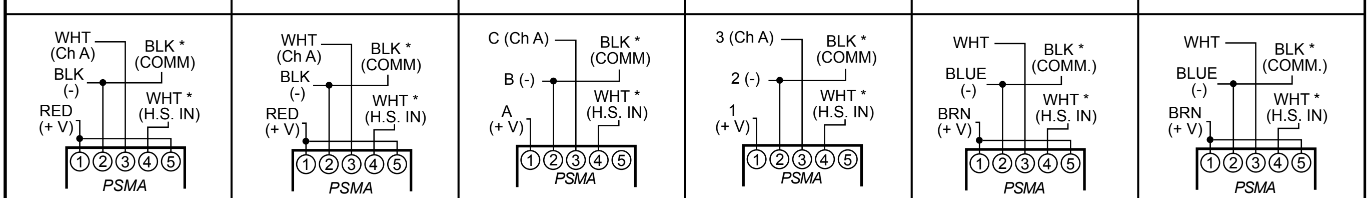
C48C



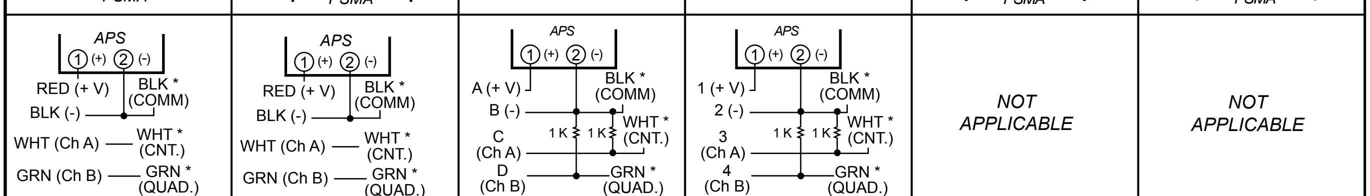
CUB7



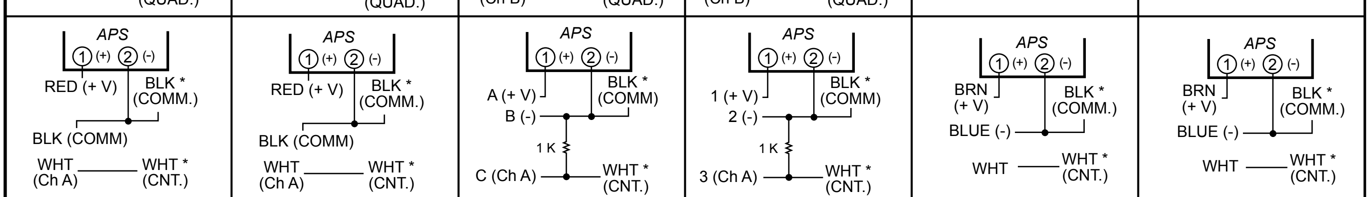
CUB1, CUB2



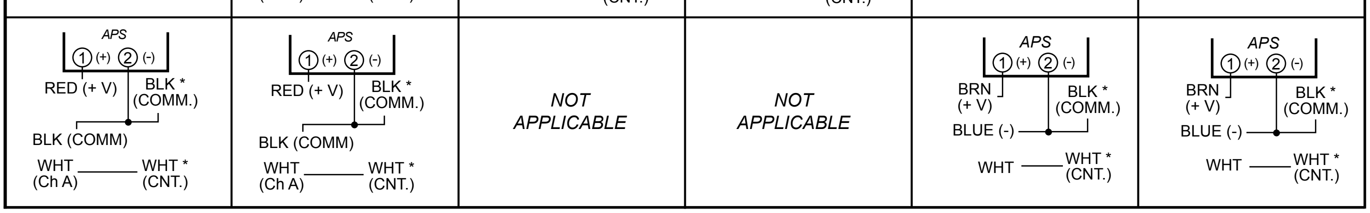
CUB2LQ



CUB2LU



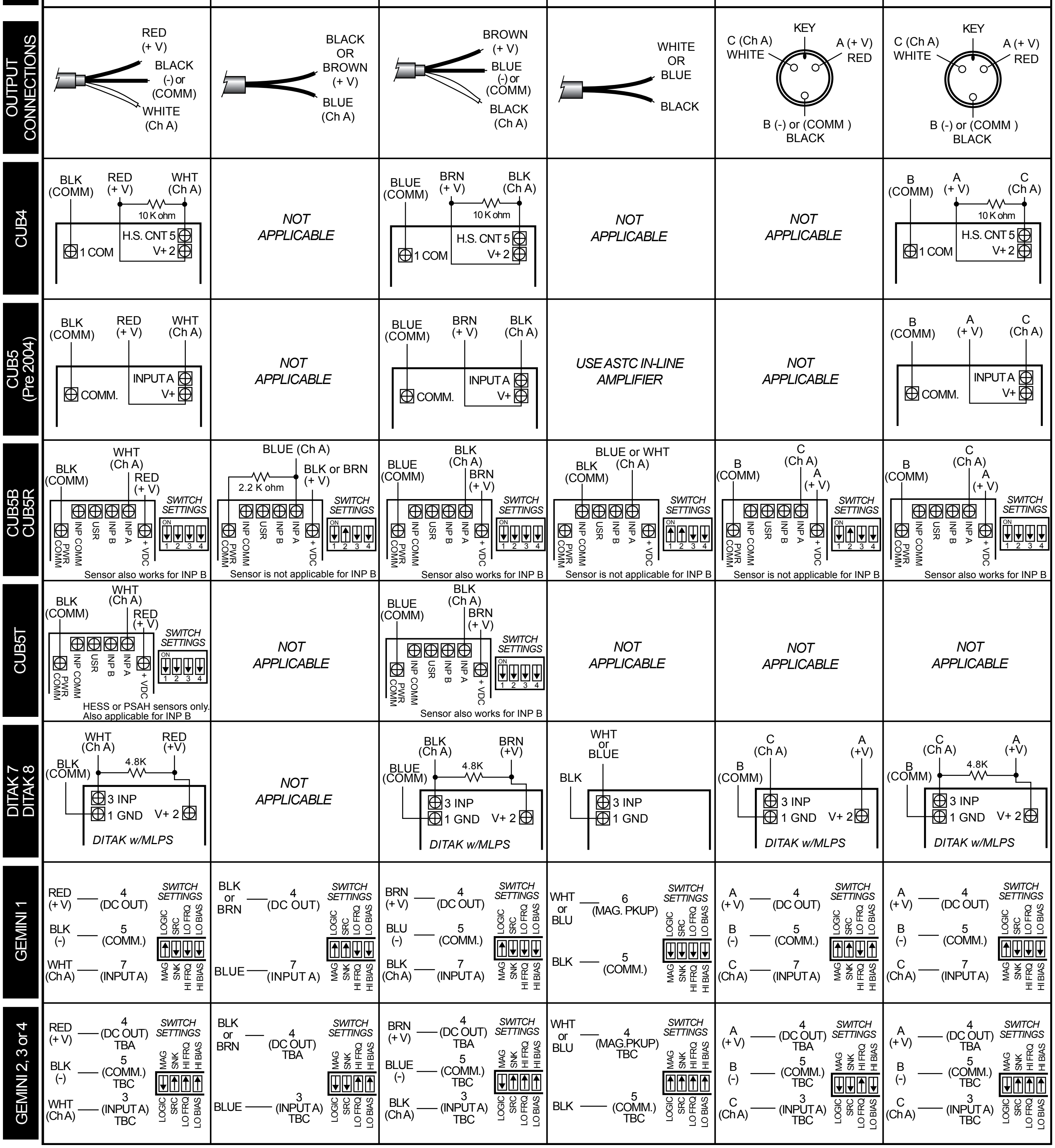
CUB3



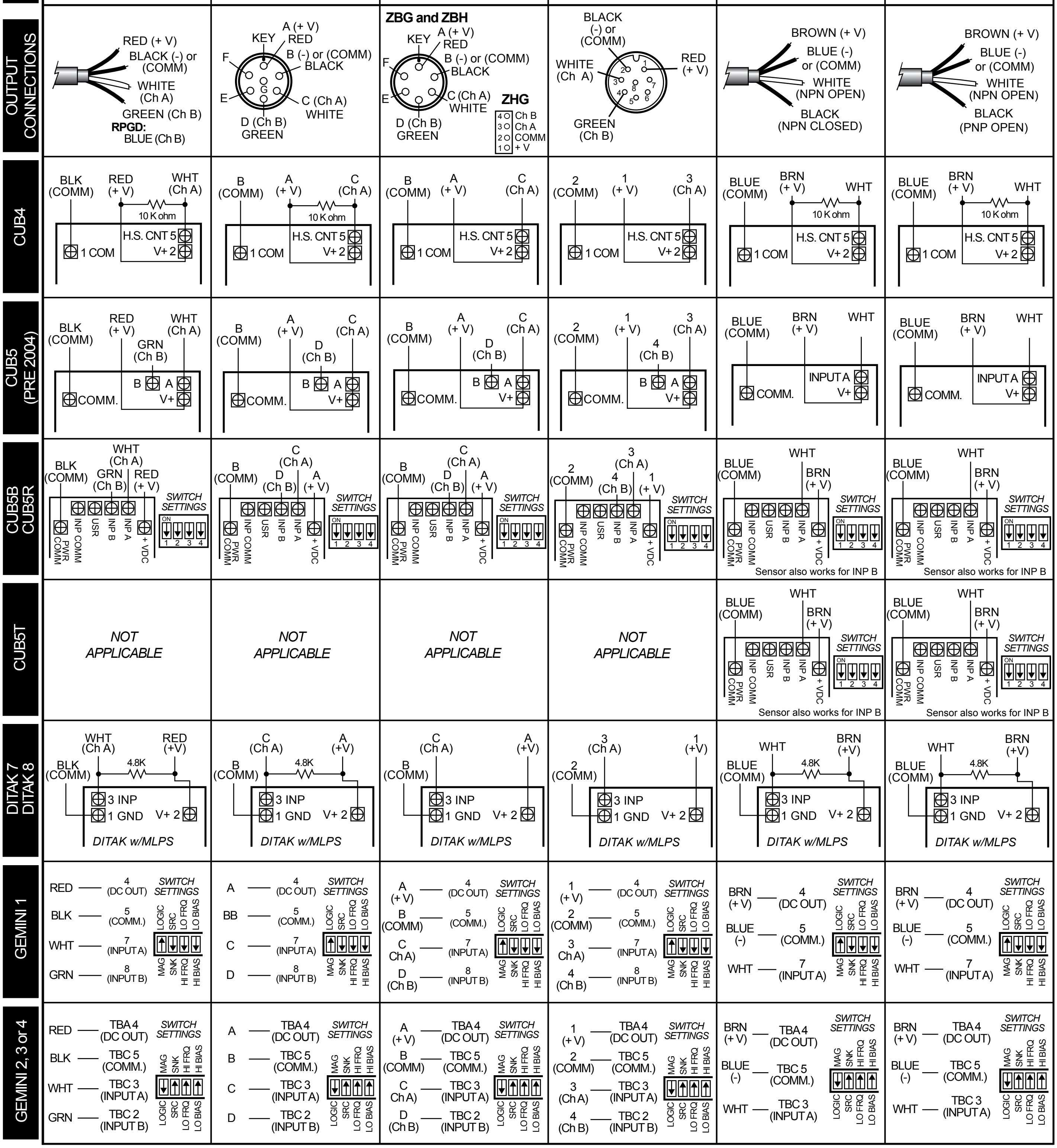
* Designates wires from the listed counter.

L

SENSOR MODEL	ASTC, LMPC, ZFG, ZCG, HESS, PSAH	PSA1B PSA2B	PSA6B PSA7B PSA8B PSAFP PSAC	MP25TA MP37TA MP37CA MP62TA MP75TX	LMPEC	LMPCC
OLD MODEL	LSC RPGC					



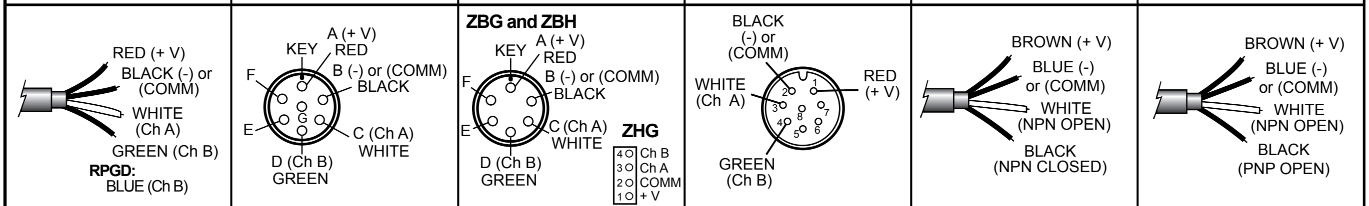
SENSOR MODEL	ZCH, ZFH, ZGH, ZMD, ZOD, ZOH, ZPJ, ZRJ, ZRL, ZSD, RPGD	ZDH ZLZ ZNH ZUK	ZBG ZBH ZHG	ZBG ZBH (M12 Connector)	PRMDC RCMDC RRMDC	PRDC RCDC RRDC
OLD MODEL	ARJ, LSM, LSQ, RPGO, RPGQ,	LE, RPGN	RPGB RPGH	RPGB		



* Designates wires from the listed counter.

SENSOR MODEL	ASTC, LMPC, ZFG, ZCG, HESS, PSAH	PSA1B PSA2B	PSA6B PSA7B PSA8B PSAFP PSAC	MP25TA MP37TA MP37CA MP62TA MP75TX	LMPEC	LMPCC
OLD MODEL	LSC RPGC					
OUTPUT CONNECTIONS	RED (+ V) BLACK (-) or (COMM) WHITE (Ch A)	BLACK OR BROWN (+ V) BLUE (Ch A)	BROWN (+ V) BLUE (-) or (COMM) BLACK (Ch A)	WHITE OR BLUE BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK
GEM52	RED (+ V) — TBA 4 (DC OUT) BLK (-) — TBC 6 (COMM.) WHT (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	BLK or BRN — TBA 4 (DC OUT) BLUE — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	BRN (+ V) — TBA 4 (DC OUT) BLUE (-) — TBC 6 (COMM.) BLK (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	WHT or BLUE — TBC 5 (MAG. PKUP) BLK — TBC 6 (COMM.) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	A (+ V) — TBA 4 (DC OUT) B (-) — TBC 6 (COMM.) C (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	A (+ V) — TBA 4 (DC OUT) B (-) — TBC 6 (COMM.) C (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS
IFMA IFMR	RED (+ V) — 7 (+12 V) WHT (Ch A) — 8 (INPUT) BLK (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	BLK or BRN — 7 (+12 V) BLUE — 8 (INPUT) SWITCH SETTINGS: SRC LOGIC SNK	BRN (+ V) — 7 (+12 V) BLK (Ch A) — 8 (INPUT) BLUE (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	WHT or BLUE — 8 (INPUT) BLK — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	A (+ V) — 7 (+12 V) C (Ch A) — 8 (INPUT) B (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	A (+ V) — 7 (+12 V) C (Ch A) — 8 (INPUT) B (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK
IMI	RED (+ V) — 5 (+12 VDC) BLK (-) — 7 (COMM.) WHT (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BLK or BRN — 5 (+12 VDC) 1.5 K — 7 (COMM.) BLUE — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BRN (+ V) — 5 (+12 VDC) BLUE (-) — 7 (COMM.) BLK (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	WHT or BLUE — 6 (SIG. IN) BLK — 7 (COMM.) SWITCH SETTINGS: MAG. PKUP. LOGIC SRC NPN OC	A (+ V) — 5 (+12 VDC) B (-) — 7 (COMM.) C (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC SRC NPN OC	A (+ V) — 5 (+12 VDC) B (-) — 7 (COMM.) C (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC SRC NPN OC
LD20, LD40, LD2T, LD4T	RED (+ V) — TBA 4 (DC +) BLK (-) — TBA 5 (DC -) WHT (Ch A) — TBB1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5	BLK or BRN — TBA 4 (DC +) 2.2 K — TBA 5 (DC -) BLUE — TBB1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5	BRN (+ V) — TBA 4 (DC +) BLUE (-) — TBA 5 (DC -) BLK (Ch A) — TBB1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5	WHT or BLUE — TBB 1 (INP A) BLK — TBB 4 (COMM) SWITCH SETTINGS: ON 1 2 3 4 5 Not applicable for INP B. Only LD200P0/LD4006P0	A (+ V) — TBA 4 (DC +) B (-) — TBA 5 (DC -) C (Ch A) — TBB1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5	A (+ V) — TBA 4 (DC +) B (-) — TBA 5 (DC -) C (Ch A) — TBB1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5
LEGEND	RED (+ V) — TBA 3 (DC OUT) BLK (-) — TBA 4/5 (COMM.) WHT (Ch A) — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	BLK or BRN — TBA 3 (DC OUT) 2.2 K — TBC 3 (COMM.) BLUE — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBA 4/5 (COMM.) BLK (Ch A) — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	WHT or BLUE — TBC 1 (INPUT A) BLK — TBC 3 (COMM.) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	A (+ V) — TBA 3 (DC OUT) B (-) — TBA 4/5 (COMM.) C (Ch A) — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	A (+ V) — TBA 3 (DC OUT) B (-) — TBA 4/5 (COMM.) C (Ch A) — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ
LIBC1 / LIBC2 LNXC1 / LNXC2	RED (+ V) — TBA 6 (DC OUT) BLK (-) — TBA 5 (COMM.) WHT (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	BLK or BRN — TBA 6 (DC OUT) BLUE — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	BRN (+ V) — TBA 6 (DC OUT) BLUE (-) — TBA 5 (COMM.) BLK (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	*NOT APPLICABLE*	A (+ V) — TBA 6 (DC OUT) B (-) — TBA 5 (COMM.) C (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	A (+ V) — TBA 6 (DC OUT) B (-) — TBA 5 (COMM.) C (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS
MDC	RED (+ V) — TBA 3 (DC OUT) BLK (-) — TBB 3 (COMM.) WHT (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	BLK or BRN — TBA 3 (DC OUT) 2.2 K — TBB 3 (COMM.) BLUE — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBB 3 (COMM.) BLK (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	WHT or BLUE — TBB 2 (FB) BLK — TBB 3 (COMM.) SWITCH SETTINGS: MAG SRC / LOGIC SNK	A (+ V) — TBA 3 (DC OUT) B (-) — TBB 3 (COMM.) C (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	A (+ V) — TBA 3 (DC OUT) B (-) — TBB 3 (COMM.) C (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK

