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

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 .................................... 2
General Meter Specifications ............................ 3
Universal DC Input Panel Meter ........................ 4
Process Input Panel Meter ............................... 4
Thermocouple and RTD Input Meter .................... 5
Accessories ............................................ 5
Installing the Meter ..................................... 6
Setting the Jumpers ..................................... 6
Wiring the Meter ....................................... 7
Reviewing the Front Buttons and Display .............. 9
Programming the Meter ................................ 10
Factory Service Operations ............................. 17
Parameter Value Chart ................................ 19
Programming Overview ................................ 20

ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory (Not required for DP5T)</td>
<td>PAXLBK10</td>
</tr>
</tbody>
</table>

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
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
   - Min./Max. capture delay time: 0 to 3275 sec.
   - Display update rate: 1 to 10 updates/sec.
   - Step response: 200 msec. max. to within 99% of final readout value
   - (digital filter and internal zero correction disabled)
   - Display update rate: 1 to 10 updates/sec.
   - Max./Min. capture delay time: 0 to 3275 sec.

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)
   - Display update rate: 1 to 10 updates/sec.
   - Max./Min. capture delay time: 0 to 3275 sec.

7. DISPLAY MESSAGES:
   - “OLUL” - 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
    - 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

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 E²PROM 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 COMPLIANCE:
    - 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-M9S
      - LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
      - Type 4X Enclosure rating (Face only), UL50
      - IEECB 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 KvatLevel 3; 8 Kvat
        - Electromagnetic RF fields EN 61000-4-3 Level 3; 10 V/m 1
        - Fast transients (burst) EN 61000-4-4 Level 4; 2 Kvat/IO
        - RF conducted interference EN 61000-4-6 Level 3; 10 V/m
        - Simulation of cordless telephones ENV 50204 Level 3; 10 V/m 1
        - 150 KHz - 80 MHz Level 3; 10 V/m 1
        - 200 Hz - 50% duty cycle Level 3; 10 V/m 1
        - 900 MHz Level 3; 10 V/m 1
        - 200 Hz, 50% duty cycle Level 3; 10 V/m 1

      - Emissions to EN 50081-2
        - RF interference EN 55011 Level 3; 10 V/m 1
        - Power mains 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.

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

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE/COMPLIANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>±200 µADC</td>
<td>0.03% of reading +0.03 µA</td>
<td>0.12% of reading +0.04 µA</td>
<td>1.11 Kohm</td>
<td>15 mA</td>
<td>10 nA</td>
</tr>
<tr>
<td>±2 mADC</td>
<td>0.03% of reading +0.3 µA</td>
<td>0.12% of reading +0.4 µA</td>
<td>111 ohm</td>
<td>50 mA</td>
<td>0.1 µA</td>
</tr>
<tr>
<td>±20 mA</td>
<td>0.03% of reading +3 µA</td>
<td>0.12% of reading +4 µA</td>
<td>11.1 ohm</td>
<td>150 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>±200 mA</td>
<td>0.05% of reading +30 µA</td>
<td>0.15% of reading +40 µA</td>
<td>1.1 ohm</td>
<td>500 mA</td>
<td>10 µA</td>
</tr>
<tr>
<td>±2 ADC</td>
<td>0.5% of reading +0.3 mA</td>
<td>0.7% of reading +0.4 mA</td>
<td>0.1 ohm</td>
<td>3 A</td>
<td>0.1 mA</td>
</tr>
<tr>
<td>±200 mVDC</td>
<td>0.03% of reading +30 µV</td>
<td>0.12% of reading +40 µV</td>
<td>1.066 Mohm</td>
<td>100 V</td>
<td>10 µV</td>
</tr>
<tr>
<td>±2 VDC</td>
<td>0.03% of reading +0.3 mV</td>
<td>0.12% of reading +0.4 mV</td>
<td>1.066 Mohm</td>
<td>300 V</td>
<td>0.1 mV</td>
</tr>
<tr>
<td>±20 VDC</td>
<td>0.03% of reading +3 mV</td>
<td>0.12% of reading +4 mV</td>
<td>1.066 Mohm</td>
<td>300 V</td>
<td>1 mV</td>
</tr>
<tr>
<td>±300 VDC</td>
<td>0.05% of reading +30 mV</td>
<td>0.15% of reading +40 mV</td>
<td>1.066 Mohm</td>
<td>300 V</td>
<td>10 mV</td>
</tr>
</tbody>
</table>

* 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.

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### MODEL DP5P - PROCESS INPUT

- DUAL RANGE INPUT (20 mA or 10 VDC)
- 24 VDC TRANSMITTER POWER

#### DP5P SPECIFICATIONS

<table>
<thead>
<tr>
<th>SENSOR INPUTS</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>INPUT (RANGE)</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE/COMPLIANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>DISPLAY RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mA (-2 to 26 mA)</td>
<td>0.03% of reading +2 µA</td>
<td>0.12% of reading +3 µA</td>
<td>20 ohm</td>
<td>150 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>10 VDC (-1 to 13 VDC)</td>
<td>0.03% of reading +2 mV</td>
<td>0.12% of reading +3 mV</td>
<td>500 Kohm</td>
<td>300 V</td>
<td>1 mV</td>
</tr>
</tbody>
</table>

* 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

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

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

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

** 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.

*** These curves have been corrected to ITS-90.

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.

THERMOCOUPLE AND RTD INPUTS
CONFORMS TO ITS-90 STANDARDS
TIME-TEMPERATURE INTEGRATOR

ACCESSORIES

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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.

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.

**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.


**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 (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), 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 Electromagnetic 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. Use 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 #28B2029-0A
   - 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

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.

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.

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.
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 User Input terminal and User Comm.
Terminal 7: In this logic, the user input of the meter is internally pulled up to +5 V with 22 kΩ 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 kΩ resistance. The input is active when a voltage greater than 3.6 VDC is applied.

4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

Display Readout Legends*
- MAX
- MIN
- TOT

Optional Custom Units Overlay

KEY
DSP  Index display through max/min/total/input readouts
PAR  Access parameter list
F1▼  Function key 1; hold for 3 seconds for Second Function 1**
F2▼  Function key 2; hold for 3 seconds for Second Function 2**
RST  Reset (Function key)**

PROGRAMMING MODE OPERATION
- Quit programming and return to display mode
- Store selected parameter and index to next parameter
- Increment selected parameter value
- Decrement selected parameter value
- 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.

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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.

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 MO). 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 MO. 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 MO)

The Programming Mode is exited by pressing the DSP key (from anywhere in the Programming Mode) or the PAR key (with Pro MO 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.)
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**

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>300u</td>
<td>±200.00 mV</td>
</tr>
<tr>
<td>200uA</td>
<td>±2.0000 mA</td>
</tr>
<tr>
<td>0.02A</td>
<td>±2.0000 mV</td>
</tr>
<tr>
<td>0.02A</td>
<td>±2.00.0 mA</td>
</tr>
<tr>
<td>2A</td>
<td>±20.00 mA</td>
</tr>
<tr>
<td>2A</td>
<td>±20.00 mV</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02A</td>
<td>±20.00 mA</td>
</tr>
<tr>
<td>10u</td>
<td>±10.00 mA</td>
</tr>
</tbody>
</table>

Select the input range that corresponds to the external signal.

### DPST INPUT TYPE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SELECTION</th>
<th>SELECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T TC</td>
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<tr>
<td>E</td>
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<tr>
<td>J</td>
<td>J TC</td>
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<td>K</td>
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<tr>
<td>R</td>
<td>R TC</td>
<td>R TC</td>
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<tr>
<td>S</td>
<td>S TC</td>
<td>S TC</td>
</tr>
<tr>
<td>B</td>
<td>B TC</td>
<td>B TC</td>
</tr>
<tr>
<td>N</td>
<td>N TC</td>
<td>N TC</td>
</tr>
</tbody>
</table>

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.

### DISPLAY DECIMAL POINT

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, DSP 1 and DSP 2 parameters.

### DISPLAY ROUNING

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.

### TEMPERATURE SCALE

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.

### DP5T: TEMPERATURE DISPLAY OFFSET

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*

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*

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 STYLE

STYLE  KEY IN DATA  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 (APL Y) scaling style must be used. After using the Apply (APL Y) 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

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 (APL Y), 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 I value in the APL Y style.

Note: APL Y 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

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APL Y scaling styles. The decimal point follows the DECPT selection.

INPUT VALUE FOR SCALING POINT 2

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (APL Y), adjust the signal source externally until the next desired Input Value appears.

DISPLAY VALUE FOR SCALING POINT 2

Enter the second coordinating Display Value by using the arrow keys. This is the same for KEY and APL Y 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 cannot 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 (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 I / D SP I & INP 2 / D SP 2). If INP I = 4 mA and D SP I = 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.

* 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 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**

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**

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), rEL 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 (OFF5e). 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**

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. The Absolute (absolute) or rEL (relative) is momentarily displayed at transition to indicate which display is active.

### HOLD DISPLAY

**USr-1**

The shown display is held but all other meter functions continue as long as activated (maintained action).

### HOLD ALL FUNCTIONS

**USr-1**

The meter disables processing the input and holds all display contents as long as activated (maintained action).

### SYNCHRONIZE METER READING

**USr-1**

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**

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**

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.
PROGRAM MODE SECURITY CODE*

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.
**MAX CAPTURE DELAY TIME***

0.1 to 32750 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***

0.1 to 32750 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***

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.

**DISPLAY OFFSET VALUE***

This parameter does not apply for the DP5T.

-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***

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.

* Factory Setting can be used without affecting basic start-up.
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 temperature integrated, 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**

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**

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**

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**

A low cut value does not apply if the Input Display value falls below the value programmed.

**TOTALIZER POWER UP RESET**

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 “N” denotes the high order display.

**TOTALIZER BATCHING**

The Totalizer Time Base and scale factor are overridden when the user input or function key is programmed for store batch (\(bBASE\)). 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:

\[
\text{Input Display} \times \text{Totalizer Scale Factor} = \text{Totalizer Time Base}
\]

Example: 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. 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 CALCULATION EXAMPLES**

1. Changing the Totalizer Decimal Point (\(dECPt\)) location from Input Display Decimal Point (\(dECPt\)), the required Totalizer Scale Factor is multiplied by a power of ten.

Example: Input \(dECPt\) = 0.0 Input \(dECPt\) = 0.0

<table>
<thead>
<tr>
<th>Totalizer</th>
<th>Scale Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>10</td>
</tr>
<tr>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>100</td>
<td>0.001</td>
</tr>
</tbody>
</table>

\(x = \text{Totalizer display is round to tens or hundreds}\)

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 \(bBASE\). The timer will control the start (reset) and the stopping (hold) of the totalizer.
2. Choose the range to be calibrated by using the arrow keys and press OP.

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 OP 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 mA DC

6. Press PAR and OP will appear on the display for about 10 seconds.

7. When PAR 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.

1. Use the arrow keys to display CadE 50 and press PAR.

The meter will display rESk and then return to CadE 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 (RPLY) 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.

**WARNING**: Calibration of this meter requires precision instrumentation operated by qualified technicians. It is recommended that a calibration service calibrates the meter.

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. na 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 CadE 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 OP 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 mA DC
6. Press PAR and OP will appear on the display for about 10 seconds.
7. When PAR 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.

**10 OHM RTD Range Calibration**

1. Set the Input Range Jumper to 10 ohm.
2. Use the arrow keys to display CadE 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 CadE 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.
TROUBLESHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power level, power connections</td>
</tr>
<tr>
<td>PROGRAM LOCKED-OUT</td>
<td>CHECK: Active (lock-out) user input</td>
</tr>
<tr>
<td>MAX, MIN, TOT LOCKED-OUT</td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td>INCORRECT INPUT DISPLAY VALUE</td>
<td>CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level, Module 4 Display Offset is zero, press DSP for Input Display</td>
</tr>
<tr>
<td>&quot;OLOL&quot; in DISPLAY (SIGNAL HIGH)</td>
<td>CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level</td>
</tr>
<tr>
<td>&quot;ULUL&quot; in DISPLAY (SIGNAL LOW)</td>
<td>CHECK: Module 1 programming, Input Range Jumper position, input connections, input signal level</td>
</tr>
<tr>
<td>JITTERY DISPLAY</td>
<td>INCREASE: Module 1 filtering, rounding, input range</td>
</tr>
<tr>
<td>ERROR CODE (Err 1-4)</td>
<td>PRESS: Reset KEY (If cannot clear contact factory.)</td>
</tr>
</tbody>
</table>

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

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products. The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter. No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Company acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
### 1 - INP Signal Input Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>rANGE</td>
<td>INPUT RANGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tYPE</td>
<td>DP5T: INPUT TYPE</td>
<td>tC - F</td>
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</tr>
<tr>
<td>sCALE</td>
<td>DP5T: TEMPERATURE SCALE</td>
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<td></td>
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<tr>
<td>dECPt</td>
<td>* DISPLAY RESOLUTION</td>
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<td>FILTER SETTING</td>
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<td>bAND</td>
<td>FILTER ENABLE BAND</td>
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<td>Style</td>
<td>SCALING STYLE - NOT DP5T</td>
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<tr>
<td>INP 1</td>
<td>* INPUT VALUE 1</td>
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<td></td>
</tr>
<tr>
<td>dSP 1</td>
<td>* DISPLAY VALUE 1</td>
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</tr>
<tr>
<td>INP 2</td>
<td>* INPUT VALUE 2</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>dSP 2</td>
<td>* DISPLAY VALUE 2</td>
<td>1000</td>
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</tbody>
</table>

### 2 - FNC User Input and Function Key Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>USr - 1</td>
<td>USER INPUT 1</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>F 1</td>
<td>FUNCTION KEY 1</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>F 2</td>
<td>FUNCTION KEY 2</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>rSk</td>
<td>RESET KEY</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Sc - F 1</td>
<td>2nd FUNCTION KEY 1</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Sc - F 2</td>
<td>2nd FUNCTION KEY 2</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

### 3 - LOC Display and Program Lockout Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>HI</td>
<td>MAX DISPLAY LOCKOUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>LO</td>
<td>MIN DISPLAY LOCKOUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>dLo</td>
<td>TOTAL DISPLAY LOCKOUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>CodeE</td>
<td>SECURITY CODE</td>
<td>0</td>
<td></td>
</tr>
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</table>

### 4 - SEC Secondary Function Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>rANGE</td>
<td>MAX CAPTURE DELAY TIME</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>tBASE</td>
<td>MIN CAPTURE DELAY TIME</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>dSPt</td>
<td>DISPLAY UPDATE TIME</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>b - Lt</td>
<td>UNITS LABEL BACKLIGHT - DP5T</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>OFFSt</td>
<td>DISPLAY OFFSET - NOT DP5T</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>ICE</td>
<td>DP5T: ICE POINT COMPENSATION</td>
<td>ON</td>
<td></td>
</tr>
</tbody>
</table>

### 5 - TOl Totalizer (Integrator) Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>dECPt</td>
<td>* TOTALIZER DECIMAL POINT</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>tBASE</td>
<td>TOTALIZER TIME BASE</td>
<td>1 IN</td>
<td></td>
</tr>
<tr>
<td>SCFAC</td>
<td>TOTALIZER SCALE FACTOR</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Locut</td>
<td>* TOTALIZER LOW CUT VALUE</td>
<td>-19999</td>
<td></td>
</tr>
<tr>
<td>P - UP</td>
<td>TOTALIZER POWER-UP RESET</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

* Decimal point location is model dependent.

---

10

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
MODEL PAX - 1/8 DIN DIGITAL INPUT PANEL METERS

- 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

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 (3A), 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.

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 . . . . . . . . . . . . . . . . . . . 2  
General Meter Specifications . . . . . . . . . . . . . 3  
PAXC Counter . . . . . . . . . . . . . . . . . . . . . . . 4  
PAXR Rate Meter . . . . . . . . . . . . . . . . . . . . . 4  
PAXI Counter/Rate Meter . . . . . . . . . . . . . . . 5  
Optional Plug-In Output Cards . . . . . . . . . . . 6  
Installing the Meter . . . . . . . . . . . . . . . . . . . . 7  
Setting the Jumper and DIP Switches . . . . . . 7  
Installing Plug-In Cards . . . . . . . . . . . . . . . 8  
Wiring the Meter . . . . . . . . . . . . . . . . . . . . . 8  
Reviewing the Front Buttons and Display . . . . 11  
Programming the Meter . . . . . . . . . . . . . . . 12  
Factory Service Operations . . . . . . . . . . . . . 28  
Troubleshooting . . . . . . . . . . . . . . . . . . . . . 29  
Parameter Value Chart . . . . . . . . . . . . . . . . 30  
Programming Overview . . . . . . . . . . . . . . . 32  

**ORDERING INFORMATION**

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAX</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

- **C** - Counter/Dual Counter
- **R** - Rate Meter
- **I** - Counter/Dual Counter/Rate Meter/Slave Display
- **0** - Red, Sunlight Readable Display
- **1** - Green Display
- **0 - 85 to 250 VAC**
- **1 - 11 to 36 VDC, 24 VAC**

Option Card and Accessories Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional</td>
<td>PAXCDC</td>
<td>Dual Setpoint Relay Output Card</td>
<td>PAXCDS10</td>
</tr>
<tr>
<td>Plug-In</td>
<td></td>
<td>Quad Setpoint Relay Output Card</td>
<td>PAXCDS20</td>
</tr>
<tr>
<td>Plug-In</td>
<td></td>
<td>Quad Setpoint Sinking Open Collector Output Card</td>
<td>PAXCDS30</td>
</tr>
<tr>
<td>Cards</td>
<td></td>
<td>Quad Setpoint Sourcing Open Collector Output Card</td>
<td>PAXCDS40</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>RS485 Serial Communications Card with Terminal Block</td>
<td>PAXCDC10</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Extended RS485 Serial Communications Card with Dual RJ11 Connector</td>
<td>PAXCDC1C</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>RS232 Serial Communications Card with Terminal Block</td>
<td>PAXCDC20</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Extended RS232 Serial Communications Card with 9 Pin D Connector</td>
<td>PAXCDC2C</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>DeviceNet Communications Card</td>
<td>PAXCDC30</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Modbus Communications Card</td>
<td>PAXCDC40</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Extended Modbus Communications Card with Dual RJ11 Connector</td>
<td>PAXCDC4C</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Profibus-DP Communications Card</td>
<td>PAXCDC50</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td>Analog Output Card</td>
<td>PAXCDL10</td>
</tr>
<tr>
<td>Accessories</td>
<td>SFCRD*</td>
<td>Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP</td>
<td>SFCRD200</td>
</tr>
<tr>
<td>Accessories</td>
<td>ICM8</td>
<td>Communication Gateway</td>
<td>ICM80000</td>
</tr>
</tbody>
</table>

*Crimson software is available for free download from http://www.redlion.net/

Shaded areas are only available for the PAXI!
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 V AC, ±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
   - Response Time: 6 msec. typical; function dependent. Certain resets, stores and inhibits respond within 25 usec if an edge occurs with the associated counter or within 6 msec if no count edge occurs with the associated counter. These functions include $\text{US}_4\text{U}-$, $\text{US}_4\text{U}&$, $\text{US}_4\text{U}_\text{E}$, $\text{US}_4\text{U}_\text{F}$, $\text{US}_4\text{U}_\text{G}$, $\text{US}_4\text{U}_\text{H}$, $\text{US}_4\text{U}_\text{I}$, $\text{US}_4\text{U}_\text{J}$. 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 E2PROM retains all programmable parameters and display values.

7. **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 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
     - 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
         - 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/m
         - 150 KHz - 80 MHz
         - 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

   Note:
   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
   - 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.

11. **WEIGHT:** 10.1 oz. (286 g)
**MODEL PAXC - 1/8 DIN COUNTER**

**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**

<table>
<thead>
<tr>
<th>Single: Counter A or B</th>
<th>Dual: Counter A &amp; B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are any setpoints used?</td>
<td>N</td>
</tr>
<tr>
<td>Is Counter C used?</td>
<td>N</td>
</tr>
</tbody>
</table>

**COUNT MODE** (Values are in KHz)

- Count x1: 34 | 25 | 18 | 15 | 13 | 12 | 9 | 7.5
- Count x2: 17 | 13 | 9 | 7 | 7 | 6 | 4 | 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
- D' - 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 VIL = 1.5 V max.; VIH = 3.75 V min.
  - Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, IMAX = 1.9 mA.
  - Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, VMAX = 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**

**PAXR SPECIFICATIONS**

**ANNUNCIATORS:**
- S - 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: “S 0-0-”

**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 VIL = 1.5 V max.; VIH = 3.75 V min.
- Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, IMAX = 1.9 mA.
- Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA max. @ 28 VDC, VMAX = 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
ANNUNCIATORS:

- **A**: Counter A
- **B**: Counter B
- **C**: Counter C
- **r**: Rate
- **H**: Maximum (High) Rate
- **L**: Minimum (Low) Rate
- **GF**: 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 **DF**”

**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 \( V_{IL} = 1.5 \text{ V max.} \); \( V_{IH} = 3.75 \text{ V min.} \) Current sinking: Internal 7.8 K\( \Omega \) pull-up to +12 VDC, \( I_{MAX} = 1.9 \text{ mA} \). Current sourcing: Internal 3.9 K\( \Omega \) pull-down, 7.3 mA max. @ 28 VDC, \( V_{MAX} = 30 \text{ VDC} \)
- 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 K\( \Omega \) @ 60 Hz
  - Maximum input voltage: ±40 V peak, 50 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: \( I_{SNK} = 100 \text{ mA max.} \); \( V_{OE} = 1 \text{ VDC max.} \)
- \( V_{OIH} = 30 \text{ VDC max.} \) With duty cycle of 25% min. and 50% max.

---

**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.

<table>
<thead>
<tr>
<th>FUNCTION QUESTIONS</th>
<th>Single: Counter A or B (with/without rate) or Rate only</th>
<th>Dual: Counter A &amp; B or Rate not assigned to active single counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are any setpoints used?</td>
<td>N N N N</td>
<td>Y Y Y Y</td>
</tr>
<tr>
<td>Is Prescaler Output used?</td>
<td>N N Y Y</td>
<td>N N Y Y</td>
</tr>
<tr>
<td>Is Counter C used?</td>
<td>N Y N Y</td>
<td>N Y N Y</td>
</tr>
<tr>
<td><strong>COUNTER MODE</strong></td>
<td><strong>(Values are in KHz)</strong></td>
<td><strong>(Values are in KHz)</strong></td>
</tr>
<tr>
<td>Count x1</td>
<td>34 25 21 17</td>
<td>13 12 13 11</td>
</tr>
<tr>
<td>Count x2</td>
<td>17 13 16 12</td>
<td>9 7 8 7</td>
</tr>
<tr>
<td>Quadrature x1</td>
<td>22 19 20 17</td>
<td>7 * 6 * 6 * 5 *</td>
</tr>
<tr>
<td>Quadrature x2</td>
<td>17 13 16 12</td>
<td>9 7 8 6</td>
</tr>
<tr>
<td>Quadrature x4</td>
<td>8 6 8 6</td>
<td>4 3 4 3</td>
</tr>
<tr>
<td>Rate Only</td>
<td>34 N/A 21 N/A</td>
<td>34 N/A 21 N/A</td>
</tr>
</tbody>
</table>

**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.)
**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 (PAXDCD), 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 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 to 2 to 50 msec or 50 to 100 msec (RS485)
- **Transmit Delay:** Selectable for 2 to 50 msec or 50 to 100 msec (RS485)

**DEVICE NET™ CARD**

- **Compatibility:** Group 2 Server Only, not UCMM capable
- **Baud Rates:** 12 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 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**

Crimson 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 PAX meter. The PAX 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 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 with 3 msec. nominal release
  - **Time 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 with 3 msec. nominal release
  - **Time 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 @ VSA T= 0.7 V max. VMAX = 30 V
- **Response Time:** Counter = 25 usec; Rate = Low Update time
  - **Time 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 usec; Rate = Low Update time
  - **Time Accuracy:** Counter = ± 0.01% + 10 msec.
    - **Rate = ± 0.01% + 20 msec.**

**PAXI 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.

**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.
- **Response Time:** 50 msec. max., 10 msec. typ.
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 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 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.

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.

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

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 usec.

Switches 2 and 5
SRC.: Adds internal 3.9 KΩ pull-down resistor, 7.3 mA max. @ 28 VDC, \( V_{\text{MAX}} = 30 \text{ VDC} \).
SNK.: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, \( I_{\text{MAX}} = 1.9 \text{ mA} \).

Switches 1 and 4
LOGIC: Input trigger levels \( V_{\text{IL}} = 1.5 \text{ V max.} \); \( V_{\text{IH}} = 3.75 \text{ V min.} \).
MAG: 200 mV peak input (must also have SRC on). Not recommended with counting applications.
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.

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 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. 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 (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)
   - Ferrite Suppression Cores for signal and control cables: Schaffner # ZCAT3035-1330A
   - Ferrite Suppression Cores for signal and control cables: Steward # 28B2029-0A0
   - Line Filters for input power cables: Schaffner # FN610-1/07 (RLC# LFIL0000)
   - Line Filters for input power cables: 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: 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 3.6 VDC is applied.

3.6 VDC

V SUPPLY (30V max.)
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.

---

### Magnetic Pickup

Input A

**AC Inputs From Tach Generators, Etc.**

Input A

**Two Wire Proximity, Current Source**

Input A

---

### Current Sinking Output

Input A

### Current Sourcing Output

Input A

### Interfacing With TTL

Input A

---

### Switch or Isolated Transistor; Current Sink

Input A

### Switch or Isolated Transistor; Current Source

Input A

### Emitter Follower; Current Source

Input A

---

### Current Sink Output; Quad/Direction

Input A

### Current Sink Output; Quad/Direction

Input A

---

### Current Sink Output; Quad/Direction

Input A & Rate B

Counter A

---

Switch position is application dependent.

Shaded areas not recommended for counting applications.

---

4.4 SETPOINT (ALARMS) WIRING

---

**SETPOINT PLUG-IN CARD TERMINALS**

<table>
<thead>
<tr>
<th>Dual Relay PAXCDS10</th>
<th>Quad Relay PAXCDS20</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>21 RLY1</td>
<td>21 COMM</td>
</tr>
<tr>
<td>22</td>
<td>22 RLY2</td>
</tr>
<tr>
<td>23</td>
<td>23 RLY3</td>
</tr>
<tr>
<td>24 RLY2</td>
<td>24 COMM</td>
</tr>
<tr>
<td>25</td>
<td>25 RLY4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quad Sinking PAXCDS30</th>
<th>Quad Sourcing PAXCDS40</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - Common</td>
<td>20 - External Supply</td>
</tr>
<tr>
<td>21 - 01 Snk.</td>
<td>21 - 01 Src.</td>
</tr>
<tr>
<td>22 - 02 Snk.</td>
<td>22 - 02 Src.</td>
</tr>
<tr>
<td>23 - 03 Snk.</td>
<td>23 - 03 Src.</td>
</tr>
<tr>
<td>24 - 04 Snk.</td>
<td>24 - 04 Src.</td>
</tr>
<tr>
<td>25 - Common</td>
<td>25 - Common</td>
</tr>
</tbody>
</table>

---

**SOURCING OUTPUT LOGIC CARD**

---

**SINKING OUTPUT LOGIC CARD**

---

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
4.5 PAXI SERIAL COMMUNICATION WIRING

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 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.

4.6 PAXI ANALOG OUTPUT WIRING

ANALOG OPTION CARD FIELD TERMINALS

4.7 PAXI PRESCALER OUTPUT WIRING

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

Counter Readout Legends*

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 d5F5.5k (Reset Display).
6.0 PROGRAMMING THE METER

OVERVIEW

PROGRAMMING MENU

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 1SP and the present module. The arrow keys (F1 S and F2 T) 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 1SP /0. 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 S and F2 T) 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.

6.1 MODULE 1 - COUNT A & B INPUT PARAMETERS (1- INP)

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.
Select the operating mode for Counter A.

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
<td>cnt</td>
<td>Adds Input A falling edge.</td>
</tr>
<tr>
<td></td>
<td>cntud</td>
<td>Adds Input A falling edge if Input B is high.</td>
</tr>
<tr>
<td></td>
<td>dcntud</td>
<td>Subtracts Input A falling edge if Input B is low.</td>
</tr>
<tr>
<td></td>
<td>qwAd1</td>
<td>Quad X1 Adds Input A rising edge when Input B is high. Subtracts Input A falling edge if User 1 is low.</td>
</tr>
<tr>
<td></td>
<td>qwAd2</td>
<td>Quad X2 Adds Input A rising edge when Input B is high and Input A falling edge when Input B is low.</td>
</tr>
<tr>
<td></td>
<td>qwAd4</td>
<td>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 high, and Input B falling edge when Input A is low.</td>
</tr>
<tr>
<td></td>
<td>dqwAd1</td>
<td>Quad X1 Adds Input A rising edge when User 1 is high. Subtracts Input A falling edge when User 1 is high.</td>
</tr>
<tr>
<td></td>
<td>dqwAd2</td>
<td>Quad X2 Adds Input A rising edge when User 1 is high and Input A falling edge when User 1 is low.</td>
</tr>
<tr>
<td></td>
<td>cnt2</td>
<td>Count X2 Adds Input A rising and falling edges.</td>
</tr>
<tr>
<td></td>
<td>cntud2</td>
<td>Count X2 Adds Input A rising and falling edges if Input B is high. Subtracts Input A falling and rising edge if Input B is low.</td>
</tr>
<tr>
<td></td>
<td>dctud2</td>
<td>Count X2 Adds Input A rising and falling edges if User 1 is high. Subtracts Input A rising and falling edge if User 1 is low.</td>
</tr>
</tbody>
</table>

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.

When reset to count load action is selected, Counter A will reset to this value.

Counter A may be programmed to reset at each meter power-up.

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. 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.)

The prescaler output frequency is the Input A frequency times the prescaler scale value.

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.)

* Factory Setting can be used without affecting basic start-up.
Select the operating mode for Counter B.

**SELECT** | **MODE** | **DESCRIPTION**
---|---|---
**NONE** | **cnt** | Count X1
**none** | **dcntud** | Count X1 with direction
**dquAd1** | **Quad X1** | Adds Input B rising edge if User 2 is high. Subtracts Input B falling edge if User 2 is low.
**dquAd2** | **Quad X2** | Adds Input B rising edge when User 2 is high and Input B falling edge when User 2 is low.
**cnt2** | **Count X2** | Adds Input B rising and falling edges if User 2 is high. Subtracts Input B rising and falling edge if User 2 is low.
**dctud2** | **Count X2 with direction** | Adds Input B rising and falling edges.

**COUNTER B OPERATING MODE**

1. **Counter B Decimal Position**
   - **bdECPE**
   - 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.

2. **Counter B Scale Factor**
   - **bS$CFAC**
   - 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.)

3. **Counter B Scale Multiplier**
   - **bS$CALr**
   - 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.)

4. **Counter B Count Load Value**
   - **bC$NLd**
   - When reset to count load action is selected, Counter B will reset to this value.

5. **Counter B Reset Power-Up**
   - **b P-UP**
   - Counter B may be programmed to reset at each meter power-up.

**COUNTER B RESET POWER-UP**

* Factory Setting can be used without affecting basic start-up.

**8 DIGIT COUNT VALUES**

Any counter display value below -999999 or above 9999999 (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 “SF” 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-CM), scale factor (xSFAC), scale multiplier (xSFACr) and decimal point (xdECP). The scale factor is calculated using:

$$SF (xSFAC) = \frac{\text{Desired Display Decimal DDD}}{(\text{Number of pulses per 'single' unit} \times \text{CM} \times \text{SM})}$$

Where:

- Desired Display Decimal DDD
- xDECP: Counter Decimal Selection

- 1
- 0.0
- 0.00
- 0.000
- 0.0000
- 0.00000

- Tenths
- Hundredths
- Thousandths
- Ten Thousandths
- Hundred Thousandths

**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 1.0000. 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 1.0000 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 1.0000.

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.)

**Counter B Count Load Value**

- **-999999 to 9999999**

When reset to count load action is selected, Counter B will reset to this value.
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 programmed 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**

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**

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**

When activated (momentary action), the display advances to the next display that is not locked out from the Display Mode.

**RESET DISPLAY**

When activated (momentary action), the shown display is reset. This is the factory setting for the Reset (RST) Key.

**EXCHANGE PARAMETER LISTS**

Two lists of values are available for SP-1, SP-2, SP-3, SP-4, RSCFAC, RSCFAC, RSCFAC, RSCFAC, RSCFAC, RSCFAC, NO, YES, YES, YES, YES. The two lists are named L1S-R and L1S-B. If a user input is used to select the list then L1S-R is selected when the user input is not active and L1S-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 L1S-R and L1S-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, RSCFAC, RSCFAC, RSCFAC, RSCFAC, RSCFAC, RSCFAC, NO, YES, YES, YES, YES. If any other parameters are changed then the other list values must be reprogrammed.

**PAXI: PRINT REQUEST**

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**

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.
### MAINTAINED (LEVEL) RESET AND INHIBIT

The meter performs a reset and inhibits the displays configured as **YES**, as long as activated (maintained action).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A CN₆</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CN₆</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>c CN₆</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### PAXR: MAINTAINED (LEVEL) RESET AND INHIBIT

The meter performs a reset and inhibits the displays configured as **YES**, as long as activated (maintained action).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### MOMENTARY (EDGE) RESET

When activated (momentary action), the meter resets the displays configured as **YES**. (Momentary resets improve max. input frequencies over maintained resets.)

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A CN₆</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CN₆</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>c CN₆</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### PAXR: MOMENTARY (EDGE) RESET

When activated (momentary action), the meter resets the displays configured as **YES**. (Momentary resets improve max. input frequencies over maintained resets.)

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### INHIBIT

The meter inhibits the displays configured as **YES**, as long as activated (maintained action).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A CN₆</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CN₆</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>c CN₆</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### STORE DISPLAY

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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A CN₆</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CN₆</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>c CN₆</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L O</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>

### DEACTIVATE SETPOINT MAINTAINED (LEVEL)

The meter deactivates the setpoints configured as **YES**, as long as activated (maintained action). This action only functions with a Setpoint card installed.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1</td>
<td>Setpoint 1</td>
<td>NO</td>
</tr>
<tr>
<td>SP-2</td>
<td>Setpoint 2</td>
<td>NO</td>
</tr>
<tr>
<td>SP-3</td>
<td>Setpoint 3</td>
<td>NO</td>
</tr>
<tr>
<td>SP-4</td>
<td>Setpoint 4</td>
<td>NO</td>
</tr>
</tbody>
</table>

### DEACTIVATE SETPOINT MOMENTARY (EDGE)

When activated (momentary action), the meter deactivates the setpoints configured as **YES**. This action only functions with a Setpoint card installed.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1</td>
<td>Setpoint 1</td>
<td>NO</td>
</tr>
<tr>
<td>SP-2</td>
<td>Setpoint 2</td>
<td>NO</td>
</tr>
<tr>
<td>SP-3</td>
<td>Setpoint 3</td>
<td>NO</td>
</tr>
<tr>
<td>SP-4</td>
<td>Setpoint 4</td>
<td>NO</td>
</tr>
</tbody>
</table>

### HOLD SETPOINT STATE

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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1</td>
<td>Setpoint 1</td>
<td>NO</td>
</tr>
<tr>
<td>SP-2</td>
<td>Setpoint 2</td>
<td>NO</td>
</tr>
<tr>
<td>SP-3</td>
<td>Setpoint 3</td>
<td>NO</td>
</tr>
<tr>
<td>SP-4</td>
<td>Setpoint 4</td>
<td>NO</td>
</tr>
</tbody>
</table>

### ACTIVATE SETPOINT MAINTAINED (LEVEL)

The meter activates the setpoints configured as **YES**, as long as activated (maintained action). This action only functions with a Setpoint card installed.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1</td>
<td>Setpoint 1</td>
<td>NO</td>
</tr>
<tr>
<td>SP-2</td>
<td>Setpoint 2</td>
<td>NO</td>
</tr>
<tr>
<td>SP-3</td>
<td>Setpoint 3</td>
<td>NO</td>
</tr>
<tr>
<td>SP-4</td>
<td>Setpoint 4</td>
<td>NO</td>
</tr>
</tbody>
</table>

### ACTIVATE SETPOINT MOMENTARY (EDGE)

When activated (momentary action), the meter activates the setpoints configured as **YES**. This action only functions with a Setpoint card installed.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP-1</td>
<td>Setpoint 1</td>
<td>NO</td>
</tr>
<tr>
<td>SP-2</td>
<td>Setpoint 2</td>
<td>NO</td>
</tr>
<tr>
<td>SP-3</td>
<td>Setpoint 3</td>
<td>NO</td>
</tr>
<tr>
<td>SP-4</td>
<td>Setpoint 4</td>
<td>NO</td>
</tr>
</tbody>
</table>

### CHANGE DISPLAY INTENSITY LEVEL

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. 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.
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.

“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 and scale factor values can still be read and/or changed per the selections below. The Display Intensity Level (E-LOC) parameter also appears whenever Quick Programming Mode is enabled, and the security code is greater than zero.

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>rEd</td>
<td>Visible in Display Mode</td>
</tr>
<tr>
<td>LOC</td>
<td>Not visible in Display Mode</td>
</tr>
</tbody>
</table>

The setpoint displays can be programmed for LOC, rEd, or EEn. (See the following table). Accessible only with the Setpoint Plug-in card installed.

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>rEd</td>
<td>Visible but not changeable in Quick Programming Mode</td>
</tr>
<tr>
<td>EEn</td>
<td>Visible and changeable in Quick Programming Mode</td>
</tr>
<tr>
<td>LOC</td>
<td>Not visible in Quick Programming Mode</td>
</tr>
</tbody>
</table>

The Scale Factor values can be programmed for LOC, rEd, or EEn.

<table>
<thead>
<tr>
<th>SECURITY CODE</th>
<th>0 to 999</th>
</tr>
</thead>
</table>

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 022. 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.
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 IMP is actually r LE IMP on the unit's display and r DSP is actually r LE DSP on the unit’s display.

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 SFPAX 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 IMP). 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 SEE5:2, 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.

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>SCALING POINT</th>
<th>DISPLAY PARAMETER</th>
<th>DISPLAY DEFAULT</th>
<th>INPUT PARAMETER</th>
<th>INPUT DEFAULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>rDSP 0</td>
<td>000000</td>
<td>r IMP 0</td>
<td>000000</td>
<td>000000.0</td>
</tr>
<tr>
<td>2</td>
<td>rDSP 1</td>
<td>001000</td>
<td>r IMP 1</td>
<td>010000.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>rDSP 2</td>
<td>002000</td>
<td>r IMP 2</td>
<td>020000.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>rDSP 3</td>
<td>003000</td>
<td>r IMP 3</td>
<td>030000.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>rDSP 4</td>
<td>004000</td>
<td>r IMP 4</td>
<td>040000.0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>rDSP 5</td>
<td>005000</td>
<td>r IMP 5</td>
<td>050000.0</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>rDSP 6</td>
<td>006000</td>
<td>r IMP 6</td>
<td>060000.0</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>rDSP 7</td>
<td>007000</td>
<td>r IMP 7</td>
<td>070000.0</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>rDSP 8</td>
<td>008000</td>
<td>r IMP 8</td>
<td>080000.0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>rDSP 9</td>
<td>009000</td>
<td>r IMP 9</td>
<td>090000.0</td>
<td></td>
</tr>
</tbody>
</table>

PAXI: RATE DISPLAY VALUE FOR SCALING POINT 1

Confirm the Rate Display Value for the first Scaling Point is 0. This parameter is automatically set to 0 and does not appear when SEE5:2. (See Note)

PAXI: RATE INPUT VALUE FOR SCALING POINT 1

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 IMP 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 SEE5:2.

PAXI: LINEARIZER SEGMENTS

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 SEE5:2 (factory setting).

For non-zero based 2 scaling point applications, set SEE5:2; 1, to enter both the zero segment (r IMP 0 & rDSP 0) and segment 1 (r IMP 1 & rDSP 1).

RATe DISPLAY VALUE FOR SCALING POINT 2

Enter the desired Rate Display Value for the second Scaling Point by using the arrow keys.

* Factory Setting can be used without affecting basic start-up.
RATE INPUT VALUE FOR SCALING POINT 2

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 *

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 *

The Low Cut Out value forces the Rate display to zero when the Rate display falls below the value entered.

MAXIMUM CAPTURE DELAY TIME *

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 'M' in the display and will continue to function independent of being displayed.

MINIMUM CAPTURE DELAY TIME *

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 "-OL0L". During this overflow condition, the Minimum and Maximum rate values will stay at their values even during resets.

* Factory Setting can be used without affecting basic start-up.

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 (rDSP) and Scaling Input (r 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:

<table>
<thead>
<tr>
<th>RATE PER</th>
<th>DISPLAY (rDSP)</th>
<th>INPUT (r inP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>1</td>
<td># of pulses per unit</td>
</tr>
<tr>
<td>Minute</td>
<td>60</td>
<td># of pulses per unit</td>
</tr>
<tr>
<td>Hour</td>
<td>3600</td>
<td># of pulses per unit</td>
</tr>
</tbody>
</table>

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 Input value is raise or moved, 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.
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 *

- **NONE**: Does not count.
- **R**: 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 less any effects of scaling.)
- **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 less any effects of scaling.)

*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.*

### COUNTER C SCALE FACTOR

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 **R** (Numeric transmissions) modes 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

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 the display of the actual number of input counts. For **R** (Numeric transmissions) modes 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 COUNT LOAD VALUE

When reset to count load action is selected, Counter C will reset to this value.

### COUNTER C RESET POWER-UP *

Counter C may be programmed to reset at each meter power-up.

* Factory Setting can be used without affecting basic start-up.
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. This section replaces the bulletin that comes with the setpoint plug-in card. Please discard the separate literature when using the Plug-in card with the Digital PAX. For maximum input frequency, unused Setpoints should be configured for 0'' action.

The setpoint assignment and the setpoint action determine certain setpoint feature availability. The chart below illustrates this.

### SETPOINT PARAMETER AVAILABILITY

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>RATE</th>
<th>COUNTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TIMED OUT</td>
<td>BOUNDARY</td>
</tr>
<tr>
<td>Lit-n</td>
<td>Annunciators</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Out-n</td>
<td>Output Logic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sup-n</td>
<td>Power Up State</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sp-n</td>
<td>Setpoint Value</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Trc-n</td>
<td>Setpoint Tracking</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Typ-n</td>
<td>Boundary Type</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stb-n</td>
<td>Standby Operation</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hys-n</td>
<td>Setpoint Hysteresis</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Off-n</td>
<td>Setpoint Off Delay</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>On-n</td>
<td>Setpoint On Delay</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Out-n</td>
<td>Setpoint Time Out</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Auto-n</td>
<td>Counter Auto Reset</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sd-n</td>
<td>Reset With Display Reset</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sas-n</td>
<td>Reset When SPn+1 Activates</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sae-n</td>
<td>Reset When SPn+1 Deactivates</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### SETPOINT SELECT

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 N0. Select the next setpoint to be programmed and continue the sequence for each setpoint. Pressing PAR at SPSEL N0 will exit Module 6.

### SETPOINT ANNUNCIATORS*

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 *

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 *

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.

* Factory Setting can be used without affecting basic start-up.
**SETPOINT ACTION**

<table>
<thead>
<tr>
<th>Act-n</th>
<th>Off</th>
<th>Latch</th>
<th>Latch Out</th>
<th>Bound</th>
</tr>
</thead>
</table>

OFF: When not using a setpoint, it should be set to OFF (no action).

For Counter Assignments:

- **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.

- **Bound**
  - With Boundary action, the setpoint output activates when the count value is greater than or equal to (for \( SP = H \)) or less than or equal to (for \( SP = L \)) the setpoint value. The setpoint output will deactivate when the count value is less than (for \( SP = H \)) or greater than (for \( SP = L \)) the setpoint value.

For Rate Assignments:

- **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 \( SP = H \)) or less than or equal to (for \( SP = L \)) the setpoint value, the setpoint output will reactivate.

- **Bound**
  - With Boundary action, the setpoint output activates when the rate value is greater than or equal to (for \( SP = H \)) or less than or equal to (for \( SP = L \)) the setpoint value. The setpoint output will deactivate (Auto reset) as determined by the hysteresis value.

- **Out**
  - With Timed Out action, the setpoint output activates when the rate value is greater than or equal to (for \( SP = H \)) or less than or equal to (for \( SP = L \)) the setpoint value. The Setpoint Time Out \((\text{Out}^n)\) and Setpoint On Delay \((\text{Out}^n)\) values determine the cycling times.

**PAXC & I: SETPOINT ASSIGNMENT**

| RSN-n | A | B | C | Rate |

Select the display that the setpoint is to be assigned.

**SETPOINT VALUE**

<table>
<thead>
<tr>
<th>SP-n</th>
<th>-99999 to 999999</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Enter the desired setpoint value. Setpoint values can also be entered in the Quick Programming Mode when the setpoint is configured as ER in Module 3. (See Module 2 for Exchange Parameter Lists explanation.)

**SETPOINT TRACKING**

<table>
<thead>
<tr>
<th>EFC-n</th>
<th>No</th>
<th>SP-1</th>
<th>SP-2</th>
<th>SP-3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SP-4</td>
<td>BCDlD</td>
<td></td>
</tr>
</tbody>
</table>

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 (in the Quick Programming Mode), the “n” setpoint value will also change (or follow) by the same amount.

**SETPOINT BOUNDARY TYPE**

<table>
<thead>
<tr>
<th>EYP-n</th>
<th>H</th>
<th>L</th>
</tr>
</thead>
</table>

H activates the output when the assigned display value \((\text{Act-n})\) equals or exceeds the setpoint value. L activates the setpoint when the assigned display value is less than or equal to the setpoint.

**SETPOINT STANDBY OPERATION**

| Stb-n | 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**

<table>
<thead>
<tr>
<th>HYS-n</th>
<th>0 to 9999</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

The hysteresis value is added to (for \( SP = H \)) or subtracted from (for \( SP = L \)), 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**

<table>
<thead>
<tr>
<th>EOff-n</th>
<th>0.00 to 99999 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>EOn-n</th>
<th>0.00 to 99999 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

This is the amount of time the Rate display must meet the setpoint activation requirements (below setpoint for \( SP = L \) and above setpoint for \( SP = H \)) 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.

**PAXI & I: COUNTER AUTO RESET**

<table>
<thead>
<tr>
<th>Aut-n</th>
<th>No</th>
<th>2E+0 RS</th>
<th>ClDAS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2E+0 RE</td>
<td>ClDAS</td>
</tr>
</tbody>
</table>

This automatically resets the display value of the Setpoint Assignment \((\text{RSN-n})\) counter each time the setpoint value is reached. This reset may be different than the Counter’s Reset Action \((\times \text{Foot})\) in Module 1 or 5.

**Factory Setting can be used without affecting basic start-up.**
PAXC & I: SETPOINT RESET WHEN SPn+1 ACTIVATES *

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.

* Factory Setting can be used without affecting basic start-up.

PAXR & I: SETPOINT (ALARM) FIGURES FOR RATE
(For Reverse Action, The Alarm state is opposite.)

LOW ACTING WITH NO DELAY

HIGH ACTING WITH NO DELAY

HIGH ACTING WITH TIMEOUT

LOW ACTING WITH TIMEOUT
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. Red Lion's SFPAX software can be used for configuring the PAXI (See Ordering Information). For serial hardware and wiring details, refer to section 4.5 Serial Communication Wiring.

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 PAXI. 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.

### BAUD RATE

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

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

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

Enter the serial meter (node) address. With a single unit, 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.

### ABBREVIATED PRINTING

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

**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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Factory</th>
<th>Mnemonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Cnt</td>
<td>Counter A</td>
<td>YES</td>
<td>CTA</td>
</tr>
<tr>
<td>b Cnt</td>
<td>Counter B</td>
<td>NO</td>
<td>CTB</td>
</tr>
<tr>
<td>c Cnt</td>
<td>Counter C</td>
<td>NO</td>
<td>CTC</td>
</tr>
<tr>
<td>r Rate</td>
<td>Rate</td>
<td>NO</td>
<td>RTE</td>
</tr>
<tr>
<td>Max. &amp; Min.</td>
<td></td>
<td>NO</td>
<td>MIN MAX</td>
</tr>
<tr>
<td>A B C Scale Factors</td>
<td></td>
<td>NO</td>
<td>SFA SFB SFC</td>
</tr>
<tr>
<td>A B C Count Load</td>
<td></td>
<td>NO</td>
<td>LDA LDB LDC</td>
</tr>
<tr>
<td>1 2 3 4 Setpoints</td>
<td></td>
<td>NO</td>
<td>SP1 SP2 SP3 SP4</td>
</tr>
</tbody>
</table>

*Setpoints are plug-in card dependent.*
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 $. The <CR> is also available as a terminator when Counter C is in the SLAVE mode.

Command Chart

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Node (Meter) Address Specifier</td>
<td>Address a specific meter. Must be followed by two digit node address. Not required when address = 00</td>
</tr>
<tr>
<td>T</td>
<td>Transmit Value (read)</td>
<td>Read a register from the meter. Must be followed by register ID character.</td>
</tr>
<tr>
<td>V</td>
<td>Value change (write)</td>
<td>Write to register of the meter. Must be followed by register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a register or output. Must be followed by register ID character</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers are defined in programming.</td>
</tr>
</tbody>
</table>

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 response is established in Module 7.

Register Identification Chart

<table>
<thead>
<tr>
<th>ID</th>
<th>VALUE DESCRIPTION</th>
<th>REGISTER NAME 1</th>
<th>COMMAND</th>
<th>TRANSMIT DETAILS 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Count A</td>
<td>CTA</td>
<td>T, V, R</td>
<td>6 digit (V), 8 digit (T)</td>
</tr>
<tr>
<td>B</td>
<td>Count B</td>
<td>CTB</td>
<td>T, V, R</td>
<td>6 digit (V), 8 digit (T)</td>
</tr>
<tr>
<td>C</td>
<td>Count C</td>
<td>CTC</td>
<td>T, V, R</td>
<td>6 digit (V), 8 digit (T)</td>
</tr>
<tr>
<td>D</td>
<td>Rate</td>
<td>RTE</td>
<td>T, V</td>
<td>5 digit, positive only</td>
</tr>
<tr>
<td>E</td>
<td>Min</td>
<td>MIN</td>
<td>T, V, R</td>
<td>5 digit, positive only</td>
</tr>
<tr>
<td>F</td>
<td>Max</td>
<td>MAX</td>
<td>T, V, R</td>
<td>5 digit, positive only</td>
</tr>
<tr>
<td>G</td>
<td>Scale Factor A</td>
<td>SPA</td>
<td>T, V</td>
<td>6 digit, positive only</td>
</tr>
<tr>
<td>H</td>
<td>Scale Factor B</td>
<td>SFB</td>
<td>T, V</td>
<td>6 digit, positive only</td>
</tr>
<tr>
<td>I</td>
<td>Scale Factor C</td>
<td>SFC</td>
<td>T, V</td>
<td>6 digit, positive only</td>
</tr>
<tr>
<td>J</td>
<td>Count Load A</td>
<td>LDA</td>
<td>T, V</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>K</td>
<td>Count Load B</td>
<td>LDB</td>
<td>T, V</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>L</td>
<td>Count Load C</td>
<td>LDC</td>
<td>T, V</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>M</td>
<td>Setpoint 1</td>
<td>SP1</td>
<td>T, V, R</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>O</td>
<td>Setpoint 2</td>
<td>SP2</td>
<td>T, V, R</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>Q</td>
<td>Setpoint 3</td>
<td>SP3</td>
<td>T, V, R</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>S</td>
<td>Setpoint 4</td>
<td>SP4</td>
<td>T, V, R</td>
<td>5 negative / 6 positive</td>
</tr>
<tr>
<td>U</td>
<td>Auto/Manual Register</td>
<td>MMR</td>
<td>T, V</td>
<td>0 - auto, 1 - manual</td>
</tr>
<tr>
<td>W</td>
<td>Analog Output Register</td>
<td>AOR</td>
<td>T, V</td>
<td>0 - 4095 normalized</td>
</tr>
<tr>
<td>X</td>
<td>Setpoint Register</td>
<td>SOR</td>
<td>T, V</td>
<td>0 - not active, 1 - active</td>
</tr>
</tbody>
</table>

Abbreviated Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>13</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>14</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>15</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

Abbreviated Transmission

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

Command String Examples:
1. Address = 17, Write 350 to Setpoint 1
   String: N17VM350S
2. Address = 5, Read Count A value, response time of 50 - 100 msec. min.
   String: N05TA*
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. The meter response is established in Module 7.

Full Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>2 byte Node (Meter) Address field (00-99)</td>
</tr>
<tr>
<td>3</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>4-6</td>
<td>3 byte Register Mnemonic field</td>
</tr>
<tr>
<td>7-18</td>
<td>12 byte numeric data field: 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>19</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>20</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>21</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>22</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>23</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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 mnemonics. 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

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>13</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>14</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>15</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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, Count A = 875
   17 CTA 875<CR><LF>
2. Address = 0, 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.

Example: U abcd

- c = Analog Output
- d = SP4
- e = 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:

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>0.005</td>
</tr>
<tr>
<td>2047</td>
<td>10.000</td>
</tr>
<tr>
<td>4094</td>
<td>19.995</td>
</tr>
<tr>
<td>4095</td>
<td>20.000</td>
</tr>
</tbody>
</table>

*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).

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 EPROM 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 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
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.

<table>
<thead>
<tr>
<th>Logic</th>
<th>Interface State</th>
<th>RS232* Voltage Levels</th>
<th>RS485* Voltage Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mark (idle)</td>
<td>TXD,RXD: -3 to -15 V</td>
<td>a-b &lt; -200 mV</td>
</tr>
<tr>
<td>0</td>
<td>space (active)</td>
<td>TXD,RXD: +3 to +15 V</td>
<td>a-b &gt; +200 mV</td>
</tr>
</tbody>
</table>

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.

Stop bit

The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver 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.

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.

Character Frame Figure

SERIAL TIMING

<table>
<thead>
<tr>
<th>Command</th>
<th>Comment</th>
<th>PROCESS TIME (t2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeric Slave</td>
<td>2-50 msec.</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>2-50 msec.</td>
</tr>
<tr>
<td>#</td>
<td>Literal</td>
<td>2-50 msec.</td>
</tr>
<tr>
<td>V</td>
<td>Write</td>
<td>100-200 msec.</td>
</tr>
<tr>
<td>T</td>
<td>Transmit</td>
<td>2-50 msec. for $</td>
</tr>
<tr>
<td>P</td>
<td>Print</td>
<td>2-50 msec. for $</td>
</tr>
</tbody>
</table>

Timing Diagrams

NO REPLY FROM METER

RESPONSE FROM METER

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 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 (‘*’ or slave only ‘<CR>’) is received by the meter. The time duration of t1 is dependent on the number of characters and baud rate of the channel.

\[ t_1 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

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 (See Timing Diagrams). 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. The ‘*’ or ‘<CR>’ 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 ‘$’ results in a response time window of 2 msec. minimum and 50 msec. maximum. The faster the RS485 bus. Terminating the command line with ‘$’ results in a response time window of 50 msec. minimum and 100 msec.