L

SENSOR MODEL	ZCH, ZFH, ZGH, ZMD, ZOD, ZOH, ZPJ, ZRJ, ZRL, ZSD RPGD	ZDH ZLZ ZNH ZUK	ZBG ZBH ZHG	ZBG ZBH (M12 Connector)	PRMDC RCMDC RRMDC	PRDC RCDC RRDC
OLD MODEL	ARJ, LSM, LSQ, RPGO, RPGQ,	LE, RPGN	RPGB RPGH	RPGB		
OUTPUT CONNECTIONS 	RED (+ V) BLACK (-) or (COMM) WHITE (Ch A) GREEN (Ch B) **RPGD:** BLUE (Ch B)	KEY A (+ V) RED B (-) or (COMM) BLACK C (Ch A) WHITE D (Ch B) GREEN E F G	**ZBG and ZBH** KEY A (+ V) RED B (-) or (COMM) BLACK C (Ch A) WHITE D (Ch B) GREEN E F **ZHG** 4 Ch B 3 Ch A 2 COMM 1 + V	BLACK (-) or (COMM) WHITE (Ch A) RED (+ V) GREEN (Ch B) 1 2 3 4 5 6 7 8	BROWN (+ V) BLUE (-) or (COMM) WHITE (NPN OPEN) BLACK (NPN CLOSED)	BROWN (+ V) BLUE (-) or (COMM) WHITE (NPN OPEN) BLACK (PNP OPEN)
GEM52	RED (+ V) — TBA 4 (DC OUT) BLK (-) — TBC 6 (COMM.) WHT (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	A (+ V) — TBA 4 (DC OUT) B (-) — TBC 6 (COMM.) C (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	A (+ V) — TBA 4 (DC OUT) B (-) — TBC 6 (COMM.) C (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	1 (+ V) — TBA 4 (DC OUT) 2 (-) — TBC 6 (COMM.) 3 (Ch A) — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	BRN (+ V) — TBA 4 (DC OUT) BLUE (-) — TBC 6 (COMM.) WHT — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS	BRN (+ V) — TBA 4 (DC OUT) BLUE (-) — TBC 6 (COMM.) WHT — TBC 4/2 (INPUT) SWITCH SETTINGS: MAG SNK HI FRQ HI BIAS / LOGIC SRC LO FRQ LO BIAS
IFMA IFMR	RED (+ V) — 7 (+12 V) WHT (Ch A) — 8 (INPUT) BLK (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	A (+ V) — 7 (+12 V) C (Ch A) — 8 (INPUT) B (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	A (+ V) — 7 (+12 V) C (Ch A) — 8 (INPUT) B (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	1 (+ V) — 7 (+12 V) 3 (Ch A) — 8 (INPUT) 2 (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	BRN (+ V) — 7 (+12 V) WHT — 8 (INPUT) BLUE (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK	BRN (+ V) — 7 (+12 V) WHT — 8 (INPUT) BLUE (-) — 9 (COMM.) SWITCH SETTINGS: SRC LOGIC SNK
IMI	RED (+ V) — 5 (+12 VDC) BLK (-) — 7 (COMM.) WHT (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	A (+ V) — 5 (+12 VDC) B (-) — 7 (COMM.) C (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	A (+ V) — 5 (+12 VDC) B (-) — 7 (COMM.) C (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	1 (+ V) — 5 (+12 VDC) 2 (-) — 7 (COMM.) 3 (Ch A) — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BRN (+ V) — 5 (+12 VDC) BLUE (-) — 7 (COMM.) WHT — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC	BRN (+ V) — 5 (+12 VDC) BLUE (-) — 7 (COMM.) WHT — 6 (SIG. IN) SWITCH SETTINGS: MAG. PKUP. LOGIC NPN OC
LD20, LD40, LD2T, LD4T	RED (+ V) — TBA 4 (DC +) BLK (-) — TBA 5 (DC -) WHT (Ch A) — TBB1 (INP A) GRN or BLUE — TBB 2 (INP B) SWITCH SETTINGS: ON 1 2 3 4 5 Only LD200P0/LD4006P0	A (+ V) — TBA 4 (DC +) B (-) — TBA 5 (DC -) C (Ch A) — TBB1 (INP A) D (Ch B) — TBB 2 (INP B) SWITCH SETTINGS: ON 1 2 3 4 5 Only LD200P0/LD4006P0	A (+ V) — TBA 4 (DC +) B (-) — TBA 5 (DC -) C (Ch A) — TBB1 (INP A) D (Ch B) — TBB 2 (INP B) SWITCH SETTINGS: ON 1 2 3 4 5 Only LD200P0/LD4006P0	1 (+ V) — TBA 4 (DC +) 2 (-) — TBA 5 (DC -) 3 (Ch A) — TBB1 (INP A) 4 (Ch B) — TBB 2 (INP B) SWITCH SETTINGS: ON 1 2 3 4 5 Only LD200P0/LD4006P0	BRN (+ V) — TBA 4 (DC +) BLUE (-) — TBA 5 (DC -) WHT — TBB 1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5	BRN (+ V) — TBA 4 (DC +) BLUE (-) — TBA 5 (DC -) WHT — TBB 1 (INP A) SWITCH SETTINGS: ON 1 2 3 4 5
LEGEND	RED — TBA 3 (DC OUT) BLK — TBA 4/5 (COMM.) WHT — TBC 1 (INPUT A) GRN or BLUE — TBC 2 (INPUT B) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	A (+ V) — TBA 3 (DC OUT) B (-) — TBA 4/5 (COMM.) C (Ch A) — TBC 1 (INPUT A) D (Ch B) — TBC 2 (INPUT B) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	A (+ V) — TBA 3 (DC OUT) B (-) — TBA 4/5 (COMM.) C (Ch A) — TBC 1 (INPUT A) D (Ch B) — TBC 2 (INPUT B) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	1 (+ V) — TBA 3 (DC OUT) 2 (-) — TBA 4/5 (COMM.) 3 (Ch A) — TBC 1 (INPUT A) 4 (Ch B) — TBC 2 (INPUT B) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBA 4/5 (COMM.) WHT — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBA 4/5 (COMM.) WHT — TBC 1 (INPUT A) SWITCH SETTINGS: MAG SRC LO FRQ / LOGIC SNK HI FRQ
LIBC1 / LIBC2 LNXC1 / LNXC2	RED (+ V) — TBA 6 (DC OUT) BLK (-) — TBA 5 (COMM.) WHT (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	A (+ V) — TBA 6 (DC OUT) B (-) — TBA 5 (COMM.) C (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	A (+ V) — TBA 6 (DC OUT) B (-) — TBA 5 (COMM.) C (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	1 (+ V) — TBA 6 (DC OUT) 2 (-) — TBA 5 (COMM.) 3 (Ch A) — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	BRN (+ V) — TBA 6 (DC OUT) BLUE (-) — TBA 5 (COMM.) WHT — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS	BRN (+ V) — TBA 6 (DC OUT) BLUE (-) — TBA 5 (COMM.) WHT — TBA 4 (CNT. IN) SWITCH SETTINGS: SNK HI FRQ HI BIAS / SRC LO FRQ LO BIAS
MDC	RED (+ V) — TBA 3 (DC OUT) BLK (-) — TBB 3 (COMM.) WHT (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	A (+ V) — TBA 3 (DC OUT) B (-) — TBB 3 (COMM.) C (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	A (+ V) — TBA 3 (DC OUT) B (-) — TBB 3 (COMM.) C (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	1 (+ V) — TBA 3 (DC OUT) 2 (-) — TBB 3 (COMM.) 3 (Ch A) — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBB 3 (COMM.) WHT — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK	BRN (+ V) — TBA 3 (DC OUT) BLUE (-) — TBB 3 (COMM.) WHT — TBB 2 (FB) SWITCH SETTINGS: MAG SRC / LOGIC SNK

* Designates wires from the listed counter.

L

SENSOR MODEL	ASTC, LMPC, ZFG, ZCG, HESS, PSAH	PSA1B PSA2B	PSA6B PSA7B PSA8B PSAFP PSAC	MP25TA MP37TA MP37CA MP62TA MP75TX	LMPEC	LMPCC
OLD MODEL	LSC RPGC					
OUTPUT CONNECTIONS	RED (+ V) BLACK (-) or (COMM) WHITE (Ch A)	BLACK OR BROWN (+ V) BLUE (Ch A)	BROWN (+ V) BLUE (-) or (COMM) BLACK (Ch A)	WHITE OR BLUE BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK	KEY C (Ch A) WHITE A (+ V) RED B (-) or (COMM) BLACK
PRS1 / PRA1	RED (+ V) — 9 BLK (-) — 8 WHT (Ch A) — 7 SWITCH SETTINGS SRC LOGIC SNK	BLK or BRN — 9 BLUE — 7 SWITCH SETTINGS SRC LOGIC SNK	BRN (+ V) — 9 BLUE (-) — 8 BLK (Ch A) — 7 SWITCH SETTINGS SRC LOGIC SNK	BLK — 8 WHT or BLUE — 7 SWITCH SETTINGS SRC LOGIC SNK	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 SWITCH SETTINGS SRC LOGIC SNK	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 SWITCH SETTINGS SRC LOGIC SNK
PRA2	RED (+ V) — 9 BLK (-) — 8 WHT (Ch A) — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2	BLK or BRN — 9 BLUE — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2	BRN (+ V) — 9 BLUE (-) — 8 BLK (Ch A) — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2	BLK — 8 WHT or BLUE — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 SWITCH SETTINGS SNK LOGIC SRC SW1 SW2
PAXC, PAXI, PAXR	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 5 or 6 (INP A/B) SWITCH SETTINGS ON 1 2 3 4 5 6	BLK or BRN — 3 (+12 V) 2.2 K — 4 (COMM) BLUE — 5 or 6 (INP A/B) SWITCH SETTINGS ON 1 2 3 4 5 6	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) BLK (Ch A) — 5 or 6 (INP A/B) SWITCH SETTINGS ON 1 2 3 4 5 6	BLK — 4 (COMM) WHT or BLUE — 5 (INP A) SWITCH SETTINGS ON 1 2 3 4 5 6	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 or 6 (INP A/B) SWITCH SETTINGS ON 1 2 3 4 5 6	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 or 6 (INP A/B) SWITCH SETTINGS ON 1 2 3 4 5 6
PAXC PAXI Dual Quad A	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*
PAXC PAXI Dual Quad B	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*
PAXLC, PAXLR PAXLPT	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 5 (INP) SWITCH SETTINGS ON 1 2 3 4	BLK or BRN — 3 (+12 V) 2.2 K — 4 (COMM) BLUE — 5 (INP) SWITCH SETTINGS ON 1 2 3 4	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) BLK (Ch A) — 5 (INP) SWITCH SETTINGS ON 1 2 3 4	BLK — 4 (COMM) WHT or BLUE — 5 (INP) SWITCH SETTINGS ON 1 2 3 4 Not applicable for PAXLC.	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP) SWITCH SETTINGS ON 1 2 3 4	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP) SWITCH SETTINGS ON 1 2 3 4
PAXTM, PAXCK	*NOT APPLICABLE*	BLK or BRN — 3 (+12 V) SRC 2.2 K — 4 (COMM) JUMPER BLUE — 5 or 6 (INP A/B)	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) SNK BLK (Ch A) — 5 or 6 (INP A/B) JUMPER	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*

L

SENSOR MODEL	ZCH, ZFH, ZGH, ZMD, ZOD, ZOH, ZPJ, ZRJ, ZRL, ZSD, RPGD	ZDH ZLZ ZNH ZUK	ZBG ZBH ZHG	ZBG ZBH (M12 Connector)	PRMDC RCMDC RRMDC	PRDC RCDC RRDC
OLD MODEL	ARJ, LSM, LSQ, RPGO, RPGQ,	LE, RPGN	RPGB RPGH	RPGB		
OUTPUT CONNECTIONS	RED (+ V) BLACK (-) or (COMM) WHITE (Ch A) GREEN (Ch B) **RPGD:** BLUE (Ch B)	KEY A (+ V) RED B (-) or (COMM) BLACK F G E C (Ch A) WHITE D (Ch B) GREEN	**ZBG and ZBH** KEY A (+ V) RED B (-) or (COMM) BLACK F E C (Ch A) WHITE D (Ch B) GREEN **ZHG** 4 Ch B 3 Ch A 2 COMM 1 + V	BLACK (-) or (COMM) WHITE (Ch A) RED (+ V) GREEN (Ch B) 1 2 3 4 5 6 7 8	BROWN (+ V) BLUE (-) or (COMM) WHITE (NPN OPEN) BLACK (NPN CLOSED)	BROWN (+ V) BLUE (-) or (COMM) WHITE (NPN OPEN) BLACK (PNP OPEN)
PRS1 / PRA1	RED (+ V) — 9 BLK (-) — 8 WHT (Ch A) — 7 *SWITCH SETTINGS* SRC LOGIC SNK	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 *SWITCH SETTINGS* SRC LOGIC SNK	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 *SWITCH SETTINGS* SRC LOGIC SNK	1 (+ V) — 9 2 (-) — 8 3 (Ch A) — 7 *SWITCH SETTINGS* SRC LOGIC SNK	BRN (+ V) — 9 BLUE (-) — 8 WHT — 7 *SWITCH SETTINGS* SRC LOGIC SNK	BRN (+ V) — 9 BLUE (-) — 8 WHT — 7 *SWITCH SETTINGS* SRC LOGIC SNK
PRA2	RED (+ V) — 9 BLK (-) — 8 WHT (Ch A) — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2	A (+ V) — 9 B (-) — 8 C (Ch A) — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2	1 (+ V) — 9 2 (-) — 8 3 (Ch A) — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2	BRN (+ V) — 9 BLUE (-) — 8 WHT — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2	BRN (+ V) — 9 BLUE (-) — 8 WHT — 7 *SWITCH SETTINGS* SNK LOGIC SRC SW1 SW2
PAXC, PAXI, PAXR	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 5 (INP A) GRN or BLUE (QUAD) — 6 (INP B) *SWITCH SETTINGS* ON 1 2 3 4 5 6	A (+ V) — 3 (+12 V) B — 4 (COMM) C (Ch A) — 5 (INP A) D (QUAD) — 6 (INP B) *SWITCH SETTINGS* ON 1 2 3 4 5 6	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP A) D (QUAD) — 6 (INP B) *SWITCH SETTINGS* ON 1 2 3 4 5 6	1 (+ V) — 3 (+12 V) 2 (-) — 4 (COMM) 3 (Ch A) — 5 (INP A) 4 (QUAD) — 6 (INP B) *SWITCH SETTINGS* ON 1 2 3 4 5 6	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 or 6 (INP A/B) *SWITCH SETTINGS* ON 1 2 3 4 5 6	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 or 6 (INP A/B) *SWITCH SETTINGS* ON 1 2 3 4 5 6
PAXC PAXI Dual Quad A	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 5 (INP A) GRN or BLUE (QUAD) — 7 (USER 1) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP A) D (QUAD) — 7 (USER 1) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP A) D (QUAD) — 7 (USER 1) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	1 (+ V) — 3 (+12 V) 2 (-) — 4 (COMM) 3 (Ch A) — 5 (INP A) 4 (QUAD) — 7 (USER 1) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	*NOT APPLICABLE*	*NOT APPLICABLE*
PAXC PAXI Dual Quad B	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 6 (INP B) GRN or BLUE (QUAD) — 8 (USER 2) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 6 (INP B) D (QUAD) — 8 (USER 2) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 6 (INP B) D (QUAD) — 8 (USER 2) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	1 (+ V) — 3 (+12 V) 2 (-) — 4 (COMM) 3 (Ch A) — 6 (INP B) 4 (QUAD) — 8 (USER 2) *SWITCH SETTINGS* ON 1 2 3 4 5 6 User Jumper = SNK	*NOT APPLICABLE*	*NOT APPLICABLE*
PAXLC, PAXLR PAXLPT	RED (+ V) — 3 (+12 V) BLK (-) — 4 (COMM) WHT (Ch A) — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4	A (+ V) — 3 (+12 V) B (-) — 4 (COMM) C (Ch A) — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4	1 (+ V) — 3 (+12 V) 2 (-) — 4 (COMM) 3 (Ch A) — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 (INP) *SWITCH SETTINGS* ON 1 2 3 4
PAXTM, PAXCK	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	*NOT APPLICABLE*	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 or 6 (INP A/B) SNK JUMPER	BRN (+ V) — 3 (+12 V) BLUE (-) — 4 (COMM) WHT — 5 or 6 (INP A/B) SNK JUMPER

L

L

This page intentionally left blank.

PART NUMBER INDEX

M

The Trusted Source for
Innovative Control Solutions

Terms of Sale

All sales of Red Lion Controls products are made subject to our Terms and Conditions of Sale, which are available on request.

Summarized Warranty

Red Lion Controls warrants that all equipment shall be free from defects in material and workmanship under normal use for a period of two years from date of shipment to Buyer save that Red Lion Controls does not warrant that operation of the software will be completely uninterrupted or error free, or that all program errors will be corrected. Buyer shall be responsible for determining that the equipment is suitable for Buyer's use and that such use complies with any applicable local, state or federal law.

Limitation of Liability

IN NO EVENT, REGARDLESS OF THE FORM OF ACTION, SHALL RED LION CONTROLS BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL LOSSES OR DAMAGES ARISING OUT OF THE SALE OF ITS PRODUCTS. BUYER'S EXCLUSIVE REMEDY ARISING OUT OF ITS PURCHASE AND USE OF RED LION CONTROLS'S PRODUCTS, OR ARISING OUT OF ANYTHING DONE IN CONNECTION WITH ANY CONTRACT, SHALL BE FOR DAMAGES NO GREATER IN AMOUNT IN AGGREGATE THAN THE PURCHASE PRICE OF THE PRODUCTS IN RESPECT OF WHICH DAMAGES ARE CLAIMED.

PART NUMBER LIST

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
		SENSING GEARS	
0910875		10/60 Gear, Standard Bore	869
0919999		10/60 Gear, Special Bore *	869
0920750		10/30 Gear Split, Standard Bore	869
0929999		10/30 Gear Split, Special Bore *	869
0930875		10/60 Gear Split, Standard Bore	869
0939999		10/60 Gear Split, Special Bore *	869
0941125		12/60 Gear, ARCJ-2A	869
0941375		12/60 Gear, ARCJ-2B	869
0941625		12/60 Gear, ARCJ-2C	869
0949999		12/60 Gear, Special Bore *	869
0950500		16/30 Gear, Standard Bore	869
0959999		16/30 Gear, Special Bore *	869
0960625		20/60 Gear, ARCJ-1A	869
0960875		20/60 Gear, ARCJ-1B	869
0970375		20/60 Gear, Standard Bore	869
0979999		20/60 Gear, Special Bore *	869
* Special Bore - Not Stocked at Factory, add $24.00 set up charge for each different gear and/or bore size.			
		MISCELLANEOUS PRODUCTS	
2300200		Socket, 12-Pin	NL
2500030		Connector, 3-Pin	NL
		PROXIMITY SENSORS	
4100600	MPS	Magnetic	NL
		SENSOR MOUNTS	
5400100		Block Mount	863
5403701		Plug Mount, Steel	863
5403702		Plug Mount, Stainless Steel	863
		SIGNAL CONDITIONING DIN RAIL MODULE	
AAMA3535	AAMA	Universal, 3 Way Isolated	795
		APOLLO ACCESSORIES	
ACA10000	ACA1	18” DIP Plug Cable Assembly	NL
ACE10000	ACE1	Edgecard w/Solder Eyelet 3 & 4-Digit	NL
ACE40000	ACE4	Edgcrd w/Solder Eyelet, 5 & 6-Digit	NL
		CONVERTER MODULE	
AFCM0000	AFCM	Analog to Frequency Converter Module	771
		SIGNAL CONDITIONING DIN RAIL MODULES	
AIMI0202	AIMI	Passive Loop Powered	773
		ANALOG ALARM DIN RAIL MODULE	
AIMR5306	AIMR	Loop Powered	NL
		APOLLO CURRENT METERS	
APLID400	APLID	DC, 115V	NL
APLIT405	APLIT	5AMP AC, 115V	NL
		APOLLO RATE INDICATORS	
APLR0600	APLR	Time Base, 115V	NL
APLRI600	APLRI	Time Interval, 115V	NL
APLRI630	APLRI	Time Interval, 24VDC	NL

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
		APOLLO SLAVE DISPLAYS	
APLSP3A0	APLSP3	3-Digit, 5VDC	NL
APLSP3B0	APLSP3	3-Digit, 10-28VDC	NL
APLSP4A0	APLSP4	4-Digit, 5VDC	NL
APLSP4B0	APLSP4	4-Digit, 10-28VDC	NL
APLSP5A0	APLSP5	5-Digit, 5VDC	NL
APLSP5B0	APLSP5	5-Digit, 10-28VDC	NL
APLSP6A0	APLSP6	6-Digit, 5VDC	NL
APLSP6B0	APLSP6	6-Digit, 10-28VDC	NL
		APOLLO VOLTMETERS	
APLVD400	APLVD	DC, 115V	NL
		SIGNAL CONDITIONING DIN RAIL MODULES	
APMR0016	APMR	3 Phase Fault Detector 230VAC	800
APMR0086	APMR	3 Phase Fault Detector 380VAC	800
APMR0096	APMR	3 Phase Fault Detector 480VAC	800
		ACCESSORIES	
APS01000	APS01	Accessory Power Supply, 115VAC	945
APSCM010		10AMP Current Shunt	NL
APSCM100		100AMP Current Shunt	NL
APSIS000	APSIS	Power Supply/Current Source, 115V	947
APSIS010	APSIS	Power Supply/Current Source, 230V	947
		C FLANGE ADAPTER RINGS MAGNETIC PICK-UP	
ARCJ1000	ARCJ1	Small Ring w/o Gear	865
ARCJ1A00	ARCJ1	56C Magnetic Ring Kit	865
ARCJ1B00	ARCJ1	143TC Magnetic Ring Kit	865
		C FLANGE ADAPTER RINGS WITH HESS SENSOR	
ARCJ10Z0	ARCJ1	Small Ring w/o Gear	865
ARCJ1AZ0	ARCJ1	56C Ring Kit	865
ARCJ1BZ0	ARCJ1	143TC Ring Kit	865
		C FLANGE ADAPTER RINGS MAGNETIC PICK-UP	
ARCJ2000	ARCJ2	Large Ring w/o Gear	865
ARCJ2A00	ARCJ2	182TC Magnetic Ring Kit	865
ARCJ2B00	ARCJ2	213TC Magnetic Ring Kit	865
ARCJ2C00	ARCJ2	254TC Magnetic Ring Kit	865
		C FLANGE ADAPTER RINGS WITH HESS SENSOR	
ARCJ20Z0	ARCJ2	Large Ring w/o Gear	865
ARCJ2AZ0	ARCJ2	182TC Ring Kit	865
ARCJ2BZ0	ARCJ2	213TC Ring Kit	865
ARCJ2CZ0	ARCJ2	254TC Ring Kit	865
		MISCELLANEOUS PRODUCTS	
ASTC0000	ASTC	In-Line Amplifier, NPN O.C.	861
		APOLLO ACCESSORY BOARDS FOR SLAVE DISPLAY	
ATB10000	ATB1	w/Terminal Blk for 16 BCD Inputs	NL
ATB20000	ATB2	w/o Terminal Blk for 16 BCD Inputs	NL
ATB30000	ATB3	w/Terminal Blk for 24 BCD Inputs	NL
ATB40000	ATB4	w/o Terminal Blk for 24 BCD Inputs	NL

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
BASE MOUNT KITS			
BMK10000	BMK1	CUB 1 Base Mount Kit	NL
BMK11000	BMK11	CUB5 or MLPS DIN Rail Base Mount Kit	1020
BMK1A000	BMK1A	CUB 1 Base Mount Kit	NL
BMK20000	BMK2	CUB 2 Base Mount Kit	NL
BMK30000	BMK3	Libra/Lynx Base Mount Kit	1014
BMK40000	BMK4	Apollo/Gemini Base Mount Kit	1014
BMK50000	BMK5	Cub 3 Base Mount Kit	NL
BMK60000	BMK6	Open Base Mount Kit CUB4/DT7	1016
BMK70000	BMK7	Base Mount Kit CUB4/DT7 W/MLPS	1016
BMK7A000	BMK7A	Base Mount CUB5 with MLPS	1016
BMK80000	BMK8	Base Mount Kit CUB7	1018
BMK90000	BMK9	DIN Rail Mount PAX	1019
ACCESSORIES			
BNA00001	BNA	Batteries N Alkaline	NL
BNL00000	BNL	3V Lithium Battery	NL
BNL10000	BNL	3V Lithium Battery, Less Leads	23
BNL20000	BNL	3V Lithium Battery CR2025	NL
BNL30000	BNL	3V Lithium Battery CR2032	NL
C48 BATCH COUNTERS			
C48CB001	C48CB	3 Preset, Reflective, PNP OC	136
C48CB003	C48CB	3 Preset, Reflective, NPN OC, RLY	136
C48CB004	C48CB	3 Preset, Reflective, PNP OC, RLY	136
C48CB005	C48CB	3 Preset, Reflective, NPN OC, SER	136
C48CB008	C48CB	3 Preset, Reflective, NPN OC, RLY, SER	136
C48CB009	C48CB	3 Preset, Reflective, PNP OC, RLY, SER	136
C48CB011	C48CB	DC, 3 Preset, Reflective, PNP OC	136
C48CB014	C48CB	DC, 3 Preset, Reflective, PNP OC, RLY	136
C48CB100	C48CB	3 Preset, Backlit, NPN OC	136
C48CB101	C48CB	3 Preset, Backlit, PNP OC	136
C48CB103	C48CB	3 Preset, Backlit, NPN OC, RLY	136
C48CB104	C48CB	3 Preset, Backlit, PNP OC, RLY	136
C48CB105	C48CB	3 Preset, Backlit, NPN OC, SER	136
C48CB108	C48CB	3 Preset, Backlit, NPN OC, RLY, SER	136
C48CB109	C48CB	3 Preset, Backlit, PNP OC, RLY, SER	136
C48CB110	C48CB	DC, 3 Preset, Backlit, NPN OC	136
C48CB111	C48CB	DC, 3 Preset, Backlit, PNP OC	136
C48CB114	C48CB	DC, 3 Preset, Backlit, PNP OC, RLY	136
C48CB119	C48CB	DC, 3 Preset, Backlit, PNP OC, RLY, SER	136
C48 2 PRESET COUNTER			
C48CD002	C48CD	2 Preset, Reflective, RLY	136
C48CD005	C48CD	2 Preset, Reflective, NPN OC, SER	136
C48CD007	C48CD	2 Preset, Reflective, RLY, SER	136
C48CD012	C48CD	DC, 2 Preset, Reflective, RLY	136
C48CD015	C48CD	DC, 2 Preset, Reflective, NPN OC, SER	136
C48CD017	C48CD	DC, 2 Preset, Reflective, RLY, SER	136
C48CD100	C48CD	2 Preset, Backlit, NPN OC	136

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
C48CD101	C48CD	2 Preset, Backlit, PNP OC	136
C48CD102	C48CD	2 Preset, Backlit, RLY	136
C48CD105	C48CD	2 Preset, Backlit, NPN OC, SER	136
C48CD106	C48CD	2 Preset, Backlit, PNP OC, SER	136
C48CD107	C48CD	2 Preset, Backlit, RLY, SER	136
C48CD110	C48CD	DC, 2 Preset, Backlit, NPN OC	136
C48CD111	C48CD	DC, 2 Preset, Backlit, PNP OC	136
C48CD112	C48CD	DC, 2 Preset, Backlit, RLY	136
C48CD115	C48CD	DC, 2 Preset, Backlit, NPN OC, SER	136
C48CD116	C48CD	DC, 2 Preset, Backlit, PNP OC, SER	136
C48CD117	C48CD	DC, 2 Preset, Backlit, RLY, SER	136
C48 2 PRESET COUNTER w/PRESCALER			
C48CP001	C48CP	2 Preset, Reflective, PNP OC	136
C48CP005	C48CP	2 Preset, Reflective, NPN OC, SER	136
C48CP011	C48CP	DC, 2 Preset, Reflective, PNP OC	136
C48CP015	C48CP	DC, 2 Preset, Reflective, NPN OC, SER	136
C48CP100	C48CP	2 Preset, Backlit, NPN OC	136
C48CP101	C48CP	2 Preset, Backlit, PNP OC	136
C48CP105	C48CP	2 Preset, Backlit, NPN OC, SER	136
C48CP110	C48CP	DC, 2 Preset, Backlit, NPN OC	136
C48CP111	C48CP	DC, 2 Preset, Backlit, PNP OC	136
C48CP115	C48CP	DC, 2 Preset, Backlit, NPN OC, SER	136
C48 1 PRESET COUNTER			
C48CS003	C48CS	1 Preset, Reflective, NPN OC, RLY	136
C48CS004	C48CS	1 Preset, Reflective, PNP OC, RLY	136
C48CS013	C48CS	DC, 1 Preset, Reflective, NPN OC, RLY	136
C48CS014	C48CS	DC, 1 Preset, Reflective, PNP OC, RLY	136
C48CS103	C48CS	1 Preset, Backlit, NPN OC, RLY	136
C48CS104	C48CS	1 Preset, Backlit, PNP OC, RLY	136
C48CS113	C48CS	DC, 1 Preset, Backlit, NPN OC, RLY	136
C48CS114	C48CS	DC, 1 Preset, Backlit, PNP OC, RLY	136
C48 2 PRESET TIMER			
C48TD001	C48TD	2 Preset, Reflective, PNP OC	194
C48TD002	C48TD	2 Preset, Reflective, RLY	194
C48TD005	C48TD	2 Preset, Reflective, NPN OC, SER	194
C48TD007	C48TD	2 Preset, Reflective, RLY, SER	194
C48TD011	C48TD	DC, 2 Preset, Reflective, PNP OC	194
C48TD012	C48TD	DC, 2 Preset, Reflective, RLY	194
C48TD101	C48TD	2 Preset, Backlit, PNP OC	194
C48TD102	C48TD	2 Preset, Backlit, RLY	194
C48TD105	C48TD	2 Preset, Backlit, NPN OC, SER	194
C48TD106	C48TD	2 Preset, Backlit, PNP OC, SER	194
C48TD107	C48TD	2 Preset, Backlit, RLY, SER	194
C48TD111	C48TD	DC, 2 Preset, Backlit, PNP OC	194
C48TD112	C48TD	DC, 2 Preset, Backlit, RLY	194
C48TD116	C48TD	DC, 2 Preset, Backlit, PNP OC, SER	194
C48TD117	C48TD	DC, 2 Preset, Backlit, RLY, SER	194

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
C48 1 PRESET TIMER			
C48TS003	C48TS	1 Preset, Reflective, NPN OC, RLY	194
C48TS004	C48TS	1 Preset, Reflective, PNP OC ,RLY	194
C48TS013	C48TS	DC, 1 Preset, Reflective, NPN OC, RLY	194
C48TS014	C48TS	DC, 1 Preset, Reflective, PNP OC ,RLY	194
C48TS103	C48TS	1 Preset, Backlit, NPN OC, RLY	194
C48TS104	C48TS	1 Preset, Backlit, PNP OC ,RLY	194
C48TS113	C48TS	DC, 1 Preset, Backlit, NPN OC, RLY	194
C48TS114	C48TS	DC, 1 Preset, Backlit, PNP OC ,RLY	194
CABLE ASSEMBLIES			
CBJ11A07	CBJ	RJ11 w/7 ft unterminated cable	NL
CBJ11BD5	CBJ	6” RJ11 Jumper Cable	NL
CBJ11C07	CBJ	DLCD RJ11 to RJ45	NL
CBJ11SP0	CBJ	RJ11 Splitter	NL
CBLxxxxx	CBL	Communication Cables	NL
CBLPROG0	CBL	Programming Cable for CS, G3, & Paradigm	NL
CBLRLCxx	CBL	Interface Cables	NL
CBLUSB00	CBL	Cable USB Type A-B	NL
CBLUSB01	CBL	Cable USB Type A-Mini B	NL
CBLUSB23	CBL	USB Serial Adaptor RS-232	NL
CBPRO007	DLC	RJ11 Program & Interface Cable	NL
CCA3PC00	LMP	3-Cond. 3-Pin w/10 ft Cable	863
CCA3PC25	LMP	3-Cond. 3-Pin w/25 ft Cable	863
CCA3PC50	LMP	3-Cond. 3-Pin w/50 ft Cable	863
CCA3PC99	LMP	3-Cond. 3-Pin w/Special Length Cable	863
CCARPG00		Mating, 6-Pin MS Connector	NL
CCARPG01		4-Cond. 6-Pin w/10ft Cable	889
CCARPG25		4-Cond. 6-Pin w/25 ft Cable	889
CCARPG50		4-Cond. 6-Pin w/50 ft Cable	889
CCARPG99		4-Cond. 6-Pin w/Special Length Cable	889
CCBRPG00		7-Pin Connector	NL
CCBRPG01		6-Cond. 7-Pin w/10 ft Cable	876
CCBRPG02		7-Pin Connector with 10 ft Cable - S159	NL
CCBRPG03		7-Pin Connector with 20 ft Cable - S159	NL
CCBRPG04		10-Pin Connector	NL
CCBRPG05		10-Pin Connector with 10 ft Cable	NL
CCBRPG06		10-Pin Connector with 20 ft Cable	NL
CCBRPG99		6-Cond. 7-Pin w/Special Length Cable	876
CCM12890		10 Meter 8-Pin 5-wire M12 Cable/Connector	889
CCM12894		4 Meter 8-Pin 5-wire M12 Cable/Connector	889
CCM12S01		M12 Cable Assembly, 1 M, Shielded	889
CCM12S06		M12 Cable Assembly, 6 M, Shielded	889
CCM12U02		4 Wire Unshielded, 2 M, Cable/Connector	910
CCMPE000	CCMPE	Pico Quick Disconnect Cable	903
X Special Length - Not stocked at factory, add $17.00 setup charge for each different length, plus $0.40/ft over 10 ft.			