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. At the end of t3, the meter is ready to receive the next command.

\[ t_3 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_1 = \text{t2} \text{ and } t_3 = \text{t1} \times 10 \times \frac{\text{# of characters}}{\text{baud rate}} \]

The most recent command is completed before the next command is received. At the start of time interval t4, the next command is received. The time interval t4 varies (See Timing Diagrams). If no response from the meter is expected, the meter is ready to accept another command.

At the beginning of time interval t5, the meter processes the command and when complete, performs the command function. This time interval t5 varies (See Timing Diagrams). 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 t5 is controlled by the use of the command terminating character. The ‘*’ or ‘<CR>’ 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 ‘$’ results in a response time window of 2 msec. minimum and 50 msec. maximum. The faster the RS485 bus. Terminating the command line with ‘$’ results in a response time window of 50 msec. minimum and 100 msec.

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_5 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_1 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

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 (See Timing Diagrams). 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. The ‘*’ or ‘<CR>’ 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 ‘$’ results in a response time window of 2 msec. minimum and 50 msec. maximum. The faster the RS485 bus. Terminating the command line with ‘$’ results in a response time window of 50 msec. minimum and 100 msec.

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. At the end of t3, the meter is ready to receive the next command.

\[ t_3 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_1 = \text{t2} \text{ and } t_3 = \text{t1} \times 10 \times \frac{\text{# of characters}}{\text{baud rate}} \]

The most recent command is completed before the next command is received. At the start of time interval t4, the next command is received. The time interval t4 varies (See Timing Diagrams). 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 t4 is controlled by the use of the command terminating character. The ‘*’ or ‘<CR>’ 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 ‘$’ results in a response time window of 2 msec. minimum and 50 msec. maximum. The faster the RS485 bus. Terminating the command line with ‘$’ results in a response time window of 50 msec. minimum and 100 msec.

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_5 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]

The maximum serial throughput of the meter is limited to the sum of the times t1, t2 and t3.

\[ t_1 = \frac{10 \times \text{(number of characters)}}{\text{baud rate}} \]
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). This section replaces the bulletin that comes with the analog plug-in card. Please discard the separate literature when using the plug-in card with the PAXI.

**ANALOG TYPE**

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>0 to 20 mA</td>
</tr>
<tr>
<td>4-20</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>0-10</td>
<td>0 to 10 V</td>
</tr>
</tbody>
</table>

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**

Select the display that the analog output is to follow:

- \( R_{A} \text{ CNt} = \text{Counter A Value} \)
- \( R_{B} \text{ CNt} = \text{Counter B Value} \)
- \( R_{C} \text{ CNt} = \text{Counter C Value} \)
- \( rAtE = \text{Rate Value} \)
- \( cLo = \text{Minimum Value} \)
- \( cHi = \text{Maximum Value} \)

**ANALOG LOW SCALE VALUE**

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**

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.

**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 \( \text{Code} \ 66 \) and press \( \text{PAR} \). The meter will display \( \text{rESet} \) and then returns to \( \text{Code} \ 50 \). Press \( \text{DSP} \) key to return to the Display Mode. This will overwrite all user settings with the factory settings.

Pressing the \( \text{PAR} \) and \( \text{DSP} \) keys at the same time on power-up will load the factory settings and display \( \text{Err} \). This allows operation in the event of a memory failure or corrupted data. Immediately press \( \text{RST} \) key and reprogram the meter. If the meter is powered down again before pressing the \( \text{RST} \) key, the existing dynamic data will not be overwritten.
PAXI: CALIBRATION

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 starting calibration.

TROUBLESHOOTING

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

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power level, power connections</td>
</tr>
<tr>
<td>PROGRAM LOCKED-OUT</td>
<td>CHECK: Active (lock-out) user input</td>
</tr>
<tr>
<td>CERTAIN DISPLAYS ARE LOCKED OUT</td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td>INCORRECT DISPLAY VALUE or NOT COUNTING</td>
<td>CHECK: Module 3 programming</td>
</tr>
<tr>
<td>USER INPUT NOT WORKING CORRECTLY</td>
<td>CHECK: User input wiring, user input jumper,</td>
</tr>
<tr>
<td>OUTPUT DOES NOT WORK</td>
<td>USER input being used for signal, Module 2</td>
</tr>
<tr>
<td>JITTERY DISPLAY</td>
<td>CHECK: Corresponding plug-in card installation,</td>
</tr>
<tr>
<td></td>
<td>output configuration, output wiring</td>
</tr>
<tr>
<td>&quot;r 6L6&quot; RATE</td>
<td>CHECK: Lower input signal frequency, reduce</td>
</tr>
<tr>
<td></td>
<td>rate scaling</td>
</tr>
<tr>
<td>MODULES or PARAMETERS NOT ACCESSIBLE</td>
<td>CHECK: Corresponding plug-in card installation,</td>
</tr>
<tr>
<td></td>
<td>related controlling parameter selected</td>
</tr>
<tr>
<td>ERROR CODE (Err 1-4)</td>
<td>PRESS: Reset key (if unable to clear contact</td>
</tr>
<tr>
<td>SERIAL COMMUNICATIONS</td>
<td>factory.)</td>
</tr>
</tbody>
</table>

SELECTION | EXTERNAL METER | ACTION             |
----------|----------------|--------------------|
0.0     | 0.00           | Adjust if necessary, press PAR |
4.0     | 4.00           | Adjust if necessary, press PAR |
20.0    | 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 Err 50 appears, press PAR twice and remove the external meters.

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. Error 65 is displayed. Use the arrow keys to select 65 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.

4. When Code 50 appears, press PAR twice and remove the external meters.

Shaded areas are model dependent.
### Parameter Value Chart

#### Display and Program Lockout Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>A CNb</td>
<td>COUNTER A DISPLAY LOCK-OUT</td>
<td>rEd</td>
<td></td>
</tr>
<tr>
<td>b CNb</td>
<td>COUNTER B DISPLAY LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>c CNb</td>
<td>COUNTER C DISPLAY LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>r ALE</td>
<td>RATE DISPLAY LOCK-OUT</td>
<td>rEd</td>
<td></td>
</tr>
<tr>
<td>r Ed</td>
<td>MAX DISPLAY LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>L0</td>
<td>MIN DISPLAY LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>SP- 1</td>
<td>SETPOINT 1 ACCESS LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>SP- 2</td>
<td>SETPOINT 2 ACCESS LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>SP- 3</td>
<td>SETPOINT 3 ACCESS LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>SP- 4</td>
<td>SETPOINT 4 ACCESS LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>RACNtLd</td>
<td>COUNT LOAD A ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>bCNtLd</td>
<td>COUNT LOAD B ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>cCNtLd</td>
<td>COUNT LOAD C ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>ASCFAC</td>
<td>SCALE FACTOR A ACCESS</td>
<td>ENb</td>
<td></td>
</tr>
<tr>
<td>bSCFAC</td>
<td>SCALE FACTOR B ACCESS</td>
<td>LOC</td>
<td></td>
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### Rate Input Parameters - PAXI & R only

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<td>r ALEEn</td>
<td>RATE ASSIGNMENT</td>
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<td>r dSP 3</td>
<td>SCALING PT. 3 - DISPLAY VALUE</td>
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* See Module 2, Exchanging Parameter Lists, for details on programming this value.

Shaded areas are model dependent.
### 6-SPt Setpoint (Alarm) Parameters

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<th>FACTORY SETTING</th>
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<td>OUT-n</td>
<td>SETPOINT OUTPUT LOGIC</td>
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<td>SUP-n</td>
<td>SETPOINT POWER UP STATE</td>
<td>OFF</td>
<td>OFF</td>
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<tr>
<td>Rct-n</td>
<td>SETPOINT ACTION</td>
<td>OFF</td>
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<td>AS-n</td>
<td>SETPOINT ASSIGNMENT</td>
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<td>R Cnt</td>
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<td>SETPOINT VALUE (A)</td>
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<td>trC-n</td>
<td>SETPOINT TRACKING</td>
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<td>SETPOINT BOUNDARY TYPE</td>
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<td>Stb-n</td>
<td>STANDBY OPERATION</td>
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<td>HYS-n</td>
<td>SETPOINT Hysteresis (rate)</td>
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<td>OFF-n</td>
<td>SETPOINT OFF DELAY</td>
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<td>SETPOINT ON DELAY</td>
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<td>SETPOINT RESET WITH DISPLAY</td>
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<td>rSE-n</td>
<td>RESET WHEN SPhn+1 DEACTIVATES</td>
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* See Module 2, Exchanging Parameter Lists, for details on programming this value.

Shaded areas are model dependent.

### 7-SrL Serial Communication Parameters - PAXI only

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<td>Cnt B</td>
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### 8-RnR Analog Output Parameters - PAXI only

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### 9-FC5 Factory Service Parameters

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<th>FACTORY SETTING</th>
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<td>DISPLAY INTENSITY LEVEL</td>
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### LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Counter parameters apply to the PAXC and PAXI, while the rate parameters apply to the PAXR and PAXI.
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.

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.

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.
**ORDERING INFORMATION**

**Meter Part Numbers**

<table>
<thead>
<tr>
<th>PAX</th>
<th>0</th>
</tr>
</thead>
</table>

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

**Option Card and Accessories Part Numbers**

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<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
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<td>PAXCDS</td>
<td>Dual Setpoint Relay Output Card</td>
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<td>Quad Setpoint Relay Output Card</td>
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<td>Quad Setpoint Sinking Open Collector Output Card</td>
<td>PAXCDS30</td>
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<td>Quad Setpoint Sourcing Open Collector Output Card</td>
<td>PAXCDS40</td>
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<td>PAXCDC</td>
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<td>PAXCDC4C</td>
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<td>Profinbus-DP Communications Card</td>
<td>PAXCDC50</td>
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<td>PAXRTC</td>
<td>Real-Time Clock Card (Replacement Only)</td>
<td>PAXRTC00</td>
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<td></td>
<td>SFCRD*</td>
<td>Crimson® 2 PC Configuration Software for Windows 98, ME, 2000 and XP</td>
<td>SFCRD200</td>
</tr>
</tbody>
</table>

*Crimson® software is available for download from http://www.redlion.net/*
1. **DISPLAY**: 6 digit, 0.56" (14.2 mm) red sunlight readable or standard green LED

2. **POWER**:  
   AC Versions (PAXC0000, PAXT0000):  
   - 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 (PAXC0100, PAXT0100):  
   - DC Power: 11 to 36 VDC, 14 W  
     (Note: 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  
     (Note: 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**:  
   - Cycle Counter Display: SP1 - Setpoint 1 Output  
   - Cycle Counter Display: SP2 - Setpoint 2 Output  
   - 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 (PAXC)**:  
   - 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 Expecancy: 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): \( V_{IL} = 0.9 \, \text{V max.}, \ 22 \, \Omega \) pull-up to +12 VDC.  
    - Current Sourcing (active high): \( V_{IH} = 3.6 \, \text{V min.}, \ 22 \, \Omega \) 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): \( V_{IL} = 0.9 \, \text{V max.}, \ 22 \, \Omega \) pull-up to +12 VDC.  
    - Current Sourcing (active high): \( V_{IH} = 3.6 \, \text{V min.}, \ 22 \, \Omega \) pull-down, Max. Continuous Input: 30 VDC.  
    - Isolation To Timer Input Common: Not isolated  
    - Response Time: 10 msec

12. **MEMORY**: Non-volatile EEPROM 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  
      - Listed by Underwriters Laboratories, Inc.  
      - UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M05  
      - Type 4X Enclosure rating (Face only), UL50  
      - CB Scheme Test Report # 04ME11209-20041018  
    - **EMC**:  
      - **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  
        - Fast transients (burst) EN 61000-4-4: Level 4; 2 kV 1/O  
        - RF conducted interference EN 61000-4-6: Level 3; 10 V/m  
        - RF interference EN 55022: 150 KHz - 80 MHz  
      - **Emissions to EN 55022**:  
        - EN 55022: 150 KHz - 80 MHz  
    - **Certifications and Compliance**:  
      - UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M05  
      - Type 4X Enclosure rating (Face only), UL50  
      - CB Scheme Test Report # 04ME11209-20041018  
    - **Enclosure Class**:  
      - UL Listed, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1  
      - UL50  
      - CB Scheme Test Report # 04ME11209-20041018  
    - **Power Mains Class**:  
      - UL Listed, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1  
      - UL50  
      - CB Scheme Test Report # 04ME11209-20041018  
    - **Power Mains Class**:  
      - UL Listed, File # E179259, UL61010A-1, CSA C22.2 No. 61010-1  
      - UL50  
      - CB Scheme Test Report # 04ME11209-20041018  

**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 outdoor use.  

17. **WEIGHT**: 10.1 oz. (286 g)
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.

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.

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 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.

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.

**Optional Plug-in Cards and Accessories**

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

**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 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.

**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.

**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 All 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
- **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 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 @ VSA T= 0.7 V max. VMAX = 30 V
- **Response Time**: 400 µsec. nominal with 2 msec. nominal turnover
- **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 turnover
- **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.

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.

**EMC INSTALLATION GUIDELINES**

- **Connections**
  - 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).

**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.

**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 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.

**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.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Part Number</th>
<th>RLC#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corcom</td>
<td>1 VR3</td>
<td>FCOR0000</td>
</tr>
<tr>
<td>TDK</td>
<td>ZCAT30S-1330A</td>
<td>LFCI0000</td>
</tr>
<tr>
<td>Steward</td>
<td>28B2019A-0A</td>
<td>RLC#</td>
</tr>
<tr>
<td>Fair-Rite</td>
<td>0443167251</td>
<td>FCOR0000</td>
</tr>
<tr>
<td>Schaffner</td>
<td>FN610-1/07</td>
<td>LFIL0000</td>
</tr>
<tr>
<td>Schaffner</td>
<td>FN670-1-8/07</td>
<td>LFCI0000</td>
</tr>
</tbody>
</table>

**Note:** Reference manufacturer’s instructions when installing a line filter.

**Line Filters for input power cables:**

- Schaffner # FN610-1/07 (RLC# LFIL0000)
- Schaffner # FN670-1-8/07 (RLC# LFCI0000)
- Corcom # 1 VR3

**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 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.
4.4 SETPOINT (ALARMS) WIRING

### SETPOINT PLUG-IN CARD TERMINALS

<table>
<thead>
<tr>
<th>DUAL RELAY PAXCDS10</th>
<th>QUAD RELAY PAXCDS20</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>21</td>
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<td>22</td>
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<td>24</td>
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<tr>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUAD SINKING PAXCDS30</th>
<th>QUAD SOURCING PAXCDS40</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - COMMON</td>
<td>20 - EXTERNAL SUPPLY</td>
</tr>
<tr>
<td>21 - O1 SNK.</td>
<td>21 - O1 SRC.</td>
</tr>
<tr>
<td>22 - O2 SNK.</td>
<td>22 - O2 SRC.</td>
</tr>
<tr>
<td>23 - O3 SNK.</td>
<td>23 - O3 SRC.</td>
</tr>
<tr>
<td>24 - O4 SNK.</td>
<td>24 - O4 SRC.</td>
</tr>
<tr>
<td>25 - COMMON</td>
<td>25 - COMMON</td>
</tr>
</tbody>
</table>

### SOURCING OUTPUT LOGIC CARD

- +24V
- EXTERNAL SUPPLY (30 V MAX.)
- ISOLATION
- SOURCE OUT
- COMM.

### SINKING OUTPUT LOGIC CARD

- SINK OUT (30 V MAX.)
- ISOLATION
- COMM.

4.5 SERIAL COMMUNICATION WIRING

#### 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 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.
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.

5.0 REVIEWING THE Front Buttons And Display

Readout Legends*

Setpoint Alarm Annunciators

** 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 $\text{dr$:St•f}$ (Reset Display)
6.0 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; 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 “*” 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 Prn and the present module (initially NO). The arrow keys (F1, F2 and F3) 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 Prn 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, F2 and F3) 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 Prn NO)**

The Programming Mode is exited by pressing the DSP key (from anywhere in the Programming Mode) or the PAR key (with Prn 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.)
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**

- **Seconds**
  - 0.01 sec
  - 0.001 sec
  - 0.1 sec
  - 0.01 sec
  - 1 sec

- **Minutes**
  - 0.01 min
  - 0.001 min
  - 1 min
  - 0.01 min
  - 0.1 min
  - 1 min

- **Hours**
  - 0.01 hr
  - 0.001 hr
  - 1 hr
  - 0.01 hr
  - 0.1 hr
  - 1 hr

- **Days/Hours/Minutes**
  - 0.01 day
  - 0.001 day
  - 1 day
  - 0.01 day
  - 0.1 day
  - 1 day

**TIMER INPUT OPERATION**

- **EdgE-2, Edr5-2**
  - Edge Triggered Operation - 2 Input
  - Timing direction can be reversed through a User Input. (See Module 2.)

- **HoLd-2, HoSt-2**
  - Hold Operation - 2 Input, with Display Hold

**PARAMETER MENU**

- **Timer Range**
- **Timer Input Operation**
- **Timer Input Filtering**
- **Timer Start Value**
- **Timer Stop Value**

**TIMING DIRECTION**

Timing direction can be reversed through a User Input. (See Module 2.)

**TIMER INPUT FILTERING**

Provides a 50 msec debounce for the Timer Inputs (A and B). Select ON when using relays or switch contacts as a signal source.

**TIMER START VALUE**

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**

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.
6.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)

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

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

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

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 L 15k-a and L 15k-b. If a User Input is used to select the list, then L 15k-a is selected when the User Input is in the inactive state and L 15k-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 L 15k-a and L 15k-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 1st-1, t 1st-2, t 1st-3, t 1st-4), and if applicable, the Setpoint On/Off and Time-Out Values (SP-1, SP-2, SP-3, SP-4), and the Setpoint Daily On/Off Occurrence (d ON-1, d ON-2, d ON-3, d ON-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 - I**

**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.

<table>
<thead>
<tr>
<th>Scrolling Speed</th>
<th>25 SEC</th>
<th>5 SEC</th>
</tr>
</thead>
</table>

### DISPLAY SELECT (Edge Triggered)

**USER - I**

**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 - I**

**drSk - 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 - I**

**drSk - 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 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 - I**

**rSk - L**

When active (maintained action), the meter continually resets the displays entered as YES in the sublist. Program only one user input for this function. This function does not apply to the RTC Time or Date displays.

### MOMENTARY RESET (Edge Triggered)

**USER - I**

**rSk - 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 HOLD (Level Active)

**USER - I**

**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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-dSP</td>
<td>Timer</td>
<td>NO</td>
</tr>
<tr>
<td>C-dSP</td>
<td>Cycle Counter</td>
<td>NO</td>
</tr>
</tbody>
</table>

### DISPLAY HOLD and RESET (Level Active Reset)

**USER - I**

**HrSk - 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 HOLD and RESET (Edge Triggered Reset)

**USER - I**

**HrSk - 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.

### INHIBIT (Level Active)

**USER - I**

**INHIB - W**

When active (maintained action), timing and counting ceases for the displays entered as YES in the sublist. The inhibit function is not a tSk or tSkSP event in Setpoint programming. This function does not apply to RTC Time or Date displays. Program only one user input for this function.

### CHANGE DIRECTION (Level Active)

**USER - I**

**C-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.
**CHANGE DISPLAY INTENSITY LEVEL**

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. 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**

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)**

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.

**OUTPUT SET (Level Active)**

When activated (maintained action), the meter continually activates the output for all Setpoints entered as YES in the sublist.

**OUTPUT SET (Edge Triggered)**

When activated (momentary action), the meter activates the output for all Setpoints entered as YES in the sublist.

**OUTPUT RESET (Level Active)**

When activated (maintained action), the meter continually deactivates the output for all Setpoints entered as YES in the sublist.

**OUTPUT RESET (Edge Triggered)**

When activated (momentary action), the meter deactivates the output for all Setpoints entered as YES in the sublist.

**CHANGE DISPLAY INTENSITY LEVEL**

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. 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**

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)**

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.

**OUTPUT SET (Level Active)**

When activated (maintained action), the meter continually activates the output for all Setpoints entered as YES in the sublist.

**OUTPUT SET (Edge Triggered)**

When activated (momentary action), the meter activates the output for all Setpoints entered as YES in the sublist.

**OUTPUT RESET (Level Active)**

When activated (maintained action), the meter continually deactivates the output for all Setpoints entered as YES in the sublist.

**OUTPUT RESET (Edge Triggered)**

When activated (momentary action), the meter deactivates the output for all Setpoints entered as YES in the sublist.
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 (E-&7) 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:

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>rEd</td>
<td>Visible in Display Mode</td>
</tr>
<tr>
<td>Lock</td>
<td>rLoc</td>
<td>Not visible in Display Mode</td>
</tr>
</tbody>
</table>

These displays can be programmed for rEd or rLoc. When a particular meter function is not used, the Display Lock-out should be set to rLoc 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:

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read</td>
<td>rEd</td>
<td>Visible, not changeable, in Quick Programming Mode</td>
</tr>
<tr>
<td>Enter</td>
<td>ENt</td>
<td>Visible and changeable in Quick Programming Mode</td>
</tr>
<tr>
<td>Lock</td>
<td>rLoc</td>
<td>Not visible in Quick Programming Mode</td>
</tr>
</tbody>
</table>

Setpoint Values for SP1 thru SP4 can be programmed for rEd, ENt, or rLoc. SPDF-n and rOut-n are only displayed when they apply to the Setpoint Action (rEd-n) programmed for that particular Setpoint. (See Module 6 for details.)
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**

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-@t) 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.

**CYCLE COUNTER COUNTING DIRECTION**

Counting direction can be reversed through a User Input. (See Module 2.)

**CYCLE COUNTER START VALUE**

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**

The Cycle Counter stops counting when this value is reached, regardless of the operation of the Timer. Selecting yes will display the 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.

**CYCLE COUNTER RESET AT POWER-UP**

The Cycle Counter can be programmed to Reset at each meter power-up.

---

**6.4 MODULE 4 - CYCLE COUNTER PARAMETERS (CYC-CTY)**

**6.5 MODULE 5 - TIMER OPERATING MODES (S-OPEr)**

This module can only be accessed if a Setpoint Card is installed.

**PREDEFINED TIMER OPERATING MODE**

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 will appear.

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.
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.

Input A
Output 1

On-Delay Timing

Input A
Output 1

Off-Delay Timing

Input A
Output 1

Repeat Cycle Timing

Input A
Output 1

Interval Timing (Level triggered)

Input A
Output 1

Interval Timing (Edge triggered)

Input A
Output 1

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).

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).

Parameter Settings for Predefined Timer Operating Modes

**MODULE 1 - Timer Input Parameters (1*INP)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>ON-dLY</th>
<th>OFF-dLY</th>
<th>rEPEAt</th>
<th>dLY INk</th>
<th>INk-1</th>
<th>INk-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>INP OP</td>
<td>Timer Input Operation</td>
<td>EdrS-2</td>
<td>EdrS-2</td>
<td>EdrS-2</td>
<td>EdrS-2</td>
<td>LEUrSb</td>
<td>EdrS-2</td>
</tr>
</tbody>
</table>

**MODULE 2 - User Input Parameters (2*FNC)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>ON-dLY</th>
<th>OFF-dLY</th>
<th>rEPEAt</th>
<th>dLY INk</th>
<th>INk-1</th>
<th>INk-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE-1</td>
<td>User Input 1</td>
<td>N/A</td>
<td>rSk-L</td>
<td>N/A</td>
<td>N/A</td>
<td>rSk-E</td>
<td>N/A</td>
</tr>
<tr>
<td>rSb</td>
<td>Reset Key</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

**MODULE 6 - Setpoint Parameters (6*SPk)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>ON-dLY</th>
<th>OFF-dLY</th>
<th>rEPEAt</th>
<th>dLY INk</th>
<th>INk-1</th>
<th>INk-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPSEL</td>
<td>Setpoint Select</td>
<td>SP-I</td>
<td>SP-I</td>
<td>SP-I</td>
<td>SP-I</td>
<td>SP-I</td>
<td>SP-I</td>
</tr>
<tr>
<td>RSN-1</td>
<td>Setpoint Assignment</td>
<td>rSk-SP</td>
<td>rSk-SP</td>
<td>rSk-SP</td>
<td>rSk-SP</td>
<td>rSk-SP</td>
<td>rSk-SP</td>
</tr>
<tr>
<td>RClk-1</td>
<td>Setpoint Action</td>
<td>LRClk</td>
<td>ON-OFF</td>
<td>ON-OFF</td>
<td>ON-OFF</td>
<td>ON-OFF</td>
<td>ON-OFF</td>
</tr>
<tr>
<td>OUT-1</td>
<td>Output Logic</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
</tr>
<tr>
<td>ON-1</td>
<td>Setpoint On</td>
<td>rULe</td>
<td>rSk-b</td>
<td>rULe</td>
<td>rSk-b</td>
<td>rSk-b</td>
<td>rSk-b</td>
</tr>
<tr>
<td>SP-1</td>
<td>Setpoint On Value</td>
<td>T*</td>
<td>N/A</td>
<td>T*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>OFF-1</td>
<td>Setpoint Off</td>
<td>N/A</td>
<td>TRUE</td>
<td>N/A</td>
<td>T*</td>
<td>N/A</td>
<td>T*</td>
</tr>
<tr>
<td>SPDf-1</td>
<td>Setpoint Off Value</td>
<td>N/A</td>
<td>T*</td>
<td>N/A</td>
<td>T*</td>
<td>N/A</td>
<td>T*</td>
</tr>
<tr>
<td>TDUT-1</td>
<td>Time-out Value</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>T*</td>
<td>N/A</td>
</tr>
<tr>
<td>LSTP-1</td>
<td>Timer Stop</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
</tr>
<tr>
<td>RST-1</td>
<td>Timer/Counter Auto Reset</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
<td>rOr</td>
</tr>
<tr>
<td>ORd-1</td>
<td>Output Reset with display Reset</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>L*Clk-1</td>
<td>Setpoint Annunciator</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>P-UP-1</td>
<td>Power-up State</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

* 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)

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.

SETPOINT SELECT

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

Select the meter display to which the Setpoint is assigned. This parameter determines when the Setpoint output will activate. Output activation can occur at a specific Setpoint Value (VALUE) or can be triggered by various "events", as shown in the parameter list. Such events include the Timer starting (t-STK) or stopping (t-SLOP), 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.

By selecting VALUE, the date value is entered in month.day.year format (mdy). When assigned to the Real-Time Clock Time Display (t-CF-t), the date value is always entered in HH-MMP 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.

SETPOINT ACTION

This parameter determines the mode for output deactivation as shown below. Output deactivation is controlled by the SETPOINT ON parameter setting.

<table>
<thead>
<tr>
<th>LATCH</th>
<th>t-OUT</th>
<th>ON-OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latched Output Mode</td>
<td>At Reset (Manual or Automatic)</td>
<td>After &quot;Time-Out Value&quot; Elapses</td>
</tr>
</tbody>
</table>

The t-OUT and ON-OFF selections are not available when Setpoint is assigned to t-CF-t.

OUTPUT LOGIC

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

This parameter determines when the Setpoint output will activate. Output activation can occur at a specific Setpoint Value (VALUE) or can be triggered by various "events", as shown in the parameter list. Such events include the Timer starting (t-STK) or stopping (t-SLOP), 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 VALUE 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 (RSN-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 (t-CF-t), the date value is entered in month.day.year format (mdy). When assigned to the Real-Time Clock Time Display (t-CF-t), the Setpoint value is always entered in HH-MMP 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.

SETPOINT OFF

The Setpoint Off parameter only appears when the Setpoint Action (t-CF-t) 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 (VALUE) or can be triggered by various "events", as shown in the parameter list. Such events include the Timer starting (t-STK) or stopping (t-SLOP), 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 VALUE 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 (RSN-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 (t-CF-t), the date value is entered in month.day.year format (mdy). When assigned to the Real-Time Clock Time Display (t-CF-t), the value is always entered in HH-MMP format (Hours-Minutes with AM/PM selection).
The Time-Out Value only appears when the Setpoint Action (RSet-\text{-}n) is programmed for Timed Output mode (\text{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**

This parameter only appears when the Setpoint is assigned (\text{RSn-}\text{n}) to the Real-Time Clock Time display (\text{tEC-}\text{t}). This parameter determines the days of the week the Setpoint output will activate.

Selecting \text{YES} displays a sublist for choosing the days of the week. On all days entered as \text{YES} in the sublist, the output will activate. On all days entered as \text{NO}, the output will not activate. The output activation is repetitive, and will occur every week on the chosen day(s).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>Sunday</td>
<td>NO</td>
</tr>
<tr>
<td>Mon</td>
<td>Monday</td>
<td>YES</td>
</tr>
<tr>
<td>Tue</td>
<td>Tuesday</td>
<td>YES</td>
</tr>
<tr>
<td>Wed</td>
<td>Wednesday</td>
<td>YES</td>
</tr>
<tr>
<td>Thu</td>
<td>Thursday</td>
<td>YES</td>
</tr>
<tr>
<td>Fri</td>
<td>Friday</td>
<td>YES</td>
</tr>
<tr>
<td>Sat</td>
<td>Saturday</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Setpoint One-Shot Mode**

If all days are set to \text{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 lit (flashing). When the 2nd digit decimal point is lit, the Setpoint is enabled. The Setpoint enable status is saved repeatedly while the AM/PM digit is selected (flashing). When the 2nd digit shot alarm, go to the Setpoint value entry display and press the Up or Dn key set time and disable itself from activating again. To enable or re-enable a one-shot setpoint is enabled (armed), the setpoint output will activate at the

determines the days of the week when the Setpoint output will deactivate.

If all days are set to \text{NO}, the output will not deactivate. The output deactivation is repetitive, and will occur every week on the chosen day(s).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>Sunday</td>
<td>NO</td>
</tr>
<tr>
<td>Mon</td>
<td>Monday</td>
<td>YES</td>
</tr>
<tr>
<td>Tue</td>
<td>Tuesday</td>
<td>YES</td>
</tr>
<tr>
<td>Wed</td>
<td>Wednesday</td>
<td>YES</td>
</tr>
<tr>
<td>Thu</td>
<td>Thursday</td>
<td>YES</td>
</tr>
<tr>
<td>Fri</td>
<td>Friday</td>
<td>YES</td>
</tr>
<tr>
<td>Sat</td>
<td>Saturday</td>
<td>NO</td>
</tr>
</tbody>
</table>

**PAXCK: DAILY OFF OCCURRENCE**

This parameter only appears when the Setpoint is assigned (\text{RSn-}\text{n}) to the Real-Time Clock Time display (\text{tEC-}\text{t}) and when the Setpoint Action (\text{RSet-}\text{n}) is programmed for On-Off Output mode (\text{OOn-}\text{r}). In this mode, this parameter determines the days of the week the Setpoint output will deactivate.

Selecting \text{YES} displays a sublist for choosing the days of the week. On all days entered as \text{YES} in the sublist, the output will deactivate. On all days entered as \text{NO}, the output will not deactivate. The output deactivation is repetitive, and will occur every week on the chosen day(s).

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>Sunday</td>
<td>NO</td>
</tr>
<tr>
<td>Mon</td>
<td>Monday</td>
<td>YES</td>
</tr>
<tr>
<td>Tue</td>
<td>Tuesday</td>
<td>YES</td>
</tr>
<tr>
<td>Wed</td>
<td>Wednesday</td>
<td>YES</td>
</tr>
<tr>
<td>Thu</td>
<td>Thursday</td>
<td>YES</td>
</tr>
<tr>
<td>Fri</td>
<td>Friday</td>
<td>YES</td>
</tr>
<tr>
<td>Sat</td>
<td>Saturday</td>
<td>NO</td>
</tr>
</tbody>
</table>
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 PAX. (See ordering information.) For serial hardware and wiring details, refer to the bulletin shipped with each card.

### Baud Rate

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

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

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 odd, an additional stop bit is used to force the frame size to 10 bits.

### Meter Address

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

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

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

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.

### Table: Parameters

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Factory</th>
<th>Mnemonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-DSP</td>
<td>YES</td>
<td>CNT</td>
</tr>
<tr>
<td>t-DSP</td>
<td>NO</td>
<td>DAT</td>
</tr>
<tr>
<td>r-EC-d</td>
<td>NO</td>
<td>TIM</td>
</tr>
<tr>
<td>r-EC-t</td>
<td>NO</td>
<td>TIM</td>
</tr>
<tr>
<td>SPnL</td>
<td>SP1 SP2 SP3 SP4</td>
<td></td>
</tr>
<tr>
<td>SPnLOF</td>
<td>SO1 SO2 SO3 SO4</td>
<td></td>
</tr>
<tr>
<td>StrSFP</td>
<td>TST TSP CST CSP</td>
<td></td>
</tr>
</tbody>
</table>

* 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 B, 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

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Node (Meter) Address Specifier</td>
<td>Address a specific meter. Must be followed by node address. Not required when address = 00.</td>
</tr>
<tr>
<td>T</td>
<td>Transmit Value (read)</td>
<td>Read a register from the meter. Must be followed by register ID character.</td>
</tr>
<tr>
<td>V</td>
<td>Value change (write)</td>
<td>Write to register of the meter. Must be followed by register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a register or output. Must be followed by register ID character.</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers are defined in programming.</td>
</tr>
</tbody>
</table>

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 EPROM memory. Values are not stored if the $ terminator is used.

Register Identification Chart

<table>
<thead>
<tr>
<th>ID</th>
<th>DESCRIPTION</th>
<th>REGISTER NAME</th>
<th>COMMAND</th>
<th>TRANSMIT DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Timer Value</td>
<td>TMR</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>B</td>
<td>Cycle Counter Value</td>
<td>CNT</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>C</td>
<td>RTC Time Value</td>
<td>TIM</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>D</td>
<td>RTC Date Value</td>
<td>DAT</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>E</td>
<td>Setpoint 1</td>
<td>SP1</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>F</td>
<td>Setpoint 2</td>
<td>SP2</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>G</td>
<td>Setpoint 3</td>
<td>SP3</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>H</td>
<td>Setpoint 4</td>
<td>SP4</td>
<td>T, V, R</td>
<td>6 digit</td>
</tr>
<tr>
<td>I</td>
<td>Setpoint 1 Off Value</td>
<td>SO1</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>J</td>
<td>Setpoint 2 Off Value</td>
<td>SO2</td>
<td>T, V</td>
<td>5 digit</td>
</tr>
<tr>
<td>K</td>
<td>Setpoint 3 Off Value</td>
<td>SO3</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>L</td>
<td>Setpoint 4 Off Value</td>
<td>SO4</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>M</td>
<td>Timer Start Value</td>
<td>TST</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>O</td>
<td>Cycle Counter Start Value</td>
<td>CST</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>Q</td>
<td>Timer Stop Value</td>
<td>TSP</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>S</td>
<td>Cycle Counter Stop Value</td>
<td>CSP</td>
<td>T, V</td>
<td>6 digit</td>
</tr>
<tr>
<td>U</td>
<td>Auto/Man Register</td>
<td>MMR</td>
<td>T, V</td>
<td>0 - auto, 1 - manual</td>
</tr>
<tr>
<td>W</td>
<td>Day of Week Value</td>
<td>DAY</td>
<td>T, V</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Setpoint Register</td>
<td>SOR</td>
<td>T, V</td>
<td>0 - not active, 1 - active</td>
</tr>
</tbody>
</table>

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.

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. (i.e. 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 (HHIMMSS)
  - 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 (Rbbr = 1D)**

<table>
<thead>
<tr>
<th>BYTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>2 byte Node (Meter) Address field [00-99]</td>
</tr>
<tr>
<td>3</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>4-6</td>
<td>3 byte Register Mnemonic field</td>
</tr>
<tr>
<td>7-18</td>
<td>12 byte numeric data field: 6 bytes for number, up to 3 for decimal points.</td>
</tr>
<tr>
<td>19</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>20</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>21</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>22</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>23</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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 mnemonics.

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 (Rbbr = 1E5)**

<table>
<thead>
<tr>
<th>BYTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 6 bytes for number, up to 3 bytes for decimal points.</td>
</tr>
<tr>
<td>13</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>14</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>15</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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 <LF> Fk in programming module 7 (serial) to 1D. 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.

---

**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 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.

\[ t₁ = \left( \frac{10 \text{ times the # of characters}}{\text{baud rate}} \right) \]

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. 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. 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 (t₂) 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 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. At the end of t₃, the meter is ready to receive the next command.

\[ t₃ = \left( \frac{10 \text{ times the # of characters}}{\text{baud rate}} \right) \]

---

**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.

**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.

**Example:** VX10* will result in output 1 active and output 2 inactive.

---

**Serial Timing**

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>COMMENT</th>
<th>PROCESS TIME (t₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Reset</td>
<td>2-50 msec.</td>
</tr>
<tr>
<td>V</td>
<td>Write</td>
<td>100-200 msec.</td>
</tr>
<tr>
<td>T</td>
<td>Transmit</td>
<td>2-50 msec. for $</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-100 msec. for $</td>
</tr>
<tr>
<td>P</td>
<td>Print</td>
<td>2-50 msec. for $</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-100 msec. for $</td>
</tr>
</tbody>
</table>

**Timing Diagrams**

**NO REPLY FROM METER**

**RESPONSE FROM METER**

---

22
**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.

<table>
<thead>
<tr>
<th>LOGIC</th>
<th>INTERFACE STATE</th>
<th>RS232*</th>
<th>RS485*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mark (idle)</td>
<td>TXD,RXD; -3 to -25 V</td>
<td>a-b &lt; -200 mV</td>
</tr>
<tr>
<td>0</td>
<td>space (active)</td>
<td>TXD,RXD; +3 to +25 V</td>
<td>a-b &gt; +200 mV</td>
</tr>
</tbody>
</table>

* 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.

**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.

---

**6.8 MODULE 8 - REAL-TIME CLOCK PARAMETERS (B-rkE) - 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**

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.

**SET DATE**

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.

**SET DAY**

Set the Day of the week for the Real-Time Clock.
**TIME DISPLAY FORMAT**

```
12-59P 12-59 23-59
```

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**

```
Jan-31 31-Jan Sun-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
```

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
```

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 (#25), 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 Daylight Savings Time. (Adjustment dates are U.S.A. standard only.) Avoid setpoints that occur during adjustment (Sundays 1 to 3 AM).

**CALIBRATE REAL-TIME CLOCK**

```
Cal
```

*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
```

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:**

<table>
<thead>
<tr>
<th>SECONDS GAINED IN 30 DAYS</th>
<th>ENTER THIS OFFSET VALUE</th>
<th>SECONDS GAINED IN 30 DAYS</th>
<th>ENTER THIS OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>01</td>
<td>90</td>
<td>17</td>
</tr>
<tr>
<td>11</td>
<td>02</td>
<td>95</td>
<td>18</td>
</tr>
<tr>
<td>16</td>
<td>03</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td>04</td>
<td>105</td>
<td>20</td>
</tr>
<tr>
<td>26</td>
<td>05</td>
<td>111</td>
<td>21</td>
</tr>
<tr>
<td>32</td>
<td>06</td>
<td>116</td>
<td>22</td>
</tr>
<tr>
<td>37</td>
<td>07</td>
<td>121</td>
<td>23</td>
</tr>
<tr>
<td>42</td>
<td>08</td>
<td>127</td>
<td>24</td>
</tr>
<tr>
<td>47</td>
<td>09</td>
<td>132</td>
<td>25</td>
</tr>
<tr>
<td>53</td>
<td>10</td>
<td>137</td>
<td>26</td>
</tr>
<tr>
<td>58</td>
<td>11</td>
<td>142</td>
<td>27</td>
</tr>
<tr>
<td>63</td>
<td>12</td>
<td>148</td>
<td>28</td>
</tr>
<tr>
<td>69</td>
<td>13</td>
<td>153</td>
<td>29</td>
</tr>
<tr>
<td>74</td>
<td>14</td>
<td>158</td>
<td>30</td>
</tr>
<tr>
<td>79</td>
<td>15</td>
<td>163</td>
<td>31</td>
</tr>
<tr>
<td>84</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IF RTC CLOCK LOST TIME:**

<table>
<thead>
<tr>
<th>SECONDS LOST IN 30 DAYS</th>
<th>ENTER THIS OFFSET VALUE</th>
<th>SECONDS LOST IN 30 DAYS</th>
<th>ENTER THIS OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>33</td>
<td>179</td>
<td>49</td>
</tr>
<tr>
<td>21</td>
<td>34</td>
<td>190</td>
<td>50</td>
</tr>
<tr>
<td>32</td>
<td>35</td>
<td>200</td>
<td>51</td>
</tr>
<tr>
<td>42</td>
<td>36</td>
<td>211</td>
<td>52</td>
</tr>
<tr>
<td>53</td>
<td>37</td>
<td>221</td>
<td>53</td>
</tr>
<tr>
<td>63</td>
<td>38</td>
<td>232</td>
<td>54</td>
</tr>
<tr>
<td>74</td>
<td>39</td>
<td>243</td>
<td>55</td>
</tr>
<tr>
<td>84</td>
<td>40</td>
<td>253</td>
<td>56</td>
</tr>
<tr>
<td>95</td>
<td>41</td>
<td>264</td>
<td>57</td>
</tr>
<tr>
<td>105</td>
<td>42</td>
<td>274</td>
<td>58</td>
</tr>
<tr>
<td>116</td>
<td>43</td>
<td>285</td>
<td>59</td>
</tr>
<tr>
<td>127</td>
<td>44</td>
<td>295</td>
<td>60</td>
</tr>
<tr>
<td>137</td>
<td>45</td>
<td>306</td>
<td>61</td>
</tr>
<tr>
<td>148</td>
<td>46</td>
<td>316</td>
<td>62</td>
</tr>
<tr>
<td>156</td>
<td>47</td>
<td>327</td>
<td>63</td>
</tr>
<tr>
<td>169</td>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 $E& 0$ and then returns to Code 056. 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 Calibration 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.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power level, power connections</td>
</tr>
<tr>
<td>PROGRAMMING LOCKED-OUT</td>
<td>CHECK: User input set for program lock-out function is in Active state</td>
</tr>
<tr>
<td></td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td>CERTAIN DISPLAYS ARE LOCKED-OUT</td>
<td>CHECK: Display Lock-out programming in Module 3</td>
</tr>
<tr>
<td>MODULES or PARAMETERS NOT ACCESSIBLE</td>
<td>CHECK: Corresponding plug-in card installation, Program Lock-out/ Value Access parameter programming in Module 3</td>
</tr>
<tr>
<td>TIMER NOT RUNNING</td>
<td>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</td>
</tr>
<tr>
<td>USER INPUT NOT WORKING PROPERLY</td>
<td>CHECK: User input wiring, user input plug jumper setting, user input signal level, user input programming in Module 2</td>
</tr>
<tr>
<td>OUTPUTS NOT WORKING PROPERLY</td>
<td>CHECK: Setpoint plug-in card installation, wiring, Setpoint programming in Module 6</td>
</tr>
<tr>
<td>REAL-TIME CLOCK NOT WORKING PROPERLY</td>
<td>CHECK: RTC plug-in card installation, RTC programming in Module 8, check for proper battery installation, replace battery. <strong>DO NOT ADJUST TRIM CAP ON RTC CARD!</strong></td>
</tr>
<tr>
<td>SERIAL COMMUNICATIONS NOT WORKING</td>
<td>CHECK: Serial plug-in card installation, Serial wiring, Serial settings in Module 7, host settings</td>
</tr>
<tr>
<td>ERROR CODE (Err 1-4)</td>
<td>PRESS: Reset key (If unable to clear, contact factory.)</td>
</tr>
</tbody>
</table>

Shaded areas are model dependent.

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

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No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
## 1 - IMP Timer Input Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>rANGE</td>
<td>TIMER RANGE</td>
<td>SSSSSS</td>
<td></td>
</tr>
<tr>
<td>t-INP</td>
<td>TIMER INPUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FILTER</td>
<td>TIMER FILTERING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t STp</td>
<td>TIMER START VALUE</td>
<td>000000</td>
<td></td>
</tr>
<tr>
<td>t SToP</td>
<td>TIMER STOP VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>uRANGE</td>
<td>TIMER RANGE VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t STp</td>
<td>TIMER START VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>uRANGE</td>
<td>TIMER RANGE VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t SToP</td>
<td>TIMER STOP VALUE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 2 - FNC User Input and Function Key Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>USEr-1</td>
<td>USER INPUT 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USEr-2</td>
<td>USER INPUT 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USEr-3</td>
<td>USER INPUT 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>FUNCTION KEY 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>FUNCTION KEY 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rSt</td>
<td>RESET KEY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEC-F1</td>
<td>SECONDARY FUNCTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEC-F2</td>
<td>SECONDARY FUNCTION</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 3 - LOC Display and Program Lock-out Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>t dSP</td>
<td>TIMER DISPLAY LOCK-OUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C dSP</td>
<td>CYCLE COUNT DISPLAY LOCK-OUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rEd</td>
<td>RTC DATE DISPLAY LOCK-OUT</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>tEd</td>
<td>RTC TIME DISPLAY LOCK-OUT</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>tOUT-1</td>
<td>SP1 TIME-OUT VALUE ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>tOUT-2</td>
<td>SP2 TIME-OUT VALUE ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>tOUT-3</td>
<td>SP3 TIME-OUT VALUE ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>tOUT-4</td>
<td>SP4 TIME-OUT VALUE ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>t STrk</td>
<td>TIMER START VALUE ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>t SToP</td>
<td>TIMER STOP ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>t OUT</td>
<td>RTC TIME SETTING ACCESS</td>
<td></td>
<td>LOC</td>
</tr>
<tr>
<td>CoDE</td>
<td>SECURITY CODE</td>
<td>000</td>
<td></td>
</tr>
</tbody>
</table>

## 4 - CNt Cycle Counter Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Src</td>
<td>CYCLE COUNTER COUNT SOURCE</td>
<td></td>
<td>NONE</td>
</tr>
<tr>
<td>C dR</td>
<td>CYCLE COUNTER START VALUE</td>
<td></td>
<td>UP</td>
</tr>
<tr>
<td>C STrk</td>
<td>CYCLE COUNTER START VALUE (A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C SToP</td>
<td>CYCLE COUNTER STOP (A &amp; B)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>uRANGE</td>
<td>CYCLE COUNTER STOP VALUE (A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C P-UP</td>
<td>CYCLE. CNTR. RESET AT POWER-UP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 5 - OPeR Timer Operating Modes

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>t OPeR</td>
<td>PREDEFINED TIMER OPER. MODE</td>
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<tr>
<td>tSP-1</td>
<td>SETPOINT 1 ON VALUE</td>
<td></td>
<td></td>
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<tr>
<td>tSPDF-1</td>
<td>SETPOINT 1 OFF VALUE</td>
<td></td>
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<tr>
<td>tOUT-1</td>
<td>SETPOINT 1 TIME-OUT VALUE</td>
<td></td>
<td></td>
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</tbody>
</table>

* * See Module 2, Exchanging Parameter Lists, for details on programming this value.

Shaded areas are model dependent.
### 7-SrL Serial Communication Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
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<th>FACTORY SETTING</th>
<th>USER SETTING</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>bRulb</td>
<td>BAUD RATE</td>
<td>9600</td>
</tr>
<tr>
<td></td>
<td>dAlr</td>
<td>DATA BITS</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>par</td>
<td>PARITY BIT</td>
<td>odd</td>
</tr>
<tr>
<td></td>
<td>Addr</td>
<td>METER UNIT ADDRESS</td>
<td>00</td>
</tr>
<tr>
<td></td>
<td>abbr</td>
<td>ABBREVIATED PRINTING</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>rLCFlt</td>
<td>REAL-TIME CLOCK PRINT FORMAT</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Opt</td>
<td>PRINT OPTIONS</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>t-dSP</td>
<td>TIMER DISPLAY</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>c-dSP</td>
<td>CYCLE COUNTER DISPLAY</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>rLCdt</td>
<td>RTC DATE DISPLAY</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>rLCt</td>
<td>RTC TIME DISPLAY</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>SPAL</td>
<td>SETPOINT VALUES</td>
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</tr>
<tr>
<td></td>
<td>SPALOF</td>
<td>SETPOINT OFF/TIME-OUT VALUES</td>
<td>NO</td>
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</tbody>
</table>

### 8-rLc Real-Time Clock Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
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<tbody>
<tr>
<td></td>
<td>dSp-lt</td>
<td>TIME DISPLAY FORMAT</td>
<td>12-Sp</td>
</tr>
<tr>
<td></td>
<td>dSp-d</td>
<td>DATE DISPLAY FORMAT</td>
<td>12-31</td>
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<tr>
<td></td>
<td>ch-dSt</td>
<td>AUTO TIME CHANGE FOR D.S.T.</td>
<td>NO</td>
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<tr>
<td></td>
<td>Sync</td>
<td>SYNCHRONIZATION UNIT TYPE</td>
<td>SLAVE</td>
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<td></td>
<td>Cal</td>
<td>CALIBRATE REAL-TIME CLOCK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Offset</td>
<td>RTC CALIBRATION OFFSET VALUE</td>
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### 9-FcF5 Factory Service Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d-leu</td>
<td>DISPLAY INTENSITY LEVEL</td>
<td>3</td>
</tr>
</tbody>
</table>

* See Module 2, Exchanging Parameter Lists, for details on programming this value.

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 PAX – 1/8 DIN ANALOG INPUT PANEL METERS

- 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)
- RETRANSMITTER 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.

DIMENSIONS In inches (mm)

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.

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# Table of Contents

- Ordering Information ........................................... 2
- General Meter Specifications ............................... 3
- Universal DC Input Panel Meter ............................ 4
- Process Input Panel Meter .................................... 4
- AC True RMS Voltage and Current Meter ............... 5
- Strain Gage Input Panel Meter .............................. 5
- Thermocouple and RTD Input Meter ....................... 6
- Optional Plug-In Cards ....................................... 7
- Installing the Meter ........................................... 8
- Setting the Jumpers ............................................ 8
- Wiring the Meter ............................................... 10
- Reviewing the Front Buttons and Display ............... 13
- Programming the Meter ....................................... 14
- Factory Service Operations ................................. 23
- Parameter Value Chart ....................................... 25
- Programming Overview ....................................... 27

## Ordering Information

### Meter Part Numbers

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PAX</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

- **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.

### Option Card and Accessories Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PAXCDS</strong></td>
<td>Dual Setpoint Relay Output Card</td>
<td>PAXCDS10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quad Setpoint Relay Card</td>
<td>PAXCDS20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quad Setpoint Sinking Open Collector Output Card</td>
<td>PAXCDS30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quad Setpoint Sourcing Open Collector Output Card</td>
<td>PAXCDS40</td>
<td></td>
</tr>
<tr>
<td><strong>PAXCDC</strong></td>
<td>RS485 Serial Communications Output Card with Terminal Block</td>
<td>PAXCDC10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extended RS485 Serial Communications Output Card with Dual RJ11 Connector</td>
<td>PAXCDC1C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RS232 Serial Communications Output Card with Terminal Block</td>
<td>PAXCDC20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extended RS232 Serial Communications Output Card with 9 Pin D Connector</td>
<td>PAXCDC2C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DeviceNet Communications Card</td>
<td>PAXCDC30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Modbus Communications Card</td>
<td>PAXCDC40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extended Modbus Communications Card with Dual RJ11 Connector</td>
<td>PAXCDC4C</td>
<td></td>
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<tr>
<td></td>
<td>Profibus-DP Communications Card</td>
<td>PAXCDC50</td>
<td></td>
</tr>
<tr>
<td><strong>PAXCDL</strong></td>
<td>Analog Output Card</td>
<td>PAXCDL10</td>
<td></td>
</tr>
<tr>
<td><strong>PAXLBK</strong></td>
<td>Units Label Kit Accessory (Not required for PAXT)</td>
<td>PAXLBK10</td>
<td></td>
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<tr>
<td><strong>SFCRD</strong></td>
<td>Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP</td>
<td>SFCRD200</td>
<td></td>
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</tbody>
</table>

*Crimson software is available for 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  
   "h . . ." - Denotes the high order display of the Totalizer.  
   "E . . ." - Appears when Totalizer exceeds 9 digits.  
   "- . . ." - Appears when display values exceed - display range.  
   ". . . ." - Appears when display values exceed + display range.  
   PAXT: "OPEN" - Appears when open sensor is detected.  
   PAXT: "SHrt" - Appears when shorted sensor is detected. (RTD only)  
   "ULUL" - Appears when measurement exceeds - signal range  
   Total: 9 digits, display alternates between high order and low order readouts  
   Low Signal Cut-out: -19,999 to 99,999  
   Scale Factor: 0.001 to 65.000  
   Max/Min capture delay time: 0 to 3275 sec.  
   Analog output update rate: 0 to 10 sec  
   Setpoint output on/off delay time: 0 to 3275 sec.  
   Display update rate: 1 to 20 updates/sec.  
   Setpoint output on/off delay time: 0 to 3275 sec.  
   Max./Min. capture delay time: 0 to 3275 sec.

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)

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

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 E2PROM 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, 2g’s.  
    Shock According to IEC 68-2-27: Operational 25 g (10g 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  
    IEC6 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 K V/I/O  
    Level 3; 2 K 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 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.  

    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:

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE/COMPLIANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>±200 µADC</td>
<td>±0.03% of reading +0.2% µA</td>
<td>±0.12% of reading +0.04µA</td>
<td>1.11 Kohm</td>
<td>15 mA</td>
<td>10 nA</td>
</tr>
<tr>
<td>±2 mADC</td>
<td>±0.03% of reading +0.3 µA</td>
<td>±0.12% of reading +0.4 µA</td>
<td>111 ohm</td>
<td>50 mA</td>
<td>0.1 µA</td>
</tr>
<tr>
<td>±20 mADC</td>
<td>±0.03% of reading +3µA</td>
<td>±0.12% of reading +4 µA</td>
<td>11.1 ohm</td>
<td>150 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>±200 mADC</td>
<td>±0.05% of reading +30 µA</td>
<td>±0.15% of reading +60 µA</td>
<td>1.1 ohm</td>
<td>500 mA</td>
<td>10 µA</td>
</tr>
<tr>
<td>±2 ADC</td>
<td>±0.5% of reading +0.3 mA</td>
<td>±0.7% of reading +0.4 mA</td>
<td>0.1 ohm</td>
<td>3 A</td>
<td>0.1 µA</td>
</tr>
<tr>
<td>±200 mVDC</td>
<td>±0.12% of reading +30 µV</td>
<td>±0.12% of reading +60 µV</td>
<td>1.066 Mohm</td>
<td>100 V</td>
<td>1 µV</td>
</tr>
<tr>
<td>±2 VDC</td>
<td>±0.12% of reading +0.3 mV</td>
<td>±0.12% of reading +0.4 mV</td>
<td>1.066 Mohm</td>
<td>300 V</td>
<td>1 mV</td>
</tr>
<tr>
<td>±20 VDC</td>
<td>±0.12% of reading +3 mV</td>
<td>±0.15% of reading +10 mV</td>
<td>1.066 Mohm</td>
<td>1000 V</td>
<td>10 mV</td>
</tr>
<tr>
<td>±300 VDC</td>
<td>±0.15% of reading +30 mV</td>
<td>±0.15% of reading +40 mV</td>
<td>1.066 Mohm</td>
<td>300 V</td>
<td>10 mV</td>
</tr>
<tr>
<td>100 ohm</td>
<td>±0.2% of reading +100 ohm</td>
<td>±0.2% of reading +125 ohm</td>
<td>100 V</td>
<td>30 V</td>
<td>0.01 ohm</td>
</tr>
<tr>
<td>1000 ohm</td>
<td>±0.2% of reading +1000 ohm</td>
<td>±0.2% of reading +1250 ohm</td>
<td>17.5 V</td>
<td>30 V</td>
<td>1 ohm</td>
</tr>
<tr>
<td>10 Kohm</td>
<td>±0.2% of reading +1000 ohm</td>
<td>±0.2% of reading +1250 ohm</td>
<td>17.5 V</td>
<td>30 V</td>
<td>1 ohm</td>
</tr>
</tbody>
</table>

* 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.