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
MODULAR CONTROLLER SERIES			
CSBASE00		Replacement Base	NL
CSBUNG00		Replacement End Cap	NL
CSDIO14R	CSDIO	Eight Inputs, Six Relay Outputs	NL
CSDIO14S	CSDIO	Eight Inputs, Six Solid State Outputs	NL
CSINI800	CSINI	8 Channel 0(4)-20 mA Input Module	NL
CSINI8L0	CSINI	8 Chan 0(4)-20 mA Input Mod 100 Linearizer	NL
CSINV800	CSINV	8 Channel ±10 V Input Module	NL
CSINV8L0	CSINV	8 Chan ±10 V Input Mod 100 Linearizer	NL
CSMSTRGT	CSMSTR	Master, Data Logger, Full VGA Virtual HMI	NL
CSMSTRLE	CSMSTR	Master, Multiple Protocol Cnvtr, Ethernet	NL
CSMSTRSX	CSMSTR	Master, Data Logger, Virtual HMI	NL
CSMSTRV2	CSMSTR	Master, Comms, Ethernet	NL
CSOUT400	CSOUT	4 Channel Analog Output	NL
CSPID1R0	CSPID	Single Loop Module, Relay Outputs	NL
CSPID1RA	CSPID	Single Loop Module, Relay Outputs, Analog	NL
CSPID1RM	CSPID	Single Loop Module, Relay Outputs, HCM	NL
CSPID1S0	CSPID	Single Loop Module, Solid State Outputs	NL
CSPID1SA	CSPID	Single Loop Module, Solid State Out. Analog	NL
CSPID1SM	CSPID	Single Loop Module Solid State, HCM	NL
CSPID1TA	CSPID	Single Loop Module, Triac Outputs, Analog	NL
CSPID2R0	CSPID2	Dual Loop Module, Relay Outputs	NL
CSPID2RM	CSPID2	Dual Loop Module, Relay Outputs, HCM	NL
CSPID2S0	CSPID2	Dual Loop Module, Solid State Outputs	NL
CSPID2SM	CSPID2	Dual Loop Module, Solid State Outputs, HCM	NL
CSPID2T0	CSPID2	Dual Loop Module, Triac Outputs	NL
CSPID2TM	CSPID2	Dual Loop Module, Triac Outputs, HCM	NL
CSRTD600	CSRTD	6 Channel Input, RTD	NL
CSSG10RA	CSSG1	Single Loop, 1 SG Input, Rly Outpts, Analog	NL
CSSG10SA	CSSG1	Single Loop, 1 SG Input, Solid State Out, Anlg	NL
CSSG11RA	CSSG1	Single Loop, 2 SG Inpts, Rly Outpts, Analog	NL
CSSG11SA	CSSG1	Single Loop, 2 SG Inpts, Solid State Out, Anlg	NL
CSTC8000	CSTC	8 Channel Thermocouple Module	NL
CSTC8ISO	CSTC	Isolated, 8 Channel Thermocouple Module	NL
CSTERM00		Replacement Termination Plug	NL
CURRENT TRANSFORMERS			
CT004001		40 : 0.1A for use with TCU/PCU, & P48/T48	926
CT005001		50 : 0.1A for use with TCU/PCU, & P48/T48	925
CT005050		50 : 5A for use with IMH/APLIT	925
CT020050		200 : 5A for use with IMH/APLIT	925
DC CURRENT TRANSDUCER			
CTD00000		DC/DC, Split Case	928
AC CURRENT TRANSDUCERS			
CTL0052S		5A/4-20ma, Split Case	930
CTL0501F		50A/10VDC, Fixed Case	930
CTL0502F		50 A 4 - 20 mA, Fixed Case	930
CTL0502S		50A/4-20ma, Split Case	930

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
CTL2001F		200A/10VDC, Fixed Case	930
CTL2002F		200A/4-20ma, Fixed Case	930
CTL2002S		200A/4-20ma, Split Case	930
TRUE RMS AC CURRENT TRANSDUCERS			
CTR05000		50A/4-20ma, Split Case	932
CTR20000		200A/4-20ma, Split Case	932
CURRENT OPERATED SWITCHES			
CTSF0000		Current Switch, Fixed Case	934
CTSG0000		Current Switch, GO/NO GO	934
CTSS0000		Current Switch, Split Case	934
CUB 1 MINIATURE COUNTERS			
CUB10000	CUB1	Counter	NL
CUB 2 MINIATURE COUNTERS			
CUB20000	CUB2	Counter	NL
CUB2L000	CUB2L	Counter w/Lithium Battery	NL
CUB2L800	CUB2L8	8-Digit Counter w/Lithium Battery	NL
CUB 3 MINIATURE INDICATORS			
CUB30000	CUB3	Counter	NL
CUB3L000	CUB3L	Counter w/Lithium Battery	NL
CUB3LR00	CUB3LR	Cntr w/Lithium Batt & Remote Reset	NL
CUB3R000	CUB3R	Counter w/Remote Reset	NL
CUB 3T MINIATURE TIMERS W/LITHIUM BATTERY			
CUB3T300	CUB3T	1 hr; Remote Reset	NL
CUB3T310	CUB3T	0.1 hr; Remote Reset	NL
CUB3T320	CUB3T	0.01 hr; Remote Reset	NL
CUB3T330	CUB3T	0.1 min; Remote Reset	NL
CUB3T400	CUB3T	1 hr; Front Panel & Remote Reset	NL
CUB3T410	CUB3T	0.1 hr; Front Panel & Remote Reset	NL
CUB3T420	CUB3T	0.01 hr; Front Panel & Remote Reset	NL
CUB3T430	CUB3T	0.1 min; Front Panel & Remote Reset	NL
CUB 4 SERIES			
CUB4CL10	CUB4CL	Current Loop w/Yel/Grn Neg Backlighting	363
CUB4CL20	CUB4CL	Current Loop w/Red Neg Backlighting	363
CUB4CL30	CUB4CL	Current Loop w/Yel/Grn Pos Backlighting	363
CUB4CL40	CUB4CL	Current Loop w/Red Pos Backlighting	363
CUB4I000	CUB4I	DC Current Meter, Reflective Display	233
CUB4I010	CUB4I	DC Current Meter w/Yel/Grn Backlighting	233
CUB4I020	CUB4I	DC Current Meter w/Red Backlighting	233
CUB4L000	CUB4L	Counter, Reflective Display	29
CUB4L010	CUB4L	Counter w/Yel/Grn Backlighting	29
CUB4L020	CUB4L	Counter w/Red Backlighting	29
CUB4L800	CUB4L8	8-Digit Counter, Reflective Display	29
CUB4L80M	CUB4L8	8-Digit Counter, Reflective w/V+ Terminal	29
CUB4L810	CUB4L8	8-Digit Counter w/Yel/Grn Backlighting	29
CUB4L820	CUB4L8	8-Digit Counter w/Red Backlighting	29
CUB4L8W0	CUB4L8W	8-Digit Counter Positive Reflective	32
CUB4L8W1	CUB4L8W	8-Digit Counter w/Yel/Grn Backlighting	32

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
CUB4L8W2	CUB4L8W	8-Digit Counter w/Red Backlighting	32
CUB4L8WM	CUB4L8W	8-Digit Counter w/V+ Terminal	32
CUB4LM00	CUB4LM	6-Digit Counter w/V+ Terminal	29
CUB4LP00	CUB4LP	Loop Pwrd Process Meter, Reflective	363
CUB4LP40	CUB4LP	Loop Pwrd Process Meter, Red Backlighting	363
CUB 4 SERIES			
CUB4V000	CUB4V	DC Voltmeter	233
CUB4V010	CUB4V	DC Voltmeter w/Yel/Grn Backlighting	233
CUB4V020	CUB4V	DC Voltmeter w/Red Backlighting	233
CUB 5 SERIES			
CUB5B000	CUB5	Dual Count & Rate Indicatr w/Bklght Display	35
CUB5COM1	CUB5	RS485 Serial Communication Card	964
CUB5COM2	CUB5	RS232 Serial Communication Card	964
CUB5IB00	CUB5I	DC Current Meter with Red/Green Backlight	244
CUB5IR00	CUB5I	DC Current Meter with Reflective Display	244
CUB5PB00	CUB5P	Process Meter with Red/Green Backlight	367
CUB5PR00	CUB5P	Process Meter with Reflective Display	367
CUB5R000	CUB5	Dual Count & Rate Indicatr w/Reflctve Dsply	35
CUB5RLY0	CUB5	Single Relay Option Card	35
CUB5RTB0	CUB5RT	RTD Meter with Red/Green Backlight	480
CUB5RTR0	CUB5RT	RTD Meter with Reflective Display	480
CUB5SNK0		Dual Sinking Open Collector Output Card	35
CUB5TB00	CUB5T	Preset Timer & Cycle Counter w/Bklght Dsply	181
CUB5TCB0	CUB5TC	Thermocouple Meter with Red/Green Bcklght	469
CUB5TCR0	CUB5TC	Thermocouple Meter with Reflective Display	469
CUB5TR00	CUB5T	Preset Timr & Cycle Countr w/Reflctve Dsply	181
CUB5USB0	CUB5USB	USB Option Card	962
CUB5VB00	CUB5V	DC Voltmeter with Red/Green Backlight	233
CUB5VR00	CUB5V	DC Voltmeter with Reflective Display	233
CUB 7 MINIATURE COUNTERS AND TIMERS			
CUB7CCG0	CUB7	8-Digit Counter, Low Volt, Green Backlight	23
CUB7CCR0	CUB7	8-Digit Counter, Low Volt, Red Backlight	23
CUB7CCS0	CUB7	8-Digit Counter, Low Volt Reflective Disply	23
CUB7CVG0	CUB7	8-Digit Counter, High Volt, Green Backlight	23
CUB7CVR0	CUB7	8-Digit Counter, High Volt, Red Backlight	23
CUB7CVS0	CUB7	8-Digit Counter, High Volt, Reflective Disply	23
CUB7P000	CUB7P	8-Digit Counter, Contact, Reflective Display	NL
CUB7P010	CUB7P	8-Digit Counter, Contact, Green Backlight	NL
CUB7P020	CUB7P	8-Digit Counter, Contact, Red Backlighting	NL
CUB7P100	CUB7P	8-Digit Counter, Voltage, Reflective Display	NL
CUB7P110	CUB7P	8-Digit Counter, Voltage, Green Backlight	NL
CUB7P120	CUB7P	8-Digit Counter, Voltage, Red Backlighting	NL
CUB7P200	CUB7P	8-Digit Counter, Logic, Reflective Display	NL
CUB7P210	CUB7P	8-Digit Counter, Logic, Green Backlight	NL
CUB7P220	CUB7P	8-Digit Counter, Logic, Red Backlighting	NL
CUB7P300	CUB7P	8-Digit Counter, Low Volt Reflective Disply	NL
CUB7P310	CUB7P	8-Digit Counter, Low Volt, Green Backlight	NL
CUB7P320	CUB7P	8-Digit Counter, Low Volt, Red Backlight	NL
CUB7TCG0	CUB7T	8-Digit Timer, Low Volt, Green Backlight	23

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
CUB7TCG1	CUB7T	8-Digit Timer, Low Volt, SRC Only, Grn Bcklt	23
CUB7TCR0	CUB7T	8-Digit Timer, Low Volt, Red Backlighting	23
CUB7TCR1	CUB7T	8-Digit Timer, Low Volt, SRC Only, Red Bcklt	23
CUB7TCS0	CUB7T	8-Digit Timer, Low Volt, Reflctv Disply	23
CUB7TCS1	CUB7T	8-Digit Timer, Low Volt, SRC Only, Reflect	23
CUB7TVG0	CUB7T	8-Digit Timer, High Volt, Green Backlight	23
CUB7TVR0	CUB7T	8-Digit Timer, High Volt, Red Backlight	23
CUB7TVS0	CUB7T	8-Digit Timer, High Volt, Reflective Disply	23
DUAL LOOP CONTROLLER			
DLC00001	DLC	Dual Loop Controller with Dual Isolation	NL
DLC01001	DLC	Dual Isolated Controller with 2 Analog Out.	NL
DLC11001	DLC	Setpoint Controller with 2 Analog Outputs	NL
DIGITAL PANEL METERS			
DP5D0000	DP5D	Universal DC Input, AC Powered	283
DP5D0010	DP5D	Universal DC Input, DC Powered	283
DP5P0000	DP5P	Process Input, AC Powered	283
DP5P0010	DP5P	Process Input, DC Powered	283
DP5T0000	DP5T	Thermocouple/RTD Input, AC Powered	283
DP5T0010	DP5T	Thermocouple/RTD Input, DC Powered	283
ADAPTER			
DRRJ11T6		RJ11 to Terminal Adapter	NL
DRRJ45P6		RJ45 Parallel Connector	NL
DRRJ45T8		RJ45 to Terminal Adapter	NL
DATA STATION PLUS			
DSPGT000	DSP	Protocol Cnvtr, Data Logger, VGA Virtual HMI	NL
DSPGT001	DSP	Ext Temp, Prot Cnvtr, Logger, VGA Virtual HMI	NL
DSPLE000	DSP	Protocol Cnvtr, Comms, Ethernet	NL
DSPLE001	DSP	Ext Temp, Prot Cnvtr, Comms, Ethernet	NL
DSPSX000	DSP	Protocol Cnvtr, Data Logger, Virtual HMI	NL
DSPSX001	DSP	Ext Temp, Prot Cnvtr, Data Logger, Virtual HMI	NL
DIGITAL TACHOMETERS			
DT800000	DT8	Adjustable Time Base Tachometer	153
DT800010	DT8	Adj. Time Base Tach. w/Yel/Grn Bklg.	153
DT800020	DT8	Adj. Time Base Tach. w/Red Bklghtng.	153
PHOTO-ELECTRIC EMITTER SENSOR			
EMDC0000	EMDC	(Opposed Beam Pair), DC Powered	903
EMMDC000	PRM/RRM	DC Emitter (Opposed Beam Pair)w/Cable	907
EMMDC001	PRM/RRM	DC Emitter (Opposed Beam Pair)w/Pico Conn.	907
ENCLOSURES			
ENC10000		Small Utility Enclosure, NEMA 1	NL
ENC11000		1/16 DIN Enclosure, NEMA 4	1006
ENC11A00		1/16 DIN Single Enclosure, NEMA 4	1006
ENC11B00		1/16 DIN Double Enclosure, NEMA 4	1006
ENC12000		EPAX 6 Enclosure, NEMA 4	1012
ENC13000		CUB7 Single NEMA 4 Enclosure	1001
ENC20000		Large Utility Enclosure, NEMA 1	NL
ENC30000		Libra/Lynx Enclosure, NEMA 1	NL
ENC40000		Libra Series Enclosure, NEMA 4	NL
ENC50000		Apollo Series Enclosures, NEMA 4	NL

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
ENC5A000		PAX Enclosure, NEMA 4	1008
ENC5B000		Fiberglass Enclosure for 1 PAX unit	1008
ENC5C000		Fiberglass Enclosure for 2 PAX units	1008
ENC60000		Gemini Series Enclosures, NEMA 4	NL
ENC80000		CUB4/5, DT7 NEMA 4	1002
ENC8A000		CUB4/5, DT8 NEMA 4X Fiberglass	1002
ENC8B000		CUB 4/5, DT8 NEMA 4X, use with MLPS	1002
ENC90000		LPAX Enclosure, NEMA 4	1010
EXTRA LARGE PAX PANEL METER			
EPAX0500	EPAX5	5-Digit Extra Large Display Module Analog	737
EPAX0600	EPAX6	6-Digit Extra Large Display Module Digital	743
EPAXENSH		NEMA 4/IP65 Enclosure and Shroud	1012
EPAXPGM0		Programming Remote w/10 ft cable	743
FERRITE SUPPRESSION CORE			
FCOR0000	FCOR	Ferrite Suppression Core	994
GRAPHITE OPERATOR PANELS			
G07C0000		7 inch Touchscreen, Indoor, 24 VDC pwr	NL
G07S0000		7 inch Touchscrn, Indoor/Outdoor, 24 VDC pwr	NL
G09C0000		9 inch Touchscreen, Indoor, 24 VDC pwr	NL
G09C1000		9 inch Touch, Indoor, +Eth, 24 VDC pwr	NL
G0FILM07		Pck of ten prtctve films for G07	NL
G0FILM09		Pck of ten prtctve films for G09	NL
G0FILM10		Pck of ten prtctve films for G10	NL
G0FILM12		Pck of ten prtctve films for G12	NL
G0FILM15		Pck of ten prtctve films for G15	NL
G10C0000		10 inch Touchscreen, Indoor, 24 VDC pwr	NL
G10C1000		10 inch Touch, Indoor, +Eth, 24 VDC pwr	NL
G10R0000		10 inch High Res, Indoor, 24 VDC pwr	NL
G10R1000		10 in High Res, Indoor, +Eth, 24 VDC pwr	NL
G10S0000		10 inch Touchscrn, Indoor/Outdoor, 24 VDC pwr	NL
G10S1000		10 in Touch, In/Outdoor, +Eth, 24 VDC pwr	NL
G12C0000		12 inch Touchscreen, Indoor, 24 VDC pwr	NL
G12C1100		12 in Touch, Indoor, +Eth, +Ser, 24 VDC pwr	NL
G15C0000		15 inch Touchscreen, Indoor, 24 VDC pwr	NL
G15C1100		15 in Touch, Indoor, +Eth, +Ser, 24 VDC pwr	NL
G3 OPERATOR INTERFACE PANELS			
G303M000	G303	LCD, 128 x 64 Indoor	NL
G303S000	G303	LCD, 128 x 64 Outdoor	NL
G304K200		Kadet 4.3 inch TFT	NL
G306A000	G306	LCD 320 X 240 Indoor, 5 button keypad TFT	NL
G306C000	G306	Replaced by G306A000	NL
G306M000	G306	LCD, Mono, 320 x 240, Indr, 5 button keypd	NL
G306MS00	G306	LCD, Mono, 320 x 240, In/Outdoor, 5 button	NL
G307K200		Kadet 7 inch TFT	NL
G308A210	G308	TFT, Indr, Isolated Comms, 1 Eth, USB Hst	NL
G308A230	G308	TFT, Indr, Isolated Comms, 2 Eth, USB Hst	NL
G308C100	G308	LCD, DSTN, 640 X 480 Indr, 7 button keypad	NL