MODEL PAXP - PROCESS INPUT

- DUAL RANGE INPUT (20 mA or 10 VDC)
- 24 VDC TRANSMITTER POWER

PAXP SPECIFICATIONS

SENSOR INPUTS:

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE/COMPLIANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>DISPLAY RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mA</td>
<td>±0.03% of reading +2 µA</td>
<td>±0.12% of reading +3 µA</td>
<td>20 ohm</td>
<td>150 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>10 VDC</td>
<td>±0.03% of reading +2 mV</td>
<td>±0.12% of reading +3 mV</td>
<td>500 Kohm</td>
<td>300 V</td>
<td>1 mV</td>
</tr>
</tbody>
</table>

* 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

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY*</th>
<th>IMPEDANCE (60 Hz)</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>MAX DC BLOCKING</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>0.1% of reading +0.4 mV</td>
<td>686 Kohm</td>
<td>30 V</td>
<td>±10 V</td>
<td>0.01 mV</td>
</tr>
<tr>
<td>2 V</td>
<td>0.1% of reading +0.2 mV</td>
<td>686 Kohm</td>
<td>30 V</td>
<td>±50 V</td>
<td>0.1 mV</td>
</tr>
<tr>
<td>20 V</td>
<td>0.1% of reading +20 mV</td>
<td>686 Kohm</td>
<td>300 V</td>
<td>±300 V</td>
<td>1 mV</td>
</tr>
<tr>
<td>300 V</td>
<td>0.2% of reading +0.3 V</td>
<td>686 Kohm</td>
<td>300 V</td>
<td>±300 V***</td>
<td>0.1 V</td>
</tr>
<tr>
<td>200 µA</td>
<td>0.1% of reading +0.4 µA</td>
<td>1.11 Kohm</td>
<td>15 mA</td>
<td>±15 mA</td>
<td>0.01 µA</td>
</tr>
<tr>
<td>2 mA</td>
<td>0.1% of reading +2 µA</td>
<td>111 ohm</td>
<td>50 mA</td>
<td>±50 mA</td>
<td>0.1 µA</td>
</tr>
<tr>
<td>20 mA</td>
<td>0.1% of reading +20 µA</td>
<td>11.1 ohm</td>
<td>150 mA</td>
<td>±150 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>200 mA</td>
<td>0.1% of reading +0.2 mA</td>
<td>1.1 ohm</td>
<td>500 mA</td>
<td>±500 mA</td>
<td>10 µA</td>
</tr>
<tr>
<td>5 A</td>
<td>0.5% of reading +5 mA</td>
<td>0.02 ohm</td>
<td>7 A**</td>
<td>±7 A***</td>
<td>1 mA</td>
</tr>
</tbody>
</table>

*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 (Vp/VRMS): 5 @ Full Scale Input

INPUT COUPLING: AC or AC and DC

INPUT CAPACITANCE: 10 pF

COMMON MODE VOLTAGE: 125 V AC 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:

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>±24 mVDC</td>
<td>0.02% of reading +3 µV</td>
<td>0.07% of reading +4 µV</td>
<td>100 Mohm</td>
<td>30 V</td>
<td>1 µV</td>
</tr>
<tr>
<td>±240 mVDC</td>
<td>0.02% of reading +30 µV</td>
<td>0.07% of reading +40 µV</td>
<td>100 Mohm</td>
<td>30 V</td>
<td>10 µV</td>
</tr>
</tbody>
</table>

* 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

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

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>RANGE</th>
<th>ACCURACY(^{\circ C}) (18 to 28°C)</th>
<th>ACCURACY(^{\circ C}) (0 to 50°C)</th>
<th>STANDARD</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>-200 to 400°C</td>
<td>1.2°C</td>
<td>2.1°C</td>
<td>ITS-90</td>
<td>(+) blue (+) red (+) white (+) blue</td>
</tr>
<tr>
<td>E</td>
<td>-200 to 871°C</td>
<td>1.0°C</td>
<td>2.4°C</td>
<td>ITS-90</td>
<td>(+) purple (+) red (+) brown (+) blue</td>
</tr>
<tr>
<td>J</td>
<td>-200 to 760°C</td>
<td>1.1°C</td>
<td>2.3°C</td>
<td>ITS-90</td>
<td>(+) white (+) red (+) yellow (+) blue</td>
</tr>
<tr>
<td>K</td>
<td>-200 to 1372°C</td>
<td>1.3°C</td>
<td>3.4°C</td>
<td>ITS-90</td>
<td>(+) yellow (+) red (+) brown (+) blue</td>
</tr>
<tr>
<td>R</td>
<td>-50 to 1768°C</td>
<td>1.9°C</td>
<td>4.0°C</td>
<td>ITS-90</td>
<td>no standard (+) white (+) blue</td>
</tr>
<tr>
<td>S</td>
<td>-50 to 1768°C</td>
<td>1.9°C</td>
<td>4.0°C</td>
<td>ITS-90</td>
<td>no standard (+) white (+) blue</td>
</tr>
<tr>
<td>B</td>
<td>100 to 300°C</td>
<td>3.9°C</td>
<td>5.7°C</td>
<td>ITS-90</td>
<td>no standard no standard</td>
</tr>
<tr>
<td>N</td>
<td>-200 to 1300°C</td>
<td>1.3°C</td>
<td>3.1°C</td>
<td>ITS-90</td>
<td>(+) orange (+) red (+) orange (+) blue</td>
</tr>
<tr>
<td>C</td>
<td>0 to 2315°C</td>
<td>1.9°C</td>
<td>6.1°C</td>
<td>ASTM E988-90***</td>
<td>no standard no standard</td>
</tr>
</tbody>
</table>

---

* 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 environment 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

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>RANGE</th>
<th>ACCURACY(^{\circ C}) (18 to 28°C)</th>
<th>ACCURACY(^{\circ C}) (0 to 50°C)</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 ohm Pt</td>
<td>-200 to 850°C</td>
<td>0.4°C</td>
<td>1.6°C</td>
<td>IEC 751</td>
</tr>
<tr>
<td>alpha = .00385</td>
<td>-200 to 850°C</td>
<td>0.4°C</td>
<td>1.6°C</td>
<td>no official standard</td>
</tr>
<tr>
<td>120 ohm Nickel</td>
<td>-80 to 260°C</td>
<td>0.2°C</td>
<td>0.5°C</td>
<td>no official standard</td>
</tr>
<tr>
<td>alpha = .00672</td>
<td>-80 to 260°C</td>
<td>0.2°C</td>
<td>0.5°C</td>
<td>no official standard</td>
</tr>
<tr>
<td>10 ohm Copper</td>
<td>-100 to 260°C</td>
<td>0.4°C</td>
<td>0.9°C</td>
<td>no official standard</td>
</tr>
<tr>
<td>alpha = .00427</td>
<td>-100 to 260°C</td>
<td>0.4°C</td>
<td>0.9°C</td>
<td>no official standard</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>RANGE</th>
<th>ACCURACY(^{\circ C}) (18 to 28°C)</th>
<th>ACCURACY(^{\circ C}) (0 to 50°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom mV</td>
<td>-10 to 85 mV</td>
<td>0.02% of reading + 4µV</td>
<td>0.12% of reading + 5µV</td>
</tr>
<tr>
<td>range (1 µV res.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custom</td>
<td>0 to 400 Ω</td>
<td>0.02% of reading + 0.04 Ω</td>
<td>0.12% of reading + 0.05 Ω</td>
</tr>
<tr>
<td>100 ohm range (10 MΩ res.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custom</td>
<td>0 to 25 Ω</td>
<td>0.04% of reading + 0.005 Ω</td>
<td>0.20% of reading + 0.007 Ω</td>
</tr>
<tr>
<td>10 ohm range (1 MΩ res.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 10.0 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.
**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.

### 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 RLCPro, a Windows® based program, the RS232 or RS485 Cards must be used.

- PAXCDC10 - RS485 Serial
- PAXCDC20 - RS232 Serial
- PAXCDC30 - DeviceNet

### 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)

### DEVICE NET™ 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 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 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

**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

**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 @ VSA T= 0.7 V max. VMAX = 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

**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)**
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.

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.

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.

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.
PAXP Jumper Selection

**JUMPER SELECTIONS**
The □ indicates factory setting.

**USER INPUT LOGIC JUMPER**
- □ SINK
- □ SOURCE

---

**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.

---

**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.

**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.

---

**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.

Avoid placing a jumper across two ranges.

---

**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.
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 #28B2029-0A
   - 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.

3.0 WIRING THE METER

3.1 POWER WIRING

<table>
<thead>
<tr>
<th>AC Power</th>
<th>DC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1: VAC</td>
<td>Terminal 1: +VDC</td>
</tr>
<tr>
<td>Terminal 2: VAC</td>
<td>Terminal 2: -VDC</td>
</tr>
</tbody>
</table>

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.

PAXT Jumper Selection

RTD INPUT JUMPER

100 ohms [ ]
10 ohms [ ]

USER INPUT JUMPERS

SINK [ ]
SOURCE [ ]
3.2 INPUT SIGNAL WIRING

PAXD INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper and Excitation Jumper should be verified for proper position.

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 5: +ADC
Terminal 6: +VDC

Excitation Jumper: 24 V

Voltage Signal (3 wire requiring excitation)
Terminal 3: +VDC (signal)
Terminal 5: -VDC (common)
Terminal 6: +VDC (common)

Excitation Jumper: 24 V

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.
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.

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.

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

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.
3.3 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 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 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.

---

3.4 SETPOINT (ALARMS) WIRING
3.5 SERIAL COMMUNICATION WIRING
3.6 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for details.

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4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

**Display Readout Legends**

- **MAX**
- **MIN**
- **TOT**
- **SP1**
- **SP2**
- **SP3**
- **SP4**
- **F1**
- **F2**
- **RST**

**Optional Custom Units Overlay**

- **Setpoint Alarm Annunciators**

**KEY**

- **DSP**  Index display through max/min/total/input readouts
- **PAR**  Access parameter list
- **F1**  Function key 1; hold for 3 seconds for Second Function 1
- **F2**  Function key 2; hold for 3 seconds for Second Function 2
- **RST**  Reset (Function key)

**PROGRAMMING MODE OPERATION**

- Quit programming and return to display mode
- Store selected parameter and index to next parameter
- Increment selected parameter value
- Decrement selected parameter value
- 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 “**#-fΔ**” 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 of preceding parameters. After completing a module, the display will return to Pr a 9. From this point, programming may continue by selecting and entering additional modules. (See MODULE ENTRY above.)

### 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 Pr a 9 and the present module (initially **9**). The arrow keys (F1 Δ and F2 Λ) 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.

#### PROGRAMMING MODE EXIT (DSP KEY or PAR KEY at Pr a 9)

The Programming Mode is exited by pressing the **DSP** key (from anywhere in the Programming Mode) or the **PAR** key (with Pr a 9 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 (1-1NP)

PAXH INPUT RANGE

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.

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.

PAXT INPUT TYPE

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.

PAXS PARAMETER MENU

Refer to the appropriate Input Range for the selected meter. Use only one Input Range, then proceed to Display Decimal Point.

PAXD INPUT RANGE

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

Select the input range that corresponds to the external signal.

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

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

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

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.

For the PAXT, these are only available with Custom Scaling.

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.

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.

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.
Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of 0.5' 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 ROUNING**

<table>
<thead>
<tr>
<th>round</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

These bottom selections are not available for the PAXT.

**PAXT: TEMPERATURE DISPLAY OFFSET**

OFFSET

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 '0' will remove the affects of offset.

**FILTER SETTING**

FILTER

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

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.

**DISPLAY VALUE FOR SCALING POINT 1**

DSP 1

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and RPLY scaling styles. The decimal point follows the DECP selection.

**INPUT VALUE FOR SCALING POINT 2**

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (RPLY), adjust the signal source externally until the next desired Input Value appears. (Follow the same procedure if using more than 2 scaling points.)

**SCALING POINTS**

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 (\( \text{INP} \)) and an associated desired Display Value (\( \text{DSP} \)).

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 (\( \text{INP} \)) and an associated desired Display Value (\( \text{DSP} \)). 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.

**INPUT VALUE FOR SCALING POINT 1**

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 (RPLY), 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.

**SCALING STYLE**

This parameter does not apply for the PAXT. Scaling values for the PAXT must be keyed-in.

**INPUT VALUE FOR SCALING POINT 2**

For Key-in (KEY), enter the known second Input Value by using the arrow keys. For Apply (RPLY), adjust the signal source externally until the next desired Input Value appears. (Follow the same procedure if using more than 2 scaling points.)

For the PAXT, the following parameters only apply to Custom Sensor Scaling.

**PAXT: ICE POINT SLOPE**

This parameter sets the slope value for ice point compensation for the Custom TC range (C5-C6) only. The fixed thermocouple ranges are automatically compensated by the meter and do not require this setting. To calculate this slope, use \( \mu V \) data obtained from thermocouple manufacturers' tables for two points between 0°C and 50°C. Place this corresponding \( \mu V \) and °C information into the equation:

\[ \text{slope} = \frac{\mu V_2 - \mu V_1}{(C_2 - C_1)} \]

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.
DISPLAY VALUE FOR SCALING POINT 2

Enter the second coordinating Display Value by using the arrow keys. This is the same for \texttt{PES} and \texttt{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 cannot 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).

5.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FNC)

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.

\textbf{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. \texttt{USr - I} will represent all three user inputs. \texttt{F 1} will represent all five function keys.

\begin{itemize}
  \item \textbf{NO FUNCTION}

  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.

  \item \textbf{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.

  \item \textbf{ZERO (TARE) DISPLAY}

  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), \texttt{ES&-} 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 (\texttt{OFFS}). If another Zero (tare) Display is performed, the display will again change to zero and the Display reading will shift accordingly.

  \item \textbf{RELATIVE/ABSOLUTE DISPLAY}

  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 \texttt{DSP} and \texttt{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. \texttt{d-rEL} (absolute) or \texttt{rEL} (relative) is momentarily displayed at transition to indicate which display is active.
\end{itemize}
HOLD DISPLAY
The shown display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS
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
The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the resart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER
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
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 display but not the Maximum function.

RESET TOTALIZER
When activated (momentary action), $E_SEE_d$ 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
When activated (momentary action), $E_SEE_d$ flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer resets and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER
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
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
When activated (momentary action), $E_SEE_d$ 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
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
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
When activated (momentary action), $E_SEE_d$ 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
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
When activated (momentary action), $E_SEE_d$ 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
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.
5.3 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.

“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 (E-7) parameter also appears whenever Quick Programming Mode is enabled and the security code is greater than zero.

**SELECTION** | **DESCRIPTION**
--- | ---
*Ed | Visible but not changeable in Quick Programming Mode
EmE | Visible and changeable in Quick Programming Mode
LOC | Not visible in Quick Programming Mode

* Factory Setting can be used without affecting basic start-up.

### PROGRAM MODE SECURITY CODE*

By entering any non-zero value, the prompt Code 0 to 255 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.

### SETPOINT SELECTIONS

The following selections are accessible only with the Setpoint plug-in card installed. Refer to the Setpoint Card Bulletin shipped with the Setpoint plug-in card for an explanation of their operation.

**Setpoint Card Only**

- U1SE - Select main or alternate setpoints
- r1 - Reset Setpoint 1 (Alarm 1)
- r2 - Reset Setpoint 2 (Alarm 2)
- r3 - Reset Setpoint 3 (Alarm 3)
- r4 - Reset Setpoint 4 (Alarm 4)
- r23 - Reset Setpoint 2 & 3 (Alarm 2 & 3)
- r234 - Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)
- rALL - Reset Setpoint All (Alarm All)

PRINT REQUEST

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.

### MAXIMUM 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.

### MINIMUM DISPLAY LOCK-OUT*

### TOTALIZER DISPLAY LOCK-OUT*

### SP-1 SP-2 SP-3 SP-4 SETPOINT ACCESS*

The setpoint displays can be programmed for -0$, S&E, or &/U (See the following table). Accessible only with the Setpoint plug-in card installed.

### PROGRAM MODE SECURITY CODE*

Throughout this document, Programming Mode (without Quick in front) always refers to “Full” Programming (all meter parameters are accessible).
**MAX CAPTURE DELAY TIME***

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***

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***

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***

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 not to 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.

**PAXS: AUTO-ZERO BAND***

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 not to 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.

**UNITS LABEL BACKLIGHT***

The Units Label Kit Accessory contains a sheet of custom unit overlays which can be installed into 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.

**PAXT: ICE POINT COMPENSATION***

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.
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**

For most applications, this matches the Input Display Decimal Point (deEPt). If a different location is desired, refer to Totalizer Scale Factor.

**TOTALIZER TIME BASE**

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**

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**

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

**TOTALIZER POWER UP RESET**

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 (ARt). 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:

\[
\text{Input Display} \times \text{Totalizer Scale Factor} = \text{Totalizer Time Base}
\]

Where:

- Input Display - the present input reading
- Totalizer Scale Factor - 0.001 to 65,000
- Totalizer Time Base - (the division factor of \( b \)ase)

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:

\[
10.0 \times 1.000 = 0.1667 \text{ gallon accumulates each second}
\]

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 (deEPt) location from the Input Display Decimal Point (deEPt), the required Totalizer Scale Factor is multiplied by a power of ten.

   Example:
   \[
   \text{Input} \ (\text{deEPt}) = 0 \quad \text{Input} \ (\text{deEPt}) = 0.0 \quad \text{Input} \ (\text{deEPt}) = 0.00
   \]

<table>
<thead>
<tr>
<th>Totalizer \ (deEPt)</th>
<th>Scale Factor</th>
<th>Totalizer \ (deEPt)</th>
<th>Scale Factor</th>
<th>Totalizer \ (deEPt)</th>
<th>Scale Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>10</td>
<td>0.00</td>
<td>10</td>
<td>0.00</td>
<td>10</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
<td>1</td>
<td>0.1</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>0.01</td>
<td>0.01</td>
<td>0.0</td>
<td>0.01</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>0.001</td>
<td>0.001</td>
<td>0</td>
<td>0.001</td>
<td>0</td>
<td>0.001</td>
</tr>
</tbody>
</table>

   \( (x = \text{Totalizer display is round by tens or hundreds}) \)

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 \( \text{t} \)ime\( \text{b} \)ase. The timer will control the start (reset) and the stopping (hold) of the totalizer.
Modules 6, 7, and 8 are accessible only with the appropriate plug-in cards installed. A quick overview of each Module is listed below. Refer to the corresponding plug-in card bulletin for a more detailed explanation of each parameter selection.

### 5.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (6-SPΧ)

<table>
<thead>
<tr>
<th>Parameter Menu</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPSEL - SELECT SETPOINT</td>
<td>No SP-1 SP-2 SP-3</td>
</tr>
<tr>
<td>AEt - SETPOINT ACTION</td>
<td>OFF dE-HI Ab-HI dE-LO Ab-LO bAND AU-HI tAbLo AU-LO tAbHI</td>
</tr>
<tr>
<td>SP - SETPOINT VALUE</td>
<td>-9999 to 99999</td>
</tr>
<tr>
<td>HY5 - SETPOINT HYSTERESIS</td>
<td>1 to 65000</td>
</tr>
<tr>
<td>SPON-n - ON TIME DELAY</td>
<td>0.0 to 32750 sec</td>
</tr>
<tr>
<td>SPDF-n - OFF TIME DELAY</td>
<td>0.0 to 32750 sec</td>
</tr>
<tr>
<td>aut-n - OUTPUT LOGIC</td>
<td>nor rEu</td>
</tr>
<tr>
<td>rSt-n - RESET ACTION</td>
<td>&amp;UrLa LACe2 LAcE1</td>
</tr>
<tr>
<td>Sbb-n - STANDBY OPERATION</td>
<td>NO YES</td>
</tr>
<tr>
<td>Lt-n - SETPOINT ANNUNCIATORS</td>
<td>OFF rEu nor FLASH</td>
</tr>
<tr>
<td>bnn-n - PROBE BURN-OUT ACTION</td>
<td>ON OFF</td>
</tr>
</tbody>
</table>

Repeat programming for each setpoint.

### 5.7 MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SRL)

<table>
<thead>
<tr>
<th>Parameter Menu</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>bRud - BAUD RATE</td>
<td>300 4800</td>
</tr>
<tr>
<td>600 9600</td>
<td></td>
</tr>
<tr>
<td>1200 19200</td>
<td></td>
</tr>
<tr>
<td>2400</td>
<td></td>
</tr>
<tr>
<td>dAltA - DATA BITS</td>
<td>7 8</td>
</tr>
<tr>
<td>Pr - PARITY BIT</td>
<td>Odd EVEN</td>
</tr>
<tr>
<td>Addr - METER ADDRESS</td>
<td>0 to 99</td>
</tr>
<tr>
<td>Abtu - ABBREVIATED PRINTING</td>
<td>NO YES</td>
</tr>
<tr>
<td>Opt - PRINT OPTIONS</td>
<td>NO</td>
</tr>
<tr>
<td>YESGrSS LAcE</td>
<td></td>
</tr>
<tr>
<td>INP HILD</td>
<td></td>
</tr>
<tr>
<td>tot SPAl</td>
<td></td>
</tr>
</tbody>
</table>

These two options are for the PAXS ONLY.

### 5.8 MODULE 8 - ANALOG OUTPUT PARAMETERS (8-Out)

<table>
<thead>
<tr>
<th>Parameter Menu</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE - ANALOG TYPE</td>
<td>0-20 0-10</td>
</tr>
<tr>
<td>4-20</td>
<td></td>
</tr>
<tr>
<td>RS IN - ANALOG ASSIGNMENT</td>
<td>INP LO</td>
</tr>
<tr>
<td>HI tot</td>
<td></td>
</tr>
<tr>
<td>RAN-LO - ANALOG LOW SCALE VALUE</td>
<td>-9999 to 99999</td>
</tr>
<tr>
<td>RAN-HI - ANALOG HIGH SCALE VALUE</td>
<td>-9999 to 99999</td>
</tr>
<tr>
<td>udt - ANALOG UPDATE TIME</td>
<td>0.0 to 100 sec.</td>
</tr>
<tr>
<td>burn - PROBE BURN-OUT ACTION</td>
<td>H1 LO</td>
</tr>
</tbody>
</table>
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 \textit{Code} \textit{56} and press \textit{PAR}. The meter will display \textit{ES&4&U} and then return to \textit{Code} \textit{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 \textit{Apply} (\textit{RPLY}) 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

\textit{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. \textit{na} and \textit{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 \textit{Code} \textit{48} and press \textit{PAR}.
2. Choose the range to be calibrated by using the arrow keys and press \textit{PAR}. (\textit{na} and \textit{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 \textit{PAR} and \textit{++++} 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 \textit{PAR} and \textit{++++} will appear on the display for about 10 seconds.
7. When \textit{na} appears, press \textit{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

\textit{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:

\begin{itemize}
  \item +1\% of full scale, DC
  \item -1\% of full scale, DC
  \item +100\% of full scale, DC; (300 V range = +100 V calibration)
  \item -100\% of full scale, DC; (300 V range = -100 V calibration)
\end{itemize}

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. \textit{na} and \textit{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 \textit{Code} \textit{48} and press \textit{PAR}.
2. The meter displays \textit{ES&U}. Use the arrow keys to select the range that matches the Signal Jumper setting. Press \textit{PAR}.
3. Apply the signal matching the meter prompt.
4. Press \textit{PAR} and \textit{++++} will appear on the display, wait for next prompt.
5. Repeat steps 3 and 4 for the remaining three prompts.
6. When \textit{na} appears, press \textit{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: 200 V; Couple: dC; Decimal Point: 0; Round: f; Filter: 05; Band: 20; Points: 2; Style: YES; INP1: 0.000; DSP1: 0; INP2: 200000; DSP2: 20000
5. In Module 4, program as follows: Hi-t: 00; Lo-t: 32711
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 C0de 48 and press PAR.
13. Press the down arrow key twice to RC-0F and press PAR.
14. Calculate the offset OFFS1 using the following formula:
   \[ \text{OFFS1} = \text{AC coupled reading (step 11)} - \text{DC coupled reading (step 7)} \]
15. Use the arrow keys to enter the calculated OFFS1.
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.

ICE POINT Calibration

Remove all option cards or invalid results will occur.

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. Connect the thermocouple to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press PAR.
4. At 300 °C, 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.

100 OHM RTD Range Calibration

1. Set the Input Range Jumper to 100 ohm.
2. Use the arrow keys to display C0de 48 and press PAR. Then choose r - 100 and press PAR.
3. At 0 °C, apply a direct short to input terminals 3, 4 and 5 using a three wire link. Wait 10 seconds, then press PAR.
4. At 150 °C, 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.
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power level, power connections</td>
</tr>
<tr>
<td>PROGRAM LOCKED-OUT</td>
<td>CHECK: Active (lock-out) user input</td>
</tr>
<tr>
<td></td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td>MAX, MIN, TOT LOCKED-OUT</td>
<td>CHECK: Module 3 programming</td>
</tr>
<tr>
<td>INCOMPLETE INPUT DISPLAY</td>
<td>CHECK: Active (lock-out) user input</td>
</tr>
<tr>
<td></td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td></td>
<td>PROGRAM: Module 4 as Hi-t: 0.0 LO-t: 3271.1 (to disable zero chop feature)</td>
</tr>
<tr>
<td></td>
<td>PRESS: Reset KEY (If cannot clear contact factory.)</td>
</tr>
<tr>
<td>ERROR CODE (Err 1-4)</td>
<td>PRESS: Reset KEY (If cannot clear contact factory.)</td>
</tr>
<tr>
<td>MODULES or PARAMETERS NOT ACCESSIBLE</td>
<td>CHECK: Corresponding plug-in card installation</td>
</tr>
<tr>
<td>JITTERY DISPLAY</td>
<td>INSTALL: Module 1 filtering, rounding, input range</td>
</tr>
<tr>
<td></td>
<td>CHECK: Wiring is per EMC installation guidelines</td>
</tr>
<tr>
<td>DISPLAY ZERO'S AT LEVELS BELOW 1% OF RANGE</td>
<td>PROGRAM: Module 4 as Hi-t: 0.0 LO-t: 3271.1 (to disable zero chop feature)</td>
</tr>
</tbody>
</table>

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

## PARAMETER VALUE CHART

### Signal Input Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>r RANGE</td>
<td>MODEL DEPENDENT</td>
<td></td>
<td></td>
<td>iNP 6</td>
<td>* INPUT VALUE 6</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>L TYPE</td>
<td>PAXT: INPUT TYPE</td>
<td>bc - j</td>
<td></td>
<td>dSP 6</td>
<td>* DISPLAY VALUE 6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SCALE</td>
<td>PAXT: TEMPERATURE SCALE</td>
<td>of</td>
<td></td>
<td>iNP 7</td>
<td>* INPUT VALUE 7</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>COUPL</td>
<td>PAXH: INPUT COUPLE</td>
<td>RC</td>
<td></td>
<td>dSP 7</td>
<td>* DISPLAY VALUE 7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>dECPl</td>
<td>* DISPLAY RESOLUTION</td>
<td>0</td>
<td></td>
<td>iNP 8</td>
<td>* INPUT VALUE 8</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>round</td>
<td>DISPLAY ROUNCING INCREMENT</td>
<td>1</td>
<td></td>
<td>dSP 8</td>
<td>* DISPLAY VALUE 8</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>OFFSt</td>
<td>PAXT: DISPLAY OFFSET</td>
<td>0</td>
<td></td>
<td>iNP 9</td>
<td>* INPUT VALUE 9</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>Filttr</td>
<td>FILTER SETTING - PAXH</td>
<td>05</td>
<td></td>
<td>dSP 9</td>
<td>* DISPLAY VALUE 9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>bAnd</td>
<td>FILTER ENABLE BAND - PAXH</td>
<td>0020</td>
<td>10</td>
<td></td>
<td>iNP 10</td>
<td>* INPUT VALUE 10</td>
<td>0,000</td>
</tr>
<tr>
<td>ICE</td>
<td>PAXT: ICE POINT SLOPE</td>
<td>0,000</td>
<td></td>
<td>dSP 10</td>
<td>* DISPLAY VALUE 10</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>PlS5</td>
<td>SCALING POINTS</td>
<td>2</td>
<td></td>
<td>iNP 11</td>
<td>* INPUT VALUE 11</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>Style</td>
<td>SCALING STYLE - NOT PAXT</td>
<td>KEY</td>
<td></td>
<td>dSP 11</td>
<td>* DISPLAY VALUE 11</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>iNP 1</td>
<td>* INPUT VALUE 1</td>
<td>0,000</td>
<td></td>
<td>dSP 12</td>
<td>* DISPLAY VALUE 12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>iNP 2</td>
<td>* INPUT VALUE 2</td>
<td>0000</td>
<td></td>
<td>iNP 13</td>
<td>* INPUT VALUE 13</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>iNP 3</td>
<td>* INPUT VALUE 3</td>
<td>0000</td>
<td></td>
<td>dSP 13</td>
<td>* DISPLAY VALUE 13</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>dSP 3</td>
<td>* DISPLAY VALUE 3</td>
<td>0000</td>
<td></td>
<td>iNP 14</td>
<td>* INPUT VALUE 14</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>iNP 4</td>
<td>* INPUT VALUE 4</td>
<td>0000</td>
<td></td>
<td>dSP 14</td>
<td>* DISPLAY VALUE 14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>dSP 4</td>
<td>* DISPLAY VALUE 4</td>
<td>0000</td>
<td></td>
<td>iNP 15</td>
<td>* INPUT VALUE 15</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>iNP 5</td>
<td>* INPUT VALUE 5</td>
<td>0000</td>
<td></td>
<td>dSP 15</td>
<td>* DISPLAY VALUE 15</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>dSP 5</td>
<td>* DISPLAY VALUE 5</td>
<td>0000</td>
<td></td>
<td>iNP 16</td>
<td>* INPUT VALUE 16</td>
<td>0,000</td>
<td></td>
</tr>
</tbody>
</table>

* Decimal point location is model and programming dependent.
### 5-LOC Totalizer (Integrator) Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECPt</td>
<td>* TOTALIZER DECIMAL POINT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>tBASE</td>
<td>TOTALIZER TIME BASE</td>
<td>1, 1</td>
<td>1, 1</td>
</tr>
<tr>
<td>SCFAC</td>
<td>TOTALIZER SCALE FACTOR</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Locut</td>
<td>* TOTALIZER LOW CUT VALUE</td>
<td>-19999</td>
<td>-19999</td>
</tr>
<tr>
<td>P-UP</td>
<td>TOTALIZER POWER-UP RESET</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

### 7-5rL Serial Communication Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>bAud</td>
<td>BAUD RATE</td>
<td>9600</td>
<td>9600</td>
</tr>
<tr>
<td>dAtA</td>
<td>DATA BIT</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>PAr</td>
<td>PARITY BIT</td>
<td>Odd</td>
<td>Odd</td>
</tr>
<tr>
<td>Addr</td>
<td>METER ADDRESS</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Abrw</td>
<td>ABBREVIATED PRINTING</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Opt</td>
<td>ENTER PRINT OPTIONS</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PAXS</td>
<td>PAX: PRINT GROSS OFFSET</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>tArE</td>
<td>PAX: PRINT TARE OFFSET</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>InP</td>
<td>PRINT INPUT VALUE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>tOt</td>
<td>PRINT TOTAL VALUE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>tLd</td>
<td>PRINT MAX &amp; MIN VALUES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>tPnt</td>
<td>PRINT SETPOINT VALUES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

### 3-LOC Display and Program Lockout Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>UI</td>
<td>MAX DISPLAY LOCKOUT</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>LO</td>
<td>MIN DISPLAY LOCKOUT</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>tOt</td>
<td>TOTAL DISPLAY LOCKOUT</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>Sp-1</td>
<td>SETPOINT 1 ACCESS</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>Sp-2</td>
<td>SETPOINT 2 ACCESS</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>Sp-3</td>
<td>SETPOINT 3 ACCESS</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>Sp-4</td>
<td>SETPOINT 4 ACCESS</td>
<td>LOC</td>
<td>LOC</td>
</tr>
<tr>
<td>Cade</td>
<td>SECURITY CODE</td>
<td>0</td>
<td>0</td>
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</table>

### 6-SEC Secondary Function Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1-t</td>
<td>MAX CAPTURE DELAY TIME</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>L0-t</td>
<td>MIN CAPTURE DELAY TIME</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>dsP-t</td>
<td>DISPLAY UPDATE TIME</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PAXS</td>
<td>PAXS: AUTO-ZERO DELAY</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PAXs-b</td>
<td>PAXS: AUTO-ZERO BAND</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>b-lLt</td>
<td>UNITS LABEL BACKLIGHT - PAX</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>dSPSt</td>
<td>DISPLAY OFFSET - NOT PAX</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>ICE</td>
<td>PAX: ICE POINT COMPENSATION</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

### 9-FC5 Factory Setting Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>d-LEu</td>
<td>DISPLAY INTENSITY LEVEL</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### 9-FSP Setpoint (Alarm) Parameters

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rct-n</td>
<td>SETPOINT ACTION</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>SPC-n</td>
<td>* SETPOINT VALUE (main)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SPC-n</td>
<td>* SETPOINT VALUE (alternate)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Hys-n</td>
<td>* SETPOINT Hysteresis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ton-n</td>
<td>ON TIME DELAY</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>tOf-n</td>
<td>OFF TIME DELAY</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>out-n</td>
<td>OUTPUT LOGIC</td>
<td>nar</td>
<td>nar</td>
</tr>
<tr>
<td>rSt-n</td>
<td>RESET ACTION</td>
<td>Ruka</td>
<td>Ruka</td>
</tr>
<tr>
<td>Stb-n</td>
<td>STANDBY OPERATION</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Lct-n</td>
<td>SETPOINT ANNUNCIATORS</td>
<td>nar</td>
<td>nar</td>
</tr>
<tr>
<td>brn-n</td>
<td>PAXT: PROBE BURN-OUT ACTION</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

† Select alternate list to program these values.

* Decimal point location is model and programming dependent.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
**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 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 Analog or Digital 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**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDC</td>
<td>PAX PROFIBUS-DP Communications Card</td>
<td>PAXCDC50</td>
</tr>
</tbody>
</table>

---

**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 ANALOG OR DIGITAL PAX METER TYPE**

**FREEZE MODE AND SYNC MODE SUPPORTED**

**DIAGNOSTIC LEDs INDICATE CARD STATUS**

**PNO CERTIFIED, CONFORMANCE TESTED SLAVE DEVICE**

---
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.

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 PAX register index which, when set, will force that register to be read from the PAX Meter. This Demand Write Mask 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.
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

<table>
<thead>
<tr>
<th>BYTES</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESCRIPTION</td>
<td>-</td>
<td>Polled Read Mask</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEFAULT</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x01</td>
</tr>
<tr>
<td>EXAMPLE</td>
<td>0x00</td>
<td>0x00</td>
<td>0x00</td>
<td>0x01</td>
<td>0x01</td>
</tr>
</tbody>
</table>

CONFIGURATION

The 2 basic PAX meter types are the Analog PAX (5-digit units) and the Digital PAX (6-digit units). 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. 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)”, that correspond to the host PAX Meter type.

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 the Digital PAX meters, the Data Block size is 84 bytes Input, 84 bytes Output.

<table>
<thead>
<tr>
<th>REGISTER INDEX</th>
<th>DATA BLOCK BYTES</th>
<th>PAX ANALOG INPUT METER (5-Digit)</th>
<th>PAXDP ANALOG INPUT METER (5-Digit)</th>
<th>PAXI DIGITAL COUNT / RATE (6-Digit)</th>
<th>PAXCK DIGITAL CLOCK / TIMER (6-Digit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1 - 4</td>
<td>Demand Write Mask (Output) / Service Status (Input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>5 - 8</td>
<td>Store Mask (Output) / Unused (Input)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>9 - 12</td>
<td>Input * Input A (relative) Count A Timer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13 - 16</td>
<td>Total * Input B (relative) Count B Counter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17 - 20</td>
<td>Max. Input * Calculation Count C RTC Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>21 - 24</td>
<td>Min. Input * Total Rate RTC Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>25 - 28</td>
<td>Setpoint 1 Min Input Max Rate Setpoint 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>29 - 32</td>
<td>Setpoint 2 Max Input Max Rate Setpoint 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>33 - 36</td>
<td>Setpoint 3 Input A (absolute) Scale Factor A Setpoint 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>37 - 40</td>
<td>Setpoint 4 Input B (absolute) Scale Factor B Setpoint 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>41 - 44</td>
<td>AOR ** Input A (offset) Scale Factor C Setpoint Off 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>45 - 48</td>
<td>CSR ** Input B (offset) Count Load A Setpoint Off 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>49 - 52</td>
<td>*** Count Load B Setpoint Off 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>53 - 56</td>
<td>*** Count Load C Setpoint Off 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>57 - 60</td>
<td>*** Setpoint 1 Setpoint 1 Timer Start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>61 - 64</td>
<td>*** Setpoint 2 Counter Start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>65 - 68</td>
<td>*** Setpoint 3 Counter Stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>69 - 72</td>
<td>*** Setpoint 4 Counter Stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>73 - 76</td>
<td>*** MMR ** MMR ** MMR **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>77 - 80</td>
<td>*** AOR ** AOR ** RTC Day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>81 - 84</td>
<td>*** SOR ** SOR ** SOR **</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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 masks.
**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 Status
- bit 1: Setpoint 2 Output Status
- bit 2: Setpoint 3 Output Status
- bit 3: Setpoint 4 Output Status
- bit 4: Auto/Manual Mode
- bit 5: Unused (always stays 0)
- bit 6: Sensor Status (PAXT only)
- 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/PAXI/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:

- bit 0: Analog Output
- bit 1: Setpoint 4 Output
- bit 2: Setpoint 3 Output
- bit 3: Setpoint 2 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/PAXI 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/PAXI/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**

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-20 mA</td>
</tr>
<tr>
<td>1</td>
<td>20.000</td>
</tr>
<tr>
<td>0-4094</td>
<td>20.000 - 4094</td>
</tr>
<tr>
<td>4095</td>
<td>4095</td>
</tr>
<tr>
<td>4096</td>
<td>4096</td>
</tr>
</tbody>
</table>

*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/PAXI). 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.
**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.

---

**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.

---

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDC</td>
<td>PAX DeviceNet™ Output Card</td>
<td>PAXCDC30</td>
</tr>
</tbody>
</table>

---

**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.
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 mscc 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

<table>
<thead>
<tr>
<th>SWITCH #</th>
<th>SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 6</td>
<td>MAC ID (all off = 0, all on = 63) Switch 1 is LSB (1), switch 6 is MSB (32).</td>
</tr>
<tr>
<td>7 off, 8 off</td>
<td>125 K baud</td>
</tr>
<tr>
<td>7 on, 8 off</td>
<td>250 K baud</td>
</tr>
<tr>
<td>7 off, 8 on</td>
<td>500 K baud</td>
</tr>
<tr>
<td>7 on, 8 on</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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. However, some meter configuration is supported.

MESSAGE | PRODUCED | CONSUMED |
----------|----------|----------|
Explicit   | 4 Bytes  | 4 Bytes  |
P polled    | 4 Bytes  | 6 Bytes  |
Bit Strobe | 4 Bytes  | 8 Bytes  |

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.

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. The data field for the Set Attribute Command is determined by setting Service Code 1, 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.

Vendor Specific Error Responses

<table>
<thead>
<tr>
<th>CODE ERROR #</th>
<th>ERROR CODE MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1F (General Code)</td>
<td>Vendor Specific Error</td>
</tr>
<tr>
<td>1 (Additional Code)</td>
<td>Meter Response Time-out</td>
</tr>
<tr>
<td>2 (Additional Code)</td>
<td>Vendor Service Not Supported</td>
</tr>
<tr>
<td>3 (Additional Code)</td>
<td>Command String Syntax Error</td>
</tr>
</tbody>
</table>

Note: Not all meter attributes respond to a Set or Reset Attribute command. Refer to the Attribute Identification Chart for details.
### Attribute Identification Chart

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
<th>SERVICE CODES SUPPORTED</th>
<th>POLLING</th>
<th>STORE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Data Swapping Flag ➊</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 0</td>
<td>Attr 26, bit 0</td>
</tr>
<tr>
<td>2</td>
<td>Bit Strobe Attribute</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 1</td>
<td>Attr 26, bit 1</td>
</tr>
<tr>
<td>3</td>
<td>Polling Flags 1 ➋</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 2</td>
<td>Attr 26, bit 2</td>
</tr>
<tr>
<td>5</td>
<td>Polling Flags 3 ➋</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 4</td>
<td>Attr 26, bit 4</td>
</tr>
<tr>
<td>6</td>
<td>DIP Switch ➋</td>
<td>G, G, G</td>
<td>Attr 3, bit 5</td>
<td>Attr 26, bit 5</td>
</tr>
<tr>
<td>7</td>
<td>Input</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 6</td>
<td>Attr 26, bit 6</td>
</tr>
<tr>
<td>8</td>
<td>Total</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 7</td>
<td>Attr 26, bit 7</td>
</tr>
<tr>
<td>12</td>
<td>SP 2</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 11</td>
<td>Attr 26, bit 11</td>
</tr>
<tr>
<td>16</td>
<td>CSR ➋</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 15</td>
<td>Attr 26, bit 15</td>
</tr>
<tr>
<td>18</td>
<td>-----</td>
<td>G, S, G, S, G, S</td>
<td>Attr 3, bit 17</td>
<td>Attr 26, bit 17</td>
</tr>
</tbody>
</table>

### 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 (PAX 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
  - 0 = output off
  - 1 = output on

- **bit 5**: Always stays 0, even if 1 is sent.

- **bit 1**: SP2 Output
  - 0 = output off
  - 1 = output on

- **bit 6**: Sensor Status (PAX only)
  - 0 = sensor normal
  - 1 = sensor fail

- **bit 2**: SP3 Output
  - 0 = automatic mode
  - 1 = manual mode

- **bit 4**: Manual Mode
  - 0 = automatic mode
  - 1 = manual mode

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

---

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 DIP Switch Values: (1 byte), Attribute 6, Instance 1, Class 100 (decimal). Returns the dip switch setting. Switch 1 = LSB, 1 = on.

③ 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 attribute. 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.

④ 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 Set 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.

---

### TYPICAL UPDATE TIMES

- **PAX**: All values (10) - 1.00 sec
  - 5 values - 500 msec
  - 1 value - 100 msec

- **PAXIPACK/PAXDP**: All values (19) - 750 msec
  - 10 values - 430 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.
MANUAL MODE DESCRIPTION (CONTINUED)

(MMR) Auto/Manual Mode Register [23] (PAXI/PAXCK/PAXDP)
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:

<table>
<thead>
<tr>
<th>PAXI/PAXDP</th>
<th>PAXCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0: Analog Output</td>
<td>bit 0: SP4</td>
</tr>
<tr>
<td>bit 1: SP4</td>
<td>bit 1: SP3</td>
</tr>
<tr>
<td>bit 2: SP3</td>
<td>bit 2: SP2</td>
</tr>
<tr>
<td>bit 3: SP2</td>
<td>bit 3: SP1</td>
</tr>
<tr>
<td>bit 4: SP1</td>
<td>0 = Auto Mode</td>
</tr>
<tr>
<td>1 = Manual Mode</td>
<td>1 = Manual Mode</td>
</tr>
</tbody>
</table>

Example:
1. Select manual mode for all outputs and AOR (PAXI, PAXDP):
   Value to write to attribute 23: 001Fh

(SOR) Setpoint Output Register [25] (PAXI/PAXCK/PAXDP)
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:

<table>
<thead>
<tr>
<th>PAXI/PAXDP</th>
<th>PAXCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0: SP1</td>
<td>bit 0: SP4</td>
</tr>
<tr>
<td>bit 1: SP2</td>
<td>bit 1: SP3</td>
</tr>
<tr>
<td>bit 2: SP3</td>
<td>bit 2: SP2</td>
</tr>
<tr>
<td>bit 3: SP4</td>
<td>bit 3: SP1</td>
</tr>
<tr>
<td>0 = Output off</td>
<td>0 = Auto Mode</td>
</tr>
<tr>
<td>1 = Output on</td>
<td>1 = Manual Mode</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Attribute Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000 mA 0.000 V</td>
</tr>
<tr>
<td>1</td>
<td>0.005 mA 0.0025 V</td>
</tr>
<tr>
<td>2047</td>
<td>10.000 mA 5.000 V</td>
</tr>
<tr>
<td>4094</td>
<td>19.995 mA 9.9975 V</td>
</tr>
<tr>
<td>4095</td>
<td>20.000 mA 10.000 V</td>
</tr>
</tbody>
</table>

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).

LIMITED WARRANTY
The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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.

**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.

**MODEL PAXCDC -MODBUS OUTPUT OPTION CARD**

**DESCRIPTION**
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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.
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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**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDC</td>
<td>PAX MODBUS Output Card</td>
<td>PAXCDC40</td>
</tr>
<tr>
<td>PAXCDC</td>
<td>PAX MODBUS Output Card with RJ11 Card</td>
<td>PAXCDC4C</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>SETTINGS AVAILABLE</th>
<th>FACTORY SETTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OFF: ASCII ON: RTU</td>
<td>RTU</td>
</tr>
<tr>
<td>2</td>
<td>OFF: 7 Bits ON: 8 Bits</td>
<td>8 Bits</td>
</tr>
<tr>
<td>3</td>
<td>OFF: None ON: Parity</td>
<td>No Parity</td>
</tr>
<tr>
<td>4</td>
<td>OFF: Even ON: Odd</td>
<td>OFF</td>
</tr>
<tr>
<td>5</td>
<td>Baud Rate</td>
<td>(See Baud Rate Switch Selections) 9600</td>
</tr>
<tr>
<td>6</td>
<td>Baud Rate</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Baud Rate</td>
<td></td>
</tr>
</tbody>
</table>

BAUD RATE SWITCH SELECTIONS

<table>
<thead>
<tr>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>38400</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>19200</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>9600</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>4800</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>2400</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>1200</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>600</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>300</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

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.
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, 40041 – 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 <0000>.
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.

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:

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0: SP1 Output</td>
<td>0 = output off, 1 = output on</td>
</tr>
<tr>
<td>bit 1: SP2 Output</td>
<td>0 = output off, 1 = output on</td>
</tr>
<tr>
<td>bit 2: SP3 Output</td>
<td>0 = output off, 1 = output on</td>
</tr>
<tr>
<td>bit 3: SP4 Output</td>
<td>0 = output off, 1 = output on</td>
</tr>
<tr>
<td>bit 4: Manual Mode</td>
<td>0 = automatic mode, 1 = manual mode</td>
</tr>
<tr>
<td>bit 5: Always stays 0, even if 1 is sent.</td>
<td></td>
</tr>
<tr>
<td>bit 6: Sensor Status (PAXT only)</td>
<td>0 = sensor normal, 1 = sensor fail</td>
</tr>
</tbody>
</table>

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/PAXCK)
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:

<table>
<thead>
<tr>
<th>PAXI</th>
<th>PAXCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0: Analog Output</td>
<td>bit 0: SP4</td>
</tr>
<tr>
<td>bit 1: SP4</td>
<td>bit 1: SP3</td>
</tr>
<tr>
<td>bit 2: SP3</td>
<td>bit 2: SP2</td>
</tr>
<tr>
<td>bit 3: SP2</td>
<td>bit 3: SP1</td>
</tr>
<tr>
<td>bit 4: SP1</td>
<td>0 = Auto Mode</td>
</tr>
<tr>
<td></td>
<td>1 = Manual Mode</td>
</tr>
</tbody>
</table>

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, PAXCK):
   - Value to write to holding register 40036: 001Fh

(SOR) Setpointoutput Register [40038] (PAXI/PAXCK)
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:

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0: SP1</td>
<td>0 = Output off, 1 = Output on</td>
</tr>
<tr>
<td>bit 1: SP2</td>
<td>0 = Output off, 1 = Output on</td>
</tr>
<tr>
<td>bit 2: SP3</td>
<td>0 = Output off, 1 = Output on</td>
</tr>
<tr>
<td>bit 3: SP4</td>
<td>0 = Output off, 1 = Output on</td>
</tr>
</tbody>
</table>

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 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 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.

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000 0.000</td>
</tr>
<tr>
<td>1</td>
<td>1.005 0.0025</td>
</tr>
<tr>
<td>2047</td>
<td>10.000 5.000</td>
</tr>
<tr>
<td>4094</td>
<td>19.995 9.9975</td>
</tr>
<tr>
<td>4095</td>
<td>20.000 10.000</td>
</tr>
</tbody>
</table>

*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 voltage 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): 0FFFh (4095).
2. Set output to zero scale:
   - Value to write to holding register 40020 (PAX) or 40037 (PAXI): 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).

* 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 EPROM memory. On power-up, the calculated value is compared to the value read back from the EPROM. 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.

<table>
<thead>
<tr>
<th>HOLDING REGISTER</th>
<th>PAX</th>
<th>ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001:</td>
<td>Input (HI)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40002:</td>
<td>Input (LO)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40003:</td>
<td>Total (HI)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40004:</td>
<td>Total (LO)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40005:</td>
<td>Min (HI)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40006:</td>
<td>Min (LO)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40007:</td>
<td>Max (HI)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40008:</td>
<td>Max (LO)</td>
<td>Read Only</td>
</tr>
<tr>
<td>40009:</td>
<td>SP1 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4010:</td>
<td>SP1 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4011:</td>
<td>SP2 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4012:</td>
<td>SP2 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4013:</td>
<td>SP3 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4014:</td>
<td>SP3 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4015:</td>
<td>SP4 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4016:</td>
<td>SP4 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4017:</td>
<td>Polling1 *</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4019:</td>
<td>TRX Delay 3</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4020:</td>
<td>AOR 2</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4021:</td>
<td>CSR</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4022:</td>
<td>Terminate1</td>
<td>Read/Write</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>HOLDING REGISTER</th>
<th>PAX</th>
<th>ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001:</td>
<td>CTA (HI)</td>
<td>Timer (HI)</td>
</tr>
<tr>
<td>40002:</td>
<td>CTA (LO)</td>
<td>Timer (LO)</td>
</tr>
<tr>
<td>40003:</td>
<td>CTB (HI)</td>
<td>Counter (HI)</td>
</tr>
<tr>
<td>40004:</td>
<td>CTB (LO)</td>
<td>Counter (LO)</td>
</tr>
<tr>
<td>40005:</td>
<td>CTC (HI)</td>
<td>RTC Time (HI)</td>
</tr>
<tr>
<td>40006:</td>
<td>CTC (LO)</td>
<td>RTC Time (LO)</td>
</tr>
<tr>
<td>40007:</td>
<td>RTE (HI)</td>
<td>RTC Date (HI)</td>
</tr>
<tr>
<td>40008:</td>
<td>RTE (LO)</td>
<td>RTC Date (LO)</td>
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<tr>
<td>40009:</td>
<td>Min (HI)</td>
<td>SP1 (HI)</td>
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<tr>
<td>4010:</td>
<td>Min (LO)</td>
<td>SP1 (LO)</td>
</tr>
<tr>
<td>4011:</td>
<td>Max (HI)</td>
<td>SP2 (HI)</td>
</tr>
<tr>
<td>4012:</td>
<td>Max (LO)</td>
<td>SP2 (LO)</td>
</tr>
<tr>
<td>4013:</td>
<td>SFA (HI)</td>
<td>SP3 (HI)</td>
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<tr>
<td>4014:</td>
<td>SFA (LO)</td>
<td>SP3 (LO)</td>
</tr>
<tr>
<td>4015:</td>
<td>SFB (HI)</td>
<td>SP4 (HI)</td>
</tr>
<tr>
<td>4016:</td>
<td>SFB (LO)</td>
<td>SP4 (LO)</td>
</tr>
<tr>
<td>4017:</td>
<td>SFC (HI)</td>
<td>SP1 Off (HI)</td>
</tr>
<tr>
<td>4018:</td>
<td>SFC (LO)</td>
<td>SP1 Off (LO)</td>
</tr>
<tr>
<td>4019:</td>
<td>LDA (HI)</td>
<td>SP2 Off (HI)</td>
</tr>
<tr>
<td>4020:</td>
<td>LDA (LO)</td>
<td>SP2 Off (LO)</td>
</tr>
<tr>
<td>4021:</td>
<td>LDB (HI)</td>
<td>SP3 Off (HI)</td>
</tr>
<tr>
<td>4022:</td>
<td>LDB (LO)</td>
<td>SP3 Off (LO)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>HOLDING REGISTER</th>
<th>PAX</th>
<th>PAXCK/PAXTM</th>
<th>ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40000:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40001:</td>
<td>CTA (HI)</td>
<td>Timer (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>40002:</td>
<td>CTA (LO)</td>
<td>Timer (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>40003:</td>
<td>CTB (HI)</td>
<td>Counter (HI)</td>
<td>Read/Write</td>
</tr>
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<td>CTB (LO)</td>
<td>Counter (LO)</td>
<td>Read/Write</td>
</tr>
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<td>40005:</td>
<td>CTC (HI)</td>
<td>RTC Time (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
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<td>CTC (LO)</td>
<td>RTC Time (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>40007:</td>
<td>RTE (HI)</td>
<td>RTC Date (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>40008:</td>
<td>RTE (LO)</td>
<td>RTC Date (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>40009:</td>
<td>Min (HI)</td>
<td>SP1 (HI)</td>
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</tr>
<tr>
<td>4010:</td>
<td>Min (LO)</td>
<td>SP1 (LO)</td>
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</tr>
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<td>Max (HI)</td>
<td>SP2 (HI)</td>
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<td>4012:</td>
<td>Max (LO)</td>
<td>SP2 (LO)</td>
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</tr>
<tr>
<td>4013:</td>
<td>SFA (HI)</td>
<td>SP3 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4014:</td>
<td>SFA (LO)</td>
<td>SP3 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4015:</td>
<td>SFB (HI)</td>
<td>SP4 (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4016:</td>
<td>SFB (LO)</td>
<td>SP4 (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4017:</td>
<td>SFC (HI)</td>
<td>SP1 Off (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4018:</td>
<td>SFC (LO)</td>
<td>SP1 Off (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4019:</td>
<td>LDA (HI)</td>
<td>SP2 Off (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4020:</td>
<td>LDA (LO)</td>
<td>SP2 Off (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4021:</td>
<td>LDB (HI)</td>
<td>SP3 Off (HI)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>4022:</td>
<td>LDB (LO)</td>
<td>SP3 Off (LO)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>COIL ADDRESS</td>
<td>COIL NUMBER</td>
<td>PAX</td>
<td>PAXI</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAX</td>
<td>PAXI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>0</td>
<td>SP1 Output</td>
<td>40021 (bit 6)</td>
</tr>
<tr>
<td>02</td>
<td>1</td>
<td>SP2 Output</td>
<td>40021 (bit 1)</td>
</tr>
<tr>
<td>03</td>
<td>2</td>
<td>SP3 Output</td>
<td>40021 (bit 2)</td>
</tr>
<tr>
<td>04</td>
<td>3</td>
<td>SP4 Output</td>
<td>40021 (bit 3)</td>
</tr>
<tr>
<td>05</td>
<td>4</td>
<td>Reset Max</td>
<td>40018 (bit 2)</td>
</tr>
<tr>
<td>06</td>
<td>5</td>
<td>Reset Min</td>
<td>40018 (bit 3)</td>
</tr>
<tr>
<td>07</td>
<td>6</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>08</td>
<td>7</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>09</td>
<td>8</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td>Reset Total</td>
<td>40018 (bit 4)</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>Poll Input</td>
<td>40017 (bit 0)</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>Poll Total</td>
<td>40017 (bit 1)</td>
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<td>13</td>
<td>12</td>
<td>Poll Max</td>
<td>40017 (bit 2)</td>
</tr>
<tr>
<td>14</td>
<td>13</td>
<td>Poll Min</td>
<td>40017 (bit 3)</td>
</tr>
<tr>
<td>15</td>
<td>14</td>
<td>Poll SP1</td>
<td>40017 (bit 4)</td>
</tr>
<tr>
<td>16</td>
<td>15</td>
<td>Poll SP2</td>
<td>40017 (bit 5)</td>
</tr>
<tr>
<td>17</td>
<td>16</td>
<td>Poll SP3</td>
<td>40017 (bit 6)</td>
</tr>
<tr>
<td>18</td>
<td>17</td>
<td>Poll SP4</td>
<td>40017 (bit 7)</td>
</tr>
<tr>
<td>19</td>
<td>18</td>
<td>Poll AOR</td>
<td>40017 (bit 8)</td>
</tr>
<tr>
<td>20</td>
<td>19</td>
<td>Poll CSR</td>
<td>40017 (bit 9)</td>
</tr>
<tr>
<td>21</td>
<td>20</td>
<td>Term Total</td>
<td>40022 (bit 0)</td>
</tr>
<tr>
<td>22</td>
<td>21</td>
<td>Term Max</td>
<td>40022 (bit 1)</td>
</tr>
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<td>23</td>
<td>22</td>
<td>Term Min</td>
<td>40022 (bit 2)</td>
</tr>
<tr>
<td>24</td>
<td>23</td>
<td>Term SP1</td>
<td>40022 (bit 3)</td>
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<tr>
<td>25</td>
<td>24</td>
<td>Term SP2</td>
<td>40022 (bit 4)</td>
</tr>
<tr>
<td>26</td>
<td>25</td>
<td>Term SP3</td>
<td>40022 (bit 5)</td>
</tr>
<tr>
<td>27</td>
<td>26</td>
<td>Term SP4</td>
<td>40022 (bit 6)</td>
</tr>
<tr>
<td>28</td>
<td>27</td>
<td>Term AOR</td>
<td>40022 (bit 7)</td>
</tr>
<tr>
<td>29</td>
<td>28</td>
<td>Term CSR</td>
<td>40022 (bit 8)</td>
</tr>
<tr>
<td>30</td>
<td>29</td>
<td>Response Delay</td>
<td>40017 (bit 10)</td>
</tr>
<tr>
<td>31</td>
<td>30</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>32</td>
<td>31</td>
<td>-----</td>
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<td>33</td>
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<td>41</td>
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<td>42</td>
<td>41</td>
<td>-----</td>
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<td>43</td>
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<td>46</td>
<td>45</td>
<td>-----</td>
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<td>47</td>
<td>46</td>
<td>-----</td>
<td>-----</td>
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<tr>
<td>48</td>
<td>47</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>49</td>
<td>48</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>
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 E2PROM memory. Factory settings is “on” for all Polling coils.