NOTE

NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
G310C210	G310	VGA, Indr, Isolated Comms, 1 Eth, USB Hst	NL
G310C230	G310	VGA, Indr, Isolated Comms, 2 Eth, USB Hst	NL
G310R210	G310	SVGA, Indr, Isolated Comms, 1 Eth, USB Hst	NL
G310R230	G310	SVGA, Indr, Isolated Comms, 2 Eth, USB Hst	NL
G310S210	G310	Gloss, Indr, Isolated Comms, 1 Eth, USB Hst	NL
G310S230	G310	Gloss, Indr, Isolated Comms, 2 Eth, USB Hst	NL
G315C210	G315	XGA, Indoor, USB Host	NL
G315C230	G315	XGA, Indoor, 2 Ethernet, USB Host	NL
G3BR06A0		G306A Backlight Assembly	NL
G3BR08A0		G308A Backlight Assembly	NL
G3BR10C0		G310C Backlight Assembly	NL
G3BR10C1		G310C Backlight Assembly	NL
G3BR10S1		G310S Backlight Assembly w/driver Brd	NL
G3BR10S2		G310S Backlight Assembly	NL
G3CF001G		1 G CompactFlash Card	NL
G3CF002G		2 G CompactFlash Card	NL
G3CF064M		64 MB CompactFlash Card	NL
G3CF256M		256 MB CompactFlash Card	NL
G3CF512M		512 MB CompactFlash Card	NL
G3CN0000	G3CN	G3 CANopen Option Card	NL
G3DN0000	G3DN	G3 DeviceNet Option Card	NL
G3ENET00	G3ENET	G3 Ethernet Option Card	NL
G3FILM03		Pck of ten prtctve films for G303M or G303S	NL
G3FILM06		Pck of ten prtctve films for G306	NL
G3FILM08		Pck of ten prtctve films for G308 or G308A	NL
G3FILM10		Pck of ten prtectve films for G310M or G310S	NL
G3FILM15		Pck of ten prtectve films for G315	NL
G3FILM4K		Pack of ten protective films for G304K	NL
G3FILM6K		Pack of ten protective films for G306K	NL
G3FILM7K		Pack of ten protective films for G307K	NL
G3FILM8K		Pack of ten protective films for G308K	NL
G3GSM000		GSM/GPRS Modem Option Card for G3	NL
G3PBDP00	G3PB	G3 Profibus Option Card	NL
G3QANT00		Quad-band GSM/GPRS cellular antenna	NL
G3RS0000	G3RS	G3 RS232/485 Option Card	NL
CONVERTER MODULES			
GCM23201	GCM232	Serial Converter RS232	NL
GCM42201	GCM422	Serial Converter RS422	NL
GEMINI 1000 COUNTER/RATE			
GEM10060	GEM1	w/Relay, 115/230V	NL
GEMINI 2000 COUNTER/RATE			
GEM20060	GEM2	w/Relay, 115/230V	NL
GEM20160	GEM2	w/Relay & Current Loop, 115/230V	NL
GEMINI 3300 BATCH COUNTER			
GEM33060	GEM33	w/Relay, 115/230V	NL
GEM33160	GEM33	w/Relay & Current Loop, 115/230V	NL

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
GEMINI 4100 COUNTER/RATE			
GEM41060	GEM41	w/Relay, 115/230V	NL
GEM41160	GEM41	w/Relay & Current Loop, 115/230V	NL
GEMINI 4200 COUNTER/RATE			
GEM42060	GEM42	w/Relay, 115/230V	NL
GEM42160	GEM42	w/Relay & Current Loop, 115/230V	NL
GEMINI 5200 RATE			
GEM52060	GEM52	w/Relay, 115/230V	NL
GEM52160	GEM52	w/Relay & Current Loop, 115/230V	NL
GRAPHITE I/O MODULES			
GMDIOR00	GM	Eight Inputs, Six Relay Outputs	NL
GMDIOS00	GM	Eight Inputs, Six Solid State Outputs	NL
GMINI800	GM	8 DC Current Inputs	NL
GMINV800	GM	8 DC Voltage Inputs	NL
GMOUT400	GM	4 Analog Outputs	NL
GMP1RA00	GM	Single PID, Relay and Analog Outputs	NL
GMP1RM00	GM	Single PID, Relay and Heater Current	NL
GMP1SA00	GM	Single PID, SSR and Analog Outputs	NL
GMP1SM00	GM	Single PID, SSR and Heater Current	NL
GMP2R000	GM	Dual PID, Relay Outputs	NL
GMP2RM00	GM	Dual PID, Relay and Heater Current	NL
GMP2S000	GM	Dual PID, SSR Outputs	NL
GMP2SM00	GM	Dual PID, SSR and Heater Current	NL
GMRTD600	GM	6 RTD Inputs	NL
GMTC8000	GM	8 Thermocouple Inputs	NL
GMUIN400	GM	4 Universal Inputs	NL
HALL EFFECT SENSOR			
HESS0000	HESS	Hall Effect Sensor	865
MISCELLANEOUS			
HHT00000	HHT	LCD Hand Held Contact Tachometer	NL
HHTCONC0		HHT Concave Disc	NL
HHTCONE0		HHT Cone Point Disc w/Shaft	NL
HHTP0000	HHTP	LCD Hand Held Photo Tachometer	NL
HHTRT000		HHTP Rplcmnt 4x24 Reflect Tape	NL
HHTWHL00		HHT Rubber Wheel	NL
ACCESSORIES			
HWK10000	HWK1	Hardware Kit, CUB 2	NL
HWK20000	HWK2	Hardware Kit, CUB 2	NL
HWK30000	HWK3	Bezel Kit, SUB CUB 2, SSCUB 2	NL
HWK40000	HWK4	Bezel Evaluation Kit, SUB CUB 2	NL
HWK70000	HWK7	MDM Cable Assembly	NL
DIN RAIL MODULES			
IAMA0006	IAMA6	Configurable 3-Way Isolating Amplifier	792
IAMA3535	IAMA	Universal Signal Conditioning	784
IAMA6262	IAMA	Universal Signal Conditioning Square Root	784
IAMS0001	IAMS	IAMS with analog	774
IAMS0010	IAMS	IAMS with setpoint	774
IAMS0011	IAMS	IAMS with analog and setpoint	774
IAMS3535	IAMS	Smart Setpoint Analog Module	NL

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
ACCESSORIES			
ICA00000	ICA	Spare Input Connector	NL
DIN RAIL MODULES			
ICM40030	ICM4	RS232/RS485 Converter	829
ICM50000	ICM5	3 way Isolated RS232/RS485 Converter	833
ICM80000	ICM8	Ethernet Gateway	837
IFMA0035	IFMA	Frequency to Analog Converter, DC Powered	755
IFMA0065	IFMA	Frequency to Analog Converter, AC Powered	755
IFMR0036	IFMR	Speed Switch, DC Powered	763
IFMR0066	IFMR	Speed Switch, AC Powered	763
INDUCTIVE LOAD SUPPRESSORS			
ILS11500	ILS1	115VAC	995
ILS23000	ILS2	230VAC	995
INTELLIGENT DECADE METER FOR VOLTAGE INPUTS			
IMD10060	IMD1	Base Unit, 115/230VAC	NL
IMD10160	IMD1	w/Exc, 115/230VAC	NL
IMD10162	IMD1	w/Exc & Alarms, 115/230VAC	NL
IMD13160	IMD1	w/Exc & Sw, 115/230VAC	NL
IMD13161	IMD1	w/Exc, Sw, & Serial, 115/230VAC	NL
IMD13162	IMD1	w/Exc, Sw & Alarms, 115/230VAC	NL
IMD13163	IMD1	w/Exc, Sw & Analog, 115/230VAC	NL
IMD13167	IMD1	w/Exc, Sw, Alarms, Ser, & Anlg 115/230VAC	NL
IMD13169	IMD1	w/Exc, Sw, Alrms, Ser, & V Anlg 115/230VAC	NL
INTELLIGENT DECADE METER FOR CURRENT INPUTS			
IMD20060	IMD2	Base Unit, 115/230VAC	NL
IMD20160	IMD2	w/Exc, 115/230VAC	NL
IMD20162	IMD2	w/Exc & Alarms, 115/230VAC	NL
IMD23160	IMD2	w/Exc & Sw, 115/230VAC	NL
IMD23161	IMD2	w/Exc, Sw, & Serial, 115/230VAC	NL
IMD23162	IMD2	w/Exc, Sw & Alarms, 115/230VAC	NL
IMD23163	IMD2	w/Exc, Sw & Analog, 115/230VAC	NL
IMD23167	IMD2	w/Exc, Sw, Alrms, Ser, & Anlog 115/230VAC	NL
IMD23169	IMD2	w/Exc, Sw, Alrms, Ser, & V Anlg 115/230VAC	NL
INTELLIGENT METER FOR DIGITAL RATE INPUTS			
IMI04160	IMI	Base Unit, 115/230VAC	NL
IMI04161	IMI	w/Serial, 115/230VAC	NL
IMI04162	IMI	w/Alarm, 115/230VAC	NL
IMI04163	IMI	w/Analog, 115/230VAC	NL
IMI04167	IMI	w/Alarms, Serial, & Analog, 115/230VAC	NL
IMI04169	IMI	w/Exc, Alarms, Serial, & V Anlg 115/230VAC	NL
INTELLIGENT METER FOR PROCESS INPUTS			
IMP20060	IMP	Base unit, 115/230VAC	NL
IMP20160	IMP	w/Exc, 115/230VAC	NL
IMP20162	IMP	w/Exc & Alarms, 115/230VAC	NL
IMP23160	IMP	w/Exc & Sw, 115/230VAC	NL
IMP23161	IMP	w/Exc, Sw, & Serial, 115/230VAC	NL
IMP23162	IMP	w/Exc, Sw, & Alarms, 115/230VAC	NL
IMP23163	IMP	w/Exc, Sw, & Analog, 115/230VAC	NL

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
IMP23167	IMP	w/Exc, Sw, Alrms, Serial, Anlg 115/230VAC	NL
IMP23169	IMP	w/Exc, Sw, Alrms, Serial, V Anlg 115/230VAC	NL
INTELLIGENT METER FOR STRAIN GAGE INPUTS			
IMS03160	IMS	Base unit, 115/230VAC	NL
IMS03162	IMS	w/Alarms, 115/230VAC	NL
IMS03164	IMS	w/Alarms & Serial, 115/230VAC	NL
IMS03166	IMS	w/Alarms & Analog, 115/230VAC	NL
IMS03168	IMS	w/Alarms,& V Analog 115/230VAC	NL
DIN RAIL MODULE			
IRMA2003	IRMA	Intelligent RTD, Loop Powered	804
IRMA3035	IRMA	Intelligent RTD, DC Powered	810
ITMA2003	ITMA	Intelligent Thermocouple, Loop Powered	816
ITMA3035	ITMA	Intelligent Thermocouple, DC Powered	823
ITMS4037	ITMS	Smart Thermocouple to MODBUS w/Alarms	NL
LOGIC CONVERTER MODULE			
LCM10000	LCM1	Logic Converter Module	951
LARGE DISPLAYS			
LD200400		2.25” High 4-Digit Red LED Counter	657
LD200600		2.25” High 6-Digit Red LED Counter	657
LD2006P0		2.25” 6-Dgt LED Cnt/Rte w/Rly Out & Srl Com	657
LD2A05P0		2.25” High 4-Digit Red LED Analog	685
LD2SS6P0		2.25” High 6-Digit Serial Slave Display	717
LD2T06P0		2.25” 6-Dgt Red LED Tmr w/Rly Out & Srl Com	672
LD400400		4” High 4-Digit Red LED Counter	657
LD400600		4” High 6-Digit Red LED Counter	657
LD4006P0		4” 6-Digit LED Cnt/Rte w/Rly Out & Srl Com	657
LD4A05P0		4” High 5 1/2 Digit Red LED Analog	685
LD4SS6P0		4” High 6-Digit Red LED Serial Slave Display	717
LD4T06P0		4” 6-Dgt Red LED Tmr w/Rly Out & Srl Com	672
LDPLUG00		LD Panel Hole Plug	657
LINEAR ENCODER			
LEMTBR00		ZLZ Mouting Bracket	901
LINE FILTER			
LFIL0000	LFIL	General Purpose Line FIlter	997
LEGEND COUNTER/RATE INDICATOR SERIES			
LGB00000	LGB	Four Preset Batch, w/Yel/Grn Bkltng	NL
LGB00100	LGB	Four Preset Batch, w/Red Bkltng	NL
LGD00000	LGD	Dual Prst, w/Yel/Grn Bkltng, & Relay	NL
LGD00001	LGD	Dual Preset, w/Yel/Grn Backlighting	NL
LGD00100	LGD	Dual Preset, w/Red Bklt, & Relay	NL
LGD00101	LGD	Dual Preset, w/Red Backlighting	NL
LGM00001	LGM	Multi Preset (6), w/Yel/Grn Bkltng	NL
LGM00101	LGM	Multi Preset (6), w/Red Backlighting	NL
LGPB0000	LGPB	4 Preset Batch w/Green Backlight	NL
LGPB0100	LGPB	4 Preset Batch w/Red Backlight	NL
LGPB0200	LGPB	4 Preset Batch w/Dual Color Backlight	NL
LGPBF100	LGPBF	Foot/Inch Counter	NL

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
LGS00000	LGS	Single Preset, w/Yel/Grn Bklt & Relay	NL
LGS00001	LGS	Single Preset, w/Yel/Grn Backlighting	NL
LGS00100	LGS	Single Preset, w/Red Bklt, & Relay	NL
LGS00101	LGS	Single Preset, w/Red Backlighting	NL
LIBRA SERIES			
LIBC1000	LIBC1	Single Preset LCD Cntr, 115V	NL
LIBC1010	LIBC1	Single Preset LCD Cntr, 230V	NL
LIBC1E00	LIBC1E	Single Preset LED Cntr, 115V	NL
LIBC1E10	LIBC1E	Single Preset LED Cntr, 230V	NL
LIBC2000	LIBC2	Dual Preset LCD Cntr, 115V	NL
LIBC2010	LIBC2	Dual Preset LCD Cntr, 230V	NL
LIBC2E00	LIBC2E	Dual Preset LED Cntr, 115V	NL
LIBC2E10	LIBC2E	Dual Preset LED Cntr, 230V	NL
LIBT1000	LIBT1	Single Preset LCD Timer, 115V	NL
LIBT1010	LIBT1	Single Preset LCD Timer, 230V	NL
LIBT1E00	LIBT1E	Single Preset LED Timer, 115V	NL
LIBT1E10	LIBT1E	Single Preset LED Timer, 230V	NL
LIBT2000	LIBT2	Dual Preset LCD Timer, 115V	NL
LIBT2010	LIBT2	Dual Preset LCD Timer, 230V	NL
LIBT2E00	LIBT2E	Dual Preset LED Timer, 115V	NL
LIBT2E10	LIBT2E	Dual Preset LED Timer, 230V	NL
LOGIC MAGNETIC PICKUP			
LMPC0000	LMPC	NPN O.C. w/Cable	863
LMPC0025	LMPC	NPN O.C. w/25ft Cable	863
LMPC0050	LMPC	NPN O.C. w/50ft Cable	863
LMPCC000	LMPCC	NPN O.C. 3-Pin Connector	863
LMPEC000	LMPEC	Emitter Follower, 3-Pin Connector	863
LARGE DISPLAY PAX PANEL METER			
LPAX0500	LPAX	5-Digit Large Display Module	725
LPAX0600	LPAX	6-Digit Large Display Module	729
LPAXCK00	LPAX	6-Digit Large Clock Display Module	729
LPAXDA00	LPAX	6-Digit Large Dual Process Display Module	733
MOUNTING HARDWARE FOR LENGTH SENSORS			
LSAHC001	LSAHC	Hinge Clamp Assembly	889
LSCB1000	LSCB	Conversion Bracket	889
LARGE PAX CUSTOM ANNUNCIATOR LABELS			
LX******	LX LABEL	LPAX Annunciator Label	961
MOUNTING BRACKETS			
MB200000	MB2	Bottom Mount Bracket Kit	903
MB300000	MB3	Side Mount Bracket Kit	903
MB400000	MB4	PSA7A Proximity Sensor	853
MB4B0000	MB4B	PSA7B Proximity Sensor	853
MB500000	MB5	PSA8A Proximity Sensor	853
MB5B0000	MB5B	PSA8B Proximity Sensor	853
MB700000	MB7	Mounting Spacer for PSAFP	858
MB800000	MB8	Mounting Bracket for PSAFP	858
MBLPAX00	MBLPAX	LPAX Mounting Bracket	1010

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
MBM20000	PRM/RRM	Bottom Mount Bracket Kit	907
MBM30000	PRM/RRM	Side Mount Bracket Kit	907
MBZM0001		ZMH Mounting Bracket w/Shaft	893
MBZM0002		ZMH Double Wheel Pivot Mount	893
MOTOR DRIVE CONTROLLER			
MDC00100	MDC	Motor Drive Controller	NL
MDMU COUNTER/TIMER/TACH			
MDMU0000	MDMU	Panel Mount w/Reflective Display	NL
MDMU0010	MDMU	Panel Mount w/Yel-Grn Backlighting	NL
MDMU0020	MDMU	Panel Mount w/Red Backlighting	NL
MDMU0100	MDMU	PC Board Mount w/Reflective Display	NL
MDMU0110	MDMU	PC Board Mount w/Yel-Grn Bcklghtng	NL
MDMU0120	MDMU	PC Board Mount w/Red Backlighting	NL
MDMV DC VOLTMETERS			
MDMV0000	MDMV	Panel Mount w/Reflective Display	NL
MDMV0010	MDMV	Panel Mount w/Yel-Grn Backlighting	NL
MDMV0020	MDMV	Panel Mount w/Red Backlighting	NL
MDMV0100	MDMV	PC Board Mount w/Reflective Display	NL
MDMV0110	MDMV	PC Board Mount w/Yel-Grn Bcklghtng	NL
MDMV0120	MDMV	PC Board Mount w/Red Backlighting	NL
POWER SUPPLY			
MLPS1000	MLPS1	Micro-Line, 85-250 VAC	949
MLPS2000	MLPS2	Micro-Line 24 VDC	949
MAGNETIC PICKUPS			
MP25TA00	MP25TA	1/4” Threaded	861
MP37CA00	MP37CA	3/8” Cylindrical	861
MP37TA00	MP37TA	3/8” Threaded	861
MP37TAC1	MP37TA	3/8” Threaded with M12 Connector	861
MP62TA00	MP62TA	5/8” Threaded	861
MP62TAC1	MP62TA	5/8” Threaded with M12 Connector	861
MP62TB00	MP62TB	5/8” Threaded, Blind End	861
MP75TX00	MP75TX	3/4” Threaded, Explosion Proof	861
LARGE DISPLAY PAX PANEL METER MODULES			
MPAXC020	PAX	AC Power, PAXC Count Module	729
MPAXC030	PAX	DC Power, PAXC Count Module	729
MPAXCK00	PAX	AC Power, PAXCK Clock Module	729
MPAXCK10	PAX	DC Power, PAXCK Clock Module	729
MPAXD000	PAX	AC Power, PAXD Universal DC Input Module	725
MPAXD010	PAX	DC Power, PAXD Universal DC Input Module	725
MPAXDP00	PAX	AC Power, PAXDP Dual Process Module	733
MPAXDP10	PAX	DC Power, PAXDP Dual Process Module	733
MPAXH000	PAX	AC Power, PAXH True RMS Volt/Cur Module	725
MPAXI020	PAX	AC Power, PAXI Count/Rate Module	729
MPAXI030	PAX	DC Power, PAXI Count/Rate Module	729
MPAXP000	PAX	AC Power, PAXP Process Module	725
MPAXP010	PAX	DC Power, PAXP Process Module	725
MPAXR020	PAX	AC Power, PAXR Rate Module	729
MPAXR030	PAX	DC Power, PAXR Rate Module	729
MPAXS000	PAX	AC Power, PAXS Strain Gage Module	725

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
MPAXS010	PAX	DC Power, PAXS Strain Gage Module	725
MPAXT000	PAX	AC Power, PAXT Thermocouple/RTD Module	725
MPAXT010	PAX	DC Power, PAXT Thermocouple/RTD Module	725
MPAXTM00	PAX	AC Power, PAXTM Timer Module	729
MPAXTM10	PAX	DC Power, PAXTM Timer Module	729
OUTPUT MODULES FOR TCU			
OMD00000		Relay Module	602
OMD00001		Triac Module	602
OMD00003		SSR Drive Module	602
1/16 DIN PROCESS CONTROL UNITS			
P1610000	P16	w/Relay Output	519
P1610010	P16	DC, w/Relay Output	519
P1611100	P16	w/Relay Output, 2 Alarms, and User Input	519
P1611110	P16	DC, w/Relay Out, 2 Alarms, and User Input	519
P1620000	P16	w/Solid State Output	519
P1620010	P16	DC, w/Solid State Output	519
P1621100	P16	w/Solid State Out, 2 Alarms, and User Input	519
P1621110	P16	DC, w/Solid State Out, 2 Alrms, & User Input	519
P1641100	P16	w/Analog Output, 2 Alarms, and User Input	519
P1641110	P16	DC, w/Analog Out, 2 Alarms, and User Input	519
P4800001	P48	w/Analog Output	619
P4800011	P48	DC, w/Analog Output	619
P4810000	P48	w/Relay Output	619
P4810010	P48	DC, w/Relay Output	619
P4810101	P48	w/Dual Relay, and Analog	619
P4810105	P48	w/Dual Relay, Analog, and RSP	619
P4810107	P48	w/Dual Relay, Analog, and RS485	619
P481010A	P48	w/Dual Relay, and Dual Analog	619
P4810111	P48	DC, w/Dual Relay, Analog	619
P4810115	P48	DC, w/Dual Relay, Analog, and RSP	619
P4810117	P48	DC, w/Dual Relay, Analog, and RS485	619
P481011A	P48	DC, w/Dual Relay, and Dual Analog	619
P4811100	P48	w/Dual Relay	619
P4811102	P48	w/Dual Relay, and RS485	619
P4811110	P48	DC, w/Dual Relay	619
P4811112	P48	DC, w/Dual Relay, and RS485	619
PAX METERS			
PAX2A000	PAX2A	PAX Dual Line Analog	332
PAX2D000	PAX2D	PAX Dual Line Digital	98
PAX2S000	PAX2S	PAX Dual Line Strain Gage	433
PAXC0020	PAXC	Count Indicator, Field Upgradeable Red	68
PAXC0030	PAXC	DC, Count Indicator, Field Upgradeable Red	68
PAXC0120	PAXC	Count Indicator, Field Upgradeable Green	68
PAXC0130	PAXC	DC, Count Indicator, Field Upgradeable Grn	68
PAXCDC10	PAX	RS485 Option Card	970
PAXCDC1C	PAX	Extnd. RS485 Card w/Dual RJ11 Connector	970
PAXCDC20	PAX	RS232 Option Card	970
PAXCDC2C	PAX	Extnd. RS232 Card w/9 Pin D Connector	970
PAXCDC30	PAX	DeviceNet Option Card	975

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
PAXCDC40	PAX	MODBUS Option Card	979
PAXCDC4C	PAX	Extnd. MODBUS Card with RJ11 Connector	979
PAXCDC50	PAX	PROFIBUS-DP Option Card	985
PAXCDL10	PAX	Analog Output Card	991
PAXCDS10	PAX	Dual Relay Card	989
PAXCDS20	PAX	Quad Relay Card	989
PAXCDS30	PAX	Quad NPN-OC Card	989
PAXCDS40	PAX	Quad PNP-OC Card	989
PAXCK000	PAXCK	Clock/Timer, Field Upgradeable Red	199
PAXCK010	PAXCK	DC, Clock/Timer, Field Upgradeable Red	199
PAXCK100	PAXCK	Clock/Timer, Field Upgradeable Green	199
PAXCK110	PAXCK	DC, Clock/Timer, Field Upgradeable Grn	199
PAXD0000	PAXD	Universal DC Input, Field Upgradeable Red	301
PAXD0010	PAXD	DC, Universal DC Input, Field Upgrad. Red	301
PAXD0100	PAXD	Universal DC Input Field Upgradeable Grn	301
PAXD0110	PAXD	DC, Universal DC Input, Field Upgrad. Grn	301
PAXDP000	PAXDP	Dual Process Input, Upgradeable Red	396
PAXDP010	PAXDP	DC, Dual Process Input, Upgradeable Red	396
PAXH0000	PAXH	True RMS Volt & Current, Field Upgrad. Red	301
PAXH0100	PAXH	True RMS Volt & Current, Field Upgrad. Grn	301
PAXI0020	PAXI	Smart Counter/Rate, Field Upgradeable Red	68
PAXI0030	PAXI	DC, Smart Counter/Rate, Field Upgrad. Red	68
PAXI0120	PAXI	Smart Counter/Rate, Field Upgradeable Grn	68
PAXI0130	PAXI	DC, Smart Counter/Rate, Field Upgrad. Grn	68
PAXLBK10	PAX	Label Kit for PAX Meters	960
PAX LITE METERS			
PAXLA000	PAXLA	Process Current Volt Meter	273
PAXLBK30	PAX	Label Kit for PAX Lite Analog Meters	NL
PAXLC600	PAXLC	Six Digit Totalizing Counter	50
PAXLC800	PAXLC	Eight Digit Totalizing Counter	50
PAXLCL00	PAXLCL	Current Loop Meter	378
PAXLCR00	PAXLCR	Count/Rate Meter	57
PAXLHV00	PAXLHV	AC Voltage Monitor	268
PAXLIA00	PAXLI	AC Current Meter	255
PAXLID00	PAXLI	DC Current Meter	255
PAXLIT00	PAXLIT	5 Amp Current Meter	262
PAXLPT00	PAXLPT	Process Time Meter	169
PAXLPV00	PAXLPV	Process Volt Meter	386
PAXLR000	PAXLR	Rate Meter	158
PAXLRT00	PAXLRT	RTD Meter	499
PAXLSG00	PAXLSG	Strain Gage Meter	424
PAXLT000	PAXLT	Temperature	506
PAXLTC00	PAXLTC	Thermocouple	491
PAXLVA00	PAXLV	AC Volt Meter	255
PAXLVD00	PAXLV	DC Volt Meter	255

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
PAX METERS			
PAXP0000	PAXP	Process Input, Field Upgradeable Red	301
PAXP0010	PAXP	DC, Process Input, Field Upgradeable Red	301
PAXP0100	PAXP	Process Input, Field Upgradeable Green	301
PAXP0110	PAXP	DC, Process Input, Field Upgradeable Green	301
PAXR0020	PAXR	Rate Indicator, Field Upgradeable Red	68
PAXR0030	PAXR	DC, Rate Indicator, Field Upgradeable Red	68
PAXR0120	PAXR	Rate Indicator, Field Upgradeable Green	68
PAXR0130	PAXR	DC, Rate Indicator, Field Upgradeable Green	68
PAXRTC00	PAXRTC	Real-Time Clock Card	729
PAXS0000	PAXS	Strain/Bridge Input, Field Upgradeable Red	301
PAXS0010	PAXS	DC, Strain/Bridge Input, Field Upgrad. Red	301
PAXS0100	PAXS	Strain/Bridge Input, Field Upgradeable Grn	301
PAXS0110	PAXS	DC, Strain/Bridge Input, Field Upgrad. Grn	301
PAXT0000	PAXT	Thermocouple/RTD Input, Field Upgrad. Red	301
PAXT0010	PAXT	DC, Thermo/RTD Input, Field Upgrad. Red	301
PAXT0100	PAXT	Thermocouple/RTD Input, Field Upgrad. Grn	301
PAXT0110	PAXT	DC, Thermo/RTD Input, Field Upgrad. Grn	301
PAXTM000	PAXTM	Timer, Field Upgradeable Red	199
PAXTM010	PAXTM	DC, Timer, Field Upgradeable, Red	199
PAXTM100	PAXTM	Timer, Field Upgradeable Green	199
PAXTM110	PAXTM	DC, Timer, Field Upgradeable Green	199
PAXUSB00	PAXUSB	USB Option Card	968
PROCESS CONTROL UNITS			
PCU01000	PCU	w/Analog Output	624
PCU01001	PCU	w/Alarm & Analog Output	624
PCU10000	PCU	Base unit, w/NEMA 4X	624
PCU10001	PCU	w/NEMA 4X & Alarm	624
PCU10002	PCU	w/NEMA 4X & Secondary Output	624
PCU10104	PCU	RSP w/NEMA 4X, Alarm & RS485	624
PCU10307	PCU	MVP w/NEMA 4X, Alarm & RS485	624
PCU11000	PCU	w/NEMA 4X & Analog Output	624
PCU11001	PCU	w/NEMA 4X, Analog Output & Alarm	624
PCU11002	PCU	w/NEMA 4X, Analog & Secondary	624
PCU11004	PCU	w/NEMA 4X, Analog, Alarm & RS485	624
PCU11005	PCU	w/NEMA 4X, Analog, Secondary & RS485	624
PCU11108	PCU	RSP w/NEMA 4X, 4-20 Analog & Alarm	624
PCU11306	PCU	MVP w/NEMA 4X, 4-20 Analog & Alarm	624
PCU12001	PCU	w/NEMA 4X, 0-10VDC Analog & Alarm	624
PCU12004	PCU	w/NEMA 4X, 0-10VDC Anlg, Alarm & RS485	624
PCU12005	PCU	w/NEMA 4X, 0-10 Anlg, Scdry/Alrm & RS485	624
PCU12108	PCU	RSP w/NEMA 4X, 0-10 Analog & Alarm	624
PCU12306	PCU	MVP w/NEMA 4X, 0-10 Analog & Alarm	624
PLANT FLOOR MARQUEE			
PFM1608A		TRICOLOR DISP 16x80 115V	NL
PFM1608B		TRICOLOR DISP 16x80 230V	NL
PFM2412A		TRICOLOR DISP 24x120 115V	NL

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
PFM2412B		TRICOLOR DISP 24x120 230V	NL
IAMS PROGRAMMING MODULE			
PGMMOD00		IAMS Programming Module	774
ACCESSORIES			
PKS10000	PKS1	Panel Key Switch	NL
CUB PANEL MOUNT KITS			
PMK10000	PMK1	CUB 1	NL
PMK1A000	PMK1A	CUB 1	NL
PMK1B000	PMK1B	CUB 1	NL
PMK2A000	PMK2A	CUB 2, Key Reset	NL
PMK2B000	PMK2B	CUB 2	NL
PANEL MOUNT KITS			
PMK3B000	PMK3B	Libra Mounting Panel	1014
PMK3C000	PMK3C	C48/T48 Mounting Panel	1014
PMK4A000	PMK4A	Gemini Mounting Panel	1014
PMK4B000	PMK4B	Apollo Mounting Panel	1014
PMK50000	PMK5	1/4 DIN to 1/8 DIN Panel	1022
PMK60000	PMK6	1/8 DIN to 1/16 DIN Panel	1026
PMK6A000	PMK6A	1/8 DIN to CUB5	1025
PMK70000	PMK7	1/4 DIN to 1/16 DIN Panel	1022
PMK7A000	PMK7A	1/4 to CUB5	1022
PMK80000	PMK8	Gemini to PAX Adapter Kit	1027
APOLLO PANEL MOUNT KIT			
PMKA1000	PMKA1	45.7 x 98.4 mm Panel Mnt 3 Piece Kit	1028
CUB CONTROLLER PANEL MOUNT KITS			
PMKCC100	PMKCC1	50 x 50 mm Panel Mount 3 Piece Kit	1029
PMKCC200	PMKCC2	72 x 72 mm Panel Mount 3 Piece Kit	1029
PMKCC300	PMKCC3	60 x 75 mm Panel Mount 2 Piece Kit	1029
GEMINI PANEL MOUNT KITS			
PMKG1000	PMKG1	68x138 mm Panel Mount 3 Piece Kit	NL
PANELS FOR UTILITY ENCLOSURES			
PNL1A000		Blank Panel For Small Enclosure	NL
PNL1C000		Panel For Gemini Series	NL
PNL1D000		Panel For Libra Series	NL
PNL1F000		Panel For Apollo Series	NL
PNL1G000		Panel For 1/16 DIN Units	NL
PNL2A000		Blank Panel For Large Enclosure	NL
PNL2D000		Double Cutout Panel For Large Enclsr	NL
PNL2E000		Double Cutout For 1/8 DIN Units	NL
PNL3A000		Panel For Libra Series	NL
PNL3B000		Panel For Libra Series w/Keylock	NL
PNL3C000		Panel For Lynx Series	NL
PNL3D000		Panel For Lynx Series w/Keylock	NL
PNL3E000		Blank Panel (no cut-out)	NL
PNL3F000		Panel For 1/16 DIN Units	NL
PNL3G000		Panel For 1/16 DIN Units w/Keylock	NL
FREQUENCY TO ANALOG CONVERTERS			
PRA20000	PRA2	Pulse Rate to Analog Converter	NL

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
PHOTO-ELECTRIC SENSORS			
PRDC0000	PRDC	Proximity (Diffused), DC Powered	903
PRMDC000	PRM/RRM	Miniature Prox. DC Sensor w/Cable	907
PRMDC001	PRM/RRM	Miniature Prox. DC Sensor w/Pico Conn.	907
SPEED SWITCHES			
PRS10011	PRS1	0.1-1 Hz, 115V	NL
PRS10012	PRS1	0.1-1 Hz, 230V	NL
PRS10101	PRS1	1-10 Hz, 115V	NL
PRS10102	PRS1	1-10 Hz, 230V	NL
PRS11011	PRS1	10-100 Hz, 115V	NL
PRS11012	PRS1	10-100 Hz, 230V	NL
PRS11021	PRS1	100-1000 Hz, 115V	NL
PRS11022	PRS1	100-1000 Hz, 230V	NL
PRS11031	PRS1	1000-10,000 Hz, 115V	NL
PRS11032	PRS1	1000-10,000 Hz, 230V	NL
PROXIMITY SENSORS			
PSA10000	PSA1	1.5 mm Inductive	853
PSA1B000	PSA1B	1.5 mm Inductive	853
PSA20000	PSA2	10 mm Inductive	853
PSA2B000	PSA2B	10 mm Inductive	853
PSA6B000	PSA6B	1.5 mm Inductive	853
PSA7A000	PSA7A	5 mm Inductive	853
PSA7B000	PSA7B	5 mm Inductive	853
PSA8A000	PSA8A	10 mm Inductive	853
PSA8B000	PSA8B	10 mm Inductive	853
PSAC0000	PSAC	Inductive w/10 ft Cable	856
PSAC0025	PSAC	Inductive w/25 ft Cable	856
PSAC0050	PSAC	Inductive w/50 ft Cable	856
PSAFP100	PSAFP	Flat Pack Proximity Sensor, 2 mm Range	858
PSAFP200	PSAFP	Flat Pack Proximity Sensor, 10 mm Range	858
PSAH0000	PSAH	NPN O.C. Hall Effect Sensor	852
PROCESS SETPOINT CONTROLLERS			
PSC11001	PSC	w/NEMA 4X, Alarm & 4-20 Analog Output	632
PSC11004	PSC	w/NEMA 4X, Alarm, 4-20 Analog & RS485	632
PSC11005	PSC	w/NEMA 4X, Secndry, 4-20 Analog & RS485	632
PSC12004	PSC	w/NEMA 4X, Alarm, 0-10 Analog & RS485	632
PSC12005	PSC	w/NEMA 4X, Secndry, 0-10 Analog & RS485	632
DIN RAIL POWER SUPPLIES			
PSDR0100	PSDR	24 VDC @ 1A	943
PSDR0200	PSDR	24 VDC @ 2A	943
PSDR0400	PSDR	24 VDC @ 4A	943
PRESSURE TRANSMITTER			
PT00001R	PT	2 Wire Relative, Bar 0-1, PSI 0-14.5	910
PT00002R	PT	2 Wire Relative, Bar 0-1.6, PSI 0-23.2	910
PT00010R	PT	2 Wire Relative, Bar 0-10, PSI 0-145	910
PT00250R	PT	2 Wire Relative, Bar 0-250, PSI 0-3625	910
PRODUCTVITY STATION			
PTV00000	PTV	Plant Floor Communications Solution	NL