<table>
<thead>
<tr>
<th>TYPICAL UPDATE TIMES**</th>
<th>PAX</th>
<th>PAXI/PAXCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>All values (10) - 1.15 sec</td>
<td>All values (19) - 900 msec</td>
<td></td>
</tr>
<tr>
<td>5 values - 500 msec</td>
<td>10 values - 480 msec</td>
<td></td>
</tr>
<tr>
<td>1 value - 100 msec</td>
<td>5 values - 230 msec</td>
<td></td>
</tr>
<tr>
<td>1 value - 52 msec</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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/PAXCK): 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 E2PROM memory in the PAX. If the flag is 1, an * is used as the terminating character and the value is saved to E2PROM 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 E2PROM memory. Factory setting is on.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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.

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

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDC</td>
<td>RS485 Serial Communications Output Card with Terminal Block</td>
<td>PAXCDC10</td>
</tr>
<tr>
<td></td>
<td>Extended RS485 Serial Communications Output Card with Dual RJ11 Connector</td>
<td>PAXCDC1C</td>
</tr>
<tr>
<td></td>
<td>RS232 Serial Communications Output Card with Terminal Block</td>
<td>PAXCDC20</td>
</tr>
<tr>
<td></td>
<td>Extended RS232 Serial Communications Output Card with 9 Pin D Connector</td>
<td>PAXCDC2C</td>
</tr>
</tbody>
</table>
RS232 Communications

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.

SPECIFICATIONS

PAXH Isolation For Both Cards:
- Isolation To Sensor Common: 1400 Vrms for 1 min.
- Isolation To User Input Common: 500 Vrms for 1 min.
- Working Voltage: 125 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 ms 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

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.

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.
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 7-5rL.

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.

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 YES. 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 NO.

Set the parity bit to match that of the other serial communications equipment. 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)

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.

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.

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)
**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 a the command terminator character * or $.

### Command Chart

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Node Address Specifier</td>
<td>Address a specific meter. Must be followed by one or two digit node address. Not required when node address = 0.</td>
</tr>
<tr>
<td>T</td>
<td>Transmit Value (read)</td>
<td>Read a register from the meter. Must be followed by register ID character.</td>
</tr>
<tr>
<td>V</td>
<td>Value change (write)</td>
<td>Write to register of the meter. Must be followed by register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a register or output. Must be followed by register ID character.</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers are defined in programming.</td>
</tr>
</tbody>
</table>

### 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.

### 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

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>2 byte Node Address field [00-99]</td>
</tr>
<tr>
<td>3</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>4-6</td>
<td>3 byte Register Mnemonic field</td>
</tr>
<tr>
<td>7-18</td>
<td>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)</td>
</tr>
<tr>
<td>19</td>
<td>&lt;CR&gt; carriage return</td>
</tr>
<tr>
<td>20</td>
<td>&lt;LF&gt; line feed</td>
</tr>
<tr>
<td>21</td>
<td>&lt;SP&gt;* (Space)</td>
</tr>
<tr>
<td>22</td>
<td>&lt;CR&gt;* carriage return</td>
</tr>
<tr>
<td>23</td>
<td>&lt;LF&gt;* line feed</td>
</tr>
</tbody>
</table>

* 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.

### Register Identification Chart

<table>
<thead>
<tr>
<th>ID</th>
<th>Value Description</th>
<th>Register ID</th>
<th>Applicable Commands/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Input</td>
<td>INP</td>
<td>T, P</td>
</tr>
<tr>
<td>B</td>
<td>Total</td>
<td>TOT</td>
<td>T, P, R</td>
</tr>
<tr>
<td>C</td>
<td>Max Input</td>
<td>MAX</td>
<td>T, P, R</td>
</tr>
<tr>
<td>D</td>
<td>Min Input</td>
<td>MIN</td>
<td>T, P, R</td>
</tr>
<tr>
<td>E</td>
<td>Setpoint 1</td>
<td>SP1</td>
<td>T, P, V, R</td>
</tr>
<tr>
<td>F</td>
<td>Setpoint 2</td>
<td>SP2</td>
<td>T, P, V, R</td>
</tr>
<tr>
<td>G</td>
<td>Setpoint 3</td>
<td>SP3</td>
<td>T, P, V, R</td>
</tr>
<tr>
<td>H</td>
<td>Setpoint 4</td>
<td>SP4</td>
<td>T, P, V, R</td>
</tr>
<tr>
<td>I</td>
<td>Analog Output Register</td>
<td>AOR</td>
<td>T, V</td>
</tr>
<tr>
<td>J</td>
<td>Control Status Register</td>
<td>CSR</td>
<td>T, V</td>
</tr>
</tbody>
</table>

### Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1, response delay of 2 msec min String: N17VE350S
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.*

### Abbreviated Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>13</td>
<td>&lt;CR&gt; carriage return</td>
</tr>
<tr>
<td>14</td>
<td>&lt;LF&gt; line feed</td>
</tr>
<tr>
<td>15</td>
<td>&lt;SP&gt;* (Space)</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt;* carriage return</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt;* line feed</td>
</tr>
</tbody>
</table>

* 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  
   17 875 <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>

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.
(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)
  - 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 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:

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000 mA, 0.000 V</td>
</tr>
<tr>
<td>1</td>
<td>0.005 mA, 0.0025 V</td>
</tr>
<tr>
<td>2047</td>
<td>10.000 mA, 5.000 V</td>
</tr>
<tr>
<td>4094</td>
<td>19.995 mA, 9.9975 V</td>
</tr>
<tr>
<td>4095</td>
<td>20.000 mA, 10.000 V</td>
</tr>
</tbody>
</table>

*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:
   V14095*

2. Set output to zero scale:
   V0*
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.

<table>
<thead>
<tr>
<th>LOGIC</th>
<th>INTERFACE STATE</th>
<th>RS232*</th>
<th>RS485*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mark (idle)</td>
<td>TXD, RXD; -3 to -15 V</td>
<td>a-b &lt; -200 mV</td>
</tr>
<tr>
<td>0</td>
<td>space (active)</td>
<td>TXD, RXD; +3 to +15 V</td>
<td>a-b &gt; +200 mV</td>
</tr>
</tbody>
</table>

* 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.

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.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.
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**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.

**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 that 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**

<table>
<thead>
<tr>
<th>Types</th>
<th>0 to 20 mA, 4 to 20 mA and 0 to 10 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation To Sensor &amp; User Input Commons</td>
<td>500 Vrms for 1 min.</td>
</tr>
<tr>
<td>Working Voltage</td>
<td>50 V</td>
</tr>
<tr>
<td>PAXH Only</td>
<td></td>
</tr>
<tr>
<td>Isolation To Sensor Common</td>
<td>1400 Vrms for 1 min.</td>
</tr>
<tr>
<td>Working Voltage</td>
<td>125 V</td>
</tr>
<tr>
<td>Isolation To User Input Common</td>
<td>500 V rms for 1 min.</td>
</tr>
<tr>
<td>Working Voltage</td>
<td>50 V</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.17% of FS (18 to 28°C); 0.4% of FS (0 to 50°C)</td>
</tr>
<tr>
<td>Resolution</td>
<td>1/3500</td>
</tr>
<tr>
<td>Compliance</td>
<td>10 VDC: 10 KΩ load min. 20 mA: 500 Ω load max.</td>
</tr>
<tr>
<td>Update Time</td>
<td>200 msec. max. to within 99% of final readout value (digital filter and internal zero correction disabled)</td>
</tr>
<tr>
<td></td>
<td>700 msec. max. (digital filter disabled, internal zero correction enabled)</td>
</tr>
<tr>
<td>PAXH only</td>
<td>1 sec. max. to within 99% of final readout value (digital filter disabled)</td>
</tr>
</tbody>
</table>

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDL</td>
<td>Analog Output Card</td>
<td>PAXCDL10</td>
</tr>
</tbody>
</table>

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.
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.

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**

-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**

-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**

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)**

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.

**LIMITED WARRANTY**

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**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.

**DESCRIPTION**

This bulletin serves as a guide for the installation, configuration and operation of PAX Setpoint cards. The setpoint cards are available as dual relay, quad relay, quad sourcing transistor, or quad sinking transistor outputs. Only one setpoint card can be installed at a time.

The PAX meter can be fitted with up to three 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.
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 \( \text{NO} \). Repeat step for each setpoint to be programmed. The \( \text{NO} \) chosen at SPSEL will return to PRO \( \text{NO} \). The number of setpoints available is setpoint output card dependent.

### Specifications

**Setpoint Output Cards**: Four 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**: PAXCDS30
  - Type: Four isolated sinking PNP 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**: 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: 24 VDC ± 10%, 100 mA max total all four.
  - External supply: 30 VDC max., 100 mA max each output

#### Ordering Information

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXCDS</td>
<td>Dual Relay Output Card</td>
<td>PAXCDS10</td>
</tr>
<tr>
<td></td>
<td>Quad Relay Output Card</td>
<td>PAXCDS20</td>
</tr>
<tr>
<td></td>
<td>Quad Sinking Open Collector Output Card</td>
<td>PAXCDS30</td>
</tr>
<tr>
<td></td>
<td>Quad Sourcing Open Collector Output Card</td>
<td>PAXCDS40</td>
</tr>
</tbody>
</table>

**Quad Sourcing Open Collector Output Card Supply Select**

For Quad Sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before applying power.

### Module 6 - Setpoint (Alarm) Parameters (6-SPk)

**Parameter Menu**

- SPSEL
- Act-n
- SP-n
- HYS-n
- ON-n
- OFF-n
- Out-n
- Rst-n
- Stb-n
- Ltb-n

**Setpoint Select**

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 \( \text{NO} \). Repeat step for each setpoint to be programmed. The \( \text{NO} \) chosen at SPSEL will return to PRO \( \text{NO} \). The number of setpoints available is setpoint output card dependent.

Indicates Program Mode Alternating Display.

Factory Settings are shown.
Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action.

<table>
<thead>
<tr>
<th>SETPOINT ACTION</th>
<th>SETPOINT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>OFF</code></td>
<td>-19999 to 99999</td>
</tr>
</tbody>
</table>
| `Rb-HI`          | Enter desired setpoint alarm value. These setpoint values can also be entered in the Display Mode during Program Lockout when the setpoint is programmed as `Eb` in Parameter Module 3. When a setpoint is programmed as deviation or band acting, the associated output tracks `Sp` as it is changed. The value entered is the offset, or difference from `Sp`.
| `Rb-LO`          | `Ab-HI`         |
| `RU-HI`          | `Ab-LO`         |
| `RU-LO`          | `dE-HI`         |
| `dE-LO`          | `dE-LO`         |
| `bANd`           | `bANd`          |
| `dE-LO`          | `dE-HI`         |
| `AB-Lo`          | `AB-HI`         |
| `OFF`            | `OFF`           |

* 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 `bANd` allows setpoints to function off of the lower 5 digits of the Totalizer. The upper Totalizer action `bANd` allows setpoints to function off of the upper 4 digits of the Totalizer. To obtain absolute low alarms for the Totalizer, program the `bANd` or `bANd` output logic as reverse.

Hysteresis Value

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.

Setpoint Alarm Figures

With reverse output logic `Re`, the below alarm states are opposite.
ON TIME DELAY

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 r_Eu, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

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 r_Eu, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The r_Eu logic reverses the output logic. In r_Eu, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

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.
- Latch = 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. The “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.)
- Latch = 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. The “on” alarm output is delayed by a time set in the OFF Time Delay. The “on” alarm remains reset off until the trigger point is crossed again.

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 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.

LIMITED WARRANTY

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
MODEL PAXDP – 1/8 DIN DUAL PROCESS INPUT METER

- 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 meter's readout features a Max and Min 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. 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 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.

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.
ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional</td>
<td>PAXCDS</td>
<td>Setpoint Relay Output Card</td>
<td>PAXCDS10</td>
</tr>
<tr>
<td>Plug-In Cards</td>
<td></td>
<td><strong>Quad Setpoint Relay Output Card</strong></td>
<td>PAXCDS20</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Quad Setpoint Sinking Open Collector Output Card</strong></td>
<td>PAXCDS30</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Quad Setpoint Sourcing Open Collector Output Card</strong></td>
<td>PAXCDS40</td>
</tr>
<tr>
<td>PAXCDC</td>
<td></td>
<td><strong>RS485 Serial Communications Output Card with Terminal Block</strong></td>
<td>PAXCDC10</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Extended RS485 Serial Communications Output Card with Dual RJ111 Connector</strong></td>
<td>PAXCDC1C</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>RS232 Serial Communications Output Card with Terminal Block</strong></td>
<td>PAXCDC20</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Extended RS232 Serial Communications Output Card with 9 Pin D Connector</strong></td>
<td>PAXCDC2C</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>DeviceNet Communications Card</strong></td>
<td>PAXCDC30</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ProfiBus-DP Communications Card</strong></td>
<td>PAXCDC50</td>
</tr>
<tr>
<td>PAXCDL</td>
<td></td>
<td><strong>Analog Output Card</strong></td>
<td>PAXCDL10</td>
</tr>
<tr>
<td>PAXLBK</td>
<td></td>
<td><strong>Units Label Kit Accessory</strong></td>
<td>PAXLBK10</td>
</tr>
<tr>
<td>SFCRD</td>
<td></td>
<td><strong>Crimson 2 PC Configuration Software for Windows 98, ME, 2000, XP</strong></td>
<td>SFCRD200</td>
</tr>
</tbody>
</table>

**Notes:**

1. For Modbus communications use RS485 Communications Output Card and configure communication ( \( \text{c} \) \) parameter for Modbus.
2. Crimson 2 software is available as a free download at http://www.redlion.net/

ǔ3½£
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 PAXC/D/50 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)

<table>
<thead>
<tr>
<th>INPUT UPDATE RATE</th>
<th>MAX. TIME (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>770</td>
</tr>
<tr>
<td>7.5</td>
<td>560</td>
</tr>
<tr>
<td>16.7</td>
<td>260</td>
</tr>
<tr>
<td>19.8</td>
<td>220</td>
</tr>
<tr>
<td>20</td>
<td>220</td>
</tr>
<tr>
<td>30</td>
<td>150</td>
</tr>
<tr>
<td>105</td>
<td>60</td>
</tr>
</tbody>
</table>

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:
   “OLUL” - 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:

<table>
<thead>
<tr>
<th>INPUT (RANGE)</th>
<th>ACCURACY* (18 to 28°C)</th>
<th>ACCURACY* (0 to 50°C)</th>
<th>IMPEDANCE/COMPLIANCE</th>
<th>MAX CONTINUOUS OVERLOAD</th>
<th>DISPLAY RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>±20 mA (-26 to 26 mA)</td>
<td>0.03% of reading +2 µA</td>
<td>0.12% of reading +3 µA</td>
<td>24.6 ohm</td>
<td>90 mA</td>
<td>1 µA</td>
</tr>
<tr>
<td>±10 VDC (-13 to 13 VDC)</td>
<td>0.03% of reading +2 mV</td>
<td>0.12% of reading +3 mV</td>
<td>500 Kohm</td>
<td>50 V</td>
<td>1 mV</td>
</tr>
</tbody>
</table>

* 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)

<table>
<thead>
<tr>
<th>INPUT UPDATE RATE</th>
<th>50 Hz ±1 Hz</th>
<th>60 Hz ±1 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>&gt;90 dB</td>
<td>&gt;65 dB</td>
</tr>
<tr>
<td>7.5</td>
<td>&gt;60 dB</td>
<td>&gt;55 dB</td>
</tr>
<tr>
<td>16.7</td>
<td>&gt;100 dB</td>
<td>&gt;50 dB</td>
</tr>
<tr>
<td>19.8</td>
<td>&gt;60 dB</td>
<td>&gt;95 dB</td>
</tr>
<tr>
<td>20</td>
<td>&gt;55 dB</td>
<td>&gt;100 dB</td>
</tr>
<tr>
<td>30</td>
<td>&gt;20 dB</td>
<td>&gt;20 dB</td>
</tr>
<tr>
<td>105</td>
<td>&gt;20 dB</td>
<td>&gt;13 dB</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>INPUT STATE</th>
<th>SINKING INPUTS</th>
<th>SOURCING INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>V_in &lt; 0.9 VDC</td>
<td>V_in &gt; 3.6 VDC</td>
</tr>
<tr>
<td>Inactive</td>
<td>V_in &gt; 3.6 VDC</td>
<td>V_in &lt; 0.9 VDC</td>
</tr>
</tbody>
</table>

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:

   SAFETY
   - UL Recognized Component, File #E179259, UL6101A-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
   - IEC61010-1, 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

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Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled in the programming.

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**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**

Crimson 2 (SFCRM2) is a Windows® based program for configuring and updating the firmware of the PAXDP meter from a PC. Using Crimson 2 makes programming the PAXDP meter easier and allows the user to save the PAXDP 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 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 is required to program the meter using the software.
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 (RTU) parameter for Modbus.

- **PAXCDC10 - RS485 Serial (Terminal Block)**
- **PAXCDC1C - RS485 Serial (Dual RJ11 Connector)**
- **PAXCDC20 - RS232 Serial (Terminal Block)**
- **PAXCDC2C - RS232 Serial (9 Pin D Connector)**
- **PAXCDC30 - DeviceNet**
- **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.

- **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 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.

**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.
Update time: See update rates step response specification

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5

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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.

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.

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.

PAXDP Jumper Selection

JUMPER SELECTIONS

The / indicates factory setting.

INPUT A

VOLT/CURRENT

- CURRENT (I)
- VOLTAGE (V)

INPUT B

VOLT/CURRENT

- CURRENT (I)
- VOLTAGE (V)

USER INPUT

- SINK
- SOURCE (SRC)

Note: In the figures above, the text shown in parenthesis is printed on the circuit board to help with proper jumper positioning.
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 (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 # 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.

3.1 POWER WIRING

**AC Power**
- Terminal 1: VAC
- Terminal 2: VAC

**DC Power**
- Terminal 1: +VDC
- Terminal 2: -VDC

---

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3.2 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)

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.

INPUT B SIGNAL WIRING

Voltage Signal (self powered)
Terminal 6: +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)

3.3 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.
**3.4 SETPOINT (ALARMS) WIRING**

**3.5 ANALOG OUTPUT WIRING**

See appropriate plug-in card bulletin for details.

---

**3.6 SERIAL COMMUNICATION WIRING**

### 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 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.

---

**4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY**

**Display Readout Legends**

- **A**: 8.8.8.8
- **B**: Optional Custom Units Overlay
- **C**: Setpoint Alarm Annunciators

**KEY**

- **DSP**: Index display through main displays as programmed in **3.4**
- **PAR**: Access parameter list
- **F1**: Function key 1; hold for 3 seconds for Second Function 1**
- **F2**: Function key 2; hold for 3 seconds for Second Function 2**
- **RST**: Reset (Function key)**

* Display Readout Legends may be locked out in Factory Settings.
** Factory setting for the F1, F2, and RST keys is NO mode.

**PROGRAMMING MODE OPERATION**

- Quit programming and return to display mode
- Store selected parameter and index to next parameter
- Increment selected parameter value
- Decrement selected parameter value
- Hold with F1, F2 to scroll value by x1000

---

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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 parameter 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.

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. 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 opera

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 parameter 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 programming 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 Pr0 and the present module (initially Pr0). 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 Pr0 Pr0. 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 Pr0 Pr0)

The Programming Mode is exited by pressing the DSP key (from anywhere in the Programming Mode) or the PAR key (with Pr0 Pr0 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

### INPUT A PARAMETER MENU

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>Volt</td>
<td>10.000 V</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Cur</td>
<td>20.000 mA</td>
</tr>
</tbody>
</table>

Select the input range that corresponds to the external signal. Before applying signal configure input jumper to match setting desired.

### ADC CONVERSION RATE

| Scale | 5.3 | 15.7 | 19.8 |

Select the ADC conversion rate. The selection does not affect the display update rate; however, it does affect setpoint 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

| Decimal Point | 00000 |

Select the decimal point location for the Input display. (The **TOT** display decimal point is a separate parameter.) This selection also affects the **round**, **dSP**1, and **dSP**2 parameters and setpoint values.

### DISPLAY ROUNDING*

| Display Rounding | 1 | 2 | 5 | 10 |

Rounding selections other than one cause the Input Display to "round" to the nearest rounding increment selected (i.e. 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

| Filter Setting | 00 to 250 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 B PARAMETER MENU

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>Volt</td>
<td>±10.000 V - Square Root Extraction</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Cur</td>
<td>±20.000 mA - Square Root Extraction</td>
</tr>
</tbody>
</table>

### INPUT RANGE

<table>
<thead>
<tr>
<th>Range Selection</th>
<th>Range Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volt</td>
<td>10.000 V</td>
</tr>
<tr>
<td>Cur</td>
<td>20.000 mA</td>
</tr>
</tbody>
</table>

### DISPLAY ROUNDING*

Rounding selections other than one cause the Input Display to "round" to the nearest rounding increment selected (i.e. 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

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

**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 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**) and 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 Input Signal Jumper position. A band setting of ‘0’ keeps the digital filter permanently engaged.

**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 (**U-59r** or **L-59r**). 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**) 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

<table>
<thead>
<tr>
<th>Style</th>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key-in</td>
<td>key-in data</td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>apply signal</td>
<td></td>
</tr>
</tbody>
</table>

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 (**apply**) scaling style must be used.

* The decimal point position is dependent on the selection made in the "Display Decimal Point" parameter.
**5.2 MODULE 2 - USER INPUT AND FRONT PANEL FUNCTION KEY PARAMETERS (2-FAC)**

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. FI will represent all five function keys.

---

**INPUT VALUE FOR SCALING POINT 1**

```
INP 1
0.000
-19999 to 99999
```

For Key-in (PES), 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 (RLY), 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 RLY style, the RST key can be pressed to advance the display past the INP I 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 PES and RLY scaling styles. The decimal point follows the DEC position. For Square Root Extraction Input Range, the Display 1 value must be zero.