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
PAX METERS			
PX2C8H00		Dual Line Temp/Process Control, Horiz	550
PX2C8V00		Dual Line Temp/Process Control, Vert	550
C48 REPLACEMENT OUTPUT BOARDS			
RBC48001		1 Preset, NPN-OC	136
RBC48002		1 Preset, PNP-OC	136
RBC48003		2 Preset, Relay	136
RBC48004		3 Preset, Relay, NPN-OC	136
RBC48005		3 Preset, Relay, PNP-OC	136
T48/P48 REPLACEMENT OUTPUT BOARDS			
RBD48100		Main Control Relay	542
RBD48111		Main Control & Dual Alarm Relay	542
RBD48200		Main Control Logic Output	542
RBD48211		Main Control Logic & Dual Alarm Relay	542
TLA REPLACEMENT OUTPUT BOARD			
RBDLA210		Form-C Limit Output Relay	639
PHOTO-ELECTRIC RECEIVER SENSOR			
RCDC0000	RCDC	(Opposed Beam Pair), DC Powered	903
RCMDC000	PRM/RRM	Mini(Opposed Beam Pair) DC Recv w/Cable	907
RCMDC001	PRM/RRM	Mini(Opposed Beam Pair) DC Rev w/Pico	907
RELAYS			
RLY10000	RLY	Relay, 12VDC	945
RLY30000	RLY	Relay, 115V	945
RLY50000	RLY	SSR Power Unit	954
RLY60000	RLY	25A Single Phase DIN Rail Mnt Solid State	956
RLY6A000	RLY	40A Single Phase DIN Rail Mnt Solid State	956
RLY70000	RLY	Three Phase DIN Rail Mnt Solid State Relay	958
RLYBD000	RLY	Gemini 1000 Relay	NL
RLYBD001	RLY	Gemini 4100 Relay	NL
RLYBD002	RLY	Gemini Dual Relay	NL
RLYLG001	RLY	Single Relay Board, Legend Series	NL
RLYLG002	RLY	Dual Relay Board, Legend Series	NL
BORE INSERT KIT			
RPGBII00	RPGBI	ZUK Inch Bore Insert Kit	885
RPGBII01		ZPJ Inch Standard Bore Insert Kit	887
RPGBIM00	RPGBI	ZUK Large Metric Bore Insert Kit	885
RPGBIM01		ZPJ Large Metric Bore Insert Kit	887
RPGBIM02		ZPJ Small Metric Bore Insert Kit	887
BORE SLEEVES			
RPGBSI00	RPGBSI	0.5 inch Bore Sleeve	871
RPGBSI01	RPGBSI	0.625 inch Bore Sleeve	871
RPGBSI02	RPGBSI	0.75 inch Bore Sleeve	871
RPGBSI03	RPGBSI	0.875 inch Bore Sleeve	871
RPGBSI04	RPGBSI	1 inch Bore Sleeve	871
RPGBSM00	RPGBSM	19 mm Bore Sleeve	871
RPGBSM01	RPGBSM	20 mm Bore Sleeve	871
RPGBSM02	RPGBSM	24 mm Bore Sleeve	871

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
RPGBSM03	RPGBSM	25 mm Bore Sleeve	871
		FLEXIBLE COUPLINGS	
RPGFC001		0.250” - 0.25” Flexible Coupling	875
RPGFC002		0.250” - 0.375” Flexible Coupling	875
RPGFC003		0.375” - 0.375” Flexible Coupling	877
RPGFC004		0.375” - 0.500” Flexible Coupling	877
RPGFC005		0.25” - 6 mm Flexible Coupling	875
RPGFC006		0.375” - 6 mm Flexible Coupling	877
		ACCESSORIES	
RPGMB000	RPGMB	ZDH,ZNH Foot Mounting Bracket	NL
RPGMB001	RPGMB	ZPJ ZUK Magnetic Coupling Kit	885
RPGMB002	RPGMB	ZMD Mounting Bracket	899
RPGMK000	RPGMK	ZPJ 1.575 in (40 mm) Bolt Circle Flex Mnt Kit	887
RPGMK001	RPGMK	ZPJ 1.811 in (46 mm) Bolt Circle Flex Mnt Kit	887
RPGMK002	RPGMK	ZUK Standard Tether Arm Kit 4.5 Inch	885
RPGMK003	RPGMK	ZUK Elongated Tether Arm Kit 8.5 Inch	885
RPGPC000	RPGPC	56C Protective Cover Kit	871
		PHOTO-ELECTRIC SENSORS	
RRDC0000	RRDC	Retro-Reflective, DC Powered	903
		PHOTO-ELECTRIC SENSORS	
RRMDC000	PRM/RRM	Mini Retro-Reflective, Sensor w/Cable	907
RRMDC001	PRM/RRM	Mini Retro-Reflective, Sensor w/Pico Conn.	907
		PHOTO-ELECTRIC SENSORS	
RT100000	RT1	Retro-Reflective Target 1.5”	903
RT200000	RT2	Retro-Reflective Target 3”	903
		SUB-CUB MODULES	
SCUB1000	SCUB1	SCUB-1 Counter, 6-Digit	NL
SCUB1LV0	SCUB1	SCUB-1 Counter, 6-Digit, 3.3 V	NL
SCUB2000	SCUB2	SCUB-2 Counter, 6-Digit	NL
		PROGRAMMING SOFTWARE	
SFC48xxx	SFC48	C48	136
SFCRDxxx	SFCR	Crimson for PAX	68
SFCRM200	SFCR	Crimson for G3 Software Kit	NL
SFDLC	SFDLC	DLC	NL
SFEDTxxx	SFEDT	Paradigm - EDICT97	NL
SFIMS	SFIMS	Intelligent Modules	NL
SFLGPxxx	SFLGP	Legend	NL
SFPAXxxx	SFPAX	PAX	NL
SFT48xxx	SFT48	T48/P48	542
		SHROUD	
SHREPAX0	SHR	EPAX Shroud	1012
SHRLPAX0	SHR	LPAX Shroud	1010
		MISCELLANEOUS	
SKT10000	SKT1	8-Pin Socket	945
SKTDIN00		DIN Rail Mount, 8-Pin Octal Socket	945
SNUB0000	SNUB	R-C Snubber Inductive Load Supressor	996

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
		1/16 DIN TEMPERATURE CONTROL UNITS	
T1610000	T16	w/Relay Output	519
T1610010	T16	DC, w/Relay Output	519
T1611100	T16	w/Relay Output, 2 Alarms, and Usr Inp	519
T1611110	T16	DC, w/Relay Out, 2 Alarms, and Usr Inp	519
T1620000	T16	w/Solid State Output	519
T1620010	T16	DC, w/Solid State Output	519
T1621100	T16	w/Solid State Out, 2 Alarms, and Usr Inp	519
T1621110	T16	DC, w/Solid State Out, 2 Alms and Usr Inp	519
T1641100	T16	w/Analog Output, 2 Alarms, and Usr Inp	519
T1641110	T16	DC, w/Analog Out, 2 Alarms, and Usr Inp	519
T4810000	T48	w/Relay Output	542
T4810002	T48	w/Relay Output & RS485	542
T4810010	T48	DC, w/Relay Output	542
T4810101	T48	w/Dual Relay Output & Analog	542
T4810105	T48	w/Dual Relay Output, Analog, & RSP	542
T4810106	T48	w/Dual Relay Output, Analog, & HCM	542
T4810107	T48	w/Dual Relay, Analog & RS485	542
T4810108	T48	w/Dual Relay Output, RSP, & RS485	542
T4810109	T48	w/Dual Relay Output, HCM, & RS485	542
T481010A	T48	w/Dual Relay Output & Dual Analog	542
T4810111	T48	DC, w/Dual Relay & Analog	542
T4810115	T48	DC, w/Dual Relay, Analog, & RSP	542
T4810116	T48	DC, w/Dual Relay, Analog, & HCM	542
T4810117	T48	DC, w/Dual Relay, Analog & RS485	542
T4810118	T48	DC, w/Dual Relay, RSP, & RS485	542
T4810119	T48	DC, w/Dual Relay, HCM, & RS485	542
T481011A	T48	DC, w/Dual Relay & Dual Analog	542
T4811000	T48	w/Dual Relay Output	542
T4811100	T48	w/3 Relay Output	542
T4811102	T48	w/3 Relay Output & RS485	542
T4811103	T48	w/3 Relay Outputs & RSP	542
T4811104	T48	w/3 Relay Outputs & HCM	542
T4811110	T48	DC, w/3 Relay Output	542
T4811112	T48	DC, w/3 Relay Output & RS485	542
T4811113	T48	DC, w/3 Relay Outputs & RSP	542
T4811114	T48	DC, w/3 Relay Outputs & HCM	542
T4820000	T48	w/Logic Output	542
T4820010	T48	DC, w/Logic Output	542
T4820201	T48	w/Dual Logic Output & Analog	542
T4820205	T48	w/Dual Logic Output, Analog, & RSP	542
T4820206	T48	w/Dual Logic Output, Analog, & HCM	542
T4820208	T48	w/Dual Logic Output, RSP & RS485	542
T4820209	T48	w/Dual Logic Output, HCM, & RS485	542
T4820211	T48	DC, w/Dual Logic Output & Analog	542
T4820215	T48	DC, w/Dual Logic Output, Analog, & RSP	542
T4820216	T48	DC, w/Dual Logic Output, Analog, & HCM	542
T4820218	T48	DC, w/Dual Logic Output, RSP & RS485	542
T4820219	T48	DC, w/Dual Logic Output, HCM, & RS485	542

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
T4821000	T48	w/Logic & Relay Output	542
T4821100	T48	w/Logic & Dual Relay	542
T4821102	T48	w/Logic, Dual Relay & RS485	542
T4821103	T48	w/Logic, Dual Relay, & RSP	542
T4821104	T48	w/Logic, Dual Relay, HCM	542
T4821110	T48	DC, w/Logic & Dual Relay	542
T4821112	T48	DC, w/Logic, Dual Relay & RS485	542
T4821113	T48	DC, w/Logic, Dual Relay, & RSP	542
T4821114	T48	DC, w/Logic, Dual Relay, HCM	542
T4832200	T48	w/Triac & Dual Logic Output	542
T4832210	T48	DC, w/Triac & Dual Logic Output	542
CUB7 TERMINAL BLOCKS			
TB100003		CUB7 Terminal Block, 3 Position	23
TB100004		CUB7 Terminal Block, 4 Position	23
TB100005		CUB7 Terminal Block, 5 Position	23
TRIAC CONVERTER MODULE, MICRO-LINE			
TCM10000	TCM1	115V	951
1/8 DIN TEMPERATURE CONTROL UNITS			
TCU00000	TCU	Base Unit	602
TCU00001	TCU	w/Alarm	602
TCU00002	TCU	w/Cooling Output & Alarm	602
TCU01001	TCU	w/Alarm & Analog Ouput	602
TCU01004	TCU	w/Analog Output, Alarm & RS485 Comm	602
TCU01005	TCU	w/Analog, Cooling & RS485 Comm	602
TCU10000	TCU	Base unit, w/NEMA 4X	602
TCU10001	TCU	w/NEMA 4X & Alarm	602
TCU10002	TCU	w/NEMA 4X, Cooling Output, & Alarm	602
TCU10104	TCU	Remote Setpoint w/N 4X, Alrms & RS485	602
TCU10204	TCU	Heater Crnt Mntr w/N 4X, Alrms & RS485	602
TCU10307	TCU	Motrzd Valve Pstnr w/N 4X, Alrm & RS485	602
TCU11001	TCU	w/NEMA 4X, Alarm & Analog Output	602
TCU11002	TCU	w/NEMA 4X, Cooling, Alarm & Analog	602
TCU11004	TCU	w/NEMA 4X, Analog, Alarm & RS485	602
TCU11005	TCU	w/NEMA 4X, Analog, Cooling & RS485	602
TCU11108	TCU	Remote Setpnt w/NEMA 4X, 4-20 Alg & Alrm	602
TCU11208	TCU	Htr Crnt Mntr w/NEMA 4X, 4-20 Alg & Alrm	602
TCU11306	TCU	Mtr Vl Pstnr w/NEMA 4X, 4-20 Analog & Alrm	602
TCU12001	TCU	w/NEMA 4X, Alarm, & 0-10VDC Analog	602
TCU12004	TCU	w/NEMA 4X, Alarm, RS485, & VDC Analog	602
TCU12005	TCU	w/NEMA 4X, Cool, Alarm, RS485, & Analog	602
TCU12108	TCU	Remote Setpnt w/NEMA 4X, 0-10 Alg & Alrm	602
TCU12306	TCU	Mtr Vl Pstnr w/NEMA 4X, 0-10 Anlg & Alarm	602
TEMPERATURE LIMIT ALARM			
TLA11100	TLA	Form-A Limit Relay w/2 Alarms	639
TLA11110	TLA	DC, Form-A Limit Relay w/2 Alarms	639
TLA21000	TLA	Form-C Limit Relay w/1 Alarm	639
TLA21010	TLA	DC, Form-C Limit Relay w/1 Alarm	639
RTD TEMPERATURE PROBE ACCESSORIES			
TMPA2S01	TMP	Plat Type, 400°F	911

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
TMPA2S02	TMP	Plat Type, 900°F	911
THERMOCOUPLE TEMPERATURE PROBE ACCESSORIES			
TMPACC01	TMPACC	Spring Loaded Fitting	911
TMPACC02	TMPACC	Cast Aluminum Weatherproof Head	911
TMPACC03	TMPACC	Spare Tube Sleeve	911
TMPACC04	TMPACC	Simplex Terminal Block (for TC's)	911
TMPACC05	TMPACC	Three Terminal Block (for RTD's)	911
RETRACTABLE SENSOR CABLES			
TMPCBS01	TMPCBS	2 ft retract cable Type J Bare Wire Ends	915
TMPCBS02	TMPCBS	2 ft retract cable Type K Bare Wire Ends	915
TMPCBS03	TMPCBS	2 ft retract cable Type T Bare Wire Ends	915
TMPCBS04	TMPCBS	2 ft retract cable Type E Bare Wire Ends	915
THERMOCOUPLE CONNECTORS			
TMPCNM01	TMPCN	Quick Disconnect Mini Connector Type K Male	915
TMPCNM02	TMPCN	Quick Disconnect Mini Connector Type K Female	915
TMPCNM03	TMPCN	Quick Disconnect Mini Connector Type T Male	915
TMPCNM04	TMPCN	Quick Disconnect Mini Connector Type T Female	915
TMPCNM05	TMPCN	Quick Disconnect Mini Connector Type E Male	915
TMPCNM06	TMPCN	Quick Disconnect Mini Connector Type E Female	915
TMPCNM07	TMPCN	Quick Disconnect Mini Connector Type J Male	915
TMPCNM08	TMPCN	Quick Disconnect Mini Connector Type J Female	915
TMPCNM09	TMPCN	Miniature Connector for RTD Male	920
TMPCNM10	TMPCN	Miniature Connector for RTD Female	920
TMPCNS01	TMPCN	Quick Disconnect Std Connector Type K Male	915
TMPCNS02	TMPCN	Quick Disconnect Std Connector Type K Female	915
TMPCNS03	TMPCN	Quick Disconnect Std Connector Type T Male	915
TMPCNS04	TMPCN	Quick Disconnect Std Connector Type T Female	915
TMPCNS05	TMPCN	Quick Disconnect Std Connector Type E Male	915
TMPCNS06	TMPCN	Quick Disconnect Std Connector Type E Female	915
TMPCNS07	TMPCN	Quick Disconnect Std Connector Type J Male	915
TMPCNS08	TMPCN	Quick Disconnect Std Connector Type J Female	915
THERMOCOUPLE TEMPERATURE PROBES			
TMPE2SU1	TMP	Type E, 400°F	911
TMPE2SU2	TMP	Type E, 900°F	911
TMPE2SU3	TMP	Type E, 1300°F	911
TMPEQD01		Quick Disconnect Mini Type E Stainless Steel .062	915
TMPEQD02		Quick Disconnect Mini Type E Inconel .062	915
TMPEQD03		Quick Disconnect Std Type E Stainless Steel .125	915
TMPEQD04		Quick Disconnect Std Type E Inconel .125	915
TMPJ2SU1	TMP	Type J, 400°F	911
TMPJ2SU2	TMP	Type J, 900°F	911
TMPJ2SU3	TMP	Type J, 1300°F	911
TMPJQD01		Quick Disconnect Mini Type J Stainless Steel .062	915
TMPJQD02		Quick Disconnect Mini Type J Inconel .062	915
TMPJQD03		Quick Disconnect Std Type J Stainless Steel .125	915
TMPJQD04		Quick Disconnect Std Type J Inconel .125	915
TMPK2SU1	TMP	Type K, 400°F	911

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

M

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
TMPK2SU2	TMP	Type K, 900°F	911
TMPK2SU3	TMP	Type K, 1300°F	911
TMPKBT01		Springloaded Compression Fit Stainless Steel 5 ft	914
TMPKCF01		Ceramic Overbraided Type K 10 ft	913
TMPKQD01		Quick Disconnect Mini Type K Stainless Steel .062	915
TMPKQD02		Quick Disconnect Mini Type K Inconel .062	915
TMPKQD03		Quick Disconnect Std Type K Stainless Steel .125	915
TMPKQD04		Quick Disconnect Std Type K Inconel .125	915
TMPKQD05		Quick Disconnect Std Type K XL High Temp .125	915
TRANSITION JOINT PROBES			
TMPKTJ01		K Type Inconel .063	918
TMPKTJ02		K Type Inconel .125	918
TMPKTJ03		K Type Stainless Steel .063	918
TMPKTJ04		K Type Stainless Steel .125	918
TMPKTJ05		K Type XL High Temp .125	918
TMPKTJ06		K Type XL High Temp .063	918
UTILITY THERMOCOUPLES WITH HANDLE			
TMPKUT01		Type K Stainless Steel .125 Grounded	914
TMPKUT02		Type K Inconel .125 Grounded	914
RTD SENSORS			
TMPRT001		Surface Mount Teflon PFA 10 ft	920
TMPRT002		Pipe Plug 6 ft cable with Male Mini Connector	920
THERMOCOUPLE PROBES			
TMPT2SU1	TMP	Type T, 400°F	911
TMPTQD01		Quick Disconnect Mini Type T Stainless Steel .062	915
TMPTQD02		Quick Disconnect Mini Type T Inconel .062	915
TMPTQD03		Quick Disconnect Std Type T Stainless Steel .125	915
TMPTQD04		Quick Disconnect Std Type T Inconel .125	915
THERMOCOUPLE TRANSMITTER WITH FEMALE CONNECTOR			
TMPTRN01		Type K 0-2000 F	922
TMPTRN02		Type K 0-1000 F	922
TMPTRN03		Type T 0-250 F	922
TMPTRN04		Type T 0-750 F	922
TMPTRN05		Type J 0-250 F	922
TMPTRN06		Type J 0-1000 F	922
TMPTRN07		RTD 36-1056 F	922
THERMOCOUPLE WIRE			
TMWGE025	TMW	Glass Braid Type E 25 ft 24 AWG	915
TMWGE100	TMW	Glass Braid Type E 100 ft 24 AWG	915
TMWGJ025	TMW	Glass Braid Type J 25 ft 24 AWG	915
TMWGJ100	TMW	Glass Braid Type J 100 ft 24 AWG	915
TMWGK025	TMW	Glass Braid Type K 25 ft 24 AWG	915
TMWGK100	TMW	Glass Braid Type K 100 ft 24 AWG	915
TMWGT025	TMW	Glass Braid Type T 25 ft 24 AWG	915
TMWGT100	TMW	Glass Braid Type T 100 ft 24 AWG	915
TMWSE025	TMW	Teflon Type E 25 ft 24 AWG	915
TMWSE100	TMW	Teflon Type E 100 ft 24 AWG	915

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
TMWSJ025	TMW	Teflon Type J 25 ft 24 AWG	915
TMWSJ100	TMW	Teflon Type J 100 ft 24 AWG	915
TMWSK025	TMW	Teflon Type K 25 ft 24 AWG	915
TMWSK100	TMW	Teflon Type K 100 ft 24 AWG	915
TMWST025	TMW	Teflon Type T 25 ft 24 AWG	915
TMWST100	TMW	Teflon Type T 100 ft 24 AWG	915
REPLACEMENT TIRES			
TORF1000		Neoprene, 1 Ft	889
TORM0333		Neoprene, 1/3 Meter	889
TORM0400		Neoprene, 4/10 Meter	889
TORY0400		Neoprene, 4/10 Yd	889
ACCESSORIES			
TP16KIT1	T/P16	Programming Kit w/Power Supply	519
TP16KIT2	T/P16	Programming Kit w/o Power Supply	519
TEMPERATURE SETPOINT CONTROLLERS			
TSC01001	TSC	w/Alarm & 4-20 Analog Output	611
TSC11001	TSC	w/NEMA 4X, Alarm & 4-20 Analog Output	611
TSC11002	TSC	w/NEMA 4X, Cooling Out, & 4-20 Analog	611
TSC11004	TSC	w/NEMA 4X, Alarm, 4-20 Analog & RS485	611
TSC11005	TSC	w/NEMA 4X, Cooling, 4-20 Analog & RS485	611
TSC12004	TSC	w/NEMA 4X, Alarm, 0-10 Analog & RS485	611
TSC12005	TSC	w/NEMA 4X, Cooling, 0-10 Analog & RS485	611
THUMBWHEEL SWITCHES			
TSW0A400	TSW0A4	0 True, Terminal Block, 4-Digit	NL
TSW0A600	TSW0A6	0 True, Terminal Block, 6-Digit	NL
TSW1A400	TSW1A4	1 True, Terminal Block, 4-Digit	NL
TSW1A600	TSW1A6	1 True, Terminal Block, 6-Digit	NL
VOLTAGE CONVERTER MODULES			
VCM10000	VCM1	4-50 V	NL
VCM20000	VCM2	50-270 V	NL
BALANCED WHEELS			
WF1000BF		Flat Polyurethane, 1 Ft	889
WF1000BK		Knurled Aluminum, 1 Ft	889
WHEELS			
WF1000OF		Flat Polyurethane, 1 Ft	889
WF1000OK		Knurled Aluminum, 1 Ft	889
WF1000OR		Neoprene, 1 Ft	889
WI0006OF		Urethane, 6”	899
WI0006OK		Knurled 6”	899
WM0200OF		Urethane 200 mm Circumference	899
WM0200OK		Knurled 200 mm Circumference	899
WM0333OF		Flat Polyurethane, 1/3 Meter	889
WM0333OK		Knurled Aluminum, 1/3 Meter	889
WM0333OR		Neoprene, 1/3 Meter	889
WM0400OF		Flat Polyurethane, 4/10 Meter	889
WM0400OK		Knurled Aluminum, 4/10 Meter	889
WM0400OR		Neoprene, 4/10 Meter	889
WY0400OF		Flat Polyurethane, 4/10 Yd	889
WY0400OK		Knurled Aluminum, 4/10 Yd	889
WY0400OR		Neoprene, 4/10 Yd	889

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
DSP/MODULAR CONTROLLER EXPANSION CARDS			
XCCN0000	XC	DSP/MC CANopen Option Card	NL
XCDN0000	XC	DSP/MC DeviceNet Option Card	NL
XCENET00		DSP/MC Ethernet Option Card	NL
XCGSM000	XC	GSM/GPRS Modem Option Card for G3	NL
XCPBDP00	XC	DSP/MC Profibus DP Expansion Card	NL
XCRS0000	XC	DSP/MC RS232/485 Card	NL
SINGLE CHANNEL ROTARY PULSE GENERATORS			
ZBG00012	ZBG	1 PPR 6-Pin MS Connector	889
ZBG00602	ZBG	60 PPR 6-Pin MS Connector	889
ZBG01002	ZBG	100 PPR 6-Pin MS Connector	889
ZBG01003	ZBG	100 PPR M12 Connector	889
ZBG06002	ZBG	600 PPR 6-Pin MS Connector	889
ZBG06003	ZBG	600 PPR M12 Connector	889
ZBG10002	ZBG	1000 PPR 6-Pin MS Connector	889
ZBG12002	ZBG	1200 PPR 6-Pin MS Connector	889
DUAL CHANNEL ROTARY PULSE GENERATORS			
ZBH00102	ZBH	10 PPR 6-Pin MS Connector	889
ZBH00122	ZBH	12 PPR 6-Pin MS Connector	889
ZBH01002	ZBH	100 PPR 6-Pin MS Connector	889
ZBH01003	ZBH	100 PPR M12 Connector	889
ZBH01202	ZBH	120 PPR 6-Pin MS Connector	889
ZBH05002	ZBH	500 PPR 6-Pin MS Connector	889
ZBH06002	ZBH	600 PPR 6-Pin MS Connector	889
ZBH06003	ZBH	600 PPR M12 Connector	889
SINGLE CHANNEL OUTPUT ROTARY PULSE GENERATORS			
ZCG0001C	ZCG	1 PPR	877
ZCG0010C	ZCG	10 PPR	877
ZCG0012C	ZCG	12 PPR	877
ZCG0060C	ZCG	60 PPR	877
ZCG0100C	ZCG	100 PPR	877
ZCG0120C	ZCG	120 PPR	877
ZCG0200C	ZCG	200 PPR	877
QUADRATURE OUTPUT ROTARY PULSE GENERATORS			
ZCH0100C	ZCH	100 PPR	881
ZCH0200C	ZCH	200 PPR	881
ZCH0500C	ZCH	500 PPR	881
2 INCH FLANGE MOUNT ROTARY PULSE GENERATORS			
ZDH0060H	ZDH	60 PPR	897
ZDH0100H	ZDH	100 PPR	897
ZDH0500H	ZDH	500 PPR	897
ZDH0600H	ZDH	600 PPR	897
ZDH1000H	ZDH	1000 PPR	897
ZDH1200H	ZDH	1200 PPR	897
ZDH2000H	ZDH	2000 PPR	897
ZDH2500H	ZDH	2500 PPR	897
LENGTH SENSOR SINGLE SHAFT/SINGLE CHANNEL			
ZFG00/3C	ZFG	1 Meter/Yard	877
ZFG0001C	ZFG	1 Foot	877

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
ZFG0010C	ZFG	10 PPR	877
ZFG0012C	ZFG	12 PPR	877
ZFG0020C	ZFG	20 PPR	877
ZFG0060C	ZFG	60 PPR	877
ZFG0100C	ZFG	100 PPR	877
ZFG0120C	ZFG	120 PPR	877
ZFG0200C	ZFG	200 PPR	877
ZFG03/3C	ZFG	10 Meter/Yard	877
ZFG33/3C	ZFG	100 Meter/Yard	877
LENGTH SENSOR SINGLE SHAFT/QUADRATURE OUTPUT			
ZFH0100C	ZFH	100 PPR	881
ZFH0200C	ZFH	200 PPR	881
ZFH0500C	ZFH	500 PPR	881
LENGTH SENSOR DOUBLE SHAFT/SINGLE CHANNEL			
ZGG00/3C	ZGG	1 Meter/Yard	877
ZGG0001C	ZGG	1 Foot	877
ZGG0010C	ZGG	10 PPR	877
ZGG0012C	ZGG	12 PPR	877
ZGG0020C	ZGG	20 PPR	877
ZGG0060C	ZGG	60 PPR	877
ZGG0100C	ZGG	100 PPR	877
ZGG0120C	ZGG	120 PPR	877
ZGG0200C	ZGG	200 PPR	877
ZGG03/3C	ZGG	10 Meter/Yard	877
ZGG33/3C	ZGG	100 Meter/Yard	877
LENGTH SENSOR DOUBLE SHAFT/QUADRATURE OUTPUT			
ZGH0100C	ZGH	100 PPR	881
ZGH0200C	ZGH	200 PPR	881
ZGH0500C	ZGH	500 PPR	881
HEAVY DUTY SINGLE CHANNEL ROTARY PULSE GENERATORS			
ZHG06004	ZHG	600 PPR	889
ZHG10004	ZHG	1000 PPR	889
ZHG12004	ZHG	1200 PPR	889
HEAVY DUTY DUAL CHANNEL ROTARY PULSE GENERATORS			
ZHH00104	ZHH	10 PPR	889
ZHH00204	ZHH	20 PPR	889
ZHH00404	ZHH	40 PPR	889
ZHH00604	ZHH	60 PPR	889
ZHH12004	ZHH	1200 PPR	889
LINEAR CABLE ENCODERS			
ZLZ0050G	ZLZ	Quad output 50 PPI Standard Housing	901
ZLZ0500G	ZLZ	Quad output 500 PPI Standard Housing	901
MINIATURE LENGTH SENSORS WITH QUAD OUTPUT			
ZMD0250B	ZMD	0.25 inch Shaft, 250 PPR	899
ZMD0500B	ZMD	0.25 inch Shaft, 500 PPR	899
ZMD1000B	ZMD	0.25 inch Shaft, 1000 PPR	899
ZMD2000B	ZMD	0.25 inch Shaft, 2000 PPR	899

NOTE

NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
ZMD2500B	ZMD	0.25 inch Shaft, 2500 PPR	899
ZMH0250B	ZMH	0.375 inch Shaft, 250 PPR	899
ZMH0500B	ZMH	0.375 inch Shaft, 500 PPR	899
ZMH1000B	ZMH	0.375 inch Shaft, 1000 PPR	899
ZMH2000B	ZMH	0.375 inch Shaft, 2000 PPR	899
ZMH2500B	ZMH	0.375 inch Shaft, 2500 PPR	899
2.5 INCH FLANGE MOUNT ROTARY PULSE GENERATORS			
ZNH0060H	ZNH	60 PPR	897
ZNH0100H	ZNH	100 PPR	897
ZNH0500H	ZNH	500 PPR	897
ZNH0600H	ZNH	600 PPR	897
ZNH1000H	ZNH	1000 PPR	897
ZNH1200H	ZNH	1200 PPR	897
ZNH2000H	ZNH	2000 PPR	897
ZNH2500H	ZNH	2500 PPR	897
THRU-BORE ROTARY PULSE GENERATORS			
ZOD0060A	ZOD	60 PPR 0.25 inch thru-bore	876
ZOD0100A	ZOD	100 PPR 0.25 inch thru-bore	876
ZOD0500A	ZOD	500 PPR 0.25 inch thru-bore	876
ZOD0600A	ZOD	600 PPR 0.25 inch thru-bore	876
ZOD1000A	ZOD	1000 PPR 0.25 inch thru-bore	876
ZOD1200A	ZOD	1200 PPR 0.25 inch thru-bore	876
ZOD2000A	ZOD	2000 PPR 0.25 inch thru-bore	876
ZOD2500A	ZOD	2500 PPR 0.25 inch thru-bore	876
ZOH0060A	ZOH	60 PPR 0.375 inch thru-bore	876
ZOH0100A	ZOH	100 PPR 0.375 inch thru-bore	876
ZOH0500A	ZOH	500 PPR 0.375 inch thru-bore	876
ZOH0600A	ZOH	600 PPR 0.375 inch thru-bore	876
ZOH1000A	ZOH	1000 PPR 0.375 inch thru-bore	876
ZOH1200A	ZOH	1200 PPR 0.375 inch thru-bore	876
ZOH2000A	ZOH	2000 PPR 0.375 inch thru-bore	876
ZOH2500A	ZOH	2500 PPR 0.375 inch thru-bore	876
LARGE THRU-BORE ROTARY PULSE GENERATORS			
ZPJ0060A	ZPJ	60 PPR, 0.625 inch thru-bore	887
ZPJ0100A	ZPJ	100 PPR, 0.625 inch thru-bore	887
ZPJ0500A	ZPJ	500 PPR, 0.625 inch thru-bore	887
ZPJ0600A	ZPJ	600 PPR, 0.625 inch thru-bore	887
ZPJ1000A	ZPJ	1000 PPR, 0.625 inch thru-bore	887
ZPJ1200A	ZPJ	1200 PPR, 0.625 inch thru-bore	887
ZPJ2000A	ZPJ	2000 PPR, 0.625 inch thru-bore	887
ZPJ2500A	ZPJ	2500 PPR, 0.625 inch thru-bore	887
C-FACE ENCODERS WITH NPN OPEN COLLECTOR OUTPUT			
ZRJ0256A	ZR	56C 256 PPR	873
ZRJ1024A	ZR	56C 1024 PPR	873
ZRL0256A	ZR	143TC, 145TC, 182C, 184C 256 PPR	873
ZRL1024A	ZR	143TC, 145TC, 182C, 184C 1024 PPR	873

PART NO.	MODEL NO.	DESCRIPTION	CAT PAGE
C-FACE ENCODERS WITH LINE DRIVER OUTPUT FOR MOTOR FEEDBACK			
ZRJ1024R	ZR	1024 PPR .625 inch bore 36 inch pigtail	867
ZRJ1024Z	ZR	1024 PPR .625 inch bore MS 10-pin	867
ZRJ2048R	ZR	2048 PPR .625 inch bore 36 inch pigtail	867
ZRJ2048Z	ZR	2048 PPR .625 inch bore MS 10-pin	867
ZRL1024R	ZR	1024 PPR 1 inch bore 36 inch pigtail	867
ZRL1024Z	ZR	1024 PPR 1 inch bore MS 10-pin	867
ZRL2048R	ZR	2048 PPR 1 inch bore 36 inch pigtail	867
ZRL2048Z	ZR	2048 PPR 1 inch bore MS 10-pin	867
0.25 INCH SHAFT STANDARD SERVO MOUNT ROTARY PULSE GENERATORS			
ZSD0060A	ZSD	60 PPR	875
ZSD0100A	ZSD	100 PPR	875
ZSD0500A	ZSD	500 PPR	875
ZSD0600A	ZSD	600 PPR	875
ZSD1000A	ZSD	1000 PPR	875
ZSD1200A	ZSD	1200 PPR	875
ZSD2000A	ZSD	2000 PPR	875
ZSD2500A	ZSD	2500 PPR	875
LARGE THRU-BORE ROTARY PULSE GENERATORS FOR MOTOR FEEDBACK			
ZUJ1024Z	ZUJ	1024 PPR 5/8 inch Thru-Bore	871
ZUJ2048Z	ZUJ	2048 PPR 5/8 inch Thru-Bore	871
LARGE THRU-BORE ROTARY PULSE GENERATORS			
ZUK0060H	ZUK	60 PPR 1.125 inch Thru-Bore	885
ZUK0100H	ZUK	100 PPR 1.125 inch Thru-Bore	885
ZUK0500H	ZUK	500 PPR 1.125 inch Thru-Bore	885
ZUK0600H	ZUK	600 PPR 1.125 inch Thru-Bore	885
ZUK1000H	ZUK	1000 PPR 1.125 inch Thru-Bore	885
ZUK1200H	ZUK	1200 PPR 1.125 inch Thru-Bore	885
ZUK2000H	ZUK	2000 PPR 1.125 inch Thru-Bore	885
ZUK2500H	ZUK	2500 PPR 1.125 inch Thru-Bore	885
LARGE THRU-BORE ROTARY PULSE GENERATORS FOR MOTOR FEEDBACK			
ZUL1024Z	ZUL	1024 PPR 1 inch Thru-Bore	871
ZUL2048Z	ZUL	2048 PPR 1 inch Thru-Bore	871

NOTE
NL = Available, but not listed in the catalog.
See the support section of our website.

Revised: 10/01/2013

40+ YEARS Celebrating Innovation red lion®

Red Lion is growing. In addition to the panel meters, HMIs and other industrial automation products that Red Lion customers have always trusted, we now have a broad selection of communication technologies for industrial networks, ranging from industrial Ethernet, through WiFi to complete cellular M2M solutions.

The end result? A comprehensive set of products that enable you to connect, monitor and control anything. From one device to a thousand devices. Connecting serially, via Ethernet, or over high-speed wireless networks. Speaking one protocol, or hundreds of protocols. On a single machine, across your factory, or spanning multiple sites all over the globe.

Sensors

1972 – First product. Magnetic pickup for measuring the rate at which a shaft turns. The pickup was fed to a third-party device to display.

Counters & Meters

1976 – Counters and panel meters introduced. Gives customers a complete solution to monitor and display data within a plant or process.

Operator Panels

1996 – Paradigm Controls acquired. Adds operator panels that connect to multiple devices via serial and Ethernet connections to monitor and control operations.

Protocol Conversion

2004 – Data Station Plus introduced. Leverages Red Lion's protocol library to enable the interconnection of different devices on wired or wireless networks.

N-TRON

Ethernet Switches

2010 – N-Tron acquired. Adds Ethernet switches to provide integrated solutions that reach from the enterprise network to devices on the shop floor.

Layer 3 & Industrial Cellular

2011 – Sixnet acquired. Expands Ethernet switch offering, adds cellular and remote telemetry units to control and monitor complex processes in extreme conditions and remote locations.

Sixnet

Visual Management

2012 – ProducTVity Station introduced. Offers a ready-to-depoly visual management system that seamlessly displays real-time KPI data and Andon messages on large TVs.