---

**INPUT VALUE FOR SCALING POINT 2**

```
INP 2
10.000
-19999 to 99999
```

For Key-in (PES), enter the known second Input Value by using the arrow keys. For Apply (RLY), 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
10000
-19999 to 99999
```

Enter the second coordinating Display Value by using the arrow keys. This is the same for PES and RLY 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 cannot equal 0 and 10.)
3. The same Display Value can correspond to more than one Input Value. (Example: 0 mA and 20 mA can equal 10.)
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 Display Input 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 & INP 2 / DSP 2). If INP 1 = 4 mA and DSP 1 = 0, then 0 mA would be some negative Display Value. This could be prevented by making INP 1 = 0 mA / DSP 1 = 0, INP 2 = 4 mA / DSP 2 = 0, with INP 3 = 20 mA / DSP 3 = 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 INP 2 / DSP 2 & INP 3 / DSP 3.

The calculations stop at the limits of the Signal Input.

---

**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.

---

**NO FUNCTION**

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.
**INPUT A ZERO (TARE) DISPLAY**

- **USR - I**
- **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 (DFS - 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 - I**
- **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 (DFS - 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 - I**
- **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 active (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. AFS - A (absolute) or rEl - A (relative) is momentarily displayed at transition to indicate which display is active.

**INPUT B RELATIVE/ABSOLUTE DISPLAY**

- **USR - I**
- **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 active (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. BFS - B (absolute) or rEl - B (relative) is momentarily displayed at transition to indicate which display is active.

**HOLD DISPLAY**

- **USR - I**
- **d - Hld**

The shown display is held but all other meter functions continue as long as activated (maintained action).

**HOLD ALL FUNCTIONS**

- **USR - I**
- **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.

**SYNCRONIZE METER READING**

- **USR - I**
- **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.

**STORE BATCH READING IN TOTALIZER**

- **USR - I**
- **bAL**

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 - I**
- **rTot 1**

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 - I**
- **rTot 2**

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 - I**
- **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 - I**
- **r-H l**

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

When activated (momentary action), \( ESE \) 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

When activated (momentary action), \( ESE \) 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

When activated (momentary action), the display advances to the next display that is not locked out from the Display Mode.

SELECT DISPLAY A

When activated (momentary action), the display advances to Display A, if enabled.

SELECT DISPLAY B

When activated (momentary action), the display advances to Display B, if enabled.

SELECT DISPLAY C

When activated (momentary action), the display advances to Display C, if enabled.

SELECT SETPOINT LIST

Two lists of values are available for \( SP-1 \), \( SP-2 \), \( SP-3 \), \( SP-4 \). The two lists are named \( LSr \) and \( LSb \). If a user input is used to select the list then \( LSr \) is selected when the user input is not active and \( LSb \) 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 \( LSr \) and \( LSb \), 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.

SETPOINT SELECTIONS

The following selections are functional only with the Setpoint plug-in card installed. Refer to the Setpoint Card Bulletin shipped with the Setpoint plug-in card for an explanation of their operation.

- \( L.1S \): 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)
- \( r-3A \): Reset Setpoint 3 & 4 (Alarm 3 & 4)
- \( r-23A \): Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)
- \( r-5L \): Reset Setpoint All (Alarm All)

PRINT REQUEST

The meter issues a block print through the serial port when activated, and the serial type is set to \( rLL \). 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 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 parameter also appears whenever Quick Programming Mode is enabled and the security code greater than zero.

There are six meter values that can be individually programmed for one of the main displays (A,B,C, _), 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.

### Display Assignment

<table>
<thead>
<tr>
<th>INP A</th>
<th>INP B</th>
<th>CALC</th>
<th>LOC</th>
<th>LOE</th>
<th>SP-1</th>
<th>SP-2</th>
<th>SP-3</th>
<th>SP-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment</td>
<td>Assignment</td>
<td>Calculation Assignment</td>
<td>Max Display Assignment</td>
<td>Min Display Assignment</td>
<td>Total Display Assignment</td>
<td>Setpoint 1 Access</td>
<td>Setpoint 2 Access</td>
<td>Setpoint 3 Access</td>
</tr>
</tbody>
</table>

There are six meter values that can be individually programmed for one of the main displays (A,B,C, _), 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.

<table>
<thead>
<tr>
<th>LOC</th>
<th>Not visible in Display Mode or Quick Programming Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>rEd</td>
<td>Visible in Quick Programming Mode only</td>
</tr>
<tr>
<td>dSP-A</td>
<td>Assign to Display A</td>
</tr>
<tr>
<td>dSP-B</td>
<td>Assign to Display B</td>
</tr>
<tr>
<td>dSP-C</td>
<td>Assign to Display C</td>
</tr>
</tbody>
</table>

### Programming Mode Security Code

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.

### Parameter Menu

<table>
<thead>
<tr>
<th>Parameter Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input A Assignment</td>
</tr>
</tbody>
</table>

### Setpoint Access

The setpoint displays can be programmed for LOC, rEd or Enb (see the following table). Accessible only with the Setpoint plug-in card installed.

### PROGRAM MODE SECURITY CODE

<table>
<thead>
<tr>
<th>Selection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC</td>
<td>Not visible in Quick Programming Mode Only</td>
</tr>
<tr>
<td>rEd</td>
<td>Visible in Quick Programming Mode Only</td>
</tr>
<tr>
<td>Enb</td>
<td>Visible and changeable in Quick Programming Mode Only</td>
</tr>
</tbody>
</table>

Throughout this document, Programming Mode (without Quick in front) always refers to “Full” Programming (all meter parameters are accessible).
5.4 MODULE 4 - SECONDARY FUNCTION PARAMETERS (Y-SEC)

PARAMETER MENU

INPUT A OFFSET VALUE*

**OFFS-A**

- 19999 to 19999

0.000

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*

**OFFS-B**

- 19999 to 19999

0.000

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**

Select the desired parameter that will be assigned to the Max Capture.

**LO-AS**

MIN CAPTURE ASSIGNMENT

**HI-EL**

**LO-EL**

MAX CAPTURE DELAY TIME

**LO-M**

0.0 to 32750 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.

DISPLAY UPDATE RATE

**DSP-K**

1 2 5 10 20 updates/sec.

This parameter determines the rate of display update.

UNIT LABEL BACKLIGHT

**b-L-1E**

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**

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:

- **R** = Input A relative value
- **B** = Input B relative value
- **c** = Calculation Constant Value

For the average between A and B inputs, scale the display (Input A & Input B x) values in half and then use C 4 A 4 b.

Note: + = add, - = subtract, / = division. c(R/b - 1) is displayed in the PAX as R/b - 1 and the function performs with A divided b then 1 is subtracted and the result is multiply by c.

CALCULATION DECIMAL POINT

**dP**

0 0 0 0 0 0 0 0 0 0

This parameter determines the decimal point location for the Calculation Display. For the **CFunc** 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.
The constant value is used in the Calculation Function formulas to provide offsetting or scaling capabilities. For the 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 calculation functions, the “Constant Value” must be entered as 0.00, then the “Constant Value” would be entered as 100 for no gain. The constant value is used in the Calculation Function formulas to provide offsetting or scaling capabilities. For the 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 calculation functions, the “Constant Value” must be entered as 0.00, then the “Constant Value” would be entered as 100 for no gain. The constant value is used in the Calculation Function formulas to provide offsetting or scaling capabilities. For the 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.

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The constant value is used in the Calculation Function formulas to provide offsetting or scaling capabilities. For the 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 most applications, the Constant Value is entered as 0.00 for no gain. For most applications, the Constant Value is entered as 0.00 for no gain. For most applications, the Constant Value is entered as 0.00 for no gain. For most applications, the Constant Value is entered as 0.00 for no gain. For most applications, the Constant Value is entered as 0.00 for no gain.
TOTALIZER LOW CUT VALUE*

- 19999 to 99999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET

Do not reset totalizer

Reset totalizer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to reset.

* The decimal point position is dependent on the selection made in the "Totalizer Decimal Point" parameter.

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 (Bath). 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:

\[
\text{Input Display} \times \frac{\text{Totalizer Scale Factor}}{\text{Totalizer Time Base}}
\]

Where:

- Input Display - the present input reading
- Totalizer Scale Factor - 0.001 to 65.000
- Totalizer Time Base - (the division factor of \( \text{bA} \))

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:

\[
10.0 \times 1.000 = 0.1667 \text{ gallons accumulate each second}
\]

This results in:

10.0 gallons accumulate each minute

600.0 gallons accumulate each hour
5.6 MODULE 6 - SETPOINT (ALARM) PARAMETERS (Sp6)

PARAMETER MENU

**MODULE 6 - SETPOINT (ALARM) PARAMETERS (Sp6)**

**PARAMETER MENU**

- **SPSEL**
  - Setpoint Select
- **RSn-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
- **5th-n**
  - Standby Operation
- **Lit-n**
  - Setpoint Annunciators

Repeat programming for each setpoint.

**SELECT SETPOINT**

- **SPSEL**
  - No
  - SP-1, 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.

The parameters listed below are different from those listed in the Setpoint Card Literature. Use the Refer to Setpoint Option Card Literature for all other setpoint parameters.

**SETPOINT ASSIGNMENT**

- **Rsn-n**
  - None
  - R-rEL
  - A-rEL
  - b-rEL
  - b-AbS
  - CALC
  - to

Selects the meter value that is used to trigger the Setpoint Alarm. The r-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 b-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 IMP entries.

**SETPOINT ACTION**

- **Act-n**
  - No
  - b-AbS
  - b-rEL
  - an
  - d-EL
  - e-EL
  - bAND
  - bAL n
  - bAND
  - bALh

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
- **b-AbS** = Absolute high, with balanced hysteresis
- **b-rEL** = Absolute low, with balanced hysteresis
- **b-AbS** = Absolute high, with unbalanced hysteresis
- **b-rEL** = Absolute low, with unbalanced hysteresis
- **d-EL** = Deviation high, with unbalanced hysteresis
- **e-EL** = Deviation low, with unbalanced hysteresis
- **bAND** = Outside band, with unbalanced hysteresis
- **bAL n** = Inside band, with unbalanced hysteresis
- **bALh** = Lower Totalizer absolute high, unbalance hysteresis
- **bALh** = Upper Totalizer absolute high, unbalance hysteresis

**Setpoint Alarm Figure**

With reverse output logic rEu, the below alarm state is opposite.

<table>
<thead>
<tr>
<th><strong>SP-n</strong></th>
<th><strong>HYS-n</strong></th>
<th><strong>TOn-n</strong></th>
<th><strong>TOF-n</strong></th>
<th><strong>Out-n</strong></th>
<th><strong>rSt-n</strong></th>
<th><strong>5th-n</strong></th>
<th><strong>Lit-n</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SETPOINT VALUE</strong></td>
<td><strong>SETPOINT Hysteresis</strong></td>
<td><strong>ON TIME DELAY</strong></td>
<td><strong>OFF TIME DELAY</strong></td>
<td><strong>OUTPUT LOGIC</strong></td>
<td><strong>RESET ACTION</strong></td>
<td><strong>STANDBY OPERATION</strong></td>
<td><strong>SETPOINT ANNUNCIATORS</strong></td>
</tr>
<tr>
<td>-19999 to 99999</td>
<td>1 to 65000</td>
<td>00 to 32750 sec</td>
<td>00 to 32750 sec</td>
<td>nor rEu</td>
<td>RTo LALC2</td>
<td>NO</td>
<td>OFF rEu nor FLASH</td>
</tr>
</tbody>
</table>
Module 7 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the PAXDP 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 PAXDP. In order to establish serial communications, the user must have host software that can send and receive ASCII characters or utilizes Modbus protocol. For serial hardware and wiring details, refer to section 3.6 Serial Communication Wiring.

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 PAXDP. Also, 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**

- rLC - RLC Protocol
- Modbus RTU
- 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**

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**

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**

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**

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**

Following a transmit value ('*' terminator) or Modbus command, the PAXDP will wait this minimum amount of time in seconds before issuing a serial response.
Parameters below only appear when communications type (TYPE) parameter is set to rLC.

**SERIAL MODBUS COMMUNICATIONS**

Modbus Communications requires that the Serial Communication Type Parameter (TYPE) be set to "Mbrk" or "MbrS".

**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 cannot 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 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.

**FC17: Report Slave ID**
The following is sent upon FC17 request:
RLC-PAXDP ab<0100h><20h><20h><10h>

- **L**: 16 Guid/Scratch Pad
- **ab**: Max Register Reads (32)
- **b**: Linear Card “0” = None, “1” = Yes
- **a**: SP Card, “0”-No SP, “2” or “4” SP

**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.
### PAXDP MODBUS REGISTER TABLE

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 PAXDP should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

<table>
<thead>
<tr>
<th>REGISTER ADDRESS ¹</th>
<th>REGISTER NAME</th>
<th>LOW LIMIT ²</th>
<th>HIGH LIMIT ²</th>
<th>FACTORY SETTING</th>
<th>ACCESS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>Input A Relative Value (Hi word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Process value of present input level. This value is affected by Input Type, Resolution, Scaling &amp; Offset Value (Relative Value = Absolute Input Value + Offset Value)</td>
</tr>
<tr>
<td>40002</td>
<td>Input A Relative Value (Lo word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Process value of present input level. This value is affected by Input Type, Resolution, Scaling &amp; Offset Value (Relative Value = Absolute Input Value + Offset Value)</td>
</tr>
<tr>
<td>40003</td>
<td>Input B Relative Value (Hi word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Calculation Result of Math Function</td>
</tr>
<tr>
<td>40004</td>
<td>Input B Relative Value (Lo word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Calculation Result of Math Function</td>
</tr>
<tr>
<td>40005</td>
<td>Calculation Value (Hi word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Calculation Result of Math Function</td>
</tr>
<tr>
<td>40006</td>
<td>Calculation Value (Lo word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Calculation Result of Math Function</td>
</tr>
<tr>
<td>40007</td>
<td>Maximum Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>N/A</td>
<td>Read/Write</td>
<td>Process value of present input level. This value is affected by Input Type, Resolution, Scaling &amp; Offset Value (Relative Value = Absolute Input Value + Offset Value)</td>
</tr>
<tr>
<td>40008</td>
<td>Maximum Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>N/A</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40009</td>
<td>Minimum Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>N/A</td>
<td>Read Only</td>
<td>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</td>
</tr>
<tr>
<td>40010</td>
<td>Minimum Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>N/A</td>
<td>Read Only</td>
<td>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</td>
</tr>
<tr>
<td>40011</td>
<td>Total Value (Hi word)</td>
<td>-1999999999</td>
<td>9999999999</td>
<td>N/A</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40012</td>
<td>Total Value (Lo word)</td>
<td>-1999999999</td>
<td>9999999999</td>
<td>N/A</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40013</td>
<td>Setpoint 1 Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>100</td>
<td>Read/Write</td>
<td>Setpoint List B</td>
</tr>
<tr>
<td>40014</td>
<td>Setpoint 1 Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>100</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40015</td>
<td>Setpoint 2 Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>200</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40016</td>
<td>Setpoint 2 Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>200</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40017</td>
<td>Setpoint 3 Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>300</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40018</td>
<td>Setpoint 3 Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>300</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40019</td>
<td>Setpoint 4 Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>400</td>
<td>Read/Write</td>
<td>Setpoint List B</td>
</tr>
<tr>
<td>40020</td>
<td>Setpoint 4 Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>400</td>
<td>Read/Write</td>
<td>Setpoint List B</td>
</tr>
<tr>
<td>40021</td>
<td>Setpoint Output Register (SOR)</td>
<td>0</td>
<td>15</td>
<td>N/A</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40022</td>
<td>Manual Mode Register (MMR)</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>Read/Write</td>
<td>Bit State: 0=Auto Mode, 1=Manual Mode Bit 4 = SP1, Bit 3 = SP2, Bit 2 = SP3, Bit 1 = SP4, Bit 0 = Linear Output</td>
</tr>
<tr>
<td>40023</td>
<td>Reset Output Register</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40024</td>
<td>Analog Output Register (AOR)</td>
<td>0</td>
<td>4095</td>
<td>0</td>
<td>Read/Write</td>
<td>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</td>
</tr>
<tr>
<td>40025</td>
<td>Input A Absolute Value (Hi word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Gross value of present Input A level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value</td>
</tr>
<tr>
<td>40026</td>
<td>Input A Absolute Value (Lo word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Gross value of present Input A level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value</td>
</tr>
<tr>
<td>40027</td>
<td>Input B Absolute Value (Hi word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Gross value of present Input B level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value</td>
</tr>
<tr>
<td>40028</td>
<td>Input B Absolute Value (Lo word)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Read Only</td>
<td>Gross value of present Input B level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value</td>
</tr>
<tr>
<td>40029</td>
<td>Input A Offset Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value</td>
</tr>
<tr>
<td>40030</td>
<td>Input A Offset Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value</td>
</tr>
<tr>
<td>40031</td>
<td>Input B Offset Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value</td>
</tr>
<tr>
<td>40032</td>
<td>Input B Offset Value (Lo word)</td>
<td>-19999</td>
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<td>0</td>
<td>Read/Write</td>
<td>Relative Input Value (standard meter value) is sum of Input Offset Value and Input Absolute Value</td>
</tr>
<tr>
<td>40033</td>
<td>Main Setpoint 1 Value (Hi word)</td>
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</tr>
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<td>Main Setpoint 1 Value (Lo word)</td>
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</tr>
<tr>
<td>40035</td>
<td>Main Setpoint 2 Value (Hi word)</td>
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<td>200</td>
<td>Read/Write</td>
<td>Setpoint List B</td>
</tr>
<tr>
<td>40036</td>
<td>Main Setpoint 2 Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>200</td>
<td>Read/Write</td>
<td>Setpoint List A</td>
</tr>
<tr>
<td>40037</td>
<td>Main Setpoint 3 Value (Hi word)</td>
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</tr>
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<td>Read/Write</td>
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<td>40039</td>
<td>Main Setpoint 4 Value (Hi word)</td>
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<td>40040</td>
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<td>40041</td>
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<td>99999</td>
<td>100</td>
<td>Read/Write</td>
<td>Setpoint List B</td>
</tr>
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</table>

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.
<table>
<thead>
<tr>
<th>REGISTER ADDRESS</th>
<th>REGISTER NAME</th>
<th>LOW LIMIT 2</th>
<th>HIGH LIMIT 2</th>
<th>FACTORY SETTINGS</th>
<th>ACCESS</th>
<th>COMMENTS</th>
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<td>CH B</td>
<td>INPUT PARAMETERS</td>
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<td>40101</td>
<td>40201 Input Range</td>
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<td>0=Voll, 1=Current, 2=Volt Square Root Extraction, 3=Current Square Root Extraction</td>
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<td>40202 ADC Conversion Rate (samples/sec)</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>Read/Write</td>
<td>0=5.3, 1=7.5, 2=16.7, 3=19.8, 4=20, 5=30, 6=105</td>
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<tr>
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<td>40203 Decimal Point</td>
<td>0</td>
<td>4</td>
<td>3</td>
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<td>0=0, 1=0.0, 2=0.00, 3=0.000, 4=0.0000</td>
</tr>
<tr>
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<td>40204 Rounding Factor</td>
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<td>0</td>
<td>Read/Write</td>
<td>0=1, 1=2, 2=5, 3=10, 4=20, 5=50, 6=100</td>
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<tr>
<td>40105</td>
<td>40205 Digital Input Filter</td>
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<tr>
<td>40106</td>
<td>40206 Filter Band</td>
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<td>1=1 display unit</td>
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<tr>
<td>40107</td>
<td>40207 Number of Scaling Points</td>
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<td>16</td>
<td>2</td>
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<td>Number of Linearization Scaling Points</td>
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<td>40209 Input 1 Input Value (Hi word)</td>
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<td>99999</td>
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<td>Read/Write</td>
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<tr>
<td>40110</td>
<td>40210 Input 1 Input Value (Lo word)</td>
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<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.001</td>
</tr>
<tr>
<td>40111</td>
<td>40211 Display 1 Input Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.001</td>
</tr>
<tr>
<td>40112</td>
<td>40212 Display 1 Input Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.001</td>
</tr>
<tr>
<td>thru</td>
<td>thru</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Registers 40115-40118, 40213-40226 not shown but follow ordering as shown for Input 1, Display 1</td>
</tr>
<tr>
<td>40169</td>
<td>40269 Input 16 Input Value (Hi word)</td>
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<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.001</td>
</tr>
<tr>
<td>40170</td>
<td>40270 Input 16 Input Value (Lo word)</td>
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<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.001</td>
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<tr>
<td>40171</td>
<td>40271 Input 16 Input Value (Hi word)</td>
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<td>Read/Write</td>
<td>1=0.001</td>
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<td>1=0.001</td>
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<td>USER INPUT/FUNCTION KEYS</td>
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<tr>
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<td>See User Input 1 above</td>
</tr>
<tr>
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<td>Read/Write</td>
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</tr>
<tr>
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<td>User F1 Key Action</td>
<td>0</td>
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<td>Read/Write</td>
<td>See User F1 Key Description</td>
</tr>
<tr>
<td>40304</td>
<td>User F2 Key Action</td>
<td>0</td>
<td>19</td>
<td>0</td>
<td>Read/Write</td>
<td>See User F2 Key Description</td>
</tr>
<tr>
<td>40305</td>
<td>User Reset Key Action</td>
<td>0</td>
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<td>0</td>
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<td>See User F1 Key Description</td>
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<tr>
<td>40306</td>
<td>User F1 Second Action</td>
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<td>Read/Write</td>
<td>See User F1 Key Description</td>
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<tr>
<td>40307</td>
<td>User F2 Second Action</td>
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<td>See User F1 Key Description</td>
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<tr>
<td>DISPLAY/QUICK PRO MENU LOCKS</td>
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<tr>
<td>40311</td>
<td>Input A Display Lock</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40312</td>
<td>Input B Display</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40313</td>
<td>Calculation Display</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40314</td>
<td>Maximum (Hi) Value</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40315</td>
<td>Minimum (Lo) Value</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40316</td>
<td>Total Display</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Loc, 1=Red, 2=Disp _, 3=Disp A, 4= Disp B, 5=Disp C</td>
</tr>
<tr>
<td>40317</td>
<td>SP1 Quick Pro</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0= Lock, 1=Read, 2=Enter</td>
</tr>
<tr>
<td>40318</td>
<td>SP2 Quick Pro</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0= Lock, 1=Read, 2=Enter</td>
</tr>
<tr>
<td>40319</td>
<td>SP3 Quick Pro</td>
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<td>0</td>
<td>Read/Write</td>
<td>0= Lock, 1=Read, 2=Enter</td>
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<tr>
<td>40320</td>
<td>SP4 Quick Pro</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0= Lock, 1=Read, 2=Enter</td>
</tr>
<tr>
<td>40321</td>
<td>Program Mode Security Code</td>
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<td>Read/Write</td>
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<tr>
<td>40322</td>
<td>Display Intensity Level</td>
<td>0</td>
<td>15</td>
<td>3</td>
<td>Read/Write</td>
<td>0 = Min Intensity, 15 = Max Intensity</td>
</tr>
</tbody>
</table>

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.
<table>
<thead>
<tr>
<th>REGISTER ADDRESS</th>
<th>REGISTER NAME</th>
<th>LOW LIMIT 1</th>
<th>HIGH LIMIT 1</th>
<th>FACTORY SETTING</th>
<th>ACCESS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40029</td>
<td>Input A Offset Value (Hi word)</td>
<td>-19999</td>
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<td>Read/Write</td>
<td>*Value shown here for reference</td>
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<td>40030</td>
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<td>Read/Write</td>
<td>*Value shown here for reference</td>
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<tr>
<td>40031</td>
<td>Input B Offset Value (Hi word)</td>
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<td>99999</td>
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<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40032</td>
<td>Input B Offset Value (Lo word)</td>
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<tr>
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<td>Max (Hi) Value Assignment</td>
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<tr>
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<td>Max (Hi) Capture Delay Time</td>
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<tr>
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<td>Min (Lo) Capture Delay Time</td>
<td>0</td>
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<td>Display Update Time</td>
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<td>Units Annunciator Backlight</td>
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<td>Calculation Display Rounding Factor</td>
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<tr>
<td>40342</td>
<td>Calculation Display Filter Value</td>
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<tr>
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<td>Calculation Filter Band</td>
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<td>1=Off, 1=On</td>
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<tr>
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<tr>
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<td>Total Low Cut Value (Hi word)</td>
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<td>99999</td>
<td>-19999</td>
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<td></td>
</tr>
<tr>
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<td>-19999</td>
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<tr>
<td>40353</td>
<td>Total Low Cut Value</td>
<td>-19999</td>
<td>99999</td>
<td>-19999</td>
<td>Read/Write</td>
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<td>Total Timebase</td>
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<td>Read/Write</td>
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<td>Read/Write</td>
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<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40359</td>
<td>Timebase</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40360</td>
<td>Timebase</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40361</td>
<td>Assignment</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40362</td>
<td>Action</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40363</td>
<td>Hysteresis</td>
<td>1</td>
<td>65000</td>
<td>2</td>
<td>Read/Write</td>
<td>1=Display Unit</td>
</tr>
<tr>
<td>40364</td>
<td>On Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=Second</td>
</tr>
<tr>
<td>40365</td>
<td>Off Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=Second</td>
</tr>
<tr>
<td>40366</td>
<td>Off Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=Second</td>
</tr>
<tr>
<td>40367</td>
<td>Reset</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>1=Auto, 1=Latch1, 2=Latch2</td>
</tr>
<tr>
<td>40368</td>
<td>Standby</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Read/Write</td>
<td>1=Auto, 1=Latch1, 2=Latch2</td>
</tr>
<tr>
<td>40369</td>
<td>Lit - Annunciator</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>Read/Write</td>
<td>1=Auto, 1=Latch1, 2=Latch2</td>
</tr>
</tbody>
</table>

1 For Input Registers, replace the 4xxx 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.
<table>
<thead>
<tr>
<th>REGISTER ADDRESS ¹</th>
<th>REGISTER NAME</th>
<th>LOW LIMIT ²</th>
<th>HIGH LIMIT ²</th>
<th>FACTORY SETTING</th>
<th>ACCESS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>40381</td>
<td>Assignment</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=A-Rel 2=A-Abs 3=b-Rel 4=bAbs 5=Calc 6=Tot</td>
</tr>
<tr>
<td>40382</td>
<td>Action</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Ab-Hi 2=Ab-Lo 3=AU-HI 4=AU-LO 5=toLo 6=toHL 7=toAN 8=bNdIn 9=toLo 10=toHI Do not use 5-8</td>
</tr>
<tr>
<td>40383</td>
<td>Hysteresis</td>
<td>1</td>
<td>65000</td>
<td>2</td>
<td>Read/Write</td>
<td>1=1 Display Unit</td>
</tr>
<tr>
<td>40384</td>
<td>On Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.1 Second</td>
</tr>
<tr>
<td>40385</td>
<td>Off Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.1 Second</td>
</tr>
<tr>
<td>40386</td>
<td>Output Logic</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Normal 1=Reverse</td>
</tr>
<tr>
<td>40387</td>
<td>Reset</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Auto 1=Latch1 2=Latch2</td>
</tr>
<tr>
<td>40388</td>
<td>Standby</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Yes</td>
</tr>
<tr>
<td>40389</td>
<td>Lit - Annunciator</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>Read/Write</td>
<td>0=Off 1=Normal 2=Reverse 3=Flash</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SETPOINT 4 OUTPUT PARAMETERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40391</td>
<td>Assignment</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=A-Rel 2=A-Abs 3=b-Rel 4=bAbs 5=Calc 6=Tot</td>
</tr>
<tr>
<td>40392</td>
<td>Action</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Ab-Hi 2=Ab-Lo 3=AU-HI 4=AU-LO 5=dE-HI 6=dE-LO 7=bANd 8=bNdIn 9=toLo 10=toHL See Module 7 for Description of Parameters</td>
</tr>
<tr>
<td>40393</td>
<td>Hysteresis</td>
<td>1</td>
<td>65000</td>
<td>2</td>
<td>Read/Write</td>
<td>1=1 Display Unit</td>
</tr>
<tr>
<td>40394</td>
<td>On Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.1 Second</td>
</tr>
<tr>
<td>40395</td>
<td>Off Delay</td>
<td>0</td>
<td>32750</td>
<td>0</td>
<td>Read/Write</td>
<td>1=0.1 Second</td>
</tr>
<tr>
<td>40396</td>
<td>Output Logic</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Normal 1=Reverse</td>
</tr>
<tr>
<td>40397</td>
<td>Reset</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Auto 1=Latch1 2=Latch2</td>
</tr>
<tr>
<td>40398</td>
<td>Standby</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Yes</td>
</tr>
<tr>
<td>40399</td>
<td>Lit - Annunciator</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>Read/Write</td>
<td>0=Off 1=Normal 2=Reverse 3=Flash</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERIAL COMMUNICATIONS PARAMETERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40401</td>
<td>Type</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>Read/Write</td>
<td>0=RLC Protocol 1=Modbus RTU 2=Modbus ASCII</td>
</tr>
<tr>
<td>40402</td>
<td>Baud Rate</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>Read/Write</td>
<td>0=300 1=600 2=1200 3=2400 4=4.8k 5=9.6k 6=19.2k 7=38.4k</td>
</tr>
<tr>
<td>40403</td>
<td>Data Bits</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Read/Write</td>
<td>0=7 bits 1=8 bits</td>
</tr>
<tr>
<td>40404</td>
<td>Parity</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Even 2=Odd</td>
</tr>
<tr>
<td>40405</td>
<td>Address</td>
<td>0</td>
<td>99</td>
<td>247</td>
<td>Read/Write</td>
<td>RLC Protocol: 0-99 Modbus: 1-247</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>247</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40406</td>
<td>Transmit Delay</td>
<td>0</td>
<td>250</td>
<td>10</td>
<td>Read/Write</td>
<td>1=0.001 Second</td>
</tr>
<tr>
<td>40407</td>
<td>Abbreviated Transmission (RLC only)</td>
<td>0</td>
<td>1</td>
<td>Read/Write</td>
<td>0=None 1=Yes Not used when communications type is Modbus</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40408</td>
<td>Print Options</td>
<td>0</td>
<td>63</td>
<td>0</td>
<td>Read/Write</td>
<td>0=None 1=Yes Not used when communications type is Modbus Bit 0 - Print Input A Value Bit 1 - Print Input B Value Bit 2 - Print CALC Value Bit 3 - Print Max &amp; Min Values Bit 4 - Print Total Value Bit 5 - Print Setpoint Values</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40409</td>
<td>Load Serial Settings</td>
<td>0</td>
<td>1</td>
<td>Read/Write</td>
<td>Changing 40401-40406 will not update the PAXDP until this register is written with a 1. After the write, the communicating device must be changed to the new PAXDP settings and the register returns to 0.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANALOG OUTPUT PARAMETERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40411</td>
<td>Type</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>Read/Write</td>
<td>0 = 0-20 mA 1 = 4-20 mA 2 = 0-10 V</td>
</tr>
<tr>
<td>40412</td>
<td>Assignment</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>Read/Write</td>
<td>0=NONE 1=A-Rel 2=A-Abs 3=b-Rel 4=bAbs 5=Calc 6=Tot</td>
</tr>
<tr>
<td>40413</td>
<td>Analog Low Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td>Display value that corresponds with 0 V 0 mA or 4 mA output</td>
</tr>
<tr>
<td>40414</td>
<td>Analog Low Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>10000</td>
<td>Read/Write</td>
<td>Display value that corresponds with 10 V or 20 mA output</td>
</tr>
<tr>
<td>40415</td>
<td>Analog High Value (Hi word)</td>
<td>-19999</td>
<td>99999</td>
<td>0</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40416</td>
<td>Analog High Value (Lo word)</td>
<td>-19999</td>
<td>99999</td>
<td>10000</td>
<td>Read/Write</td>
<td></td>
</tr>
<tr>
<td>40417</td>
<td>Update Time</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>Read/Write</td>
<td>0=Max update rate 1=0.1 second</td>
</tr>
</tbody>
</table>

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 rLF.

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

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Node (Meter) Address Specifier</td>
<td>Address a specific meter. Must be followed by a one or two digit node address. Not required when address = 0.</td>
</tr>
<tr>
<td>T</td>
<td>Transmit Value (read)</td>
<td>Read a register from the meter. Must be followed by register ID character.</td>
</tr>
<tr>
<td>V</td>
<td>Value change (write)</td>
<td>Write to register of the meter. Must be followed by register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a register or output. Must be followed by register ID character.</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers are defined in programming.</td>
</tr>
</tbody>
</table>

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

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 ( 참여 무) parameter.

Full Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>2 byte Node (Meter) Address field [00-99]</td>
</tr>
<tr>
<td>3</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>4-6</td>
<td>3 byte Register Mnemonic field</td>
</tr>
<tr>
<td>7-18</td>
<td>12 byte numeric data field: 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>19</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>20</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>21</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>22</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>23</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point</td>
</tr>
<tr>
<td>13</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>14</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
<tr>
<td>15</td>
<td>&lt;SP&gt; (Space)</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt; (Carriage return)</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt; (Line feed)</td>
</tr>
</tbody>
</table>

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.

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:

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Output Signal*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000, 4.000, 0.000</td>
</tr>
<tr>
<td>1</td>
<td>0.005, 4.004, 0.0025</td>
</tr>
<tr>
<td>2047</td>
<td>10.000, 12.000, 5.000</td>
</tr>
<tr>
<td>4094</td>
<td>19.995, 19.996, 9.9975</td>
</tr>
<tr>
<td>4095</td>
<td>20.000, 20.000, 10.000</td>
</tr>
</tbody>
</table>

*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).

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.

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.

\[ t1 = \left( 10 \times \# \text{of characters} \right) / \text{baud rate} \]

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 \( (dE) \). The standard command line terminating character is ‘$’. This terminating character results in a response time window of the Serial Transmit Delay time \( (dE) \) plus 15 msec. maximum. The \( dE \) 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.

\[ t3 = \left( 10 \times \# \text{of characters} \right) / \text{baud rate} \]

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**

<table>
<thead>
<tr>
<th>Command String Transmission</th>
<th>Meter Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready</td>
<td>t1</td>
</tr>
<tr>
<td>Command Terminator Received</td>
<td></td>
</tr>
</tbody>
</table>

**RESPONSE FROM METER**

<table>
<thead>
<tr>
<th>Command String Transmission</th>
<th>Meter Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready</td>
<td>t1</td>
</tr>
<tr>
<td>Command Terminator Received</td>
<td></td>
</tr>
<tr>
<td>First Character of Reply</td>
<td>t2</td>
</tr>
<tr>
<td>Reply Transmission Time</td>
<td>t3</td>
</tr>
<tr>
<td>Ready</td>
<td></td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>LOGIC</th>
<th>INTERFACE STATE</th>
<th>RS232*</th>
<th>RS485*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mark (idle)</td>
<td>TXD,RXD, -3 to -15 V</td>
<td>a-b &lt; -200 mV</td>
</tr>
<tr>
<td>0</td>
<td>space (active)</td>
<td>TXD,RXD, +3 to +15 V</td>
<td>a-b &gt; +200 mV</td>
</tr>
</tbody>
</table>

* 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.

**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.

### 5.8 MODULE 8 - ANALOG OUTPUT PARAMETERS (8-Out)

**PARAMETER MENU**

**ANALOG TYPE**

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>0 to 20 mA</td>
</tr>
<tr>
<td>4-20</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>0-10</td>
<td>0 to 10 V</td>
</tr>
</tbody>
</table>

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**
  - NONE
  - A-rEL: Relative (net) Input Value. The Relative Input Value is the Absolute Input Value that includes the Display Offset Value.
  - A-AbS: Absolute (gross) Input Value. The Absolute Input Value is based on Module 1 DSP and INP entries.
  - b-rEL: Calculation Value
  - b-AbS: Totalizer Value
  - Lo = Minimum Display Value
  - Hi = Maximum Display Value

Enter the source for the analog output to retransmit:

- **uDT**

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.

**ANALOG LOW SCALE VALUE**

-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**

-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**

0.0 to 100

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.
5.9 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 66 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 (RPLY) 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.

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.

4. When 0 appears remove the external meters and press PAR twice.

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. ND 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. (ND 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 ChL ND will appear on the display after approximately 1 second.
7. When ND 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.
## Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Display</td>
<td>Check: Power level, power connections, Module 3 programming</td>
</tr>
<tr>
<td>Program Locked-Out</td>
<td>Check: Active (lock-out) user input&lt;br&gt;Enter: Security code requested</td>
</tr>
<tr>
<td>Display Locked-Out</td>
<td>Check: Module 3 programming</td>
</tr>
<tr>
<td>Incorrect Input Display Value</td>
<td>Check: Module 1 programming, Input Jumper position, input connections, input signal level&lt;br&gt;Module 4 Display Offset is zero, press DSP for Input Display&lt;br&gt;Perform: Module 9 Calibration (If the above does not correct the problem.)</td>
</tr>
<tr>
<td>&quot;OLOL&quot; in Display (Signal High)</td>
<td>Check: Module 1 programming, Input Range Jumper position, input connections, input signal level</td>
</tr>
<tr>
<td>&quot;UULU&quot; in Display (Signal Low)</td>
<td>Check: Module 1 programming, Input Range Jumper position, input connections, input signal level</td>
</tr>
<tr>
<td>Jittery Display</td>
<td>Increase: Module 1 filtering, rounding, input range&lt;br&gt;Check: Wiring is per EMC installation guidelines</td>
</tr>
<tr>
<td>Modules or Parameters Not Accessible</td>
<td>Check: Corresponding plug-in card installation</td>
</tr>
<tr>
<td>Error Code (Err xxx or EE xxx)</td>
<td>Press: Reset Key (If cannot clear contact factory.)</td>
</tr>
</tbody>
</table>

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

---

### Parameter Value Chart

**PAXDP Model Number:** ________  **Meter #:** ________  **Security Code:** ________  **Programmer:** ________  **Date:** ________

#### 1-Inp Signal Input Parameters

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>Input A Setting</th>
<th>Input B Setting</th>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>Input A Setting</th>
<th>Input B Setting</th>
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<tr>
<td>Range</td>
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<td>dSP 1</td>
<td>Display Value 7</td>
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<td>Display Value 7</td>
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<tr>
<td>Round</td>
<td>Display Rounding Increment</td>
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<tr>
<td>Band</td>
<td>Filter Enable Band</td>
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<td></td>
<td>dSP 5</td>
<td>Display Value 9</td>
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<tr>
<td>Style</td>
<td>Scaling Points</td>
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<td></td>
<td>dSP 6</td>
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<td>Display Value 4</td>
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<td>Input Value 5</td>
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<td>Display Value 5</td>
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<tr>
<td>Inp 6</td>
<td>Input Value 6</td>
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</tr>
</tbody>
</table>

---

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

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**Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com**
### Totalizer (Integrator) Parameters

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>User Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RsIn</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totalizer Assignment</td>
<td></td>
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<tr>
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<td>dECp</td>
<td></td>
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<tr>
<td></td>
<td>Totalizer Decimal Point</td>
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<tr>
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<td>tBoSE</td>
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<td>Totalizer Time Base</td>
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<tr>
<td></td>
<td>SCFrc</td>
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<td></td>
<td>Totalizer Scale Factor</td>
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<tr>
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<td>Locut</td>
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<td>Totalizer Low Cut Value</td>
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<tr>
<td></td>
<td>P-Up</td>
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### Serial Communication Parameters

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<th>Parameter</th>
<th>Factory Setting</th>
<th>User Setting</th>
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<tbody>
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<td>Baud Rate</td>
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<td>Addr</td>
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<td>Meter Address</td>
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<td></td>
</tr>
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<td></td>
<td>Addr</td>
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<td>Print Options</td>
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<td>Baud</td>
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<tr>
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<td>Data Bit</td>
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<td>Parity Bit</td>
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<td>Delays</td>
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<td></td>
<td>Print Total Value</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Print Max &amp; Min Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Print Setpoint Values</td>
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</tbody>
</table>

### Display and Program Lockout Parameters

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>User Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>InP A</td>
<td>Input A Assignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>InP b</td>
<td>Input B Assignment</td>
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</tr>
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<td>Calc</td>
<td>Calculation Assignment</td>
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<td></td>
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<tr>
<td>H</td>
<td>Min Display Lockout</td>
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</tr>
<tr>
<td>L0</td>
<td>Total Display Lockout</td>
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</tr>
<tr>
<td>SP-1</td>
<td>Setpoint 1 Access</td>
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<tr>
<td>SP-2</td>
<td>Setpoint 2 Access</td>
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<td>SP-3</td>
<td>Setpoint 3 Access</td>
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<td>SP-4</td>
<td>Setpoint 4 Access</td>
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<tr>
<td>Code</td>
<td>Security Code</td>
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### Secondary Function Parameters

<table>
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<tr>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>User Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSF-R</td>
<td>Input A Offset Value</td>
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</tr>
<tr>
<td>DSF-b</td>
<td>Input B Offset Value</td>
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<td></td>
</tr>
<tr>
<td>H1-RS</td>
<td>Max Capture Assignment</td>
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<td>H1-t</td>
<td>Max Capture Delay Time</td>
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<tr>
<td>L0-RS</td>
<td>Min Capture Assignment</td>
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<tr>
<td>L0-t</td>
<td>Min Capture Delay Time</td>
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<tr>
<td>DSF-t</td>
<td>Display Update Time</td>
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<td></td>
</tr>
<tr>
<td>b-Lit</td>
<td>Units Label Backlight</td>
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<tr>
<td>CFun</td>
<td>Calculation Function</td>
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</tr>
<tr>
<td>c-dP</td>
<td>Calculation Decimal Point</td>
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</tr>
<tr>
<td>c-Stk</td>
<td>Calculation Constant Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c-Rnd</td>
<td>Calculation Rounding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c-FB</td>
<td>Calculation Filter Setting</td>
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</tr>
<tr>
<td>c-BFd</td>
<td>Calculation Filter Band</td>
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</tr>
</tbody>
</table>

### Setpoint (Alarm) Parameters

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Factory Setting</th>
<th>User Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPSel</td>
<td>Select Setpoint</td>
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<tr>
<td>ASn-n</td>
<td>Setpoint Assignment</td>
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<td></td>
</tr>
<tr>
<td>Ac-n</td>
<td>Setpoint Action</td>
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<td></td>
</tr>
<tr>
<td>Sn</td>
<td>Setpoint Value (main)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sn</td>
<td>Setpoint Value (alternate)*</td>
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<td></td>
</tr>
<tr>
<td>Hys-n</td>
<td>Setpoint Hysteresis</td>
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<td></td>
</tr>
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<td>tOn-n</td>
<td>On Time Delay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tOF-n</td>
<td>Off Time Delay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-n</td>
<td>Output Logic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rn-b</td>
<td>Reset Action</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stb-n</td>
<td>Standby Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-b-n</td>
<td>Setpoint Annunciators</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Select alternate list to program these values.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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.

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 V AC 50/60 Hz, 12 VA
   - DC POWER: 21.6 to 250 VDC, 6 W
   - DC Out: +24 VDC @ 100 mA if input voltage is greater than 50 V AC/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 Impedance: 0.1% of span
   - Resolution: 1.03 MΩ, 75 VDC
   - Temp Coefficient: 70 ppm /°C

   **D.C. Currents:**
   - 200 µA, 2 mA, 20 mA, 200 mA
   - Input Impedance: 1.111 KΩ, 15 mA
   - Resolution: 1.1 Ω, 150 mA
   - Temp Coefficient: 70 ppm /°C

4. INPUT RANGE

   - 4 - 20 mA: Use the 20 mA range
   - 1 - 5 VDC: Use the 10 V range
   - 1 - 10 VDC: Use the 10 V range

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXLA</td>
<td>Volt/Current/Process Meter with dual Relay Output</td>
<td>PAXLA000</td>
</tr>
<tr>
<td>PAXLBK</td>
<td>Unit Label Kit Accessory</td>
<td>PAXLBK10</td>
</tr>
</tbody>
</table>

DIMENSIONS

<table>
<thead>
<tr>
<th>Model PAXLA - PAX LITE DC VOLT/CURRENT/PROCESS METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 5 DIGIT, 0.56” HIGH RED LED DISPLAY</td>
</tr>
<tr>
<td>• PROGRAMMABLE SCALING AND DECIMAL POINTS</td>
</tr>
<tr>
<td>• PROGRAMMABLE USER INPUT</td>
</tr>
<tr>
<td>• DUAL 5 AMP FORM C RELAY</td>
</tr>
<tr>
<td>• UNIVERSALLY POWERED</td>
</tr>
<tr>
<td>• NEMA 4X/IP65 SEALED FRONT BEzel</td>
</tr>
<tr>
<td>• OPTIONAL CUSTOM UNIT OVERLAY W/ BACKLIGHT</td>
</tr>
<tr>
<td>• MINIMUM AND MAXIMUM DISPLAY CAPTURE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRAWING</th>
<th>DIMENSIONS</th>
<th>model no.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXLA-X</td>
<td>PAXLA000</td>
<td>Volt/Current/Process Meter with dual Relay Output</td>
<td></td>
</tr>
<tr>
<td>LP0722</td>
<td>PAXLBK10</td>
<td>Unit Label Kit Accessory</td>
<td></td>
</tr>
</tbody>
</table>

**CAUTION:** Risk of Danger. Risk of Electric Shock.

CAUTION: Read complete instructions prior to installation and operation of the unit.
4. **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)

5. **MEMORY:** Nonvolatile E²PROM retains all programming parameters when power is removed.

6. **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)

7. **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)
Altitude: Up to 2,000 meters

8. **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.

9. **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.

10. **CERTIFICATIONS AND COMPLIANCES:**
**SAFETY**
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
Type 4X Enclosure rating (Face only), UL50

**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: Normal operation within specified limits.
  - Criterion B: Temporary loss of performance from which the unit self-recoverers.
- Electromagnetic RF fields: EN 61000-4-3
  - Criterion A: 4 kV contact discharge
  - Criterion B: 8 kV air discharge
- Fast transients (burst): EN 61000-4-4
  - Criterion A: 10 V/m
  - Criterion B: 2 kV power
- Surge: EN 61000-4-5
  - Criterion A: 1 kV signal
  - Criterion B: 2 kV L+N-E power
- RF conducted interference: EN 61000-4-6
  - Criterion A: 3 V/rms
  - Criterion B: 0.5 cycle
- Voltage dip/interruptions: EN 61000-4-11
  - 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-recoverers.

11. **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.
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 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. 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 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

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

**DC Out Power**
Terminal 3: +24 VDC OUT
Terminal 4: Common

![Power Wiring Diagram]

3.2 USER INPUT WIRING

Terminal 8: User Input
Terminal 9: User Comm

**Sinking Logic**
Terminal 8 USER
Terminal 9 USER COM

**Sourcing Logic**
Terminal 8 USER
Terminal 9 USER COM

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

![Input Signal Wiring Diagrams]
4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

BUTTON DISPLAY MODE OPERATION
- **PAR**: Access Programming Mode
- **SEL**: Index display through selected displays
- **RST**: Resets display

PROGRAMMING MODE OPERATION
- Store selected parameter and index to next parameter
- Advance through selection list/select digit position in parameter value
- 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 **PrA** 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 **PrA 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 **PrA 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

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Display Offset Value</th>
<th>Display Decimal Point</th>
<th>Filter Setting</th>
<th>Filter Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>INP 1</td>
<td>dECP 1</td>
<td>dECP 2</td>
<td>dSP 1</td>
<td>dSP 2</td>
</tr>
<tr>
<td>INP 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INP M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INP RS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INP R</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INPUT RANGE**

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**

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the dECP 1 and dECP 2 parameters and setpoint values and offset value.

**DISPLAY OFFSET VALUE**

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 dECP selection.

**FILTER SETTING**

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**

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**

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**

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**

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 dECP selection.

**INPUT VALUE FOR SCALING POINT 2**

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**

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 dECP 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 cannot 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 (INP 1 / dSP 1 & INP 2 / dSP 2).
USER INPUT FUNCTION

<table>
<thead>
<tr>
<th>DISPLAY MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Function</td>
<td>User Input disabled.</td>
</tr>
<tr>
<td>P-Loc</td>
<td>Program Mode Lock-out</td>
</tr>
<tr>
<td>Zero Input</td>
<td>Zero the Input Display value causing Display Reading to be Offset.</td>
</tr>
<tr>
<td>Reset (Edge triggered)</td>
<td>Resets the assigned value(s) to the current input value.</td>
</tr>
<tr>
<td>Display Hold</td>
<td>Holds the assigned display, but all other meter functions continue as long as activated (maintained action).</td>
</tr>
<tr>
<td>Display Select (Edge Triggered)</td>
<td>Advance once for each activation.</td>
</tr>
<tr>
<td>Display Intensity Level (Edge Triggered)</td>
<td>Increase intensity one level for each activation.</td>
</tr>
<tr>
<td>Setpoint 1 Reset</td>
<td>Resets setpoint 1 output.</td>
</tr>
<tr>
<td>Setpoint 2 Reset</td>
<td>Resets setpoint 2 output.</td>
</tr>
<tr>
<td>Setpoint 1 and 2 Reset</td>
<td>Reset both setpoint 1 and 2 outputs.</td>
</tr>
</tbody>
</table>

USER INPUT ASSIGNMENT

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

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

5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

MAX DISPLAY ENABLE

<table>
<thead>
<tr>
<th>Hi-En</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
</table>

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>Hi-t</th>
<th>00 to 9999 sec.</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Lo-En</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
</table>

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>Lo-t</th>
<th>00 to 9999 sec.</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>FCS</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
</table>

Select Yes to perform any of the Factory Service Operations shown below.

RESTORE FACTORY DEFAULT SETTINGS

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

VIEW MODEL AND VERSION DISPLAY

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

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.
**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 CAL for about 8 seconds.
5. With the positive lead of the DC current source unconnected, press PAR. Display reads CAL for about 8 seconds.
6. When the display reads the selected range, connect the positive lead of the DC current source to the 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 CAL 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 CAL for about 8 seconds.
5. With the voltage source set to zero (or a dead short applied to the input), press PAR. Display reads CAL 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 CAL 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 (3-3dSP)

#### DISPLAY UPDATE TIME

![Display Update Time](image)

This parameter sets the display update time in seconds.

#### FRONT PANEL DISPLAY SELECT ENABLE (SEL)

![Front Panel Display Select Enable](image)

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

#### FRONT PANEL RESET ENABLE (RST)

![Front Panel Reset Enable](image)

This selection allows the RST button to reset the selected value(s).

#### ZERO DISPLAY WITH DISPLAY RESET

![Zero Display with Display Reset](image)

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 3dSP and the Input value must be displayed. If these conditions are not met, the display will not zero.
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).

---

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

**PARAMETER MENU**

<table>
<thead>
<tr>
<th>4-SPt</th>
<th>PAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPSel</td>
<td>Enb-n</td>
</tr>
</tbody>
</table>

**SETPOINT SELECT**

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**

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**

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

**SETPOINT VALUE**

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

**HYSTERESIS VALUE**

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.

---

### PROGRAMMING SECURITY CODE

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).

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN “PAR” BUTTON IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CodE</td>
<td>CodE prompt</td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at CodE prompt *</td>
<td>After Quick Programming with correct code entry at CodE prompt *</td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>CodE prompt</td>
<td>Quick Programming</td>
<td>With correct code entry at CodE prompt *</td>
</tr>
<tr>
<td></td>
<td>CodE prompt</td>
<td>0</td>
<td>Quick Programming</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>No Access</td>
<td>With correct code entry at CodE prompt *</td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>CodE prompt</td>
<td>Quick Programming</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td>CodE prompt</td>
<td>0</td>
<td>Quick Programming</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td>0-999</td>
<td>Full Programming</td>
<td>Immediate Access</td>
<td>With correct code entry at CodE prompt *</td>
</tr>
</tbody>
</table>

---

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ON TIME DELAY

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

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

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.)

OUTPUT RESET WITH DISPLAY RESET

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

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.
Press PAR key to enter Programming Mode.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL PAXLIT - PAX LITE 5 AMP AC CURRENT METER

**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 1,999 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.

**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)
## Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering Information</td>
<td>2</td>
</tr>
<tr>
<td>General Meter Specifications</td>
<td>3</td>
</tr>
<tr>
<td>Accessories</td>
<td>3</td>
</tr>
<tr>
<td>Installing the Meter</td>
<td>4</td>
</tr>
<tr>
<td>Setting the Switches</td>
<td>4</td>
</tr>
<tr>
<td>Wiring the Meter</td>
<td>5</td>
</tr>
<tr>
<td>Scaling the Meter</td>
<td>5</td>
</tr>
<tr>
<td>Application</td>
<td>6</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>6</td>
</tr>
<tr>
<td>Calibration</td>
<td>6</td>
</tr>
</tbody>
</table>

## Ordering Information

**Meter Part Numbers**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXL</td>
<td>IT - 5 Amp Current Meter</td>
<td>CT005050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT020050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT020050</td>
</tr>
</tbody>
</table>

**Accessories Part Numbers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Model No.</th>
<th>Description</th>
<th>Part Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
<tr>
<td></td>
<td>CT</td>
<td>50:5 Amp Current Transformer</td>
<td>CT005050</td>
</tr>
<tr>
<td></td>
<td>CT</td>
<td>200:5 Amp Current Transformer</td>
<td>CT020050</td>
</tr>
</tbody>
</table>
GENERAL METER SPECIFICATIONS

1. DISPLAY: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment 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)
   - 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. 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
      - IECCE 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

11. 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
     - Electromagnetic RF fields: EN 61000-4-3
     - Fast transients (burst): EN 61000-4-4
     - Surge: EN 61000-4-5
     - RF conducted interference: EN 61000-4-6
     - Voltage dip/interruptions: EN 61000-4-11

   - Emissions:
     - Emissions: EN 55011

   Notes:
   - 2. Criterion B: Temporary loss of performance from which the unit self-recoveries.

12. 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.

13. CONSTRUCTION: This unit is rated for NEMA 4X/IP65 use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.

14. 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.

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
    - Electromagnetic RF fields: EN 61000-4-3
    - Fast transients (burst): EN 61000-4-4
    - Surge: EN 61000-4-5
    - RF conducted interference: EN 61000-4-6
    - Voltage dip/interruptions: EN 61000-4-11

- Emissions:
  - Emissions: EN 55011

Notes:
2. Criterion B: Temporary loss of performance from which the unit self-recoveries.

CONNECTIONS: High compression cage-clamp terminal block
- Wire Strip Length: 0.3" (7.5 mm)
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CONSTRUCTION: This unit is rated for NEMA 4X/IP65 use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.

WEIGHT: 0.65 lbs. (0.24 Kg)
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 overtighten 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 V AC 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
<tr>
<td>5</td>
<td>Enables the Scaling Pot</td>
</tr>
</tbody>
</table>

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**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 #28B2029-0A
   - 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**

<table>
<thead>
<tr>
<th>AC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1: VAC&lt;br&gt;1</td>
</tr>
<tr>
<td>Terminal 2: VAC&lt;br&gt;2</td>
</tr>
</tbody>
</table>

**3.2 INPUT SIGNAL WIRING**

Current Signal (self powered)

<table>
<thead>
<tr>
<th>SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 4: + Amps AC&lt;br&gt;3</td>
</tr>
<tr>
<td>Terminal 3: - Amps AC&lt;br&gt;4</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power switch and line voltage</td>
</tr>
<tr>
<td>INCORRECT DISPLAY</td>
<td>CHECK: Scaling adjustment pot DIP switch position, ADJUST: Scaling pot, VERIFY: Input Signal</td>
</tr>
<tr>
<td>OVER-RANGE INDICATION</td>
<td>VERIFY: Input signal</td>
</tr>
</tbody>
</table>

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

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, 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. 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.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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.

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering Information</td>
<td>2</td>
</tr>
<tr>
<td>General Meter Specifications</td>
<td>3</td>
</tr>
<tr>
<td>Installing the Meter</td>
<td>3</td>
</tr>
<tr>
<td>Setting the Jumper and Switches</td>
<td>4</td>
</tr>
<tr>
<td>Wiring the Meter</td>
<td>4</td>
</tr>
<tr>
<td>Reviewing the Front Buttons and Display</td>
<td>6</td>
</tr>
<tr>
<td>Scaling the Meter</td>
<td>6</td>
</tr>
<tr>
<td>Programming the Meter</td>
<td>7</td>
</tr>
</tbody>
</table>

## ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAXL</th>
<th>PT</th>
<th>0</th>
<th>0</th>
</tr>
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</table>

PT - 6 Digit Process Time Meter
1. **DISPLAY**: 6-digit, 0.56" (14.2 mm), 7-segment 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 Source**: Internal 3.9 KΩ pull-down, 8 mA max. @ 30 VDC max.
   - **MAGNETIC PICK-UP**:
     - **Sensitivity**: 200 mV peak
     - **Hysteresis**: 100 mV
     - **Input impedance**: 3.9 KΩ @ 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 E2PROM** 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)
   - **Altitude**: Up to 2000 meters
9. **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
10. **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
      - **Criterions**: A
        - **4 kV contact discharge**
        - **8 kV air discharge**
      - **Electromagnetic RF fields**: EN 61000-4-3
      - **Criterions**: A
        - **10 V/m**
      - **Fast transients (burst)**: EN 61000-4-4
      - **Criterions**: A
        - **2 kV**
        - **2 kV signal**
      - **Surge**: EN 61000-4-5
      - **Criterions**: A
        - **1 kV L-L**
        - **2 kV L&N-E power**
      - **RF conducted interference**: EN 61000-4-6
      - **Criterions**: A
        - **3 V/rms**
      - **Power frequency magnetic fields**: EN 61000-4-8
      - **Criterions**: A
        - **30 A/m**
      - **Voltage dip/interruptions**: EN 61000-4-11
      - **Criterions**: 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 Capacity**: 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 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.
# 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 power-up the meter. The meter is shipped from the factory in the 230 V AC 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.

### 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.

### 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.

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. 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 # 28B2029-040
   - 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

*Switch position is application dependent.*
4.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

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.

\[ SF = DR \times PPS \]

**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.

\[
\text{PPS} = \frac{\text{RPM} \times \text{PPR}}{60}
\]

*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.

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.

\[ SF = DR \times PPS \]

**WHERE:**
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\text{PPS} = \frac{\text{RPM} \times \text{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
- **PPS** = 450 RPM x 60 PPR
  \[
  \text{PPS} = \frac{450 \times 60}{60} = 450
  \]
- **SF** = **DR** x **PPS**
  \[
  SF = 150 \times 450 = 67,500
  \]

Since the SF value is greater than 59,999, the SM will be needed to reduce the calculated value to a 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)
- **PPS** = 138 RPM x 100 PPR
  \[
  \text{PPS} = \frac{138 \times 100}{60} = 230
  \]

To calculate the Scale Factor for a 5 Digit application, first convert the DR to its base units.

\[
\text{DR} = 2 \text{ (hours)} \times 60 + 23
\]
\[
\text{DR} = 120 + 23 = 143
\]
- **SF** = **DR** x **PPS**
  \[
  SF = 143 \times 230 = 32,890
  \]

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 $ in 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)

![DECIMAL POSITION](image)

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

![SCALE FACTOR](image)

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

![SCALE MULTIPLIER](image)

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 $ % & 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. All programmed selections are now transferred to the non-volatile memory and the meter 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 $ % & 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.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Model PAXLPV - PAX Lite Process Volt Meter

**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.

**Dimensions**

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 ........................................... 2
General Meter Specifications ................................. 3
Accessories ......................................................... 3
Installing the Meter ............................................... 4
Setting the Switches ............................................ 4
Wiring the Meter .................................................. 5
Scaling the Meter .................................................. 6
Calibrating the Meter ............................................. 7
Applications ......................................................... 8

Ordering Information

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
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<td>PAXL</td>
<td>PV</td>
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PV - Process Volt Meter

Accessories Part Numbers

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<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
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<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>
GENERAL METER SPECIFICATIONS

1. DISPLAY: 3 1/2-digit, 0.56” (14.2 mm) high, 7-segment 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 MΩ

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
    - 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 Certificate # US8843A/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
        - Electromagnetic RF fields: EN 61000-4-3
        - Fast transients (burst): EN 61000-4-4
        - Surge: EN 61000-4-5
        - RF conducted interference: EN 61000-4-6
        - Power frequency magnetic fields: EN 61000-4-8
        - Voltage dip/interruptions: EN 61000-4-11

      - Notes:
        2. Criterion B: Temporary loss of performance from which the unit self-reCOVERS.

    - 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 indoor 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)

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 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
</tbody>
</table>
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

85–250 VAC

**Excitation Power**
- 5
- 6

480 mA min.
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 PAXLVP 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), andSPAN PER VOLT (Rs/Vs) must be determined.

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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>SPAN VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>550</td>
</tr>
<tr>
<td>7</td>
<td>275</td>
</tr>
<tr>
<td>8</td>
<td>140</td>
</tr>
<tr>
<td>9</td>
<td>75</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>700</td>
</tr>
<tr>
<td>4</td>
<td>350</td>
</tr>
<tr>
<td>5</td>
<td>175</td>
</tr>
</tbody>
</table>

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.

WHERE:

\[
Rs = (\text{Max. Numerical Display}) - (\text{Min. Numerical Display}) \quad \text{(Disregard Decimal Points)}
\]

\[
Vs = (\text{Voltage @ Max. Display}) - (\text{Voltage @ Min. Display})
\]

\[
Rs/Vs = \text{READOUT SPAN (Rs)} \quad \text{SWING VOLTAGE (Vs)}
\]

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
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.
MODEL PAXLR - PAX LITE RATE METER

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 1/2" (53.4) H x 5" (127) W.
**ORDERING INFORMATION**

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAXL</th>
<th>R0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

R0 - 6 Digit Rate Meter
1. DISPLAY: 6-digit, 0.56” (14.2 mm), 7-segment 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. @ 100 mA max.
   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 $V_{TH} = 1.5$ V max.; $V_{TH} = 3.75$ V min.
   Current Sinking: Internal 7.8 kΩ pull-up to +12 VDC, $I_{MAX} \leq 1.9$ 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: 3.9Ω @ 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 E2PROM 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)
   - Altitude: Up to 2000 meters

9. 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 Certificate # UL/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
   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 kV power
   - 2 kV signal
   - Surge: EN 61000-4-5 Criterion A
   - 2 kV L&N-E power
   - 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
   - Voltage dip/interruptions: EN 61000-4-11 Criterion A
   - 0.5 cycle

   Emissions:
   - Emissions EN 55011 Class B
   Notes:
   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 panel latch over the rear of the unit and DC Out/In.

**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 or change the settings. Do NOT use the front panel reset button while operating the meter.

**CUIDADO:** Use only non-conductive tools to install and remove electrical components.

**NOTICE:** Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad or change the settings.
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.

<table>
<thead>
<tr>
<th>SWITCH 1</th>
<th>SW</th>
<th>SNK</th>
<th>Adds internal 7.8 KΩ pull-up resistor to + 12 VDC, I_{MAX} = 1.9 mA.</th>
<th>SRC</th>
<th>Not Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWITCH 2</td>
<td>SW</td>
<td>SNK</td>
<td>Adds internal 3.9 KΩ pull-down resistor, 8 mA max. @ 30 VDC max.</td>
<td>SRC</td>
<td>Not Active</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH 3</th>
<th>HI Frequency: Removes damping capacitor and allows max. frequency.</th>
<th>LO Frequency: Limits input frequency to 50 Hz and input pulse widths to 10 usec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWITCH 4</td>
<td>LOGIC: Input trigger levels V_{IL} = 1.5 V max.; V_{IH} = 3.75 V max.</td>
<td>MAG: 200 mV peak input (must have SRC on).</td>
</tr>
<tr>
<td>SWITCH 5</td>
<td>Enable Programming: Enables programming through the front panel buttons.</td>
<td>Disables Programming: Disables the front panel buttons from any programming changes.</td>
</tr>
<tr>
<td>SWITCH 6</td>
<td>Not Active for the Rate Meter</td>
<td></td>
</tr>
</tbody>
</table>

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 for 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:
   a. Ferrite Suppression Cores for signal and control cables:
      - Corcom # 1 VR3
      - Schaffner # FN610-1/07 (RLC# MFIL0000)
      - Steward # 28B2029-0A0
   b. Line Filters for input power cables:
      - Fair-Rite # 0443167251 (RLC# FCOR0000)
      - TDK # ZCAT3035-1300A
      - Schaffner # FN610-1/07
      - Schaffner # FN670-1.8/07
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
5. 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.
   d. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
   e. 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.
   f. 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:
      a. Ferrite Suppression Cores for signal and control cables:
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         - TDK # ZCAT3035-1300A
         - Schaffner # FN610-1/07
         - Schaffner # FN670-1.8/07
   g. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
6. 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.
   h. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
   i. 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.
   j. 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:
      a. Ferrite Suppression Cores for signal and control cables:
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   j. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
7. 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.
   k. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
   l. 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.
   m. 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:
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         - TDK # ZCAT3035-1300A
         - Schaffner # FN610-1/07
         - Schaffner # FN670-1.8/07
   n. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
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

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 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 (\textit{SUE41}) and Scaling Input (\textit{SU*/1}). 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:

<table>
<thead>
<tr>
<th>RATE PER</th>
<th>DISPLAY (\textit{r-t-d5P})</th>
<th>INPUT (\textit{r-t-lNP})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>1</td>
<td># of pulses per unit</td>
</tr>
<tr>
<td>Minute</td>
<td>60</td>
<td># of pulses per unit</td>
</tr>
<tr>
<td>Hour</td>
<td>3600</td>
<td># of pulses per unit</td>
</tr>
</tbody>
</table>

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 “000000” 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.

INPUT FREQUENCY DIAGRAMS

![Rate Value Calculated Diagram](image)

![Zero Rate Calculated Diagram](image)
6.0 Programming the Meter

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 Pr as 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

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)

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)

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

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

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 ESFF 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.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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 setup 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.

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" (127) W.
TABLE OF CONTENTS

Ordering Information . . . . . . . . . . . . . . . . . . . 2
General Meter Specifications . . . . . . . . . . . . . 3
Accessories . . . . . . . . . . . . . . . . . . . . . . . . . 3
Installing the Meter . . . . . . . . . . . . . . . . . . . . 4
Wiring the Meter . . . . . . . . . . . . . . . . . . . . . . 4
Reviewing the Front Buttons and Display . . . 5
Programming the Meter . . . . . . . . . . . . . . . . 6
Calibrating the Meter . . . . . . . . . . . . . . . . . . 7
Troubleshooting . . . . . . . . . . . . . . . . . . . . . . 7

ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAXL</th>
<th>RT</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RT - RTD Temperature Meter

Accessories Part Numbers*

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>

*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 LED, minus sign displayed for negative temperatures.
   - Overrange/Underrange Input: Flashing “OL OL” or “UL UL”
   - 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, 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 Underwriters Laboratories, Inc.

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
    - Altitude: Up to 2000 meters.

14. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 indoor 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)

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**ACCESSORIES**

**UNITS LABEL KIT (PAXLGBK)**

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.

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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/m

- 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.

---

**CLASS B**

- EN 55011

- Emissions:
  - 0.5 cycle
  - Criterion A
  - EN 61000-4-11

- Voltage dip
  - 3 V
  - Criterion A

- Fast transients
  - 5 V
  - Criterion A

- Electrical fields
  - 8 kV
  - Criterion A

- Electrostatic discharge
  - 4 kV
  - Criterion A

---

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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 overtighten 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.

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: V AC
Terminal 2: V AC

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.

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.)

AC Power
Terminal 1: V AC
Terminal 2: V AC

3-Wire RTD

2-Wire RTD

Note: Extended cable runs can be made provided the lead resistance is less than 20 Ω/lead and the resistance is equal in each leg.

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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

View Peak, Valley and Input readings:
To view Peak, press \( \uparrow \). Meter displays \( \# \) followed by the Peak reading.
To view Valley, press \( \downarrow \). Meter displays \( \& \) followed by the Valley reading.
To view Input, press \( \text{PAR} \). Meter displays \( \#\text{PAR} \) 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.

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 \( \uparrow \). Meter displays \( \# \) followed by the Peak reading.
To view Valley, press \( \downarrow \). Meter displays \( \& \) followed by the Valley reading.
To view Input, press \( \text{PAR} \). Meter displays \( \#\text{PAR} \) followed by the current Input reading.

Reset Peak and/or Valley to the current Input reading:
To reset Peak and Valley, press \( \uparrow \) and \( \downarrow \) simultaneously.
To reset Peak only, press and hold \( \uparrow \) then press \( \text{PAR} \).
To reset Valley only, press and hold \( \downarrow \) then press \( \text{PAR} \).

In each case, the meter displays \( \#\text{5E} \) followed by the current Input reading.
4.0 PROGRAMMING THE METER

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 PrE 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

```
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

```
°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

```
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

```
-999 to 9999
0
```

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.

PROGRAMMING MODE EXIT
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

To enter Calibration Mode, select "$< > YES$ 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

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 "$PE$ 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

To enter Calibration Mode, select "$< > YES$ 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

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 "$PE$ 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.

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 "$PE$ . 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 "$PE$ . 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 "$PE$ and then 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.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>1. Power off, improperly connected, or brown-out.</td>
<td>1a. Check wiring. 1b. Verify power.</td>
</tr>
<tr>
<td>&quot;EEEE&quot; IN DISPLAY</td>
<td>1. Program data error.</td>
<td>1. Press PAR and check data set-ups.</td>
</tr>
<tr>
<td>&quot;. . . . .&quot; IN DISPLAY</td>
<td>1. Input display out of range. 2. Loss of data set-ups.</td>
<td>1a. Change display resolution to &quot;1&quot; degree. 1b. Reduce offset value. 2a. Check data set-ups. 2b. Check for electrical disturbance. 2c. Disconnect and reconnect power.</td>
</tr>
<tr>
<td>&quot;OPEN&quot; IN DISPLAY</td>
<td>1. Probe unconnected. 2. Broken or burnout probe. 3. Excessive probe temperature. 4. Input overload.</td>
<td>1. Connect probe. 2. Repair or obtain new probe. 3. Reduce temperature. 4. Check input levels.</td>
</tr>
<tr>
<td>&quot;SHORT&quot; IN DISPLAY</td>
<td>1. Input shorted.</td>
<td>1. Check input connections.</td>
</tr>
</tbody>
</table>
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL PAXLSG - PAX LITE STRAIN GAGE METER / MILLIVOLT METER

- 3 1/2-DIGIT, 0.56" (14.2 mm) HIGH 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

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 . . . . . . . . . . . . . . . . . . . 2
General Meter Specifications . . . . . . . . . . . . . 3
Accessories . . . . . . . . . . . . . . . . . . . . . . . . . 3
Installing the Meter . . . . . . . . . . . . . . . . . . . . 4
Setting the Jumpers and Switches . . . . . . . 4
Wiring the Meter . . . . . . . . . . . . . . . . . . . . . . 5
Scaling the Meter . . . . . . . . . . . . . . . . . . . . . 6
Calibrating the Meter . . . . . . . . . . . . . . . . . . . 7
Applications . . . . . . . . . . . . . . . . . . . . . . . . . 8

ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAXL</th>
<th>SG</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

SG - Strain Gage Meter

Accessories Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>
GENERAL METER SPECIFICATIONS

1. DISPLAY: 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment 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: -20° 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
    - 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
      - IEC/CECB 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
        - Electromagnetic RF fields EN 61000-4-3
        - Fast transients (burst) EN 61000-4-4
        - Surge EN 61000-4-5
        - RF conducted interference EN 61000-4-6
        - Power frequency magnetic fields EN 61000-4-8
        - Voltage dip/interruptions EN 61000-4-11
      - Emissions:
        - Emission EN 55011
      - Notes:
        - 2. Criterion B: Temporary loss of performance from which the unit self-recover.

    - CONNECTIONS:
      - 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.

    - CONSTRUCTION:
      - This unit is rated for NEMA 4X/IP65 outdoor use.

    - WEIGHT: 0.65 lbs (0.24 kg)

ACCESSORIES

UNIT 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.

Notes:
- 2. Criterion B: Temporary loss of performance from which the unit self-recover.

CONSTRUCTION:
- 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.

CONSTRUCTION:
- This unit is rated for NEMA 4X/IP65 outdoor use.

WEIGHT: 0.65 lbs (0.24 kg)
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 overtighten 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 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
</tbody>
</table>

PAXLSG Jumper Selection

JUMPER SELECTIONS
The ▼ indicates factory setting.
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 wire 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

<table>
<thead>
<tr>
<th>AC Power</th>
<th>Excitation Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1: VAC</td>
<td>Terminal 3: Common</td>
</tr>
<tr>
<td>Terminal 2: VAC</td>
<td>Terminal 4: Excitation +</td>
</tr>
</tbody>
</table>

Excitation Power: 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.
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.

\[
\text{GAIN} = \frac{\text{Max. Num. Readout} - \text{Min. Num. Readout}}{\text{Max. mV Input Sig.} - \text{Min. mV Input Sig.}}
\]

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:

\[
\text{GAIN} = \frac{1690 \text{ Units} - 500 \text{ Units}}{19 \text{ mV} - 2 \text{ mV}} = 70 \text{ Units/mV}
\]

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 (% 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)

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
Gain = 1000 = 62.5 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 Voltage), 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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td>125</td>
</tr>
</tbody>
</table>

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.

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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td>125</td>
</tr>
</tbody>
</table>

*7. 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.

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)
GAIN = Rs = Units/mV

*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).
6.0 APPLICATIONS

EXAMPLE #1  PRESSURE READOUT & SYSTEM CALIBRATION

This illustration depicts a common application using a 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 trimmed 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.

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL PAXLTC - PAX LITE THERMOCOUPLE METER

- 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 “mV” 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.

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" (127) W.
ORDERING INFORMATION

Meter Part Numbers

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXL</td>
<td>TC</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

TC - Thermocouple Temperature Meter

Accessories Part Numbers*

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>

*This meter is shipped with °F and °C overlay labels. The label kit is only needed if another units label is desired.
1. **DISPLAY**: 4-digit, 0.56” (14.2 mm) high LED, minus sign displayed for negative temperatures.
   - **Overrange/Underrange Input**: Flashing “OL OL” or “UL UL”.
   - **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%

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. Disallowed 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
   - **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, UL3101-1, 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 Certificate # UL/7470A/UL
     - CB Scheme Test Report # 03ME09282-08292003
     - 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**
     - 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
     - 2 kV power
     - 2 kV signal
     - **Fast transients (burst)** EN 61000-4-4 Criterion A
     - 1 kV L-L
     - 2 kV L-N-E power
     - 1 kV signal
     - **Surge** EN 61000-4-5 Criterion A
     - 3 V/m
     - **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 indoor 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 Gauge: 30-14 AWG copper wire
   - Torque: 4.5 inch-lbs (0.51 N-m) max.

18. **WEIGHT**:
   - 0.65 lbs. (0.24 Kg)

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**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.

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.

**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.

**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.

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

<table>
<thead>
<tr>
<th>KEY</th>
<th>DISPLAY MODE OPERATION</th>
<th>PROGRAMMING MODE OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAR</td>
<td>Access Programming Mode or Display Input Reading</td>
<td>Store selected parameter and index to next parameter</td>
</tr>
<tr>
<td>▲</td>
<td>Display Peak (HI) Reading</td>
<td>Increment value or change selection</td>
</tr>
<tr>
<td>▼</td>
<td>Display Valley (LO) Reading</td>
<td>Decrement value or change selection</td>
</tr>
</tbody>
</table>

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 ® followed by the Peak reading.
- To view Valley, press ▼. Meter displays º followed by the Valley reading.
- To view Input, press PAR. Meter displays ▼ 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 ® followed by the current Input reading.
4.0 Programming the Meter

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 “LDC” 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

<table>
<thead>
<tr>
<th>Selection</th>
<th>TC Type</th>
<th>Selection</th>
<th>TC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>tc - t</td>
<td>T</td>
<td>tc - s</td>
<td>S</td>
</tr>
<tr>
<td>tc - e</td>
<td>E</td>
<td>tc - b</td>
<td>B</td>
</tr>
<tr>
<td>tc - j</td>
<td>J</td>
<td>tc - n</td>
<td>N</td>
</tr>
<tr>
<td>tc - y</td>
<td>K</td>
<td>Volt</td>
<td>mV indicator</td>
</tr>
<tr>
<td>tc - r</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Prepare your node.

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

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

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

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

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.
5.0 CALIBRATING THE METER

CALIBRATION MODE

To enter Calibration Mode, select \texttt{CAL} \textless \textgreater \texttt{YES} at the end of Programming Mode, and press the \texttt{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

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 \texttt{PAR} key. The meter briefly displays \texttt{rSets} 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

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 display will alternate between \texttt{LC} and the old cold junction reading. At this point, key-in the new cold junction temperature according to the formula:

\[ \text{New Cold Junction Reading} = \text{Old Cold Junction Reading} + \text{Difference} \]

\[ \text{Difference} = \text{Reference Thermometer Temperature} - \text{Meter Display Temperature} \]

WHERE:

New Cold Junction Reading = Old Cold Junction Reading + Difference

5. Press \texttt{PAR}. The meter briefly displays \texttt{.....} to acknowledge the new cold junction value.

VOLTAGE CALIBRATION

Following cold junction calibration, the display \texttt{URR} \textless \textgreater \texttt{YES/NO} appears. Enter \texttt{YES} if input voltage calibration is desired. If \texttt{NO} is entered, the meter exits calibration and returns to normal display mode.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETERS</th>
<th>DESCRIPTION/COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000 mV</td>
<td>Apply 0.000 mV, wait 20 seconds, press \texttt{PAR}.</td>
<td></td>
</tr>
<tr>
<td>30.000 mV</td>
<td>Apply 30.000 mV, wait 20 seconds, press \texttt{PAR}.</td>
<td></td>
</tr>
<tr>
<td>60.000 mV</td>
<td>Apply 60.000 mV, wait 20 seconds, press \texttt{PAR}.</td>
<td></td>
</tr>
</tbody>
</table>

The meter briefly displays \texttt{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 (\texttt{TYPE} \textless \textgreater \texttt{mV}) 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.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDIES</th>
</tr>
</thead>
</table>
| 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. | 1a. Change display resolution to “1” degree.  
                                             | 2. Loss of data set-ups.                        | 1b. Reduce offset value.  
                                             |                                                  | 2a. Check data set-ups.  
                                             |                                                  | 2b. Check for electrical disturbance.  
                                             |                                                  | 2c. Disconnect and reconnect power.         |
                                            |                                                  | 1b. Disconnect and reconnect power.  
                                            |                                                  | 1c. Check for electrical disturbance.      |
| JITTERY DISPLAY | 1. Electrical “Noise” in process or sensor lines. | 1a. Increase digital filtering.  
                                            | 3. Corroded or dirty thermocouple wire connections. | 2. Dampen process to eliminate oscillations.  
                                            |                                                  | 3. Clean and tighten connections.          |
                                            | 2. Broken or burnout probe.                | 2. Repair or obtain new probe.    |
| “O L O L” IN DISPLAY | 1. Excessive positive probe temperature. | 1. Reduce temperature.  
                                         | 2. Excessive negative probe temperature. | 1. Increase temperature.       |

LIMITED WARRANTY
The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

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Tel +65 6744-6613
Fax +65 6743-3360

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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 “mV” 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.

DEFINITION OF TERMS

INSTALLATION CATEGORY (overvoltage category)

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” (127) W.
**ORDERING INFORMATION**

Meter Part Numbers

<table>
<thead>
<tr>
<th>PAXL</th>
<th>TC</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

TC - Thermocouple Temperature Meter

**Accessories Part Numbers**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>

*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 LED, minus sign displayed for negative temperatures.
   - **Overrange/Underrange Input**: Flashing “OL” or “UL”.
   - **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%.

<table>
<thead>
<tr>
<th>TC TYPE</th>
<th>RANGE</th>
<th>ACCURACY</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>-200 to +400°C</td>
<td>0.8°C</td>
<td>blue</td>
</tr>
<tr>
<td></td>
<td>-328 to +752°F</td>
<td>1.4°F</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-200 to +1000°C</td>
<td>0.8°C</td>
<td>purple</td>
</tr>
<tr>
<td></td>
<td>-328 to +1832°F</td>
<td>1.4°F</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>-200 to +760°C</td>
<td>0.8°C</td>
<td>white</td>
</tr>
<tr>
<td></td>
<td>-328 to +1400°F</td>
<td>1.4°F</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-200 to +1250°C</td>
<td>0.8°C</td>
<td>yellow</td>
</tr>
<tr>
<td></td>
<td>-328 to +2292°F</td>
<td>1.4°F</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0 to +1788°C</td>
<td>2.1°C</td>
<td>black</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>3.8°F</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0 to +1788°C</td>
<td>2.1°C</td>
<td>black</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>3.8°F</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>+150 to +1820°C</td>
<td>2.3°C</td>
<td>grey</td>
</tr>
<tr>
<td></td>
<td>+302 to +3308°F</td>
<td>4.1°F</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>-200 to +1300°C</td>
<td>0.8°C</td>
<td>orange</td>
</tr>
<tr>
<td></td>
<td>-328 to +2372°F</td>
<td>1.4°F</td>
<td></td>
</tr>
<tr>
<td>mV</td>
<td>-10.00 to +80.00 mV</td>
<td>0.01%</td>
<td></td>
</tr>
</tbody>
</table>

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
    - **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, UL3101-1, 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
   - IEC 61326
   - CB Scheme Test Certificate # UL/7470A/UL
   - CB Scheme Test Report # 03ME09282-08292003
   - 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**

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

   **Immunity**:
   - Electrostatic discharge: EN 61000-4-2
   - Criterion A: 1 kV contact discharge
   - 4 kV air discharge
   - Electromagnetic RF fields: EN 61000-4-3
   - Criterion A: 8 kV air discharge
   - Fast transients (burst): EN 61000-4-4
   - Criterion A: 2 kV power
   - Surge: EN 61000-4-5
   - Criterion A: 2 kV signal
   - 1 kV L-L,
   - 2 kV L-N-E power
   - 1 kV signal
   - RF conducted interference: EN 61000-4-6
   - Criterion A: 2 kV L&N-E power
   - 3 V/μs
   - 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 indoor 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)

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**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.

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

Thermocouple
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.

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.

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

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 \textbf{\textup{\textless;}}. Meter displays $\textsuperscript{f}$ followed by the Peak reading.
- To view Valley, press \textbf{\textup{\textgreater;}}. Meter displays $\textsuperscript{l}$ followed by the Valley reading.
- To view Input, press \textbf{\textup{\textbf{PAR}}}. Meter displays $\textsuperscript{F}$ followed by the current Input reading.

\textbf{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 \textbf{\textup{\textless;}} and \textbf{\textup{\textgreater;}} simultaneously.
- To reset Peak only, press and hold \textbf{\textup{\textless;}} then press \textbf{\textup{\textbf{PAR}}}.
- To reset Valley only, press and hold \textbf{\textup{\textgreater;}} then press \textbf{\textup{\textbf{PAR}}}.

In each case, the meter displays $\textsuperscript{5EE}$ followed by the current Input reading.
4.0 Programming the Meter

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 PrG 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

<table>
<thead>
<tr>
<th>T</th>
<th>TC-J</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>TC-T</td>
</tr>
<tr>
<td>E</td>
<td>TC-E</td>
</tr>
<tr>
<td>J</td>
<td>TC-J</td>
</tr>
<tr>
<td>K</td>
<td>TC-K</td>
</tr>
<tr>
<td>R</td>
<td>TC-R</td>
</tr>
</tbody>
</table>

Select the thermocouple type by pressing the arrow keys (Δ 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

<table>
<thead>
<tr>
<th>OF</th>
<th>°F</th>
</tr>
</thead>
</table>

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

| DCPE |

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 |

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 |

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-κ |

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.
5.0 Calibrating the Meter

Calibration Mode

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.

FACTORY SETTINGS

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 -SET- 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

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 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 -SET- to acknowledge the new cold junction value.

Voltage Calibration

Following cold junction calibration, the display USET < > 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.

### Calibration

<table>
<thead>
<tr>
<th>Calibration Type</th>
<th>Description/Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 mV</td>
<td>Apply 0.000 mV, wait 20 seconds, press PAR.</td>
</tr>
<tr>
<td>30.0 mV</td>
<td>Apply 30.0 mV, wait 20 seconds, press PAR.</td>
</tr>
<tr>
<td>60.0 mV</td>
<td>Apply 60.0 mV, wait 20 seconds, press PAR.</td>
</tr>
</tbody>
</table>

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 < > UMTL) and verifying unit accuracy at various points over the range of the meter (-10 to +80 mV).
## LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

### 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.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>1. Power off, improperly connected, or brown-out.</td>
<td>1a. Check wiring. 1b. Verify power.</td>
</tr>
<tr>
<td>“EEEE” IN DISPLAY</td>
<td>1. Program data error.</td>
<td>1. Press PAR and check data set-ups.</td>
</tr>
<tr>
<td>“. . .” or “-.-.-.” IN DISPLAY</td>
<td>1. Input display out of range. 2. Loss of data set-ups.</td>
<td>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.</td>
</tr>
<tr>
<td>JITTERY DISPLAY</td>
<td>1. Electrical “Noise” in process or sensor lines.</td>
<td>1a. Increase digital filtering. 1b. Re-route sensor wires. 2. Dampen process to eliminate oscillations. 3. Clean and tighten connections.</td>
</tr>
<tr>
<td>“OPEN” IN DISPLAY</td>
<td>1. Probe unconnected. 2. Broken or burnout probe.</td>
<td>1. Connect probe. 2. Repair or obtain new probe.</td>
</tr>
<tr>
<td>“QLD” IN DISPLAY</td>
<td>1. Excessive positive probe temperature.</td>
<td>1. Reduce temperature.</td>
</tr>
<tr>
<td>“ULD” IN DISPLAY</td>
<td>1. Excessive negative probe temperature.</td>
<td>1. Increase temperature.</td>
</tr>
</tbody>
</table>
MODEL PAXLC - PAX LITE COUNTER

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 unidirectional 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.

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

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering Information</td>
<td>2</td>
</tr>
<tr>
<td>General Meter Specifications</td>
<td>3</td>
</tr>
<tr>
<td>Installing the Meter</td>
<td>3</td>
</tr>
<tr>
<td>Setting the Switches</td>
<td>4</td>
</tr>
<tr>
<td>Wiring the Meter</td>
<td>4</td>
</tr>
<tr>
<td>Reviewing the Front Buttons and Display</td>
<td>6</td>
</tr>
<tr>
<td>Scaling the Meter</td>
<td>6</td>
</tr>
<tr>
<td>Programming the Meter</td>
<td>7</td>
</tr>
</tbody>
</table>

## Ordering Information

**Meter Part Numbers**

<table>
<thead>
<tr>
<th>PAXL</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

- C6 - 6 Digit Counter
- C8 - 8 Digit Counter
1. DISPLY: 6-digit, 0.56" (14.2 mm) or 8-digit, 0.4" (10.1 mm) 7-segment LED
Display Range: 6-digit, -999999 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 \( \searrow \) (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 \( V_{IL} = 1.5 \text{ V max.}; \ V_{IH} = 3.75 \text{ V min.} \)
   - Current Sinking: Internal 7.8 K\( \Omega \) pull-down, 8 mA max. @ 30 VDC max.
   - Current Sourcing: Internal 7.8 K\( \Omega \) pull-up to +12 V
   - 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 K\( \Omega \) pull-up to +12 V
Active: \( V_{IN} < 0.9 \text{ VDC} \)
Inactive: \( V_{IN} > 3.6 \text{ VDC} \)
Response Time:
   - Up/Down and Inhibit: 25 \( \mu \)sec max.
   - Reset and Store: 10 msec max.
8. MEMORY: Nonvolatile E2PROM 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
   - Altitude: Up to 2000 meters
10. 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 Certificate # UL/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
    - 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&E-N E power
      - RF conducted interference: EN 61000-4-6
      - Power frequency magnetic fields: EN 61000-4-8
      - Voltage dip/interruptions: EN 61000-4-11
      - Class A: 30 A/m
      - Class A 0.5 cycle
    - Emissions:
      - Emissions: EN 55011
      - Class B
    Notes:
    2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000).
    3. 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.
    - 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.
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; IMAX = 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.

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, conduits 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:
   a. Ferrite Suppression Cores for signal and control cables:
      - Fair-Rite # 0443162751 (RLC# FCOR0000)
      - TDK # ZCAT3035-1330A
      - Steward # 28B2029-0A0
   b. Line Filters for input power cables:
      - Schaffner # FN610-1/107 (RLC# LFIL0000)
      - Schaffner # KN670-1/807
      - 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.

Switch 4

LOGIC: Input trigger levels VIL = 1.5 V max; VIH = 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.
3.1 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

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.

**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.

\[ SF = \frac{DR}{EPU} \]

<table>
<thead>
<tr>
<th>( DR ) = 1 case</th>
<th>( EPU ) = 12 cans/case</th>
</tr>
</thead>
<tbody>
<tr>
<td>( SF = \frac{1}{12} )</td>
<td></td>
</tr>
<tr>
<td>( SF = 0.08333 )</td>
<td></td>
</tr>
</tbody>
</table>

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.

For calculated SF values greater than 9.99999
If the Scale Factor is a value greater than 9.99999, 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.
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 $%灯光 before 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
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
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.

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

COUNTER RESET AT POWER-UP
The totalizer may be programmed to reset at each meter power-up.

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 $%灯光 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 $%灯光 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.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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 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.

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.

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 ........................................ 2
- General Meter Specifications .............................. 3
- Accessories ..................................................... 3
- Installing the Meter ........................................... 4
- Setting the Switches ......................................... 4
- Wiring the Meter ............................................... 4
- Scaling the Meter ............................................. 6
- Calibrating the Meter ....................................... 7
- Applications ..................................................... 8

## Ordering Information

**Meter Part Numbers**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>

CL - Current Loop Meter

**Accessories Part Numbers**

- Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
GENERAL METER SPECIFICATIONS

1. **DISPLAY**: 3 1/2-digit, 0.56” (14.2 mm) high, 7-segment 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 V AC, 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 - 29.2Ω
   - 10 to 50 mA - 11.8Ω

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
    - **Altitude**: Up to 2000 meters

13. **CERTIFICATIONS AND COMPLIANCES**:
    - **SAFETY**
      - UL Recognized Component, File # E179259, UL3101-1, 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
      - ICEE CB Scheme Test Certificate # UL7470A/UL
      - CB Scheme Test Report # 03ME09282-08292003
      - 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
      - IP20 enclosure rating (Rear of unit), IEC 529

    - **ELECTROMAGNETIC COMPATIBILITY**
      - **Emissions and Immunity to EN 61326**
      - **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-recover.

    - **EXCITATION SUPPLY**: 24 VDC @ 50 mA max. Regulated and isolated.

    - **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.

    - **CONSTRUCTION**
      - This unit is rated for NEMA 4X/IP65 use. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/case.
      - Flame resistant. Panel gasket and mounting clip included.

    - **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.

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Notes:

1. **Criterion A**: Normal operation within specified limits.
2. **Criterion B**: Temporary loss of performance from which the unit self-recover.

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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 overtighten 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (0000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
</tbody>
</table>

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.

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.

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.
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 0-5 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. Either case, the voltage drop generated across the summing 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 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. Each switch 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 “nullled” 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:

\[
Rs = (\text{Max. Numerical Display}) - (\text{Min. Numerical Display}) \quad \text{(Disregard Decimal Points)}
\]

\[
Is = (\text{Current @ Max. Display}) - (\text{Current @ Min. Display})
\]

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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>SPAN VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>2100</td>
</tr>
<tr>
<td>7</td>
<td>1050</td>
</tr>
<tr>
<td>8</td>
<td>525</td>
</tr>
<tr>
<td>9</td>
<td>260</td>
</tr>
<tr>
<td>10</td>
<td>130</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>SWITCH NUMBER</th>
<th>OFFSET VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1400</td>
</tr>
<tr>
<td>3</td>
<td>700</td>
</tr>
<tr>
<td>4</td>
<td>350</td>
</tr>
<tr>
<td>5</td>
<td>175</td>
</tr>
</tbody>
</table>

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.

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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)

A. Null the unit to zero readout @ 0 current per Steps 1 to 4 of the calibration steps.

B. 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.

C. Set offset to readout @ 0 @ 10 mA per Step 7. Note: The readout 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.

D. 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

**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**

A. Null the unit per Steps 1 to 4.

B. Set transfer curve slope with span adjustments per Steps 5 and 6, to get a readout of +1500 @ 8 mA.

C. Apply (+) offset per Step 7 to get a reading of -1500 @ 4 mA.

D. Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 8.

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**

A. Null the unit per Steps 1 to 4.

B. Set transfer curve slope with span adjustments per Steps 5 and 6, to get a readout of +1500 @ 8 mA.

C. Apply (+) offset per Step 7 to get a reading of -1500 @ 4 mA.

D. Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 8.

---

6.0 APPLICATIONS

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

**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**

A. Null the unit per Steps 1 to 4.

B. Set transfer curve slope with span adjustments per Steps 5 and 6, to get a readout of +1500 @ 8 mA.

C. Apply (+) offset per Step 7 to get a reading of -1500 @ 4 mA.

D. Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 8.

---

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**

A. Null the unit per Steps 1 to 4.

B. Set transfer curve slope with span adjustments per Steps 5 and 6, to get a readout of +1500 @ 8 mA.

C. Apply (+) offset per Step 7 to get a reading of -1500 @ 4 mA.

D. Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 8.
MODEL PAXLHV - PAX LITE AC VOLTAGE MONITOR

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.

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 .............................................. 2
General Meter Specifications ............................... 3
Accessories .......................................................... 3
Installing the Meter ............................................... 4
Setting the Switches .............................................. 4
Wiring the Meter ................................................... 5

ORDERING INFORMATION

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAXL</td>
<td>00</td>
<td>HV - AC Voltage Input</td>
<td></td>
</tr>
</tbody>
</table>

Accessories Part Number

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
</tbody>
</table>
1. **DISPLAY**: 3-digit, 0.56” (14.2 mm) high character, 7-segment Red LED
2. **POWER**: 115 or 230 V AC, switch selectable. Allowable power line variation ±10%, 50/60 Hz, 6 VA. Installation Category II, Pollution Degree 2.
3. **Isolation**: 2300 Vrms for 1 min. to input
4. **Working Voltage**: 300 V max., CAT II
5. **ACCURACY**: At 23°C, 85% R.H.; ±(0.1% of Reading + 2 digits)
6. **INPUT IMPEDANCE**: 1 MΩ
7. **INPUT RANGE**: 0 to 600 V AC max. @ 45 to 500 Hz. Installation Category I
8. **RESOLUTION**: 1 V AC
9. **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
   - **Altitude**: Up to 2000 meters
10. **READING RATE**: 400 msec., nominal
11. **RESPONSE TIME**: 1 sec. nominal for a step change input.
12. **CERTIFICATIONS AND COMPLIANCES**: 
    - **SAFETY**
      - UL Recognized Component, File #E179259, UL3101-1, 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
      - IEC660 CB Scheme Test Certificate #UL7470/UL
      - CB Scheme Test Report #03ME09282-08292003
      - 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**: 
      - Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.
      - **Immunity to Industrial Locations**:
        - Electrostatic discharge: EN 61000-4-2
        - Electromagnetic RF fields: EN 61000-4-3
        - Fast transients (burst): EN 61000-4-4
        - Surge: EN 61000-4-5
        - RF conducted interference: EN 61000-4-6
        - Voltage dip/interruptions: EN 61000-4-11
    - **Notes**:
      - 1. **Criterion A**: Normal operation within specified limits.
      - 2. **Criterion B**: Temporary loss of performance from which the unit self-recoveries.
13. **CONNECTIONS**: High compression cage-clamp terminal block
14. **WIRE GAGE**: 30-14 AWG copper wire
15. **TORQUE**: 4.5 inch-lbs (0.51 N-m) max.
16. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 use. 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)

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**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.

---

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
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.

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 V AC 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
</tbody>
</table>

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 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 V AC 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.

<table>
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<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
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<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
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<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
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<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
</tbody>
</table>
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.

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**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.
   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.

---

**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.

<table>
<thead>
<tr>
<th>AC Power</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 1: VAC</td>
<td>Terminal 2: VAC</td>
<td></td>
</tr>
<tr>
<td>![AC Power Diagram]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![115/230]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**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.

<table>
<thead>
<tr>
<th>Voltage Input</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal 5: Common</td>
<td>Terminal 8: 600 VAC</td>
<td></td>
</tr>
</tbody>
</table>
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL PAXLI - PAX LITE CURRENT METERS &
MODEL PAXLV - PAX LITE VOLTMETERS

- **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 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.

**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)

**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 .............................................. 2
General Meter Specifications ................................. 3
Accessories .......................................................... 3
Installing the Meter ............................................... 4
Setting the Jumpers and Switches ................. 4
Wiring the Meter ..................................................... 5
Scaling the Meter .................................................... 6
Troubleshooting ...................................................... 7
Calibration ............................................................. 7

**Ordering Information**

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>PAXLBK</td>
<td>Units Label Kit Accessory</td>
<td>PAXLBK30</td>
</tr>
<tr>
<td>Accessories</td>
<td>APSCM</td>
<td>10 Amp DC Current Shunt</td>
<td>APSCM010</td>
</tr>
<tr>
<td>Accessories</td>
<td></td>
<td>100 Amp DC Current Shunt</td>
<td>APSCM100</td>
</tr>
</tbody>
</table>

I - Current Input
V - Voltage Input
A - AC Input
D - DC Input

 Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
GENERAL METER SPECIFICATIONS

1. DISPLAY: 3 1/2-digit, 0.56” (14.2 mm) high, 7-segment 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.):

<table>
<thead>
<tr>
<th>Input Ranges</th>
<th>DC Voltmeters</th>
<th>DC Current Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.999 V/1 mV</td>
<td>±(0.1% of Reading + 3 digits)</td>
<td>±(0.1% of Reading + 1 digit)</td>
</tr>
<tr>
<td>0-199.9 mA/1 µA</td>
<td>±(0.5% of Reading + 3 digits)</td>
<td>±(0.5% of Reading + 1 digit)</td>
</tr>
<tr>
<td>0-199.9 mA/100 mV</td>
<td>±(0.15% of Reading + 3 digits)</td>
<td>±(0.15% of Reading + 1 digit)</td>
</tr>
<tr>
<td>0-199.9 mA/1 µA</td>
<td>±(0.5% of Reading + 3 digits)</td>
<td>±(0.5% of Reading + 1 digit)</td>
</tr>
</tbody>
</table>

4. ACCURACY:

<table>
<thead>
<tr>
<th>AC Voltmeters</th>
<th>DC Voltmeters</th>
<th>DC Current Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>±0.1% of Reading + 3 digits</td>
<td>±0.1% of Reading + 3 digits</td>
<td>±0.1% of Reading + 3 digits</td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
<tr>
<th>Currents</th>
<th>199.9 µA through 19.99 mA</th>
<th>0-199.9 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-199.9 mA</td>
<td>±(0.1% of Reading + 3 digits)</td>
<td>±(0.1% of Reading + 1 digit)</td>
</tr>
<tr>
<td>0-199.9 mA</td>
<td>±(0.5% of Reading + 3 digits)</td>
<td>±(0.5% of Reading + 1 digit)</td>
</tr>
</tbody>
</table>

Note: Any individual range may be recalibrated (scaled) to ±0.1% accuracy with appropriate calibration equipment.

9. TEMPERATURE COEFFICIENTS:

<table>
<thead>
<tr>
<th>Conditions</th>
<th>DC Voltmeters</th>
<th>DC Current Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 100 PPM/°C</td>
<td>±75 PPM/°C</td>
<td>±150 PPM/°C</td>
</tr>
<tr>
<td>± 200 PPM/°C</td>
<td>±150 PPM/°C</td>
<td>±150 PPM/°C</td>
</tr>
</tbody>
</table>

10. ENVIRONMENTAL CONDITIONS:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Operating Temperature: 0° to 60°C</th>
<th>Storage Temperature: -40° to 80°C</th>
<th>Operating and Storage Humidity: 85% max. relative humidity (non-condensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>Up to 2000 meters</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 COMPLIANCE:

- 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

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&E-Power

  - RF conducted interference EN 61000-4-6
    - Criterion A
    - 3 V/m

  - Voltage dip/interruptions EN 61000-4-11
    - Criterion A
    - 0.5 cycle; 40 % variation

Emissions: EN 55011

Class B

Notes:

2. Criterion B: Temporary loss of performance from which the unit self-recoveres.

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 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)

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 10.0 mV. The APSCM010 current shunt converts a maximum 100 ADC signal into 1000 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.

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 V AC 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.

PAXLI Jumper Selection

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 V AC 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.

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Decimal Point 1 (000.0)</td>
</tr>
<tr>
<td>2</td>
<td>Decimal Point 2 (00.00)</td>
</tr>
<tr>
<td>3</td>
<td>Decimal Point 3 (0.000)</td>
</tr>
<tr>
<td>4</td>
<td>Backlight Annunciator for Units Label</td>
</tr>
<tr>
<td>5</td>
<td>Enables the Scaling Pot</td>
</tr>
</tbody>
</table>

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 overtighten 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.
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

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:

\[ \frac{V_T \times D.D.P}{D.R.} = D.F. \]

WHERE:
- \(V_T\) = Maximum Transducer Output
- \(D.D.P\) = Display Decimal Point
- \(D.F.\) = Division Factor
- \(D.R.\) = Desired Reading

\[ D.D.P.\]

- 0.000 = 1
- 0.000 = 10
- 0.000 = 100
- 0.000 = 1000

The Display Decimal Point
(\(D.D.P.\)) is determined by
the desired decimal point
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

<table>
<thead>
<tr>
<th>D.F. Use Input Position</th>
<th>Pos 1</th>
<th>Pos 2</th>
<th>Pos 3</th>
<th>Pos 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 1.2</td>
<td>0-1.999 VDC</td>
<td>0-19.99</td>
<td>0-199.9</td>
<td>0-300</td>
</tr>
<tr>
<td>1.2 to 10.5</td>
<td></td>
<td>0-19.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.5 to 100.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.5 to 1300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Only one voltage jumper should be selected. Install the jumper before the voltage signal is applied.

EXAMPLE: A relative humidity transducer delivers a 7.0 VDC voltage at a relative humidity of 75%.

\[ D.F. = \frac{V_T \times D.D.P.}{D.R.} = \frac{7.0 \times 1000}{75} = 93.3 \]

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.
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.

5.0 TROUBLESHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO DISPLAY</td>
<td>CHECK: Power switch and line voltage</td>
</tr>
<tr>
<td>INCORRECT DISPLAY</td>
<td>CHECK: Input jumper position</td>
</tr>
<tr>
<td></td>
<td>CHECK: Scaling adjustment pot DIP switch position</td>
</tr>
<tr>
<td></td>
<td>ADJUST: Scaling pot</td>
</tr>
<tr>
<td></td>
<td>VERIFY: Input Signal</td>
</tr>
<tr>
<td>OVER-RANGE INDICATION</td>
<td>CHECK: Input jumper position</td>
</tr>
<tr>
<td></td>
<td>VERIFY: Input Signal</td>
</tr>
</tbody>
</table>

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 999.

Note: Any individual range may be recalibrated (scaled) to 0.1% accuracy with appropriate calibration equipment.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
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.

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

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.
3. **CONTROLS:** Four rubber push buttons: R, P, Up, Down
4. **MEMORY:** Nonvolatile E2PROM 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
   - **Relative Humidity:** 85% max. relative humidity (non-condensing) from 0°C to 65°C.
   - **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:**
   - **SAFETY**
     - Factory Mutual Approved, Report #3014646, FM 3545, FM 3810
     - UL Recognized Component, File #E156876, UL 873, CSA C22.2 No. 24
     - Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
     - Type 4X Enclosure rating (Face only), UL 50
     - 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**
     - **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)
       - 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, 0.5 cycle)
     - **Emissions:** EN 55011, Class A
     - **Notes:** 1. Criterion A: Normal operation within specified limits.
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:** 1.0 Nm (8.9 in.-lbs.) max.
   - **Safety**
     - **Installation Category II, Pollution Degree 2.**
9. **CONSTRUCTION:**
   - **Weight:** 0.38 lbs (0.17 kgs)
   - **Dimensions:** 8.1” × 6” × 3.5” (205.7 × 152.4 × 88.9 mm)
   - **Enclosure:** NEMA 4X/IP65, conformance with Ingress Protection, US and Canada, no standard
   - **Wiring:** Two 14 AWG (2.55 mm), four 18 AWG (1.02 mm), or four 20 AWG (0.61 mm)
10. **REMOTE RESET INPUT:** Internally pulled up to +5 VDC (1Ω).

## 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. **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.
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

<table>
<thead>
<tr>
<th>RTD TYPE</th>
<th>RANGE</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>-200 to +400°C</td>
<td>blue (+)</td>
</tr>
<tr>
<td></td>
<td>-328 to +752°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>E</td>
<td>-200 to +750°C</td>
<td>violet (+)</td>
</tr>
<tr>
<td></td>
<td>-328 to +1382°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>J</td>
<td>-200 to +760°C</td>
<td>white (+)</td>
</tr>
<tr>
<td></td>
<td>-328 to +1400°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>K</td>
<td>-200 to +1250°C</td>
<td>yellow (+)</td>
</tr>
<tr>
<td></td>
<td>-328 to +2282°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>R</td>
<td>0 to 1768°C</td>
<td>black (+)</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>S</td>
<td>0 to 1768°C</td>
<td>black (+)</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>B</td>
<td>+149 to +1820°C</td>
<td>grey (+)</td>
</tr>
<tr>
<td></td>
<td>+300 to +3308°F</td>
<td>no standard</td>
</tr>
<tr>
<td>N</td>
<td>-200 to +1300°C</td>
<td>orange (+)</td>
</tr>
<tr>
<td></td>
<td>-328 to +2372°F</td>
<td>red (-)</td>
</tr>
<tr>
<td>mV</td>
<td>-5.00 to +5.60</td>
<td>no standard</td>
</tr>
</tbody>
</table>

6. **REMOTE RESET INPUT:** Internally pulled up to +5 VDC (1Ω).
   - **VIL:** 0.85 V max., **VIH:** 3.65 V min., **VIN MAX:** 5.25 VDC, **I OFF:** 1μA max.
OUTPUT SPECIFICATIONS

1. LIMIT AND ALARM OUTPUT RELAYS:
   - Contact Rating: 5 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 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.

ORDERING INFORMATION

85 to 250 VAC

<table>
<thead>
<tr>
<th>LIMIT OUTPUT</th>
<th>ALARM 1 OUTPUT</th>
<th>ALARM 2 OUTPUT</th>
<th>REPLACEMENT OUTPUT BOARD</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form-C Relay</td>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>RBDLA210</td>
<td>TLA21000</td>
</tr>
<tr>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>RBD48111</td>
<td>TLA11100</td>
</tr>
</tbody>
</table>

18 to 36 VDC / 24 VAC

<table>
<thead>
<tr>
<th>LIMIT OUTPUT</th>
<th>ALARM 1 OUTPUT</th>
<th>ALARM 2 OUTPUT</th>
<th>REPLACEMENT OUTPUT BOARD</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form-C Relay</td>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>RBDLA210</td>
<td>TLA21010</td>
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<tr>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>Form-A Relay</td>
<td>RBD48111</td>
<td>TLA11110</td>
</tr>
</tbody>
</table>

EMC INSTALLATION GUIDELINES

Although this unit 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 unit may be different for various installations. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The unit 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 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.
6. 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
   - Schaffner # FN610-1.8/07 (RLC #LFIL0000)
   - Schaffner # FN670-1.8/07
   - Corcom #1VR3
   - 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.
   - Snubbers:
     - RLC #SNUB0000

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.
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.

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.

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.

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.

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.

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.

Note: Snubber leakage current can cause some electromechanical devices to be held ON.

*Terminal numbers are model dependent. See Terminal Configurations for description.
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 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.

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 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 particularities 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.

Parameter Mode Reference Table

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>Password to access parameters</td>
<td>0 to 250</td>
<td>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).</td>
</tr>
<tr>
<td>SP</td>
<td>Limit setpoint</td>
<td>-999 to 9999</td>
<td>Range limited by SPLO &amp; SPHI.</td>
</tr>
<tr>
<td>AL-1 *</td>
<td>Alarm #1</td>
<td>-999 to 9999</td>
<td>The Alarm parameters can be independently locked out from appearing. See Configuration Module 3, Parameter Lock-outs.</td>
</tr>
<tr>
<td>AL-2 *</td>
<td>Alarm #2</td>
<td>-999 to 9999</td>
<td>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”.</td>
</tr>
<tr>
<td>CNFP</td>
<td>Configuration parameter modules</td>
<td>&quot;Up&quot; button: enter configuration modules.</td>
<td>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”.</td>
</tr>
<tr>
<td>End</td>
<td>End of Parameter Mode</td>
<td></td>
<td>When the parameter list has been scrolled through, the TLA will display “End” momentarily, and then return to the normal display mode.</td>
</tr>
</tbody>
</table>

* 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)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE (FACTORY SETTING)</th>
<th>DESCRIPTION/ COMMENTS</th>
</tr>
</thead>
</table>
| 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)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE (FACTORY SETTING)</th>
<th>DESCRIPTION/ COMMENTS</th>
</tr>
</thead>
</table>
| 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. |
### CONFIGURE MODULE 3 - LOCKOUT PARAMETERS (3-LC)

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE (FACTORY SETTING)</th>
<th>DESCRIPTION/COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>Password</td>
<td>0 to 250 (10)</td>
<td>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.</td>
</tr>
<tr>
<td>AL *</td>
<td>Alarms #1 and #2 access level</td>
<td>LOC - lockout, prevents the alarms from appearing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>rEd - read only, alarms appear, but cannot be modified</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ent - enter, alarms appear, and can be modified</td>
<td></td>
</tr>
<tr>
<td>FPrS</td>
<td>Front panel reset</td>
<td>NO - disabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES - active (YES)</td>
<td>The front panel R button can be enabled or disabled. The Remote Reset input is not affected by this setting.</td>
</tr>
</tbody>
</table>

* Model Number Dependent.

### CONFIGURE MODULE 4 - ALARMS PARAMETERS (4-AL)

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE (FACTORY SETTING)</th>
<th>DESCRIPTION/COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act1</td>
<td>Alarm 1 action mode</td>
<td>A-HI - absolute high</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-LO - absolute low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d-HI - deviation high</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d-LO - deviation low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b-IN - band inside</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b-Ot - band outside (A-HI)</td>
<td>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.</td>
</tr>
<tr>
<td>rSt1</td>
<td>Alarm 1 reset mode</td>
<td>Auto - automatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LATC - manual reset (Auto)</td>
<td>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.</td>
</tr>
<tr>
<td>Stb1</td>
<td>Alarm 1 standby function (delay)</td>
<td>NO or YES (NO)</td>
<td>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.</td>
</tr>
<tr>
<td>AL-1</td>
<td>Alarm 1 value</td>
<td>-999 to 9999 (0)</td>
<td>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.</td>
</tr>
<tr>
<td>Act2 *</td>
<td>Alarm 2 action mode</td>
<td>A-HI - absolute high</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-LO - absolute low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d-HI - deviation high</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d-LO - deviation low</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b-IN - band inside</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b-Ot - band outside (A-HI)</td>
<td>The Alarm 2 parameters are programmed independently of alarm 1. See the corresponding Alarm 1 parameter for description.</td>
</tr>
<tr>
<td>rSt2 *</td>
<td>Alarm 2 reset mode</td>
<td>Auto - automatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LATC - manual reset (Auto)</td>
<td></td>
</tr>
<tr>
<td>Stb2 *</td>
<td>Alarm 2 standby function (delay)</td>
<td>NO or YES (NO)</td>
<td></td>
</tr>
<tr>
<td>AL-2 *</td>
<td>Alarm 2 value</td>
<td>-999 to 9999 (0)</td>
<td>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.</td>
</tr>
<tr>
<td>AHYS</td>
<td>Alarm hysteresis value</td>
<td>1 to 250 (1)</td>
<td></td>
</tr>
</tbody>
</table>

* Model Number Dependent.
## CONFIGURE MODULE 9 - FACTORY SERVICE OPERATIONS (9-FS)

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE</th>
<th>DESCRIPTION/ COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CodE</td>
<td>Factory service function code</td>
<td>48 - Calibrate instrument</td>
<td>TLA calibration. Refer to the Calibration section for details.</td>
</tr>
<tr>
<td></td>
<td>66 - Reset parameters to factory settings</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>77 (twice in succession) - Reset TLA calibration to nominal values</td>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>

### USER PARAMETER VALUE CHART

**TLA Number _____________**

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>PARAMETER</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR5</td>
<td>Password</td>
<td>____________</td>
</tr>
<tr>
<td>SP</td>
<td>Limit Setpoint</td>
<td>____________</td>
</tr>
<tr>
<td>AL-1</td>
<td>Alarm 1 Value</td>
<td>____________</td>
</tr>
<tr>
<td>AL-2</td>
<td>Alarm 2 Value</td>
<td>____________</td>
</tr>
</tbody>
</table>

### 3-LE Lockout Parameters

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>PARAMETER</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR5</td>
<td>Password</td>
<td>____________</td>
</tr>
<tr>
<td>RL</td>
<td>Alarm(s) Access Level</td>
<td>____________</td>
</tr>
<tr>
<td>FP5</td>
<td>Front Panel Reset</td>
<td>____________</td>
</tr>
</tbody>
</table>

### 1-IN Input Parameters

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>PARAMETER</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>Input Sensor Type</td>
<td>____________</td>
</tr>
<tr>
<td>SCRL</td>
<td>Temperature Scale Units</td>
<td>____________</td>
</tr>
<tr>
<td>dCPk</td>
<td>Temperature Resolution</td>
<td>____________</td>
</tr>
<tr>
<td>FLT</td>
<td>Digital Filtering</td>
<td>____________</td>
</tr>
<tr>
<td>SHFL</td>
<td>Input Offset</td>
<td>____________</td>
</tr>
<tr>
<td>SPLD</td>
<td>Limit Setpoint Lower Limit</td>
<td>____________</td>
</tr>
<tr>
<td>SPHI</td>
<td>Limit Setpoint Upper Limit</td>
<td>____________</td>
</tr>
</tbody>
</table>

### 4-RL Configure Alarm Parameters

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>PARAMETER</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc1</td>
<td>Alarm 1 Action Mode</td>
<td>____________</td>
</tr>
<tr>
<td>rS1</td>
<td>Alarm 1 Reset Mode</td>
<td>____________</td>
</tr>
<tr>
<td>Sb1</td>
<td>Alarm 1 Standby Enabled</td>
<td>____________</td>
</tr>
<tr>
<td>AL-1</td>
<td>Alarm 1 Value</td>
<td>____________</td>
</tr>
<tr>
<td>Rc2</td>
<td>Alarm 2 Action Mode</td>
<td>____________</td>
</tr>
<tr>
<td>rS2</td>
<td>Alarm 2 Reset Mode</td>
<td>____________</td>
</tr>
<tr>
<td>Sb2</td>
<td>Alarm 2 Standby Enabled</td>
<td>____________</td>
</tr>
<tr>
<td>AL-2</td>
<td>Alarm 2 Value</td>
<td>____________</td>
</tr>
<tr>
<td>RHYS</td>
<td>Alarm Hysteresis Value</td>
<td>____________</td>
</tr>
</tbody>
</table>

### 2-OP Output Parameters

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>PARAMETER</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-RC</td>
<td>Limit Output Trip Action</td>
<td>____________</td>
</tr>
</tbody>
</table>
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.

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.
**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.

Factory Service Operations - Calibration (9-FS)

### 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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>RANGE</th>
<th>DESCRIPTION/ COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL</td>
<td>Millivolt calibration</td>
<td>yes/no</td>
<td>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.</td>
</tr>
<tr>
<td>CJC</td>
<td>Thermocouple cold junction temperature calibration</td>
<td>yes/no</td>
<td>Not required if only using RTD input. This procedure can only be performed AFTER an accurate mV calibration.</td>
</tr>
<tr>
<td>rtd</td>
<td>RTD resistance calibration</td>
<td>yes/no</td>
<td>Not required if only using TC input. This procedure can only be performed AFTER an accurate mV calibration.</td>
</tr>
</tbody>
</table>

### Thermocouple Cold Junction Calibration (CJC)
This procedure must be performed AFTER an accurate mV calibration.

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:
     \[ \text{CJ Error} = \text{reference probe temperature} - \text{displayed TLA temperature} \]
5. Enter Factory Service Operations Module (9-FS).

### 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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>ACTION</th>
<th>DESCRIPTION/ COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rtd1</td>
<td>Connect 0.0 ohm</td>
<td>Wait 10 seconds, press P.</td>
</tr>
<tr>
<td>Rtd2</td>
<td>Connect 277.0 ohm</td>
<td>Wait 10 seconds, press P.</td>
</tr>
</tbody>
</table>

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.
# 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

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLA NOT WORKING</td>
<td>1. Incorrect parameter set-up.</td>
<td>1. Check set-up parameters.</td>
</tr>
<tr>
<td>&quot;E-FP&quot; IN DISPLAY</td>
<td>1. Defective front panel button.</td>
<td>1. Press R to escape, then check all buttons for proper operation. 2. Replace unit.</td>
</tr>
<tr>
<td>&quot;E-UP&quot; IN DISPLAY</td>
<td>1. Internal problem with TLA.</td>
<td>1. Replace unit.</td>
</tr>
</tbody>
</table>
| "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 setup 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. |
**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**

<table>
<thead>
<tr>
<th>ALARM RELAYS</th>
<th>LIMIT RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 N.O. COMM.</td>
<td>A1 N.O. COMM.</td>
</tr>
<tr>
<td>1 13 14 6 2 7</td>
<td></td>
</tr>
<tr>
<td>3 9 10 4</td>
<td></td>
</tr>
</tbody>
</table>

REMOTE RESET COMM. TC + RTD

85–250 VAC 50/60 Hz 8VA

### DC Models

**Form-A Limit Relay with 2 Alarms**

<table>
<thead>
<tr>
<th>ALARM RELAYS</th>
<th>LIMIT RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 N.O. COMM.</td>
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<td>1 13 14 6 2 7</td>
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<td>3 9 10 4</td>
<td></td>
</tr>
</tbody>
</table>

REMOTE RESET COMM. TC + RTD

POWER(+) DC 18–36V 7W AC 24V ±10% 50/60 Hz 9VA

---

Form-C Limit Relay with 1 Alarm

### AC Models

<table>
<thead>
<tr>
<th>ALARM 1 RELAY</th>
<th>LIMIT RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O. COMM.</td>
<td>N.C. COMM.</td>
</tr>
<tr>
<td>1 13 14 6 2 7</td>
<td></td>
</tr>
<tr>
<td>3 9 10 4</td>
<td></td>
</tr>
</tbody>
</table>

REMOTE RESET COMM. TC + RTD

85–250 VAC 50/60 Hz 8VA

---

Form-C Limit Relay with 1 Alarm

### DC Models

<table>
<thead>
<tr>
<th>ALARM 1 RELAY</th>
<th>LIMIT RELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O. COMM.</td>
<td>N.C. COMM.</td>
</tr>
<tr>
<td>1 13 14 6 2 7</td>
<td></td>
</tr>
<tr>
<td>3 9 10 4</td>
<td></td>
</tr>
</tbody>
</table>

REMOTE RESET COMM. TC + RTD

POWER(+) DC 18–36V 7W AC 24V ±10% 50/60 Hz 9VA

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL CUB4I - MINIATURE D.C. CURRENT METER &
MODEL CUB4V - MINIATURE D.C. VOLTMETER

- LCD, POSITIVE REFLECTIVE OR NEGATIVE TRANSMISSIVE
  WITH YELLOW/GREEN OR RED BACKLIGHTING
- FOUR SELECTABLE D.C. RANGES
  0 to 199.9 mV, 1.999 V, 19.99 V, 199.9 V (CUB4V)
  0 to 199.9 µA, 1.999 mA, 19.99 mA, 199.9 mA (CUB4I)
- 0.6 INCH (15.2 mm) HIGH LCD DIGITS
- BUILT-IN SCALING PROVIDED
- AUTO ZEROING CIRCUIT
- SELECTABLE DECIMAL POINTS
- WIRE CONNECTIONS MADE VIA SCREW CLAMP TYPE TERMINALS
- FITS DIN STANDARD CUT-OUT 2.68” (68 mm) x 1.30” (33 mm)
- NEMA 4X/IP65 SEALED FRONT PANEL BEZEL
- 9 TO 28 VDC POWERED

DESCRIPTION

The CUB4 Volt and Current Meters are designed and manufactured using the latest technology for a high quality, compact, affordable instrument for use in industrial environments. Each unit has a 3½-digit LCD display with 0.6 inch (15.2 mm) high digits and a DIP switch selectable decimal point. 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.

The units are 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. A CUB4V or CUB4I unit can be mounted in the same panel cutout as the CUBVD and CUBID units.

The optional Micro Line/Sensor Power Supply (MLPS1000) is designed to attach to the rear of an installed CUB4V or CUB4I to provide the necessary power for the unit. The optional supply can be powered from a 85-250 VAC source.

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. DISPLAY: 3½-digit (-1999 to 1999), 0.6” (15.2 mm) high digits. Minus (-) sign is displayed when voltage or current is negative.
2. DECIMAL POINTS: DIP switch selectable decimal points allow the display to be read in tenths, hundredths or thousandths.
3. POWER REQUIREMENTS:
   Reflective Versions: 9 to 28 VDC at 4 mA max.
   Backlight Versions: 9 to 28 VDC @ 35 mA typ., 50 mA max. Above 26 VDC, derate operating temperature to 50°C.
4. INPUT RANGES:
   D.C. VOLTAGE
   D.C. CURRENT
   (DIP Switch Selectable) (JMPR. Selectable)
   ±199.9 mVDC ±199.9 µADC
   ±1.999 VDC ±1.999 mADC
   ±19.99 VDC ±19.99 mADC
   ±199.9 VDC ±199.9 mADC
5. ACCURACY: (@ 23°C, less than 85% RH)
   D.C. Voltage: ±0.1% + 1 digit
   D.C. Current: ±0.1% + 1 digit
   ±0.15% + 1 digit
   199.9 µA, 1.999 mA, 19.99 mA ranges
   ±0.1% + 1 digit
   199.9 mA range
   ±0.15% + 1 digit
6. OVERRANGE RATINGS, PROTECTION & INDICATION:
   9 to 28 VDC power circuit is not isolated from the signal circuit.
   Max Input Voltage:
   0 to 199.9 mVDC Range: 75 VDC
   All other voltage Ranges: 300 VDC
   Max Input Current:
   199.9 µA through 19.99 mA: 10 times max. range current
   199.9 mA: 1 amp
   Overrange Indication: Overrange is indicated by a “1” displayed in the most significant digit and the blanking of the three least significant digits.
7. READING RATE: 2.5 readings per second
8. RESPONSE TIME: 1.5 seconds to settle for a step change
9. NORMAL MODE REJECTION: 60 dB 50/60 Hz

DIMENSIONS

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.15” (64.6) H x 3.00” (76.2) W.
10. INPUT IMPEDANCE:

Voltmeter: 1 MΩ

Current Meter:
199.9 µA - 1 kΩ
1.999 mA - 100 Ω
19.99 mA - 10 Ω
199.9 mA - 1 Ω

11. CERTIFICATIONS AND COMPLIANCES:

SAFETY

UL Recognized Component, File # E179259, UL3101-1, CSA C22.2 No. 1010-1
Recognized to U.S. and Canadian requirements under the Component
Recognition Program of Underwriters Laboratories, Inc.
Type 4X Enclosure rating (Face only), UL50
IEC6 CE Scheme Test Certificate # UL2356A-179259/USA,
CB Scheme Test Report # 98ME60090-000098
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

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
Fast transients (burst) EN 61000-4-4 Level 4; 2 Kv I/O
RF conducted interference EN 61000-4-6 Level 3; 2 Kv power
Level 3; 10 V/m
Power frequency magnetic fields EN 61000-4-8 Level 4; 30 A/m
Simulation of cordless telephone ENV 50204 Level 3; 900 MHz ± 5 MHz

Emissions to EN 50081-2
RF interference EN 55011 Enclosure class A
Power mains class A

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 Volt and Current meters meet
NEMA 4X/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 cutout.
The following procedure assures proper installation:
1. Cut panel opening to specified dimensions. Remove burrs and clean panel
opening.
2. Carefully remove center section of the panel gasket and discard. Slide
gasket over 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
NOT project through hole on clip.
4. Install CUB4 unit through panel cutout.
5. Slide mounting clip over rear of unit until clip is against back of panel. The
mounting clip and CUB4 housing have a latching feature to hold the unit in
place until tightened.
Note: Hold the CUB4 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.
(Recommended torque is 28 to 36 in-oz.)
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.
**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. 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, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtails 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.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

**WIRING CONNECTIONS**

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. 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. 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.

**DECIMAL POINT SELECTION**

The CUB4 Volt and Current Meters can be set-up to read in 10ths, 100ths, or 1000ths. The decimal point position is DIP switch selectable for one of three locations. If all the DIP switches are set to the “OFF” position, then **NO** decimal point will appear in the display. The DIP switches are located at the rear of the unit.
VOLTMMETER SCALING

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 is normally generated by a transducer which senses the variable and delivers a linear output voltage. To provide the desired readout at the specified voltage, the voltmeter must be scaled. The Scale switch, when in the “ON” position, enables the Scale Potentiometer. The Scale Potentiometer is used with a voltage range to provide a method of scaling the unit. The voltage DIP switches are used to select one of the four coarse Division Factor ranges and the Scale Potentiometer is a fine scale adjustment within the selected range. The chart below shows the division factor range associated with each range selection switch.

**DIVISION FACTOR RANGE SELECTION CHART**

S1: 0-199.9 mVDC (0.1 D.F. 1.2)
S2: 0-1.999 VDC  (1.2 D.F. 10.5)
S3: 0-19.99 VDC  (10.5 D.F. 100.5)
S4: 0-199.9 VDC  (100.5 D.F. 1300)

Note: Enabling the Scale Potentiometer does NOT affect the calibration of the unit.

To determine the proper voltage range for an application requiring scaling, the “Division Factor” required to provide the proper display reading must first be determined by using the following formula.

**USING THE FORMULA:**

\[
D.F = \frac{V_T \times D.D.P}{D.R.}
\]

**WHERE:**

- \(V_T\) = Maximum Transducer Output
- \(D.D.P\) = Display Decimal Point
- \(D.F\) = Division Factor
- \(D.R\) = Desired Reading

\[
D.D.P  = \begin{align*}
0.00 & = 1 \\
00.00 & = 10 \\
000.0 & = 100 \\
0000 & = 1000
\end{align*}
\]

The DISPLAY DECIMAL POINT (D.D.P) is determined by the desired decimal point placement in the readout.

- 0.000 = 1
- 00.00 = 10
- 000.0 = 100
- 0000 = 1000

After the Division Factor for the application has been calculated, the proper voltage range switch that will provide for the Division Factor is set to the “ON” position. Use the “Division Factor Range Selection Chart” to choose the proper DIP switch setting.

Note: Only one voltage DIP switch should be turned on. Set the switch before the voltage signal is applied.

**EXAMPLE:** A relative humidity transducer delivers a 7.0 VDC voltage at a relative humidity of 75%.

\[
D.F = \frac{V_T \times D.D.P}{D.R.} = \frac{7.0 \times 1000}{75} = 93.3
\]

This Division Factor is between 10.5 and 100.5, therefore DIP switch position S3 is set to the “ON” position. The Scaling Potentiometer is then adjusted for the desired readout at a known relative humidity.

CUB4I SIGNAL INPUT

The CUB4 Current Meter has four current ranges that are selected by positioning the jumper in the proper location on the male header strip. The SCALE DIP switch (S1) and the Scaling Potentiometer are used when it is necessary to scale the display to indicate other engineering units. The Scale switch should be left in the “OFF” position when the application requires direct current readout on the display.

When the power supply is floating (unreferenced) to the desired measurement points, the (-) signal input and the power supply common should be connected. If the power supply is not floating (referenced), the common mode voltage between the (-) signal input and power supply common terminal must not be greater than 1.0 V peak. A common mode voltage higher than 1.0 V peak will result in a measurement error.

The Calibration Potentiometer has been set at the factory and should not be adjusted unless the unit is being re-calibrated with an accurate current source.

Caution: The Maximum Current for each jumper position must not be exceeded or the unit may be damaged (See Specifications).

CURRENT METER SCALING

The CUB4 Current Meter display can be scaled to almost any lower numerical value. Setting the Scale switch to the “ON” position enables the Scale Potentiometer, which is used with the current range selection jumper to scale the unit. The Scale potentiometer can be set to divide the normal current reading by a division factor between 1 and 13.

**EXAMPLE:** The CUB4 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.)

**courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com**

**block diagram cub4v**

**block diagram cub4i**
**VOLTMETER APPLICATION**

Indicating the Speed of a D.C. Motor

A foreman in a plant wants to get a more accurate indication of the speed at which a variable speed DC motor drive is operating. The only indication he has now is the position of a dial on the control panel.

The motor has a tachometer generator that will output a 10 VDC signal when the motor is running at its maximum speed of 1800 RPM. The power supply of the control has a 15 VDC output that can supply power to the CUB4V.

Since this application requires a non-standard readout, it will be necessary to scale the display. The Scale DIP switch is set to the “ON” position to enable the Scale Potentiometer. The Division Factor is calculated using the formula:

\[
D.F. = \frac{\text{Maximum output} \times \text{D.D.P}}{\text{Desired Display}}
\]

\[
D.F. = \frac{10 \times 1000}{1800} = 5.5
\]

Since the division factor falls between 1.2 and 10.5, DIP switch position S2 is set to the “ON” position, according to the Division Factor Selection Chart.

To scale the CUB4 Voltmeter, the motor is run at full speed and a calibrated photo tachometer is used to obtain the exact speed. The Scale Potentiometer on the CUB4 Voltmeter is then adjusted until the display reading agrees with the tachometer. Alternately, the output of a precision voltage source set to +10 VDC can be connected to the signal input of the unit and then adjust the scaling potentiometer for the desired reading.

**CURRENT METER APPLICATION**

Analog Meter Replacement

A manufacturer wants to replace several 1 mA DC analog meter movements with easy to read CUB4 Current Meters with backlighting. One application involves measuring the flow rate of a liquid to indicate 0 to 250 gallons per minute.

Since 1 mA of current flow requires a display reading of 250, the CUB4 Current Meter will need to be scaled. The Scale DIP switch is set to the “ON” position enabling the Scale Potentiometer. The proper current range for the application is then selected. The Scale potentiometer will divide the display reading by 1 to 13, for the particular current range selected. A reading of 250 is 4 times less than the normal reading at 1 mA for the 0 to 1.999 mA range, therefore the jumper is installed in the 0-1.999 mA range position. No decimal point is selected because the resolution is 1 gallon.

The CUB4 Current Meter can now be scaled. Apply 1 mA to the signal input and adjust the scale potentiometer to the desired reading.

**TRoubleshooting**

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

**ORDERING INFORMATION**

<table>
<thead>
<tr>
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<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
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<td>CUB4V</td>
<td>DC Voltmeter</td>
<td>CUB4V000</td>
</tr>
<tr>
<td></td>
<td>DC Voltmeter W/Yel-Grn Backlighting</td>
<td>CUB4V010</td>
</tr>
<tr>
<td></td>
<td>DC Voltmeter W/Red Backlighting</td>
<td>CUB4V020</td>
</tr>
<tr>
<td>CUB4I</td>
<td>DC Current Meter</td>
<td>CUB4I000</td>
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<tr>
<td></td>
<td>DC Current Meter W/Yel-Grn Backlighting</td>
<td>CUB4I010</td>
</tr>
<tr>
<td></td>
<td>DC Current Meter W/Red Backlighting</td>
<td>CUB4I020</td>
</tr>
<tr>
<td>MLPS</td>
<td>Micro Line/Sensor Power Supply</td>
<td>MLPS1000</td>
</tr>
</tbody>
</table>
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL CUB4LP - LOOP POWERED PROCESS INDICATOR
MODEL CUB4CL - CURRENT LOOP INDICATOR

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.

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; 80 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 = -999 to 999.

8. LINEARITY: (@23°C, Less than 85% RH) ±0.1% + 1 digit.

9. READING RATE: 2.5 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 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
   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
   Fast transients (burst) EN 61000-4-4
   Level 2; 10 V/m
   80 MHz - 1 GHz
   Level 4; 2 K v I/O
   Level 3; 2 K v power
   RF conducted interference EN 61000-4-6
   Level 3; 10 V rms²
   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°C to 60°C
   (Derate backlight voltage to 26 VDC above 50°C)
   Storage Temperature: –40°C to 80°C
   Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to
   60°C
   Vibration According to IEC 68-2-6: 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.
4. Slide mounting clip over rear of unit until the clip is against back of panel. The mounting clip and CUB4LP/CL unit through panel cutout.
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.

EQUIPMENT/PRODUCTS (Cont’d)

5. Alternately tighten each mounting screw to ensure uniform gasket pressure.
6. If the gasket is not adequately compressed and the mounting screws cannot be tightened any further, loosen the mounting screws and assure 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)
   - Line Filters for input power cables: Schaffner # FN610-1/07 (RLC #LFIL0000)
   - 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.
**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.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
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<tr>
<td>CUB4LP</td>
<td>Reflective LCD Loop Powered Process Indicator</td>
<td>CUB4LP00</td>
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<tr>
<td>CUB4LP</td>
<td>Red Backlit LCD Loop Powered Process Indicator</td>
<td>*CUB4LP40</td>
</tr>
<tr>
<td>CUB4CL</td>
<td>Yellow/Green Backlit LCD External Powered Process Indicator</td>
<td>CUB4CL10</td>
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<tr>
<td>CUB4CL</td>
<td>Red Backlit LCD External Powered Process Indicator</td>
<td>CUB4CL20</td>
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<tr>
<td>MLPS</td>
<td>Micro Line/Sensor Power Supply (Non-hazardous use only)</td>
<td>MLPS1000</td>
</tr>
</tbody>
</table>

*Backlight intensity will vary depending on signal level.

**TROUBLESHOOTING**

For further technical assistance, contact technical support at the appropriate company numbers listed.
MODEL CUB4RT - INTELLIGENT RTD TEMPERATURE INDICATOR

DESCRIPTION
The CUB4RT is a 9 to 26 VDC powered, microprocessor based temperature indicator with decimal display for use with Pt385, Pt392, Ni672, and Cu427 RTDs. Programmable features include RTD type, Fahrenheit or Celsius display, input filtering, input filter range, and a user offset. The 0.48", 5 digit LCD display provides annunciators for Fahrenheit or Celsius indication and is available with or without a backlight.

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.

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<td>RTD Indicator, Reflective LCD</td>
<td>CUB4RT00</td>
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<tr>
<td></td>
<td>RTD Indicator, Red Backlit Transmissive LCD</td>
<td>CUB4RT20</td>
</tr>
<tr>
<td>MLPS</td>
<td>Micro Line/Sensor Power Supply</td>
<td>MPLS0000</td>
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</tbody>
</table>

SPECIFICATIONS
1. DISPLAY: Reflective LCD or Transmissive LCD with red backlight, 5 digit display 0.48"(12.2 mm) height, F or C annunciators.
2. POWER: 9 to 26 VDC @ 65 mA with backlight, 25 mA without backlight.
   Reverse polarity protected.
   Must use an RLC model MLPS or a Class 2 or SELV rated power supply.

3. RANGE & ACCURACY:
   Accuracy reflects ALL errors @12 VDC supply and 15 minute warm-up, except RTD probe errors and any unbalanced lead resistance effects.

<table>
<thead>
<tr>
<th>Type</th>
<th>Jumper Position (See Wiring Diagram)</th>
<th>Nominal @ 0°C</th>
<th>Range</th>
<th>Accuracy @ 23°C ±1LSD</th>
<th>Accuracy @ 0 to 50°C ±1LSD</th>
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<tbody>
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<td>Pt392</td>
<td>B</td>
<td>100 Ohm</td>
<td>-200 to 850</td>
<td>±0.7°C</td>
<td>±2.7°C</td>
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<tr>
<td>Pt385</td>
<td>B</td>
<td>100 Ohm</td>
<td>-200 to 850</td>
<td>±0.7°C</td>
<td>±2.7°C</td>
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<tr>
<td>Ni672</td>
<td>B</td>
<td>120 Ohm</td>
<td>-80 to 260</td>
<td>±0.7°C</td>
<td>±1.5°C</td>
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<tr>
<td>Cu427</td>
<td>A</td>
<td>9.035 Ohm</td>
<td>-100 to 260</td>
<td>±0.9°C</td>
<td>±1.7°C</td>
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</tbody>
</table>

   Lead Resistance:
   Cu427: 3 ohms/lead, 6 ohms total
   All others: 10 ohms/lead, 20 ohms total

   Balanced Lead Resistance: Automatically compensated up to max per lead.

   Unbalanced Lead Resistance: uncompensated

   * After 20 min. warm-up. Accuracy specified for the 0 to 50°C operating range includes meter temperature coefficient. The accuracy specifications include the A/D conversion errors and linearization conformity. Total system accuracy is the sum of the meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

4. INPUT:
   Isolation: SIG+, SIG+, and EXC terminals are NOT electrically isolated from the power supply.
   Response Time: 500 msec.
   Failed Sensor Display: DPE
   Overrange/Underrange Input: OLOL/ULUL
   Overrange/Underrange Display: “......”/“......”
   Normal Mode Rejection: 40 dB @ 50/60 Hz
   Common Mode Rejection: 100 dB @ DC to 60 Hz

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 3.0” (76.2) W.
5. **TEMPERATURE EFFECTS:**  
Span Drift: 100 ppm/°C max.  
Zero Drift: < 1 µV/°C max.  

6. **ENVIRONMENTAL CONDITIONS:**  
Operating Temperature Range: 0 to 50°C  
Storage Temperature Range: -30 to 80°C  
Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0 to 50°C  
Vibration According to IEC 68-2-6: 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 (6561 feet)  

7. **CERTIFICATIONS AND COMPLIANCES:**  
**SAFETY**  
UL Recognized Component, File # E179259, UL61010-1, CSA 22.2 No. 61010-1  
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.  
Type 4X Enclosure rating (Face only), UL58  
IECEE CB Scheme Test Certificate #US/9257/UL, 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**  
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  
Emissions to EN 50081-1  
RF interference EN 55022 Enclosure 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)  
   I/O cables are routed in metal conduit connected to earth ground.  

**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. 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 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.  
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 to earth ground (protective earth) only at the panel 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 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 # ZCAT3055-1330A  
   Steward #28B209-0A0  
   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.
**WIRING CONNECTIONS**

All conductors should meet voltage and current ratings of the unit. 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.

Unit should be mounted in a relatively stable temperature environment. Avoid drafts and areas subject to radical temperature shifts.

---

**BASIC OPERATION**

Normal operation begins with application of power to the CUB4RT. The unit will begin a power up sequence that displays the version of the software and any diagnostic messages. After approximately four seconds, the unit will begin to display the temperature of the RTD probe depending upon input type selected.

A diagnostic message of **FAIL** may occur on power up. This message indicates that the stored programming and/or calibration values may become corrupted. Pressing the “SEL” button will remove the current message from the display.

Once the unit is displaying temperature, the “SEL” button may be pressed to traverse the Programming Menu and to select values for the corresponding Programming Menu Items. Pressing the “SEL” button to enter the choice and return to the main menu.

**PROGRAM MENU - Selection Variables**

- **type**: Pt100, Pt385, Ni672, Cu427
- **d**: °C, °F, OC, OF
- **r**: Range

To select the input type, press the blank button to scroll through the available input types. Press the “SEL” button to enter the choice and return to the main menu.

- **Filter**: 0, 1, 2, 3

If the displayed process signal 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 1/3 new and 2/3 previous. A filter value of 3 uses 1/16 new and 15/16 previous.

To select the filter level, use the “blank” button to scroll through the list of choices. Press the “SEL” button to enter the choice and return to the main menu.

- **Range**: 0000 to 9999

The Range value selected determines if the filter, as set previously, will be applied to the new input sample. If the new input value is within the ± range of the previous display, the filter will be applied to the new input.

**Example:**

- **new input sample** = 891°C
- **previous display** = 885°C
- **range** = ±10°C

885 ± 10 = 875 to 895 degree filter range based on previous display.

The new input sample (891°C) is within ±10°C of the previous display (885°C), so the filter is applied to the new input signal.

If the new input is outside the filter range, no filter is used. This allows fast response to large signal changes and maximum filtering of small signal changes.

To enter the range value, use the “blank” button to increment the flashing digit. To select a new digit, press the “SEL” button. After the desired value is on the display, press and hold the “SEL” button for three seconds to enter the value and return to the main menu.
OFFSET: ±00000 to 99999

The offset value is used to add or subtract a constant temperature from the display. Typically this value should be zero. Changing this value does not affect calibration, but will affect the displayed temperature. If a constant offset error is occurring in the application, this feature may be used to reduce or eliminate that error.

To enter an offset value, use the “blank” button to increment the flashing digit or the sign of the number. To select a new digit or sign of the number, press the “SEL” button. If no digits are flashing, use the “blank” button to toggle the sign of the number or press the “SEL” button to wrap around to the LSD. After the desired value is on the display, press and hold the “SEL” button for three seconds to enter the value and return to the main menu.

CAL - YES/NO

Read the entire Calibration instructions before attempting to calibrate the unit. Access codes are contained in the calibration procedures. This unit is calibrated from the factory. Initial calibration is not necessary. Calibration should only be performed by individuals experienced in calibrating electronic equipment.

This item places the unit in calibration mode. Read the entire Calibration section before attempting to calibrate this unit. If calibration is entered by accident, press and hold the “SEL” button when the display shows 00000 for access code. Approximately three seconds later the display will return to £9F in the Program Menu.

To enter the Calibration Mode, use the “blank” button to change the NO to a YES. Press the “SEL” button to enter the choice.

CALIBRATING THE CUB4RT

The CUB4RT uses stored voltage and resistance calibration values to provide accurate temperature measurements. Over time, the electrical characteristics of the components inside the CUB4RT will slowly change with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration once every 1 to 2 years should be sufficient.

Calibration of the CUB4RT involves a voltage calibration and 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 CUB4RT.

Calibration Check

1. Connect a precision resistance decade box with an accuracy of ±0.01 ohms to the unit as a three wire RTD. See Calibration Wiring Diagram. All RTD Wires should be the same length, gauge, and material. Keep wire length to a minimum.
2. Verify that the unit is programmed for the correct RTD type.
3. Verify that the unit is programmed for a value of zero for OFFSET.
4. Set the precision resistance decade box to the values shown below and verify that the display reads accordingly. ±0.9°C for Cu427, and ±0.7°C for all other RTD types.

<table>
<thead>
<tr>
<th>Type</th>
<th>Pt100</th>
<th>Pt385</th>
<th>Ni872</th>
<th>Cu427</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumper</td>
<td>Ohm</td>
<td>°C</td>
<td>Ohm</td>
<td>°C</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Pos B</td>
<td></td>
<td></td>
<td>Pos B</td>
<td></td>
</tr>
<tr>
<td>Pos A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>17</td>
<td>-200.1</td>
<td>-201.1</td>
<td>66</td>
<td>-80.9</td>
</tr>
<tr>
<td>20</td>
<td>-193.2</td>
<td>-196.5</td>
<td>70</td>
<td>-74.8</td>
</tr>
<tr>
<td>80</td>
<td>-49.9</td>
<td>-50.8</td>
<td>120</td>
<td>-0.0</td>
</tr>
<tr>
<td>140</td>
<td>102.1</td>
<td>104.0</td>
<td>170</td>
<td>64.9</td>
</tr>
<tr>
<td>200</td>
<td>261.4</td>
<td>266.4</td>
<td>220</td>
<td>120.7</td>
</tr>
<tr>
<td>260</td>
<td>429.3</td>
<td>437.9</td>
<td>270</td>
<td>170.1</td>
</tr>
<tr>
<td>320</td>
<td>607.1</td>
<td>619.9</td>
<td>320</td>
<td>213.8</td>
</tr>
<tr>
<td>380</td>
<td>797.3</td>
<td>815.2</td>
<td>370</td>
<td>252.5</td>
</tr>
<tr>
<td>396</td>
<td>850.3</td>
<td>852.5</td>
<td>379</td>
<td>259.0</td>
</tr>
</tbody>
</table>

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
1. Connect a precision Voltage Source with an output range of 0.000 to 105.000 mV and an accuracy of 0.03% or better to the SIG+ (#3) and SIG- (#5) terminals. Placement of jumper does not affect voltage calibration.

2. Enter the Program Menu and step through the Program Menu list by pressing the “SEL” button until **CAL** is displayed.

3. Press the “blank” button to change **no** to **YES**. Press “SEL”.

4. The display shows **00000**. Use the “blank” button to increment the access code to **00006**, Press and hold “SEL”.

5. After entering the correct access code, the unit will display **IN1**. Follow the table below for calibration sequence. The unit displays **CALC** for about 3 seconds after pressing the “SEL” button before proceeding to the next input point.

<table>
<thead>
<tr>
<th>mV DISPLAY</th>
<th>PARAMETER</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IN1</strong></td>
<td>0.000 mV</td>
<td>Apply 0.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN2</strong></td>
<td>15.000 mV</td>
<td>Apply 15.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN3</strong></td>
<td>30.000 mV</td>
<td>Apply 30.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN4</strong></td>
<td>45.000 mV</td>
<td>Apply 45.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN5</strong></td>
<td>60.000 mV</td>
<td>Apply 60.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN6</strong></td>
<td>75.000 mV</td>
<td>Apply 75.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN7</strong></td>
<td>90.000 mV</td>
<td>Apply 90.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td><strong>IN8</strong></td>
<td>105.000 mV</td>
<td>Apply 105.000 mV, wait 5 sec., press SEL</td>
</tr>
</tbody>
</table>

6. After voltage calibration is complete, the display will show **r 200**.

7. Place the input selector jumper in position ‘B’.

8. Connect a precision resistance decade box with an accuracy of ± 0.01 ohms to the unit as a three wire RTD. See Resistance Calibration Diagram.

9. With the display showing **r 200**, set the resistance to 200 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the display will change to **r 0**.

10. With the display showing **r 0**, set the resistance to 0 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the display will change to **r 400**.

11. With the display showing **r 400**, set the resistance to 400 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the display will change to **r 10**.

12. Change the input selector jumper to position ‘A’.

13. With the display showing **r 10**, set the resistance to 10 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the display will change to **r 0**.

14. With the display showing **r 0**, set the resistance to 0 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the display will change to **r 20**.

15. With the display showing **r 20**, set the resistance to 20 ohms, then press the “SEL” button. The unit displays **CALC** for a few seconds and then the unit will return to the **CAL** program item.

Before exiting the programming menu, verify that the **TYPE** is set to the desired type and the input selector jumper is in the appropriate position. Exit programming and check the calibration. Repeat if necessary.

Entering code **85** will place the CUB4RT in a resistance display mode. This mode is for diagnostic purposes only. When power is removed from the CUB4RT, the display will return to its previously programmed state. If the RTD type is set for **Cu427** and the jumper is set to position A, the display will read **000.00** to **20.00** ohms. All other RTD types with the jumper in position B, will cause the display to read **0000.00** to **4000.00** ohms.
TROUBLESHOOTING
For further technical assistance, contact technical support at the number listed on the front of the bulletin.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL CUB4TC - INTELLIGENT THERMOCOUPLE INDICATOR

DESCRIPTION

The CUB4TC is a 9 to 26 VDC powered, microprocessor based temperature indicator, with decimal display, for use with T, E, J, K, R, S, B, or N thermocouple sensors. A mVDC display mode with a range of -10.00 to 60.00 mV is also selectable. Programmable features include thermocouple type, cold junction compensation, Fahrenheit, Celsius, or millivolt display, input filtering, input filter range, and a user offset. The 0.48”, 5 digit LCD display provides annunciators for Fahrenheit or Celsius indication and is available with or without a backlight.

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.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUB4TC</td>
<td>Thermocouple Indicator, Reflective LCD</td>
<td>CUB4TC00</td>
</tr>
<tr>
<td></td>
<td>Thermocouple Indicator, Red Backlit Transmissive LCD</td>
<td>CUB4TC20</td>
</tr>
<tr>
<td>MLPS</td>
<td>Micro Line/Sensor Power Supply</td>
<td>MLPS0000</td>
</tr>
</tbody>
</table>

SPECIFICATIONS

1. DISPLAY: Reflective LCD or Transmissive LCD with red backlight, 5 digit display 0.48”(12.2 mm) height, F or C annunciators.
2. POWER: 9 to 26 VDC @ 65 mA with backlight, 25 mA without backlight. Reverse polarity protected. Must use the MLPS or a Class 2 or SELV rated power supply. Backlight version only: 0.15 °C/V olt CJC error if powered from other than 12 VDC. May be compensated with offset. Example: 24 VDC supply, (24V-12V)*0.15 °C/V = 1.8 °C, Enter -1.8 °C user offset.
3. INPUT:
   - Isolation: TC+ and TC- terminals are not electrically isolated from the power supply.
   - Response Time: 500 msec.
   - Failed Sensor Display: RFER
   - Overrange/Underrange Input: DL DL/UL UL
   - Overrange/Underrange Display: """"/""""/""""/""
   - Normal Mode Rejection: 40 dB @ 50/60 Hz
   - Common Mode Rejection: 100 dB @ DC to 60 Hz
   - Maximum Input Voltage: 30 VDC, TC+ to TC-
   - Maximum Input Voltage TC-: 3 VDC max. with respect to common Thermocouple: Conforms to ITS-90.
     - Types: T, E, J, K, R, S, B, N
     - Input Impedance: 20 MΩ
     - Lead resistance effect: 0.25 µV/ohm
     - Cold junction compensation: Less than 1.0 °C over 0 to 50 °C ambient temp range.
   - Resolution: 1 °C/F all types, or 0.1 °C/F for T, E, J, K and N only.
4. TEMPERATURE EFFECTS:
   - Span Drift: 150 ppm/°C Max.
   - Zero Drift: < 1 µV/°C Max.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 3.0” (76.2) W.

UL Recognized Component, File # E178299
SPECIFICATIONS (Cont’d)

5. RANGE & ACCURACY:
Accuracy reflects ALL errors @12 VDC supply and 15 minute warm-up, except thermocouple probe errors and any lead resistance effects of 0.25 mV/°K.

<table>
<thead>
<tr>
<th>TC TYPE</th>
<th>DISPLAY</th>
<th>RANGE</th>
<th>ACCURACY @ 22°C ±1°C</th>
<th>ACCURACY @ 0 to 50°C ±1°C</th>
<th>WIRE COLOR</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>k</td>
<td>-200 to 400°C, 732°F to 752°F</td>
<td>2.3</td>
<td>5.8</td>
<td>BLUE, WHITE</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>y</td>
<td>-200 to 1372°C, -252 to 2502°F</td>
<td>2.3</td>
<td>5.8</td>
<td>YELLOW, BROWN</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>j</td>
<td>-200 to 760°C, -252 to 1400°F</td>
<td>1.9</td>
<td>4.3</td>
<td>WHITE, BROWN</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>°</td>
<td>0 to 1768°C, 32 to 3214°F</td>
<td>4.5</td>
<td>15.0</td>
<td>BLACK, WHITE</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>°</td>
<td>0 to 1768°C, 32 to 3214°F</td>
<td>4.5</td>
<td>15.0</td>
<td>BLACK, WHITE</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>b</td>
<td>200 to 1820°C, 300 to 3300°F</td>
<td>9.1 to 540°C, 4.5 to 540°C, 42.6 to 540°C, 15.0 to 540°C</td>
<td>GREY, NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>E</td>
<td>-200 to 787°C, -328 to 1448°F</td>
<td>2.7</td>
<td>4.9</td>
<td>VIOLET, BROWN</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>n</td>
<td>-200 to 1300°C, -328 to 2372°F</td>
<td>2.8</td>
<td>8.1</td>
<td>ORANGE, ORANGE</td>
<td></td>
</tr>
<tr>
<td>mV</td>
<td>mV</td>
<td>-10.00 to 60.00</td>
<td>0.02 mV, 0.08 mV</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Summary of Errors:
±0.1°C NIST 90 conformity.
±20 μV A/D conversion.
±150 ppm/°C span, ±1 μV/°C zero.
A/D Temperature effects.
±1°C cold junction compensation.

6. ENVIRONMENTAL CONDITIONS:
Operating Temperature Range: 0 to 50 °C
Storage Temperature Range: -30 to 85 °C
Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0 to 50 °C.
Altitude: Up to 2000 meters (6561 feet)

7. 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.
Type 4X Enclosure rating (Face only), UL50
IEC 61000-4-6, EN 61000-4-3, EN 61000-4-3

8. CONNECTION: Wire clamping screw terminals.
9. CONSTRUCTION: High impact plastic case with clear viewing window. (Panel gasket and mounting clips included.) Unit is rated for NEMA 4X/IP65 outdoor use. Installation Category I, Pollution Degree 2.
10. WEIGHT: 3.3 oz. (93.5 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. 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 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 earth ground.
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 to earth ground (protective earth) only at the panel 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 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 contacts, 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:
   a. Ferrite Suppression Cores for signal and control cables: Schaffner # FN610-1/07 (RLC #FCOR0000) TDK # ZCAT3035-1330A
   b. Line Filters for input power cables: Schaffner # FN610-1/07 (RLC #LFL0000) Schaffner # FN670-1.8/07
5. Coircom #1VR3
   a. 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.

Notes:
   a. For operation without loss of performance:
      i. Unit is panel mounted in a metal enclosure (Buckeye SM7013-0 or equivalent).
      ii. I/O cables routed in metal conduit connected to earth ground.
   b. In extremely high EMI environments, additional measures may be needed. The unit becomes more immune to EMI with fewer I/O connections.
   c. 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.
   d. Signal or Control cables within an enclosure should be routed as far away as possible from contacts, control relays, transformers, and other noisy components.
   e. 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:
      i. Ferrite Suppression Cores for signal and control cables: Schaffner # FN610-1/07 (RLC #FCOR0000) TDK # ZCAT3035-1330A
      ii. Line Filters for input power cables: Schaffner # FN610-1/07 (RLC #LFL0000) Schaffner # FN670-1.8/07
      iii. Coircom #1VR3
   f. Reference manufacturer’s instructions when installing a line filter.
   g. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
WIRING CONNECTIONS

All conductors should meet voltage and current ratings of the unit. 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.

Unit should be mounted in a relatively stable temperature environment. Avoid drafts and areas subject to radical temperature shifts.

CAUTION: To maintain the SELV rating of the CUB4TC, the thermocouple probe should be isolated from any accidental contact with hazardous voltage or non-SELV circuitry.

Electrical

Connect thermocouple wires to terminals TC+(#3) and TC-(#5), observing the correct polarity. Keep wire length to a minimum to reduce lead resistance errors. Do not run thermocouple wires with Class 1 wiring.

Connect the 9 to 26 VDC power to terminals V+(#2) and COMM.(#1), observing the correct polarity. If more than one CUB4TC are powered from the same supply, the probes must be isolated from each other.

BASIC OPERATION

Normal operation begins with application of power to the CUB4TC. The unit will begin a power up sequence that displays the version of the software and any diagnostic messages. After approximately four seconds, the unit will begin to display the temperature of the thermocouple probe or the millivolt input, depending upon input type selected.

A diagnostic message of FRL or SRL may occur on power up. This message indicates that the stored programming and/or calibration values may have become corrupted. Pressing the “SEL” button will remove the current message from the display.

Once the unit is displaying temperature or millivolts, the “SEL” button may be pressed to display the type of input the unit has been programmed to display. The display will show J, K, E, T, R, S, B, N, or Lin. The display will return to normal indication after three seconds.

DIAGNOSTIC MESSAGES

FRL - indicates that a non-volatile memory fault has occurred. The operator must acknowledge this message by pressing the “SEL” button before proceeding to normal operation. Once the unit is in normal operation, the messages FLP-9 and or FLCRL will be periodically flashed on the display.

FLP-9 - indicates that non-calibration data is corrupt. This flashing display will remain active even if power is removed and reapplied, until the unit is reprogrammed. If the message appears on next power up after the unit has been reprogrammed, it may indicate a nonfunctional memory component.

FLCRL - indicates that calibration data is corrupt and nominal values will be used to calculate the display value. This flashing display will remain active even if power is removed and reapplied, until the unit is re-calibrated. If the message appears on next power up after the unit has been recalibrated, it may indicate a nonfunctional memory component. The nominal values used to calculate the input signal value may cause indication errors of up to 10% of full scale. The unit should be recalibrated to restore normal display accuracy as soon as possible.

Programming may be entered at any time except during calibration. Exiting the Program Menu of the CUB4TC is accomplished by breaking the electrical connection between the PROGRAM terminal and the COMM terminal. During exit of programming, the unit displays SURE to indicate that the data is currently being written to non-volatile memory.

All programming data is stored upon exit of programming. If power is removed from the CUB4TC during exit of the Program Menu, data may not be saved completely or correctly, and may cause a FRL message to occur during the next power-up cycle. If power is removed from the CUB4TC before exiting the Program Menu, all changes (including calibration information) will be lost and previous values will be used upon power-up.

Programming the CUB4TC involves using the “SEL” and “blank” buttons to traverse the Programming Menu and to select values for the corresponding Programming Menu Items.

SEL: Steps to next Program Menu selection
Blank: Scrolls through selection variables and enters into programming for the selected value.

PROGRAM MENU - Selection Variables

TYPE - k, e, j, r, s, b, n or Lin

To select the input type, press the blank button to scroll through the available input types. Press the “SEL” button to enter the choice and return to the main menu.

CJC - YES, NO

This program item enables or disables cold junction compensation. Pressing the “blank” button toggles between Yes and No.

For most applications, cold junction compensation should be enabled (YES). Press the “SEL” button to enter the choice and return to the main menu.

This menu item does not appear if TYPE = Lin.

disp - DC, DCC, DF, DLF

This program item sets the display for Fahrenheit or Celsius and whole number or tenths. Tenths is not available for thermocouple types R, S, and B.

To change the display, use the “blank” button to scroll through the list of choices. Press the “SEL” button to enter the choice and return to the main menu.

This menu item does not appear if TYPE = Lin.

Filter - 0, 1, 2, 3

If the displayed process signal 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 display 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.

To select the filter level, use the “blank” button to scroll through the list of choices. Press the “SEL” button to enter the choice and return to the main menu.

Range - 00000 to 00099

The Range value selected determines if the filter, as set previously, will be applied to the new input sample. If the new input value is within the ± range of the previous display, the filter will be applied to the new input.

Example:

new input sample = 891 °C
previous display = 885 °C
range = 10 °C

885 ± 10 = 875 to 895 degree filter range based on previous display.

The new input sample (891 °C) is within ± 10 °C of the previous display (885 °C), so the filter is applied to the new input signal.

If the new input is outside the filter range, no filter is used. This allows fast response to large signal changes and maximum filtering of small signal changes.

To enter the range value, use the “blank” button to increment the flashing digit. To select a new digit, press the “SEL” button. After the desired value is on the display, press and hold the “SEL” button for three seconds to enter the value and return to the main menu.
The offset value is used to add or subtract a constant temperature from the display. Typically this value should be zero. Changing this value does not affect calibration, but will affect the displayed temperature. If a constant offset error is occurring in the application, this feature may be used to reduce or eliminate that error.

To enter an offset value, use the “blank” button to increment the flashing digit or the sign of the number. To select a new digit or sign of the number, press the “SEL” button. If no digits are flashing, use the “blank” button to toggle the sign of the number or press the “SEL” button to wrap around to the LSD. After the desired value is on the display, press and hold the “SEL” button for three seconds to enter the value and return to the main menu.

CALIBRATION
The CUB4TC 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 CUB4TC will slowly change with the result that the stored calibration values no longer accurately define the input circuit. For most applications, recalibration once every 1 to 2 years should be sufficient.

Calibration of the CUB4TC 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 CUB4TC.

Voltage Calibration Check
1. Enter the programming menu and set TYPE to IN and OFSET to 0. Exit programming.
2. Use a precision DC voltage supply with an accuracy of 0.03% or better. Connect the negative lead of the power supply to TC- (#5) and the positive lead of the power supply to TC+ (#3).
3. Compare the CUB4TC read-out to the precision DC supply at various points over the range (-10.00 mVDC to 60.00 mVDC). The tolerance is ± 2 LSD (±0.02 mV), at all points within this range.
4. Calibrate the CUB4TC if the readings are out of tolerance.

Cold Junction Calibration Check
1. Enter Programming Menu, and verify the following:
   \[
   \begin{align*}
   \text{CJC} & = \text{YES} \\
   \text{CJC} & = \text{YES} \\
   \text{OFSET} & = 0
   \end{align*}
   \]

Make any necessary changes to programming.
2. Connect a thermocouple probe of known accuracy and type (J, K, E, T, or N) to the CUB4TC. The probe should match the one selected in programming.
3. Connect a reference temperature probe to measuring end of thermocouple to monitor temperature. Allow sufficient time for temperatures to equalize (at least 15 minutes).
4. Compare unit display with reference temperature indicator. The unit display should equal the reference probe temperature. Tolerance is ±1.0 °C.
5. Calibrate the cold junction temperature if out of tolerance.

CAL - YES/NO
Read the entire Calibration instructions before attempting to calibrate the unit. Access codes are contained in the calibration procedures. This unit is calibrated from the factory. Initial calibration is not necessary. Calibration should only be performed by individuals experienced in calibrating electronic equipment.

This item places the unit in calibration mode. Read the entire Calibration section before attempting to calibrate this unit. If calibration is entered by accident, press and hold the “SEL” button when the display shows 00000 for access code. Approximately three seconds later the display will return to TYPE in the Program Menu.

To enter the Calibration Mode, use the “blank” button to change the NO to a YES. Press the “SEL” button to enter the choice.

VOLTAGE CALIBRATION

Voltage Calibration Wiring

1. Connect a precision Voltage Source with an output range of -10.000 to 60.000 mV and an accuracy of 0.03% or better to the TC- (#5) and TC+ (#3) terminals. Cold junction calibration must be performed AFTER voltage calibration.
2. Enter the Program Menu and step through the Program Menu list by pressing the “SEL” button until CAL is displayed.
3. Press the “blank” button to change NO to YES. Press “SEL”.
4. The display shows 00000. Use the “blank” button to increment the access code to 00006. Press and hold “SEL”.
5. After entering the correct access code, the unit will display IN1. Follow the table below for calibration sequence. The unit displays CALc for about 3 seconds after pressing the “SEL” button before proceeding to the next input point.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN1</td>
<td>-10.000 mV</td>
<td>Apply -10.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN2</td>
<td>0.000 mV</td>
<td>Apply 0.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN3</td>
<td>10.000 mV</td>
<td>Apply 10.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN4</td>
<td>20.000 mV</td>
<td>Apply 20.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN5</td>
<td>30.000 mV</td>
<td>Apply 30.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN6</td>
<td>40.000 mV</td>
<td>Apply 40.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN7</td>
<td>50.000 mV</td>
<td>Apply 50.000 mV, wait 5 sec., press SEL</td>
</tr>
<tr>
<td>IN8</td>
<td>60.000 mV</td>
<td>Apply 60.000 mV, wait 5 sec., press SEL</td>
</tr>
</tbody>
</table>

6. After voltage calibration is complete, the unit will return to the CAL program item. Exit programming and verify various points from -10.00 to 60.00 mVDC using the Voltage Calibration Check procedure to ensure that the calibration is correct.
7. Repeat calibration if necessary.
COLD JUNCTION CALIBRATION

This procedure must be performed AFTER an accurate voltage calibration. The ambient temperature at which this calibration should be performed is 15 to 35 °C (59 to 95 °F). A Temperature indicator with 0.1 °C resolution and accuracy is required to perform this calibration.

1. Enter Programming Menu, and verify the following:
   - TYPE = probe being connected to the unit.
   - CJC = YES
   - disp = 0.0 °C
   - OFSET = 0

Make any necessary changes to programming.

2. Connect a thermocouple probe of known accuracy and type (J, K, E, T, or N) to the CUB4TC. The probe should match the one selected in programming.

3. Connect a reference temperature probe to measuring end of the CUB4TC thermocouple. The two probes should be shielded from air movement and allowed sufficient time (15 minutes minimum) to equalize in temperature. (As an alternative, the CUB4TC thermocouple probe may be placed in a calibration bath of known temperature.)

4. Compare the unit display with reference temperature indicator (or calibration bath). If the displayed unit temperature does not equal the reference probe temperature, calculate the CJ error as follows:

   \[ \text{CJ Error} = \text{reference probe temperature} - \text{CUB4TC displayed temperature} \]

5. Enter the Program Menu and step through the Program Menu list by pressing the “SEL” button until CAL is displayed.

6. Press the “blank” button to change no to YES. Press “SEL”.

7. The display shows 00000. Use the “blank” button to increment the access code to 00003. Press and hold “SEL”.

8. After entering the correct access code, the display will alternate between CJC and the current cold junction compensation value.

9. If the current CJC value is 0.0 °C or 59.9 °C, set the CJC value to the current ambient temperature, exit calibration, and repeat the CJC calibration procedure.

10. Otherwise, the new value to be entered is the sum of the current value and the CJ Error recorded previously.

11. Exit the Programming Menu and repeat the calibration from Step 4 to verify accuracy.

INSTALLATION

The CUB4TC meets NEMA 4X/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted on an enclosed panel. The viewing window and buttons are factory sealed for a wash down environment. A sponge rubber gasket and mounting clip are provided for sealing the unit in the panel cut-out.

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 buttons of this unit.

The following procedure assures proper installation:

1. Cut the panel opening to the specified dimensions. Remove burrs and clean around the panel opening.
2. Carefully slide the panel gasket over the rear of the unit to the back of the bezel.
3. Assemble the nut fastener and mounting screw onto both sides of the mounting clip. The tip of the screw should not project from the hole in the mounting clip.
4. Install the unit through the panel cut-out until the front bezel flange contacts the panel.
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 housing.
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 the 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 panel.
Repeat the procedure for tightening the mounting screws.

TROUBLESHOOTING

For further technical assistance, contact technical support at the number listed on the front of the bulletin.
A customer desires to display the difference between the actual temperature of an oven and the desired temperature of 475.0 °F. If the temperature of the oven is 464.8 °F the display should read -10.2 °F. A K type thermocouple is to be used.

The user offset capability of the CUB4TC allows for this type of temperature indication. A key switch has been installed between PROGRAM and COMM to allow programming of the unit.

Desired oven temp = 475.0 °F, set offset for -475.0. Unit will display the temperature relative to 475.0 °F.

**Programming:**
- **TYPE** = k
- **CJC** = YES
- **disp** = 0.0 °F
- **FLtEr** = 1
- **rANGE** = 5 °F
- **OFSEt** = -475.0 °F

---

**LIMITED WARRANTY**

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL CUB5P - MINIATURE ELECTRONIC 5-DIGIT PROCESS METER

- 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 MODULES
- OPTIONAL SERIAL COMMUNICATIONS MODULES (RS232 or RS485)
- 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 modules. The setpoint output cards are field installable with programmable setpoints. Serial communications capability for RS232 or RS485 can be added with a serial option module.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5. The MLPS1 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.

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

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUBS</td>
<td>CUBSP</td>
<td>Process Meter with reflective display</td>
<td>CUBSPR00</td>
</tr>
<tr>
<td></td>
<td>CUBSPB00</td>
<td>Process Meter with backlight display</td>
<td>CUBSPB00</td>
</tr>
<tr>
<td>Optional Plug-in Cards</td>
<td>CUBSRLY0</td>
<td>Single Relay Output Card</td>
<td>CUBSRLY0</td>
</tr>
<tr>
<td></td>
<td>CUBS5NK0</td>
<td>Dual Sinking Open Collector Output Card</td>
<td>CUBS5NK0</td>
</tr>
<tr>
<td></td>
<td>CUB5COM1</td>
<td>RS485 Serial Communications Card</td>
<td>CUB5COM1</td>
</tr>
<tr>
<td></td>
<td>CUB5COM2</td>
<td>RS232 Serial Communications Card</td>
<td>CUB5COM2</td>
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<tr>
<td>Accessories</td>
<td>MLPS1</td>
<td>Micro-Line Power Supply, 85 to 250 VAC</td>
<td>MLPS1000</td>
</tr>
<tr>
<td></td>
<td>CBLPROG0</td>
<td>RS232 Programming Cable (DB9-RJ11)</td>
<td>CBLPROG0</td>
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<tr>
<td></td>
<td>CBPRO07</td>
<td>RS485 Programming Cable (DB9-RJ11)</td>
<td>CBPRO007</td>
</tr>
<tr>
<td></td>
<td>SFCRD007</td>
<td>Crimson 2 PC Configuration Software for Windows 98, ME, 2000, XP *</td>
<td>SFCRD200</td>
</tr>
</tbody>
</table>

*Crimson 2 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
   CUBSPR00: Reflective LCD with full viewing angle
   CUBSPB00: 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 MLPS1 or a Class 2 or SELV rated power supply.

3. INPUT RANGES: Jumper Selectable
   0 to 10 V, 0(4) to 20 mA, 0 to 50 mA

4. SENSOR INPUTS:

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY @23 °C, less than 85% RH</th>
<th>INPUT IMPEDANCE</th>
<th>MAX INPUT SIGNAL</th>
<th>RESOLUTION</th>
<th>TEMP. COEFFICIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 / 50 mA</td>
<td>0.1% of span</td>
<td>10 Ω</td>
<td>150 mA</td>
<td>1 μA</td>
<td>70 ppm / °C</td>
</tr>
<tr>
<td>10 VDC</td>
<td>0.1% of span</td>
<td>500 KΩ</td>
<td>10 V</td>
<td>1 mV</td>
<td>70 ppm / °C</td>
</tr>
</tbody>
</table>

5. OVERRANGE RATINGS, PROTECTION & INDICATION: 9 to 28 VDC power circuit is not isolated from the signal circuit.
   Input Overrange Indication: “OLUL”.
   Input Underrange Indication: “ULUL”.
   Display Overrange/Underrange Indication: “.....”/“.....”

6. DISPLAY RESPONSE TIME: 500 msec min.

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: $V_{IL} = 1.0$ V max; $V_{IH} = 2.4$ V min; $V_{MAX} = 28$ VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)

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’PROM memory retains all programming parameters and max/min values when power is removed.

11. CONSTRUCTION: This unit is rated for NEMA 4X/IP65 requirements for indoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.

12. ENVIRONMENTAL CONDITIONS:
   Operating Temperature Range for CUBSPR00: -35 to 75°C
   Operating Temperature Range for CUBSPB00 depends on display color and intensity level as per below:

<table>
<thead>
<tr>
<th>INTENSITY LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Display</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 60°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 50°C</td>
</tr>
</tbody>
</table>

| Green Display   | -35 to 75°C |
| 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’s.
Shock According to IEC 68-2-27: Operational 30 g, 1 msec in 3 directions. Altitude: Up to 2000 meters

13. 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 Indoor Enclosure rating (Face only), UL50
   IEC 61000-4-4
   CB Scheme Test Certificate #US/9257C/UL
   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

14. ELECTROMAGNETIC COMPATIBILITY
   Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.
   Emissions:
   Standard EN 61000-4-2: Criterion A
   3 V/rms
   Fast transients (burst) EN 61000-4-4: Criterion A
   3 V/m
   Surge EN 61000-4-5: Criterion A
   1 kV signal
   RF conducted interference EN 61000-4-6: Criterion A
   2 kV L-N-E power
   Power frequency magnetic fields EN 61000-4-8: Criterion A
   3 V/m

   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

   Notes:

   2. 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 (i.e., 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
Response Time:
  Turn On Time: 4 msec max.
  Turn Off Time: 4 msec max.

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

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**

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into 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 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 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.
2. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
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.
4. 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)
     - Steward # 28B2029-0A0
   - Line Filters for input power cables:
     - Schaffner # FN610-1/07 (RLC# LFIL000)
     - Schaffner # FN670-1.8/07
     - Corcom # 1 VR3
   - Note: Reference manufacturer’s instructions when installing a line filter.
5. 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.

**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.

**4.1 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).

**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.
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)**

<table>
<thead>
<tr>
<th>JUMPER POSITION</th>
<th>MAX SIGNAL INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 VDC</td>
<td>30 VDC</td>
</tr>
<tr>
<td>20/50 mA DC</td>
<td>150 mA</td>
</tr>
</tbody>
</table>

**Series Loop (must use separate supply for sensor power and each CUB5)**

2 Wire With External Power

2 Wire With MLPS Power

2 Wire With Separate Sensor And CUB5 Power

4.4 SETPOINT (OUTPUT) WIRING

**SINGLE SETPOINT RELAY PLUG-IN CARD**

**DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD**

**4.5 SERIAL COMMUNICATION WIRING**

**SERIAL COMMUNICATIONS PLUG-IN CARD**

**RJ11 CONNECTOR PIN OUTS**
5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

BUTTON |
--- | |
SEL | Index display through enabled values |
RST | Resets values (MIN/MAX) or outputs |

ENTERING PROGRAM MODE |
Press and hold for 2 seconds to activate |

PROGRAMMING MODE OPERATION |
Store selected parameter and index to next parameter |
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 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/values 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.

Indicates Program Mode Alternating Display

Parameter
Selection/Value

Factory Settings are shown.
6.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-1NP)

PARAMETER MENU

<table>
<thead>
<tr>
<th>Input Range</th>
<th>Display Decimal Point</th>
<th>Display Offset Value</th>
<th>Filter Setting</th>
<th>Filter Band</th>
<th>Style</th>
<th>Input Value for Scaling Point 1</th>
<th>Display Value for Scaling Point 1</th>
<th>Input Value for Scaling Point 2</th>
<th>Display Value for Scaling Point 2</th>
<th>User Input Function</th>
<th>User Input Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.000 V</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CUB5P INPUT RANGE

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

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

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

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

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.

General Notes on Scaling
1. When using the Apply (APLP) 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 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).
4. 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 (APLP) scaling style must be used.
6.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

**MAX DISPLAY ENABLE**

**H1-EN**

Enables the Maximum Display Capture capability.

**MIN DISPLAY ENABLE**

**L0-EN**

Enables the Minimum Display Capture capability.

**MIN CAPTURE DELAY TIME**

**L0-T**

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**

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

**DISPLAY MODE**

- **Pr** Print Request
- **P-RESET** Print and Reset
- **SET** Setpoint 1 and 2 Reset

**DESCRIPTION**

- Serial transmit of the active parameters selected in the Print Options menu (Module 5).
- Same as Print Request followed by a momentary reset of the assigned value(s).
- Resets setpoint 1 output.
- Resets setpoint 2 output.
- Reset both setpoint 1 and 2 outputs.

**USER INPUT ASSIGNMENT**

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.

**MAINTENANCE**

**CALIBRATION**

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 equipment 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 OFF, press and hold the SEL button for 2 seconds. The meter will display Code 48 for about 8 seconds.
3. Press the RST button to select the range to be calibrated.
4. Press the SEL button. Display reads Code 00 (OFF) if 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 apply the full scale input signal for the range. Press SEL. Display reads Code 00 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 Code 00 for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads Code 00, press the SEL button to exit calibration.

**RESTORE FACTORY DEFAULT SETTINGS**

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

**VIEW VERSION DISPLAY**

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.

**Backlight Color**

Change backlight color with each activation (backlight version only).

**Display Intensity Level**

Increase intensity one level for each activation (backlight version only).

**Display Hold**

Holds the assigned display, but all other meter functions continue as long as activated (maintained action).

**Display Select**

Advance once for each activation.

**Program Mode Lock-out**

Display Reading to be Offset.

**User Input Function**

- **HI-LO** Enables the Minimum Display Capture capability.
- **HI-EN** Enables the Maximum Display Capture capability.
- **MIN CAPTURE DELAY TIME**
- **MAX CAPTURE DELAY TIME**
- **FACTORY SERVICE OPERATIONS**
- **Print Request** Serial transmit of the active parameters selected in the Print Options menu (Module 5).
- **Print and Reset** Same as Print Request followed by a momentary reset of the assigned value(s).
- **Setpoint 1 and 2 Reset** Resets setpoint 1 output.
- **Setpoint 1 Reset** Resets setpoint 1 output.
- **Setpoint 2 Reset** Resets setpoint 2 output.
- **Print both setpoint 1 and 2 outputs.**

**Module 2 Secondary Function Menu**

- **H1-EN** Max Display Enable
- **L0-EN** Min Display Enable
- **H1-CT** Max Capture Delay Time
- **L0-CT** Min Capture Delay Time
- **FCS** Factory Service Operations
- **CodE** Access Code, Setpoint 1 Reset, Setpoint 2 Reset, Print Request

**PARAMETER MENU**

- **2-SEC**
- **SEL**
- **Max Display Enable**
- **Max Capture Delay Time**
- **Min Display Enable**
- **Min Capture Delay Time**
- **Factory Service Operations**
- **Access Code**
- **Setpoint 1 Reset**
- **Setpoint 2 Reset**
- **Print Request**
- **Code 00**
- **Code 48**
- **Code 66**
- **Code 50**

**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 OFF, press and hold the SEL button for 2 seconds. The meter will display Code 48 for about 8 seconds.
3. Press the RST button to select the range to be calibrated.
4. Press the SEL button. Display reads Code 00 (OFF) if 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 apply the full scale input signal for the range. Press SEL. Display reads Code 00 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 Code 00 for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads Code 00, press the SEL button to exit calibration.
6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

**PARAMETER MENU**

- **dSP-t**
- **SEL**
- **rSt**
- **Zero**
- **Scroll**
- **Units**
- **Color**
- **LEU**
- **CodE**

**DISPLAY UPDATE TIME**

\[ \text{dSP-t} \rightarrow 0.5 \text{ to } 2 \text{ seconds} \]

This parameter sets the display update time in seconds.

**FRONT PANEL DISPLAY SELECT ENABLE (SEL)**

\[ \text{SEL} \rightarrow \text{YES} \text{ or } \text{NO} \]

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

**FRONT PANEL RESET ENABLE (RST)**

\[ \text{rSt} \rightarrow \text{NO} \text{ or } \text{LO} \text{ or } \text{dSP} \]

This selection allows the **RST** button to reset the selected value(s).

**ZERO DISPLAY WITH DISPLAY RESET**

\[ \text{Zero} \rightarrow \text{YES} \text{ or } \text{NO} \]

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**

\[ \text{Scroll} \rightarrow \text{YES} \text{ or } \text{NO} \]

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**

\[ \text{Units} \rightarrow \text{OFF} \text{ or Likelike SEGs} \]

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)**

\[ \text{Color} \rightarrow \text{Red or Green} \]

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

**DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)**

\[ \text{dLEU} \rightarrow 1 \text{ to } 5 \]

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**

\[ \text{CodE} \rightarrow 000 \text{ to } 999 \]

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**

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN &quot;SEL&quot; BUTTON IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>not P-Loc</td>
<td></td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-999</td>
<td><strong>CodE</strong> prompt</td>
<td>With correct code entry at <strong>CodE</strong> prompt *</td>
</tr>
<tr>
<td>P-Loc</td>
<td>Active</td>
<td>1</td>
<td>Programming Lock</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at <strong>CodE</strong> prompt *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td><strong>CodE</strong> prompt</td>
<td>With correct code entry at <strong>CodE</strong> prompt *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not Active</td>
<td>0-999</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.
The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

### SETPOINT SELECT

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

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

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

### SETPOINT VALUE

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

### HYSTERESIS VALUE

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

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

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

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.)

\[ L \text{ of } L = \text{Latch with delay reset action; This action latches the output on at the trigger point per the Setpoint Action shown in Setpoint Output Figures. Latch means that the output can only be turned off by the front panel RST button or user input manual reset, serial reset command or meter power cycle. When the user input or RST button is activated (momentary action), the meter delays the event until the corresponding “on” output crosses the trigger off point. (Previously latched outputs are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous l of L reset if it is not activated at power up.)} \]

**OUTPUT RESET WITH DISPLAY RESET**

<table>
<thead>
<tr>
<th>RST</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
</table>

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**

<table>
<thead>
<tr>
<th>Sel</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
</table>

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**

<table>
<thead>
<tr>
<th>ChL-</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
</table>

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 (S-SEr)

<table>
<thead>
<tr>
<th>S-SEr</th>
<th>PARAMETER MENU</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL</td>
<td>Baud Rate</td>
</tr>
<tr>
<td></td>
<td>Data Bit</td>
</tr>
<tr>
<td></td>
<td>Parity Bit</td>
</tr>
<tr>
<td>Addr</td>
<td>Meter Address</td>
</tr>
<tr>
<td>Abbr</td>
<td>Abbreviated Printing</td>
</tr>
<tr>
<td>DPL</td>
<td>Print Options</td>
</tr>
</tbody>
</table>

The Serial Setup Parameters are only active when the optional RS232 or RS485 serial communications module is installed in the meter. Refer to the CUB5COM bulletin for complete details on CUB5 serial communications.

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**LIMITED WARRANTY**

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Press and hold SEL button to enter Programming Mode.
MODEL CUB5I - MINIATURE ELECTRONIC 5-DIGIT DC CURRENT METER

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 modules. Setpoint capability is field installable with the addition of the setpoint output modules. Serial communications capability for RS232 or RS485 is added with a serial option module.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5. The MLPS1 is powered from 85 to 250 V AC 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.

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

- **CUBS**
  - CUBSI DC Current Meter with reflective display CUBSIR00
  - DC Current with backlight display CUBSIB00

- **Optional Plug-in Cards**
  - CUB5RLY Single Relay Output Card CUB5RLY0
  - CUB5SNNK Dual Sinking Open Collector Output Card CUB5SNNK0
  - CUB5COM RS485 Serial Communications Card CUB5COMK0
  - CUB5COM2 RS232 Serial Communications Card CUB5COM2

- **Accessories**
  - MLPS1 Micro-Line Power Supply, 85 to 250 VAC MLPS1000
  - CBPROG RS232 Programming Cable (DB9-RJ11) CBPROG0
  - CBPRO RS485 Programming Cable (DB9-RJ11) CBPRO007
  - SFCRD Crimson 2 PC Configuration Software for Windows ME, 2000, XP SFCRD200

*CRIMSON 2 software is a free download from http://www.redlion.net/

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**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 MLPS1 or a Class 2 or SELV rated power supply.

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DISPLAY COLOR</th>
<th>INPUT CURRENT @ 9 VDC WITHOUT CUB5RLY0</th>
<th>INPUT CURRENT @ 9 VDC WITH CUB5RLY0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUB5IR00</td>
<td>Red (max intensity)</td>
<td>10 mA</td>
<td>40 mA</td>
</tr>
<tr>
<td>CUB5IB00</td>
<td>Red (max intensity)</td>
<td>85 mA</td>
<td>115 mA</td>
</tr>
<tr>
<td>CUB5IB00</td>
<td>Green (max intensity)</td>
<td>95 mA</td>
<td>125 mA</td>
</tr>
</tbody>
</table>

3. **INPUT RANGES**: Jumper Selectable
   - D.C. Currents: 200 µA, 2 mA, 20 mA, or 200 mA

4. **SIGNAL INPUTS**: 1.711 KΩ, 50 mA, 1 µA

5. **OVERRANGE RATINGS, PROTECTION & INDICATION**: 9 to 28 VDC power circuit is not isolated from the signal circuit.
   - Input Overrange Indication: "OL!OL!"
   - Input Underrange Indication: "UIUIUIUI"
   - Display Overrange/Underrange Indication: "............."/"............."

6. **RESPONSE TIME**: 500 msec min.

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 10 KΩ pull-up resistor to +9 to 28 VDC.

9. **THRESHOLD LEVELS**: VIL = 1.0 V, VIN= 2.4 V, VMAX = 28 VDC

10. **MEMORY**: Nonvolatile E²PROM memory retains all programming parameters and max/min values when power is removed.

11. **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:

<table>
<thead>
<tr>
<th>INTENSITY LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Display</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 70°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 60°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 50°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Green Display</th>
<th>-35 to 75°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 70°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 60°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 50°C</td>
</tr>
</tbody>
</table>

**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, 11 msec in 3 directions.

**Altitude**: Up to 2000 meters

12. **CONSTRUCTION**: This unit is rated for NEMA 4X/IP65 requirements for indoor 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**

**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 Indoor Enclosure rating (Face only), UL50
- IECEE CB Scheme Test Certificate #US/9257C/UL
- 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**
- 2. ***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 (i.e., 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

**Response Time:**
- Turn On Time: 4 msec max.
- Turn Off Time: 4 msec max.

### Dual Sinking Output Card

**Type:** Non-isolated switched DC, N Channel open drain MOSFET

**Current Rating:**
- \( V_{DS \text{ ON}} \): 0.7 V @ 100 mA
- \( V_{DS \text{ MAX}} \): 30 VDC

**Offset State 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

### 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 overtighten 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.

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 applications. 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.
6. Use of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI. Snubber: RLC# SNUB0000.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.

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

Connect external switching device between the USR and 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)

<table>
<thead>
<tr>
<th>JUMPER POSITION</th>
<th>MAX INPUT VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 VDC</td>
<td>30 VDC</td>
</tr>
<tr>
<td>20/50 mA DC</td>
<td>150 mA</td>
</tr>
</tbody>
</table>

Series Loop (must use separate supply for sensor power and each CUB5)

### 2 Wire With External Power

### 2 Wire With MLPS1 Power

### 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**
5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

<table>
<thead>
<tr>
<th>BUTTON</th>
<th>DISPLAY MODE OPERATION</th>
<th>ENTERING PROGRAM MODE</th>
<th>PROGRAMMING MODE OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL</td>
<td>Index display through enabled values</td>
<td>Press and hold for 2 seconds to activate</td>
<td>Store selected parameter and index to next parameter</td>
</tr>
<tr>
<td>RST</td>
<td>Resets values (MIN/MAX) or outputs</td>
<td></td>
<td>Advances through the program menu</td>
</tr>
</tbody>
</table>

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.

### 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
### 6.1 MODULE 1 - SIGNAL INPUT PARAMETERS

#### PARAMETER MENU

<table>
<thead>
<tr>
<th>CUB5I INPUT RANGE</th>
<th>SCALING STYLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>dECPl</strong></td>
<td><strong>dECP</strong></td>
</tr>
<tr>
<td><strong>dFSEL</strong></td>
<td><strong>dSP</strong></td>
</tr>
<tr>
<td><strong>FILTER</strong></td>
<td><strong>FILTER</strong></td>
</tr>
<tr>
<td><strong>bAND</strong></td>
<td><strong>bAND</strong></td>
</tr>
<tr>
<td><strong>STYLE</strong></td>
<td><strong>STYLE</strong></td>
</tr>
<tr>
<td><strong>RANGE</strong></td>
<td><strong>RANGE</strong></td>
</tr>
<tr>
<td><strong>INP 1</strong></td>
<td><strong>INP 1</strong></td>
</tr>
<tr>
<td><strong>DSP 1</strong></td>
<td><strong>DSP 1</strong></td>
</tr>
<tr>
<td><strong>INP 2</strong></td>
<td><strong>INP 2</strong></td>
</tr>
<tr>
<td><strong>DSP 2</strong></td>
<td><strong>DSP 2</strong></td>
</tr>
<tr>
<td><strong>INP ASSIGN</strong></td>
<td><strong>INP ASSIGN</strong></td>
</tr>
<tr>
<td><strong>dSEt</strong></td>
<td><strong>dSEt</strong></td>
</tr>
<tr>
<td><strong>dSP 1</strong></td>
<td><strong>dSP 1</strong></td>
</tr>
<tr>
<td><strong>dSP 2</strong></td>
<td><strong>dSP 2</strong></td>
</tr>
<tr>
<td><strong>dSEt</strong></td>
<td><strong>dSEt</strong></td>
</tr>
</tbody>
</table>

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

**dECP**

Select the decimal point location for the Input, MIN and MAX displays. This selection also affects the **dSP** and **dSEt** parameters and setpoint values.

#### DISPLAY OFFSET VALUE

**dFSEL**

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

**FILTER**

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**

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.

---

**General Notes on Scaling**

1. When using the Apply (RPL) 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 (INP / dSP, INP / dFSEL).
USER INPUT FUNCTION

<table>
<thead>
<tr>
<th>SETTINGS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-LOc</td>
<td>Program Mode Lock-out (Module 3).</td>
</tr>
<tr>
<td>rESEt</td>
<td>Zero Input (Edge triggered)</td>
</tr>
<tr>
<td>LO-En</td>
<td>Min Display Enable</td>
</tr>
<tr>
<td>HI-En</td>
<td>Max Display Enable</td>
</tr>
<tr>
<td>d-SEL</td>
<td>Display Select (Edge Triggered)</td>
</tr>
<tr>
<td>d-HELd</td>
<td>Display Hold</td>
</tr>
<tr>
<td>d-HLd</td>
<td>Display Hold</td>
</tr>
<tr>
<td>d-LED</td>
<td>Display Intensity Level (Edge Triggered)</td>
</tr>
<tr>
<td>h-RSt</td>
<td>Reset (Edge triggered)</td>
</tr>
<tr>
<td>ECOLd</td>
<td>Backlight Color (Edge Triggered)</td>
</tr>
</tbody>
</table>

DISPLAY MODE

- No Function: User Input disabled.
- Program Mode Lock-out: See Programming Mode Access chart (Module 3).
- Zero Input (Edge triggered): Zero the Input Display value causing Display Reading to be Offset.
- Reset (Edge triggered): Resets the assigned value(s) to the current input value.
- Display Hold: Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
- Display Select (Edge Triggered): Advance once for each activation.
- Display Intensity Level (Edge Triggered): Increase intensity one level for each activation (backlight version only).
- Backlight Color (Edge Triggered): Change backlight color with each activation (backlight version only).

USER INPUT ASSIGNMENT

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)

MAX DISPLAY ENABLE

- No
- Yes

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

- 0.0 to 9999 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

- No
- Yes

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

- 0.0 to 9999 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

- No
- Yes

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

DISPLAY MODE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr - mL</td>
</tr>
<tr>
<td>Pr - St</td>
</tr>
<tr>
<td>rSt - 1</td>
</tr>
<tr>
<td>rSt - 2</td>
</tr>
<tr>
<td>rSt - 12</td>
</tr>
</tbody>
</table>

FACTORY SERVICE OPERATIONS

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

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

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 dSP and then return to CodE 00. Press the SEL button to exit the module.
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 dFR 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 dFR, press the SEL button to exit calibration.
6.3 Module 3 - Display and Front Panel Button Parameters (3-dSP)

**Parameter Menu**

- **3-dSP**
  - SEL
  - dSP
  - rSt
  - 2ErD
  - Scrol
  - UN L5
  - COLOr
  - d-LEU
  - CodE

**Display Update Time**

- dSP·t
- 0.5 1 2 seconds

This parameter sets the display update time in seconds.

**Front Panel Display Select Enable (SEL)**

- SEL
- YES

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

**Front Panel Reset Enable (RST)**

- rSt
- NO
- LD
- dSP

This selection allows the RST button to reset the selected value(s).

**Zero Display with Display Reset**

- 2ErD
- YES

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
- 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 Indicator Selection**

- UN L5
- OFF
- 1St
- 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

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

**Display Intensity Level (Backlight Unit Only)**

- d-LEU
- 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 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 allows 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).

**Programming Security Code Chart**

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN <em>SEL</em> BUTTON IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>not P-Loc</td>
<td></td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at CodE prompt *</td>
</tr>
<tr>
<td>100-999</td>
<td></td>
<td>0</td>
<td>Programming Lock</td>
<td>No Access</td>
</tr>
<tr>
<td>P-Loc</td>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>No Access</td>
</tr>
<tr>
<td>100-999</td>
<td></td>
<td>100-999</td>
<td>CodE prompt</td>
<td>With correct code entry at CodE prompt *</td>
</tr>
<tr>
<td>Not Active</td>
<td></td>
<td>0-999</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.
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

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

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

Enter the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

- High Acting, with balanced hysteresis
- Low Acting, with balanced hysteresis
- High Acting, with unbalanced hysteresis
- Low Acting, with unbalanced hysteresis

SETPOINT VALUE

Enter the desired setpoint value. The decimal point position for the setpoint and hysteresis values follow the selection set in Module 1.

HYSTERESIS VALUE

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

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

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

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.)

\[ \text{L-dLY} \]

= 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.)

### Output Reset with Display Reset

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

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-S\textsuperscript{ER})

The Serial Setup Parameters are only active when the optional RS232 or RS485 serial communications module is installed in the meter. Refer to the CUB5COM bulletin for complete details on CUB5 serial communications.

### Limited Warranty

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products. The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Press and hold SEL button to enter Programming Mode.

CUB5I PROGRAMMING QUICK OVERVIEW

1. IMP
   - rANGE: Input Range
   - dECPl: 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

2. SEC
   - H1·En: Max Display Enable
   - H1·t: Max Capture Delay Time
   - LO·En: Min Display Enable
   - LO·t: Min Capture Delay Time
   - FCS: Factory Service Operations
   - CadE: Access Code for Service Operations

3. dSP
   - dSP·t: Display Update Time
   - SEL: Front Panel Select Enable
   - rSt: Front Reset Enable
   - ZERo: Zero Display W/Display Reset
   - Scrol: Display Scroll Enable
   - UNItS: Units Indicator Selection
   - COLOr: Display Color
   - d-LEV: Display Intensity Level
   - CadE: Programming Security Code

4. sPE
   - SPsEl: Setpoint Select
   - Acb·n: Setpoint Action
   - SP·n: Setpoint Value
   - HYS·n: Hysteresis Value
   - LON·n: On Time Delay
   - LDF·n: Off Time Delay
   - rSL·n: Output Reset Action
   - rEN·n: Output Reset W/Display Reset
   - Sbb·n: Standby Operation
   - Cnc·n: Change Display Color with Output State

5. SEr
   - bAUD: Baud Rate
   - dATa: Data Bit
   - PArty: Parity Bit
   - ADDR: Meter Address
   - ABbr: Abbreviated Printing
   - OPt: Print Options
MODEL CUB5TC - MINIATURE ELECTRONIC 5-DIGIT THERMOCOUPLE METER

- 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 MODULES
- OPTIONAL SERIAL COMMUNICATION MODULES (RS232 or RS485)
- 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 CUB5TC accepts a thermocouple input and provides a temperature display in Celsius or Fahrenheit. 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 modules. Setpoint capability is field installable with the addition of the setpoint output modules. Serial communications capability for RS232 or RS485 is added with a serial option module.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5. The MLPS1 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.

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.

Bulletin No. CUB5TC-B
Drawing No. LP0643
Released 3/07

Tel +1 (717) 767-6511
Fax +1 (717) 764-0839
www.redlion.net

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

CAUTION: Risk of electric shock.
**GENERAL METER SPECIFICATIONS**

1. **DISPLAY**: 5 digit LCD 0.48" (12.2 mm) high digits  
   **CUBSTCR0**: Reflective LCD with full viewing angle  
   **CUBSTCB0**: 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 MLPS1 or a NEC Class 2 or SELV rated power supply.

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 comm cards.  
   **Response Time**: 500 msec.  
   **Open Sensor Display**: "OPEN"  
   **Overrange/Underrange Input**: "ULUL"  
   **Response Time**: 5 msec typ.; 50 msec debounce (activation and release)  
   **External Input**: VDC max. with respect to common

<table>
<thead>
<tr>
<th>TC TYPE</th>
<th>RANGE</th>
<th>ACCURACY @ 23°C</th>
<th>ACCURACY @ -35 to 75°C</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>s/°C</td>
<td>s/°C</td>
<td>ANSI BS</td>
</tr>
<tr>
<td>T</td>
<td>-200 to 400°F</td>
<td>2.3</td>
<td>5.8</td>
<td>blue (+)</td>
</tr>
<tr>
<td>E</td>
<td>-200 to 871°F</td>
<td>2.7</td>
<td>4.9</td>
<td>purple (+)</td>
</tr>
<tr>
<td>J</td>
<td>-200 to 760°F</td>
<td>1.9</td>
<td>4.3</td>
<td>yellow (+)</td>
</tr>
<tr>
<td>K</td>
<td>-200 to 1372°F</td>
<td>2.3</td>
<td>5.8</td>
<td>white (+)</td>
</tr>
<tr>
<td>R</td>
<td>-50 to 1768°F</td>
<td>4.5</td>
<td>15.0</td>
<td>standard</td>
</tr>
<tr>
<td>S</td>
<td>-50 to 1768°F</td>
<td>4.5</td>
<td>15.0</td>
<td>standard</td>
</tr>
<tr>
<td>B</td>
<td>200 to 1820°F</td>
<td>9.1-540°C</td>
<td>8.1-540°C</td>
<td>standard</td>
</tr>
<tr>
<td>N</td>
<td>-200 to 1300°F</td>
<td>2.8</td>
<td>8.1</td>
<td>orange (+)</td>
</tr>
<tr>
<td>mV</td>
<td>-10.0 to 65.00</td>
<td>0.02 mV</td>
<td>0.08 mV</td>
<td>standard</td>
</tr>
</tbody>
</table>

   *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. **USER INPUT (USR)**: Programmable input. Connect terminal to common (USR COMM) to activate function. Internal 10KΩ pull-up resistance to +9 to 28 VDC.

6. **CERTIFICATIONS AND COMPLIANCES**:  
   **SAFETY**:  
   UL Recognized Component, File #E179259, UL61010A-1, CSA 1122.2 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 Indoor Enclosure rating (Face only), UL50  
   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.

   **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  
   Electromagnetic RF fields EN 61000-4-3 Criterion A  
   Fast transients (burst) EN 61000-4-4 Criterion A  
   Surge EN 61000-4-5 Criterion A  
   RF conducted interference EN 61000-4-6 Criterion A  
   Power frequency magnetic fields EN 61000-4-8 Criterion A

   **Emissions**:  
   Emissions EN 55011 Class A

   **Note**:  
      Refer to EMC Installation Guidelines for additional information.

6. **MEMORY**: Nonvolatile EROM memory retains all programming parameters and max/min values when power is removed.

*Crismor 2 software is a free download from http://www.redlion.net/
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 CUB5TCR0: -35 to 75°C
   Operating Temperature Range for CUB5TCB0 depends on display color and intensity level as per below:

<table>
<thead>
<tr>
<th>INTENSITY LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Display</td>
<td></td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 70°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 60°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 50°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 50°C</td>
</tr>
<tr>
<td>Green Display</td>
<td></td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 65°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 50°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 35°C</td>
</tr>
</tbody>
</table>

Storage Temperature: -35 to 85°C
Operating and Storage Humidity: 0 to 85% max. relative humidity (non-condensing)
Altitude: Up to 2000 meters

10. CONSTRUCTION: This unit is rated for NEMA 4X/IP65 requirements for indoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.

11. 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
- **Response Time:**
  - Turn On Time: 4 msec max.
  - Turn Off Time: 4 msec max.

**DUAL SINKING OUTPUT CARD**

- **Type:** Non-isolated switched DC, N Channel open drain MOSFET
- **Current Rating:** 100 mA max.
- **VDS ON:** 0.7 V @ 100 mA
- **VDS 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

---

### 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.

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), 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.
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**

3.5 SERIAL COMMUNICATION WIRING

**SERIAL COMMUNICATIONS PLUG-IN CARD**

**RJ11 CONNECTOR PIN OUTS**

RS485

RS232
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

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 Pr 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.

Indicates Program Mode Alternating Display

Parameter | Selection/Value
--- | ---
Factory Settings are shown.
5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (1-1MP)

**PARAMETER MENU**

**THERMOCOUPLE TYPE**

<table>
<thead>
<tr>
<th>Type</th>
<th>TC Type</th>
<th>Selection</th>
<th>Type</th>
<th>TC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>tc-t</td>
<td>T</td>
<td>tc-t</td>
<td>tc-t</td>
<td>S</td>
</tr>
<tr>
<td>tc-e</td>
<td>E</td>
<td>tc-e</td>
<td>tc-e</td>
<td>B</td>
</tr>
<tr>
<td>tc-j</td>
<td>J</td>
<td>tc-j</td>
<td>tc-j</td>
<td>N</td>
</tr>
<tr>
<td>tc-k</td>
<td>K</td>
<td>volt</td>
<td>tc-k</td>
<td>R</td>
</tr>
</tbody>
</table>

Select the thermocouple type used for the application. The appropriate curve will be automatically loaded for the selected type.

Selecting VOLt displays the millivolt input signal with 10 µV resolution.

**COLD JUNCTION COMPENSATION**

<table>
<thead>
<tr>
<th>CJC</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

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 = VOLt.

**TEMPERATURE SCALE**

<table>
<thead>
<tr>
<th>SCALE</th>
<th>F</th>
<th>C</th>
</tr>
</thead>
</table>

Select the temperature scale. This selection applies for the Input, MAX and MIN displays. This parameter does not appear if TYPE = VOLt.

**DISPLAY DECIMAL POINT**

| dECPl | 0 | 00 |

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 = VOLt or for types R, S or B thermocouples which have a fixed 1 degree resolution.

**DISPLAY OFFSET VALUE**

| OFSel | -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**

| Filter | 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 | 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 | AG |

**DESCRIPTION**

<table>
<thead>
<tr>
<th>Display Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>No Function</td>
</tr>
<tr>
<td>P-Loc</td>
<td>Program Mode Lock-out</td>
</tr>
<tr>
<td>rESEt</td>
<td>Reset (Edge triggered)</td>
</tr>
<tr>
<td>d-Hld</td>
<td>Display Hold</td>
</tr>
<tr>
<td>d-SEL</td>
<td>Display Select (Edge Triggered)</td>
</tr>
<tr>
<td>d-LEU</td>
<td>Display Intensity Level (Edge Triggered)</td>
</tr>
<tr>
<td>COLOr</td>
<td>Backlight Color (Edge Triggered)</td>
</tr>
<tr>
<td>Pr  amt</td>
<td>Print Request</td>
</tr>
<tr>
<td>P-Sn-1</td>
<td>Print and Reset</td>
</tr>
<tr>
<td>rSt - 1</td>
<td>Setpoint 1 Reset</td>
</tr>
<tr>
<td>rSt - 2</td>
<td>Setpoint 2 Reset</td>
</tr>
<tr>
<td>rSt - 12</td>
<td>Setpoint 1 and 2 Reset</td>
</tr>
</tbody>
</table>

**USER INPUT ASSIGNMENT**

<table>
<thead>
<tr>
<th>U-RSA</th>
<th>HI</th>
<th>H-LO</th>
</tr>
</thead>
</table>

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.
5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

MAX DISPLAY ENABLE

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>01</td>
<td>YES</td>
</tr>
</tbody>
</table>

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>20</td>
<td>YES</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>01</td>
<td>YES</td>
</tr>
</tbody>
</table>

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>20</td>
<td>YES</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>01</td>
<td>YES</td>
</tr>
</tbody>
</table>

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

RESTORE FACTORY DEFAULT SETTINGS

<table>
<thead>
<tr>
<th>Code</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>NO</td>
</tr>
<tr>
<td>66</td>
<td>YES</td>
</tr>
</tbody>
</table>

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display 0.00E+00 and then return to 0.00E+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 0.00E+00. This allows operation in the event of a memory failure or corrupted data.

CALIBRATION

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 0.00E+00, press and hold the SEL button for 2 seconds. Unit will display 0.00E+00.
3. Press the RST button to select 0.00E+00.
4. Press the SEL button. Display reads 0.00E+00.
5. With the voltage source set to zero, press SEL. Display reads 0.00E+00 for about eight seconds.
6. When display reads 0.00E+00, apply 60.000 mV input signal. Press SEL. Display reads 0.00E+00 for about eight seconds.
7. When display reads 0.00E+00, 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:
   -CODE = thermocouple type connected to the unit
   - SCALE = t
   - OFFSET = 0
   - SFSEL = 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.
7. Enter a precision DC voltage source with an accuracy of 0.01% or better to the meter.
8. Press SEL. Display reads 0.00E+00 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 0.00E+00 for about four seconds and then returns to 0.00E+00.
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**

- **3-dSP**
- **SEL**
- **dSP-1**
- **dSP**
- **dSP**
- **Scrol**
- **Color**
- **d-LEU**
- **CodE**

**DISPLAY UPDATE TIME**

![Symbol]

This parameter sets the display update time in seconds.

**FRONT PANEL DISPLAY SELECT ENABLE (SEL)**

![Symbol] **YES** **NO**

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

**FRONT PANEL RESET ENABLE (RST)**

![Symbol] **NO** **LO** **HI** **HI-LO**

This selection allows the **RST** button to reset the selected value(s).

**DISPLAY SCROLL ENABLE**

![Symbol] **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)**

![Symbol] **rEd** **grn**

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

**DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)**

![Symbol] **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**

![Symbol] **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

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN &quot;SEL&quot; BUTTON IS Pressed</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>not P-Loc</td>
<td></td>
<td></td>
<td>0</td>
<td>Full Programming Immediate Access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at <strong>CodE</strong> prompt *</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-999</td>
<td><strong>CodE</strong> prompt</td>
<td>With correct code entry at <strong>CodE</strong> prompt *</td>
</tr>
<tr>
<td>P-Loc</td>
<td>Active</td>
<td>0</td>
<td>Programming Lock</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-999</td>
<td><strong>CodE</strong> prompt</td>
<td>With correct code entry at <strong>CodE</strong> prompt *</td>
</tr>
<tr>
<td></td>
<td>Not Active</td>
<td>0-999</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.
The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

**SETPOINT SELECT**

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**

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**

Select the action for the selected setpoint (output). See Setpoint Output Figures for a visual detail of each action.

- **HI-Bl**: High Acting, with balanced hysterisis
- **LO-Bl**: Low Acting, with balanced hysterisis
- **HI-Ub**: High Acting, with unbalanced hysterisis
- **LO-Ub**: Low Acting, with unbalanced hysterisis

**HYSTERESIS VALUE**

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.

**ON TIME DELAY**

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**

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**

Select 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.
- **Letch**: 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.)

Latch (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.)

### OUTPUT RESET WITH DISPLAY RESET

#### 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

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

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

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 (S-5Er)

The Serial Setup Parameters are only active when the optional RS232 or RS485 serial communications module is installed in the meter. Refer to the CUB5COM bulletin for complete details on CUB5 serial communications.

### LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at the Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products. The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Press and hold SEL button to enter Programming Mode.
MODEL CUB5V - MINIATURE ELECTRONIC 5-DIGIT DC VOLTMETER

- 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 MODULES
- OPTIONAL SERIAL COMMUNICATIONS MODULES (RS232 or RS485)
- 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 modules. Setpoint capability is field installable with the addition of the setpoint output modules. Serial communications capability for RS232 or RS485 is added with a serial option module.

The CUB5 can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5. The MLPS1 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.

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

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUBS</td>
<td>CUB5V</td>
<td>DC Volt Meter with reflective display</td>
<td>CUB5VR00</td>
</tr>
<tr>
<td></td>
<td>CUB5B00</td>
<td>DC Volt Meter with backlight display</td>
<td>CUB5VB00</td>
</tr>
<tr>
<td>Optional Plug-in Cards</td>
<td>CUB5RLY</td>
<td>Single Relay Output Card</td>
<td>CUB5RLY0</td>
</tr>
<tr>
<td></td>
<td>CUB5SNK</td>
<td>Dual Sinking Open Collector Output Card</td>
<td>CUB5SNK0</td>
</tr>
<tr>
<td></td>
<td>CUB5COM</td>
<td>RS485 Serial Communications Card</td>
<td>CUB5COM1</td>
</tr>
<tr>
<td></td>
<td>CUB5COM2</td>
<td>RS232 Serial Communications Card</td>
<td>CUB5COM2</td>
</tr>
<tr>
<td>Accessories</td>
<td>MLPS1</td>
<td>Micro-Line Power Supply, 85 to 250 VAC</td>
<td>MLPS1000</td>
</tr>
<tr>
<td></td>
<td>CBPRO</td>
<td>RS232 Programming Cable (DB9-RJ11)</td>
<td>CBPRO007</td>
</tr>
</tbody>
</table>

* Crimson 2 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.

3. INPUT RANGES: Jumper Selectable
   D.C. Voltages: 200 mV, 2 V, 20 V, 200 V

4. SIGNAL INPUTS:

<table>
<thead>
<tr>
<th>INPUT RANGE</th>
<th>ACCURACY @25°C, less than 85% RH</th>
<th>INPUT IMPEDANCE</th>
<th>MAX INPUT SIGNAL</th>
<th>RESOLUTION</th>
<th>TEMP. COEFFICIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mVDC</td>
<td>0.1% of span</td>
<td>1.027 MΩ</td>
<td>75 VDC</td>
<td>10 μV</td>
<td>70 ppm / °C</td>
</tr>
<tr>
<td>2 VDC</td>
<td>0.1% of span</td>
<td>1.027 MΩ</td>
<td>75 VDC</td>
<td>.1 mV</td>
<td>70 ppm / °C</td>
</tr>
<tr>
<td>20 VDC</td>
<td>0.1% of span</td>
<td>1.027 MΩ</td>
<td>250 VDC</td>
<td>1 mV</td>
<td>70 ppm / °C</td>
</tr>
<tr>
<td>200 VDC</td>
<td>0.1% of span</td>
<td>1.027 MΩ</td>
<td>250 VDC</td>
<td>10 mV</td>
<td>70 ppm / °C</td>
</tr>
</tbody>
</table>

5. OVERRANGE RATINGS, PROTECTION & INDICATION:
   9 to 28 VDC power circuit is not isolated from the signal circuit.
   Input Overrange Indication: “UL”.
   Input Underrange Indication: “L”.
   Display Overrange/Underrange Indication: “..” / “...”

6. DISPLAY RESPONSE TIME: 500 msec min.

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: \( V_{IL} = 1.0 \text{ V max} \), \( V_{IH} = 2.4 \text{ V min} \), \( V_{MAX} = 28 \text{ VDC} \)
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)

9. CONNECTIONS: Wire clamping screw terminals
   Wire Gage: 30-14 AWG copper wire
   Torque: 5 inch-lbs (0.565 N-m) max.

10. MEMORY: Nonvolatile E’PROM memory retains all programming parameters and min/max values when power is removed.

11. CONSTRUCTION: This unit is rated for NEMA 4X/IP65 requirements for indoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.

12. 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:

<table>
<thead>
<tr>
<th>INTENSITY LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Display</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Green Display</td>
<td>1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

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: 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, 11 msec in 3 directions.
Altitude: Up to 2000 meters

13. CERTIFICATIONS AND COMPLIANCE:
   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 Indoor Enclosure rating (Face only), UL50
   IEEE CB Scheme Test Certificate #US/9257C/UL
   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:
   EN 55011 Class A
   Notes:

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  
**Response Time:**  
  - Turn On Time: 4 msec max.  
  - Turn Off Time: 4 msec max.

### 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

---

### 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.
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 grounded. 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).

2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The noise source frequency is above 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 in a metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are in use 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.

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.

8. Ferrite Suppression Cores for signal and control cables:
   - Fair-Rite # 0443167251 (RLC# FCOR0000)
   - TDK # ZCAT3035-1330A
   - Steward # 28B2029-0A0
   - Corcom # 1 VR3

   Note: Reference manufacturer’s instructions when installing a line filter.

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).

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 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).

4.0 WIRING THE METER
### 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.

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

### 4.4 SETPOINT (OUTPUT) WIRING

- **SINGLE SETPOINT RELAY PLUG-IN CARD**

- **DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD**

### 4.5 SERIAL COMMUNICATION WIRING

- **SERIAL COMMUNICATIONS PLUG-IN CARD**

- **RJ11 CONNECTOR PIN OUTS**
5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

It is recommended all programming changes be made offline 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/values 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 lockout 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.

### 6.0 PROGRAMMING THE METER

#### OVERVIEW

PROGRAMMING MENU

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Selection/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>USr</td>
<td>NO</td>
</tr>
<tr>
<td>Factory Settings are shown.</td>
<td></td>
</tr>
</tbody>
</table>
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**

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**

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**

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**

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**

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**

For Key-in (KEY) style, 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.

**INPUT VALUE FOR SCALING POINT 2**

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 1**

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.

**DISPLAY VALUE FOR SCALING POINT 2**

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) 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 (\( \text{DSP}1 / \text{INP}1 \) & \( \text{DSP}2 / \text{INP}2 \)).
USER INPUT FUNCTION

DISPLAY MODE
- No Function
- Program Mode Lockout
- Zero Input (Edge triggered)
- Reset (Edge triggered)
- Display Hold
- Display Select (Edge triggered)
- Display Intensity Level (Edge triggered)
- Backlight Color (Edge triggered)

DESCRIPTION
- User Input disabled.
- See Programming Mode Access chart (Module 3).
- Zero the Input Display value causing Display Reading to be Offset.
- Resets the assigned value(s) to the current input value.
- Holds the assigned display, but all other meter functions continue as long as activated (maintained action).
- Advance once for each activation.
- Increase intensity one level for each activation (backlight version only).
- Change backlight color with each activation (backlight version only).

USER INPUT ASSIGNMENT

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)

MAX DISPLAY ENABLE
- NO
- YES

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

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
- NO
- YES

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

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

- NO
- YES

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

DISPLAY MODE
- Pr
- rSt

DESCRIPTION
- Serial transmit of the active parameters selected in the Print Options menu (Module 5).
- Same as Print Request followed by a momentary reset of the assigned value(s).
- Resets setpoint 1 output.
- Resets setpoint 2 output.
- Reset both setpoint 1 and 2 outputs.

FACTORY SERVICE OPERATIONS

- rSt-1
- rSt-2
- HI-LO

RESTORE FACTORY DEFAULT SETTINGS

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

VIEW VERSION DISPLAY

Entering Code 55 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

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 rStE and then return to CodE 00. Press the SEL button to exit the module.
3. Press the rSt button to select the range to be calibrated.
5. With the voltage source set to zero (or a dead short applied to the input), press SEL. Display reads rStL 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 rStL for about 8 seconds.
7. Repeat steps 3 through 6 for each input range to be calibrated. When display reads rStL, press the SEL button to exit calibration.
6.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)

**PARAMETER MENU**

- **dSP-t**
  - Display Update Time
  - Front Panel Display Select Enable
  - Front Panel Select Enable
  - Zero Display Reset
  - Display Scroll Enable
  - Units Indicator Selection
  - Display Color
  - Display Intensity Level
  - Programming Security Code

**DISPLAY UPDATE TIME**

- **dSP-t**
  - 0-512 seconds

This parameter sets the display update time in seconds.

**FRONT PANEL DISPLAY SELECT ENABLE (SEL)**

- **SEL**
  - YES

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

**FRONT PANEL RESET ENABLE (RST)**

- **rST**
  - NO
  - LO
  - dSP
  - HI
  - HI-LO

This selection allows the RST button to reset the selected value(s).

**ZERO DISPLAY WITH DISPLAY RESET**

- **Zero D**
  - YES

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**
  - 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 INDICATOR SELECTION**

- **UN IES**
  - OFF
  - 15k
  - 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 programmed into the meter. Segments allows the user to choose which of the segments should light.

**DISPLAY COLOR (BACKLIGHT UNIT ONLY)**

- **Color**
  - rEd
  - bRn

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

**DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)**

- **d-LEU**
  - 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 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).

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN “SEL” BUTTON IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>not P-Loc</strong></td>
<td>____</td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at CodE prompt *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>CodE prompt</td>
<td>With correct code entry at CodE prompt *</td>
<td></td>
</tr>
<tr>
<td><strong>P-Loc</strong></td>
<td>Active</td>
<td>0</td>
<td>Programming Lock</td>
<td>No Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming</td>
<td>No Access</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>CodE prompt</td>
<td>With correct code entry at CodE prompt *</td>
<td></td>
</tr>
<tr>
<td>Not Active</td>
<td>0-999</td>
<td>Full Programming</td>
<td>Immediate Access</td>
<td></td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.
The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

**SETPOINT SELECT**

Select the setpoint (output) to be programmed. The number of setpoints available is setpoint output card dependent.

**SETPOINT 2 ENABLE**

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**

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

**HYSTERESIS VALUE**

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.

**ON TIME DELAY**

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**

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**

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.
Limited Warranty

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products. The Company agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter. No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

Serial Setup Parameters

The Serial Setup Parameters are only active when the optional RS232 or RS485 serial communications module is installed in the meter. Refer to the CUB5COM bulletin for complete details on CUB5 serial communications.
Press and hold SEL button to enter Programming Mode.
MODEL CUB5RT - MINIATURE ELECTRONIC 5-DIGIT RTD METER

- MINIMUM AND MAXIMUM DISPLAY CAPTURE
- LCD, REFLECTIVE OR GREEN/RED LED BACKLIGHTING
- 0.48" (12.2 mm) HIGH DIGITS
- OPTIONAL SETPOINT OUTPUT MODULES
- OPTIONAL SERIAL COMMUNICATION MODULES (RS232 or RS485)
- 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 CUB5RT accepts an RTD input and provides a temperature display in Celsius or Fahrenheit. 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 modules. Setpoint capability is field installable with the addition of the setpoint output modules. Serial communications capability for RS232 or RS485 is added with a serial option module.

The CUB5 can be powered from an optional Red Lion® Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5. The MLPS1 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 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.
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 MLPS1 or a NEC Class 2 or SELV rated power supply.

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.
   Response Time: 500 msec.
   Failed Sensor Display: OPER or Short
   Overrange/Underrange Input: ULUL/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.

5. 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: VIH = 1.0 V max; VIL = 2.4 V min; VMAX = 28 VDC
   Response Time: 5 msec typ.; 50 msec debounce (activation and release)

6. CERTIFICATIONS AND COMPLIANCES:
   SAFETY
   UL Recognized Component, File #E179259, UL61010A-1, CSA C22.2 No. 6101-0
   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
   CB Scheme Test Certificate #US/9257C/UL
   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

   Note:
   7. MEMORY: Nonvolatile E/PROM memory retains all programming parameters and max/min 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.

*Crimson 2 software is a free download from http://www.redlion.net/

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DISPLAY COLOR</th>
<th>INPUT CURRENT @ 9 VDC WITHOUT CUBSRLY0</th>
<th>INPUT CURRENT @ 9 VDC WITH CUBSRLY0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUB5RTR0</td>
<td>---</td>
<td>10 mA</td>
<td>40 mA</td>
</tr>
<tr>
<td>CUB5RTB0</td>
<td>Red (max intensity)</td>
<td>85 mA</td>
<td>115 mA</td>
</tr>
<tr>
<td>CUB5RTB0</td>
<td>Green (max intensity)</td>
<td>95 mA</td>
<td>125 mA</td>
</tr>
</tbody>
</table>

*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.
9. 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:

<table>
<thead>
<tr>
<th>INTENSITY LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Display</td>
<td></td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 70°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 60°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 50°C</td>
</tr>
<tr>
<td>Green Display</td>
<td></td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>-35 to 75°C</td>
</tr>
<tr>
<td>3</td>
<td>-35 to 65°C</td>
</tr>
<tr>
<td>4</td>
<td>-35 to 50°C</td>
</tr>
<tr>
<td>5</td>
<td>-35 to 35°C</td>
</tr>
</tbody>
</table>

   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, 5g's.
   Shock According to IEC 68-2-27: Operational 30 g, 11 msec in 3 directions.
   Altitude: Up to 2000 meters

10. CONSTRUCTION: This unit is rated for NEMA 4X/IP65 requirements for indoor use. Installation Category I, Pollution Degree 2. High impact plastic case with clear viewing window. Panel gasket and mounting clip included.

11. 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
Response Time:
   Turn On Time: 4 msec max.
   Turn Off Time: 4 msec max.

**DUAL SINKING OUTPUT CARD**

Type: Non-isolated switched DC, N Channel open drain MOSFET
Current Rating: 100 mA max.
V_{DS O N}: 0.7 V @ 100 mA
V_{DS MAX}: 30 VDC
Offset 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

---

**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.

---

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 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.
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.

Note: Reference manufacturer’s instructions when installing a line filter.
3.1 POWER WIRING

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

3.2 USER INPUT WIRING

Sinking Logic
USR COMM
USR 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

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.

3.4 SETPOINT (OUTPUT) WIRING

SINGLE SETPOINT RELAY PLUG-IN CARD

DUAL SETPOINT N-FET OPEN DRAIN PLUG-IN CARD

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

RS485
RS232
**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 Pr 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 Pr and NO. Programming may continue by accessing additional modules.

**SELECTION / VALUE ENTRY**

For each parameter, the display alternates between the present parameter and the selections/values 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 Pr 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.
5.1 MODULE 1 - SIGNAL INPUT PARAMETERS (I-IMP)

PARAMETER MENU

RTD TYPE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SELECTION</th>
<th>RANGE JUMPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt385</td>
<td>RTD Platinum 385</td>
<td>100 ohm</td>
</tr>
<tr>
<td>Pt392</td>
<td>RTD Platinum 392</td>
<td>100 ohm</td>
</tr>
<tr>
<td>Ni672</td>
<td>RTD Nickel 672</td>
<td>100 ohm</td>
</tr>
<tr>
<td>Cu427</td>
<td>RTD Copper 10 Ω</td>
<td>10 ohm</td>
</tr>
</tbody>
</table>

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

Select the temperature scale. This selection applies for the Input, MAX and MIN displays.

DISPLAY DECIMAL POINT

Select the decimal point location for the desired display resolution. This selection applies for the Input, MAX and MIN displays.

DISPLAY OFFSET VALUE

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

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

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

DISPLAY MODE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>USER INPUT FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Function</td>
<td>No</td>
</tr>
<tr>
<td>P-Loc</td>
<td>Program Mode Lock-out</td>
</tr>
<tr>
<td>r-ESet</td>
<td>Reset (Edge triggered)</td>
</tr>
<tr>
<td>d-Mld</td>
<td>Display Hold</td>
</tr>
<tr>
<td>d-Sel</td>
<td>Display Select (Edge Triggered)</td>
</tr>
<tr>
<td>d-Lev</td>
<td>Display Intensity Level (Edge Triggered)</td>
</tr>
<tr>
<td>Colr</td>
<td>Backlight Color (Edge Triggered)</td>
</tr>
<tr>
<td>Pr-Req</td>
<td>Print Request</td>
</tr>
<tr>
<td>Pr-Sk · 1</td>
<td>Print and Reset</td>
</tr>
<tr>
<td>r-Sk · 1 · 2</td>
<td>Setpoint 1 Reset</td>
</tr>
<tr>
<td>r-Sk · 1 · 2</td>
<td>Setpoint 2 Reset</td>
</tr>
<tr>
<td>r-Sk · 1 and 2 · 2</td>
<td>Setpoint 1 and 2 Reset</td>
</tr>
</tbody>
</table>

USER INPUT ASSIGNMENT

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.
5.2 MODULE 2 - SECONDARY FUNCTION PARAMETERS (2-SEC)

PARAMETER MENU

MAX DISPLAY ENABLE

<table>
<thead>
<tr>
<th>HI-En</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Enables the Maximum Display Capture capability.

MAX CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>HI-t</th>
<th>00 to 9999 sec.</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>LO-En</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Enables the Minimum Display Capture capability.

MIN CAPTURE DELAY TIME

<table>
<thead>
<tr>
<th>LO-t</th>
<th>00 to 9999 sec.</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th>FCS</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Select Yes to perform any of the Factory Service Operations shown below.

CALIBRATION

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 0.0.0.
3. Press the RST button. Display reads 0.0.0.
4. Press the SEL button. Display reads 0.0.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads 15.0r 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 00r for about 15 seconds.
7. When display reads 00r, press the SEL button to exit calibration, or proceed to the 100 ohm RTD Range Calibration.

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 0.0.0.
3. Press the RST button until the display reads 0.0.0.
4. Press the SEL button. Display reads 0.0.
5. Apply a direct short to terminals INP+, EXC, and COMM using a three wire link. Press SEL. Display reads 300.0r 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 00r for about 15 seconds.
7. When display reads 00r, press the SEL button to exit calibration.

RESTORE FACTORY DEFAULT SETTINGS

Entering Code 66 will overwrite all user settings with the factory settings. The meter will display CodE 48 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 CodE 48. This allows operation in the event of a memory failure or corrupted data.

RESISTANCE DISPLAY MODE

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 ohms. For all other RTD types, with the jumper in the 100 ohm position, the display will read resistance in ohms.

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.
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).

**PARAMETER MENU**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full Programming Mode Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>000-999</td>
<td>CodE prompt *</td>
</tr>
<tr>
<td>100-999</td>
<td>With correct code entry at CodE prompt *</td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.

**5.3 MODULE 3 - DISPLAY AND FRONT PANEL BUTTON PARAMETERS (3-dSP)**

**DISPLAY UPDATE TIME**

![dSP-t]  
This parameter sets the display update time in seconds.

**FRONT PANEL DISPLAY SELECT ENABLE (SEL)**

![SEL]  
The YES selection allows the SEL button to toggle through the enabled displays.

**FRONT PANEL RESET ENABLE (RST)**

![rSt]  
This selection allows the RST button to reset the selected value(s).

**DISPLAY SCROLL ENABLE**

![Scrol]  
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)**

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

**DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)**

![d-LEU]  
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 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).
The Setpoint Output Parameters are only active when an optional output module is installed in the meter.

**SETPOINT SELECT**

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 ACTION**

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

**HYSTERESIS VALUE**

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.

**ON TIME DELAY**

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**

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**

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.

Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.
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.)

Latch = 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 latch reset if it is not activated at power up.)

**OUTPUT RESET WITH DISPLAY RESET**

![Diagram showing Setpoint Output Reset Actions]

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**

<table>
<thead>
<tr>
<th>Off</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑</td>
<td></td>
</tr>
</tbody>
</table>

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**

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**

![Diagram showing Change Display Color with Output State]

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 (S-SEr)

The Serial Setup Parameters are only active when the optional RS232 or RS485 serial communications module is installed in the meter. Refer to the CUB5COM bulletin for complete details on CUB5 serial communications.

**LIMITED WARRANTY**

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products. The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
Press and hold SEL button to enter Programming Mode.
# IMPORTANT PRODUCT OBSOLESCENCE NOTICE

The time has come to discontinue a few of our older products due to part availability. The recommended alternative product will offer the customer a better solution than the existing product. Certain products have no listed replacements due to technological advancements. The actual discontinuation date is controlled by raw material inventories and future sales. If you have a customer using any of these products, please contact and advise them of the situation. As always, Red Lion will assist the customer as much as possible in the changeover process.

<table>
<thead>
<tr>
<th>DISCONTINUED PART/MODEL NUMBERS</th>
<th>DESCRIPTION</th>
<th>STATUS</th>
<th>ALTERNATIVE PRODUCT OFFERINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFCx0000</td>
<td>Current to Frequency Converter</td>
<td>Discontinued as parts are depleted.</td>
<td>None</td>
</tr>
<tr>
<td>CL1000x0</td>
<td>2 x 20 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>CL2000x0</td>
</tr>
<tr>
<td>CUBID001</td>
<td>CUB2 DC Current Meter, 5 VDC</td>
<td>Discontinued as parts are depleted.</td>
<td>None</td>
</tr>
<tr>
<td>CUBID002</td>
<td>CUB2 DC Current Meter, 7 to 28 VDC</td>
<td>Discontinued as parts are depleted.</td>
<td>CUB40000</td>
</tr>
<tr>
<td>CUBVD001</td>
<td>CUB2 DC Volt Meter, 5 VDC</td>
<td>Discontinued as parts are depleted.</td>
<td>None</td>
</tr>
<tr>
<td>CUBVD002</td>
<td>CUB2 DC Volt Meter, 7 to 28 VDC</td>
<td>Discontinued as parts are depleted.</td>
<td>CUB4V0000</td>
</tr>
<tr>
<td>CX1000x0</td>
<td>2 x 20 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G305x000</td>
</tr>
<tr>
<td>CX1500x0</td>
<td>2 x 40 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G305x000</td>
</tr>
<tr>
<td>GL3000x0</td>
<td>256 x 128 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G306C000</td>
</tr>
<tr>
<td>GL300T0x0</td>
<td>256 x 128 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G306C000</td>
</tr>
<tr>
<td>LPP10000</td>
<td>Loop Powered Process Meter</td>
<td>Discontinued as parts are depleted.</td>
<td>CUB4LP000</td>
</tr>
<tr>
<td>VFCx0000</td>
<td>Voltage to Frequency Converter</td>
<td>Discontinued as parts are depleted.</td>
<td>None</td>
</tr>
<tr>
<td>VX500S00</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G308C000</td>
</tr>
<tr>
<td>VX500TS0</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G308C000</td>
</tr>
<tr>
<td>VX550S00</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>G308C000</td>
</tr>
</tbody>
</table>
MODEL CUBVD - MINIATURE D.C. VOLTMETER & MODEL CUBID - MINIATURE D.C. CURRENT METER

- 4 SELECTABLE D.C. RANGES
  - 0 to 199.9 mV, 1.999 V, 19.99 V, 199.9 V (CUBVD)
  - 0 to 199.9 µA, 1.999 mA, 19.99 mA, 199.9 mA (CUBID)
- 3½-DIGIT, 0.35" (9 mm) LCD DISPLAY
- +5 VDC & 7 to 28 VDC POWERED VERSIONS
- BUILT-IN SCALING PROVISION
- AUTO ZEROING CIRCUIT
- SELECTABLE DECIMAL POINTS
- SEALED METAL FRONT BEZEL (NEMA 4/IP65)

DESCRIPTION
The Cub Volt and Current Meters are high quality, compact, affordable instruments well suited for the typical industrial environment. Their compact size makes these units a first choice when choosing a product to fit in a crowded control panel.

The attractive, rugged metal bezel not only enhances the appearance of any control panel, but it can also provide a functional protective seal for use in wash-down areas and harsh industrial settings, when properly installed.

Connections to the unit are made via reliable, high integrity, clamp-type terminal blocks. Up to two 18-gage stranded wires can be accommodated per terminal block position.

Both the Volt and Current Meter models are available in two D.C. powered versions; a +5 VDC and a 7 to 28 VDC version.

SPECIFICATIONS
1. DISPLAY: 3½-digit (-1999 to 1999), 0.35" (9 mm) high LCD display. Minus (-) sign is displayed when voltage or current is negative.
2. DECIMAL POINTS: Three DIP switch selectable, decimal points allow the display to be read in tenths, hundredths or thousandths.
3. POWER: Available in +5 VDC (±10%) or 7 to 28 VDC versions @ <4 mA.
4. INPUT RANGES:
   - D.C. VOLTAGE
     - (DIP Switch Selectable)
     - ±199.9 mVDC, ±199.9 mADC
     - ±19.99 VDC, ±19.99 mADC
     - ±199.9 VDC, ±199.9 mADC
   - D.C. CURRENT
     - (JMPR. Selectable)
     - ±199.9 µADC
     - ±19.99 mA, ±19.99 mA
     - ±199.9 mA
5. ACCURACY: (±23°C, less than 85% RH)
   - D.C. Voltage: ±(0.1% + 1 digit)
   - D.C. Current: 199.9 µA, ±0.15% + 1 digit; 199.9 mA range - ±0.15% + 1 digit
6. OVERRANGE RATINGS, PROTECTION & INDICATION:
   - Max Voltage: 0 to 199.9 mVDC range - 75 VDC
   - All other voltage ranges - 300 VDC
   - Max Shunt Currents: (on current meters)
     - 199.9 µA through 19.99 mA - 10 x max. range current
     - 199.9 mA - 1 amp
   - Overrange Indication: Overrange is indicated by a one in the most significant digit and the blanking of the three least significant digits.
7. READING RATE: 2.5 per second
8. RESPONSE TIME: 1.5 seconds to settle for a step change
9. NORMAL MODE REJECTION: 60 dB 50/60 Hz
10. INPUT IMPEDANCE:
    - Voltmeter - 1 MΩ
    - Current Meter - 1 KΩ

11. TEMPERATURE EFFECTS:
    - Operating Range: - 0 to 60° C
    - Storage Temperature: - 40 to 80° C
    - Temperature Coefficient: - 100 PPM/°C
12. CONSTRUCTION: Die cast metal bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for wash-down and dusty environments when properly installed. (Panel gasket and mounting clips included.)
13. WEIGHT: 5.4 oz (153 g)

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUBVD</td>
<td>Cub DC Voltmeter</td>
<td>CUBVD002 CUBVD001</td>
</tr>
<tr>
<td>CUBID</td>
<td>Cub DC Current Meter</td>
<td>CUBID002 CUBID001</td>
</tr>
</tbody>
</table>
CUB D.C. VOLTMETER INPUTS & CONNECTIONS

VOLTMETER SCALING

In many industrial applications, a voltage sensing instrument is required to display a reading in terms of PSI, RPM, or some other variable. The signal voltage being measured is normally generated by a transducer which senses the variable and delivers a linearly proportional output voltage. In order to provide the desired readout at the specified voltage, the voltmeter must be scaled. The Scale switch, when in the “ON” position, inserts the Scale Adj. Pot. into the circuit. The Scale Adj. Pot., in conjunction with the Voltage Range Selection switches provides a means of scaling the unit. The range switches are used to select among 4 coarse Division Factor ranges and the Scale Adj. Pot. is then used to fine scale within the selected range. The chart below shows the division factor range associated with each range selection switch.

DIVISION FACTOR RANGE SELECTION CHART

<table>
<thead>
<tr>
<th>Switch</th>
<th>Range (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0-199.9 mVDC (0.1 ≤ D.F. ≤ 1.2)</td>
</tr>
<tr>
<td>S2</td>
<td>0-19.99 VDC (1.2 ≤ D.F. ≤ 10.5)</td>
</tr>
<tr>
<td>S3</td>
<td>0-199.9 mVDC (10.5 ≤ D.F. ≤ 100.5)</td>
</tr>
<tr>
<td>S4</td>
<td>0-199.99 VDC (100.5 ≤ D.F. ≤ 1300)</td>
</tr>
</tbody>
</table>

Note: The normal decade division factors (÷10, ÷100, ÷1000) have been adjusted to account for the extra loading that occurs when the Scale Adj. pot. is switched into the above circuit (“SCALE” switch is “ON”).

In order to determine the proper range switch set-up for an application requiring scaling, the “Division Factor” that will be required to provide the proper display must first be determined.

USING THE FORMULA:

\[ \text{D.F.} = \frac{\text{VT} \times \text{D.D.P}}{\text{D.R.}} \]

WHERE:

- \( \text{VT} \) = Maximum Transducer Output
- \( \text{D.D.P} \) = Display Decimal Point
- \( \text{D.F.} \) = Division Factor
- \( \text{D.R.} \) = Desired Reading

The simplified schematic (left) shows all the features that permit the Cub Voltmeter to cover most in-plant D.C. voltage related measurements. There are 4 basic voltage ranges that can be selected by the setting of DIP switches S1 - S4.

Note: No more than one Voltage Range switch (S1-S4) is to be on at any time.

The “SCALE” switch (S5) and “SCALING ADJ. POT.”, are used when a non-voltage (other engineering units) readyout is required. The “SCALE” switch should be left in the “OFF” position when the application requires direct voltage displays.

The “CALIBRATION ADJ. POT.” has been set at the factory. This pot should not be adjusted unless the unit is being re-calibrated with an accurate voltage source.

The Power supply common and the measurement common are to be connected together at the “COMM.” position on the terminal block. If the power supply is not floating with respect to the two measurement connections, the measurement common (-) must be at the same voltage potential as the power supply common. In other words, the voltmeter cannot measure a voltage with a reference that is different than the power supply common.

Caution: When in the 0 to 199.9 mVdc range (switch S1 on), the voltage applied to the signal inputs must not exceed 75 V, or the unit may be damaged.

CUB D.C. CURRENT METER INPUTS & CONNECTIONS

The Cub Current Meters have four basic current ranges which cover 0 to 199.9 µADC to 0 to 199.9 mADC. The schematic (left) shows a functional overview of the unit. The desired range is selected by plugging a 2-position female mini-jumper in the proper position on a 6-position male header strip.

The “SCALE” DIP switch (S1) and “SCALING ADJ. POT.” is used when the readout is to be in units other than microamps or milliamperes. The “SCALE” switch should be left in the “OFF” position when direct current displays are required.

When the power supply is floating (unreferenced) to the desired measurement points, the (-) signal input and the power supply common should be connected together. If the power supply is not floating (is referenced), the common mode voltage between the “SIG.IN(-)” and “COMM.” terminal must not be greater than 1.0 V peak. A common mode voltage higher than 1.0 VP will cause display error in the measurement.

The “CALIBRATION ADJ. POT.” has been set at the factory. This pot should not be adjusted unless the unit is being re-calibrated with an accurate current source.

Caution: The Maximum Current for each shunt position must not be exceeded or the unit may be damaged (See Specifications).
CURRENT METER SCALING
The numerical value displayed by the Cub Current Meter can be scaled down to almost any lower numerical value by setting the “SCALE” switch to the “ON” position, and utilizing the “SCALE” adjustment pot along with the current range selection mini-jumper. The “SCALE” pot can be set to divide the normal numeric current reading by any division factor between ÷1 and ÷13. The shunt resistance can be changed by moving the mini-jumper to the desired resistance.

EXAMPLE - The Cub Current Meter has been connected to measure a circuit current to 120.0 mA maximum. However, in this application, the readout is to be in percent of load current, with 120.0 mA being equivalent to 100.0% readout. The scale adj. pot. can be adjusted to reduce the normal 120.0 mA display to the 100.0 display that is desired.

Scaling to obtain a numerical readout higher than the numerical value of the current can also be done in most cases by selecting a lower range. However, the maximum shunt current for the range must not be exceeded. (See “Specifications” for maximum shunt currents.)

DECIMAL POINT SELECTION
The Cub Volt and Current Meters can be set-up to read in 10ths, 100ths, or 1000ths. The decimal points are DIP switch selectable to select one of three decimal point locations. The DIP switches are located behind the rear cover.

TYPICAL VOLT & CURRENT MEASUREMENT APPLICATIONS

VOLTMETER APPLICATION
Measuring the Speed of a D.C. Motor
A foreman in a plant wants to get a more accurate indication of the speed at which a variable speed DC motor drive is operating. The only indication he has had is the position of a dial on the control panel.

The motor has a tach generator that will output a 10 VDC signal when the motor is running at its maximum speed of 1800 RPM. The power supply of the control has a 15 VDC output which can supply power to the Cub. Since this application requires a non-voltage readout, it will be necessary to scale the display. The “SCALE” DIP switch is set to the “ON” position to enable the “SCALE” adjustment pot to be used. The Division Factor is calculated utilizing the formula:

\[
\text{D.F.} = \frac{(\text{Maximum output})}{(\text{Desired Display})} = \frac{10 \times 1,000}{1800} = 5.5
\]

Utilizing the “DIVISION FACTOR SELECTION CHART”, it can be seen that with a Division Factor of 5.5, DIP switch position S2 should be set to the “ON” position, since the division factor falls between 1.2 and 10.5.

To calibrate the Cub Voltmeter, the motor is run at full speed and a photo tach is used to obtain the exact speed. The “SCALE” adjustment pot on the Cub Voltmeter is then adjusted until the display reading agrees with the tach.

CURRENT METER APPLICATION
Analog Meter Replacement
A manufacturer wants to replace several 1 mA DC analog meter movements with easily readable Cub Current Meters. One particular application involves measuring the flow rate of a liquid. The analog meter had indicated the amount of flow, 0 to 250 gallons per minute.

Since 1 mA of current flow is to give a reading of 250, the Cub Current Meter will need to be scaled. To enable the “SCALE” adjustment pot, the “SCALE” switch must be set to the “ON” position. The proper current range for the application must then be selected. The “SCALE” pot will allow us to divide the display reading by 1 to 13, for the particular current range selected. Since the reading of 250 is 4 times less than what the non-scaled reading would be when in the 0 to 1.999 mA range, that range is chosen. The 2-position female mini-jumper is installed in the 0-1.999 mA range position. No decimal point is selected because the resolution is 1 gallon.

The Cub Current Meter can now be calibrated. At a known flow rate the Cub’s “SCALE” pot is adjusted to read the same. An easy way to check the calibration of the Cub would be to compare the actual current measurement (“SCALE” switch off) with the scaled reading (“SCALE” switch on). The scaled reading should be exactly 4 times less than the actual non-scaled reading. For example, if 1.000 mA of current is flowing, the unit will read 1000 (decimal point switch is not on) with “SCALE” off and 250 with “SCALE” on, if the unit has been calibrated properly.

REAR COVER REMOVAL
The rear cover can be removed by placing a small screwdriver in the slot and applying a small amount of downward pressure.
LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
# IMPORTANT PRODUCT OBSOLESCENCE NOTICE

The time has come to discontinue a few of our older products due to part availability. The recommended alternative product will offer the customer a better solution than the existing product. Certain products have no listed replacements due to technological advancements. The actual discontinuation date is controlled by raw material inventories and future sales. If you have a customer using any of these products, please contact and advise them of the situation. As always, Red Lion will assist the customer as much as possible in the changeover process.

<table>
<thead>
<tr>
<th>DISCONTINUED PART/MODEL NUMBERS</th>
<th>DESCRIPTION</th>
<th>STATUS</th>
<th>ALTERNATIVE PRODUCT OFFERINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFCx0000</td>
<td>Current to Frequency Converter</td>
<td>Discontinued as parts are depleted.</td>
<td>None</td>
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<tr>
<td>CL1000x0</td>
<td>2 x 20 Operator Interface</td>
<td>Discontinued as parts are depleted.</td>
<td>CL2000x0</td>
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<td>CUBID001</td>
<td>CUB2 DC Current Meter, 5 VDC</td>
<td>Discontinued as parts are depleted</td>
<td>None</td>
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<tr>
<td>CUBID002</td>
<td>CUB2 DC Current Meter, 7 to 28 VDC</td>
<td>Discontinued as parts are depleted</td>
<td>CUB4000</td>
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<td>CUBVD001</td>
<td>CUB2 DC Volt Meter, 5 VDC</td>
<td>Discontinued as parts are depleted</td>
<td>None</td>
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<tr>
<td>CUBVD002</td>
<td>CUB2 DC Volt Meter, 7 to 28 VDC</td>
<td>Discontinued as parts are depleted</td>
<td>CUB4V000</td>
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<tr>
<td>CX1000x0</td>
<td>2 x 20 Operator Interface</td>
<td>Discontinued as parts are depleted</td>
<td>G305x000</td>
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<tr>
<td>CX1500x0</td>
<td>2 x 40 Operator Interface</td>
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<td>G305x000</td>
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<td>GL3000x0</td>
<td>256 x 128 Operator Interface</td>
<td>Discontinued as parts are depleted</td>
<td>G305C000</td>
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<td>GL300Tx0</td>
<td>256 x 128 Operator Interface</td>
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<td>GL3500x0</td>
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<td>Discontinued as parts are depleted</td>
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<td>Loop Powered Process Meter</td>
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<td>CUB4LP00</td>
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<tr>
<td>VFCx0000</td>
<td>Voltage to Frequency Converter</td>
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<td>VX500S00</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted</td>
<td>G308C000</td>
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<td>VX500TS10</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted</td>
<td>G308C000</td>
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<tr>
<td>VX550S00</td>
<td>640 x 480 Operator Interface</td>
<td>Discontinued as parts are depleted</td>
<td>G308C000</td>
</tr>
</tbody>
</table>
MODEL LPPI - LOOP POWERED PROCESS INDICATOR

DESCRIPTION

The Model LPPI, Loop Powered Process Indicator is designed to operate in 4 to 20 mA or 10 to 50 mA current loop signal circuits. When equipped with the proper sensor, the LPPI can be used to indicate temperature, pressure, humidity, flow, level and other process variables. The unit has a wide range of scaling and offsetting capabilities. The unit is calibrated, at the factory, for 4 to 20 mA operation with a 0.0 displayed when 4 mA is input and 100.0 displayed when 20 mA is input. The unit utilizes the 4 to 20 or 10 to 50 mA loop current to derive its operating power.

The rugged construction and sealed metal bezel meet the requirements of NEMA 4/IP65. This allows the LPPI to be used in dirty environments and in wash-down areas.

SPECIFICATIONS

1. DISPLAY: 3½-digit (-1999 to 1999), 0.35" (9 mm) high LCD display.
   Minus sign is displayed when indicator is adjusted for a negative offset.
   Overrange: Overrange is indicated by a one in the most significant digit and the blanking of the three least significant digits.

2. DECIMAL POINTS: Three, DIP switch selectable, decimal point positions allow the display to be read in tenths, hundredths or thousandths.

3. VOLTAGE DROP: 3 volts max

4. EQUIVALENT RESISTANCE:
   @ 20 mA (4 to 20 mA) 150 \( \Omega \) max
   @ 4 mA (4 to 20 mA) 750 \( \Omega \) max

5. MAXIMUM ALLOWABLE INPUT CURRENT: 100 mA

6. 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.

7. LINEARITY: ±(0.1% + 1 digit)

8. READING RATE: 2.5 per second, nominal

9. RESPONSE TIME: 1.5 seconds to settle for a step change

10. NORMAL MODE REJECTION: 60 dB 50/60 Hz

11. TEMPERATURE EFFECTS:
    Operating Range: 0° to 60°C
    Storage Temperature: -40° to 80°C
    Span Temperature Coefficient: 100 PPM/°C
    Offset Temperature Coefficient: 0.2 digits/°C

12. CONSTRUCTION: Die cast metal bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for wash-down and dusty environments when properly installed. (Panel gasket and mounting clips included.)

13. WEIGHT: 5.4 oz (153 g).

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 (4 to 20 mA or 10 to 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 the span would be 1250 [1000 -(-250) = 1250].

The LPPI can be set up 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 within a couple of counts of the desired reading, and the Fine Span Pot is used to hone in on the desired reading.

OFFSET (Adjustments)

With 4 to 20 mA and 10 to 50 mA signals, the minimum currents are not zero based. In order to obtain a zero minimum display reading, the display must be offset. The display on the LPPI can be offset by adjusting the Coarse and Fine Offset pots.

DIP SWITCH SET-UP

Four DIP switches are located behind the rear cover. These DIP switches select the current range and the desired decimal point position.
**PANEL INSTALLATION**

The Model LPPI is designed to be panel-mounted. A cut-out of the size given below should first be cut in the panel. After cutting the opening in the panel, slide the panel gasket over the rear of the Model LPPI up against the rear of the bezel. Slide the unit through the panel cut-out. Install mounting clips on each side of the unit body with the recesses in the side of the body so that the “tang ends” wedge between the panel opening and the body as the screws are tightened.

**DIMENSIONS** In inches (mm)

**REAR COVER REMOVAL**

The rear cover can be removed by placing a small screwdriver in the slot and applying a small amount of downward pressure. (See drawing below)

**CONNECTION EXAMPLE**

The diagram below shows how the LPPI is connected in the current loop with a two wire transmitter and power supply.

**CALIBRATION**

In order to calibrate the LPPI, some additional equipment will be required. Either a precision milliampere source or power supply, 4½-digit DMM, 10 K pot and 100 Ω resistor can be used. Refer to the figures below for set-up.

When calibrating the LPPI, there will be interaction between the Scale and Offset pots. This interaction will require alternately checking the min and max readings while making the adjustments.

The following procedure should be followed.

Set DIP switch position 1 for the desired current range 4 to 20 mA or 10 to 50 mA.
1. At the minimum input current (4 or 10 mA), adjust the coarse offset pot so that the display is within a couple of counts of the desired minimum reading.
2. At the maximum input current (20 or 50 mA), adjust the coarse span pot so that the display reading is within a couple of counts of the desired “full scale” reading.
3. Repeat steps 1 and 2 using the coarse adjustment pots until both the “zero” and “full scale” reading are within a couple of counts of the desired readings. Then repeat steps 1 and 2 using the fine adjustment pots to narrow in on the correct display readings.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPPI</td>
<td>Loop Powered Process Indicator</td>
<td>LPPI0000</td>
</tr>
</tbody>
</table>

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
MODEL IMA - APOLLO 6-DIGIT INTELLIGENT SERIAL SLAVE DISPLAY

- DISPLAYS 6 DIGITS OF SERIAL ASCII DATA
- INPUT ISOLATED 20 mA LOOP
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER RELIABILITY
- FULL 6-DIGIT, 7 SEGMENT, HIGH VISIBILITY, 0.56” (14.2 mm) HIGH, RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- PEAK/VALLEY MEMORY FUNCTION
- DUAL ALARM RELAY OUTPUTS (optional)
- 4 to 20 mA OR 0 to 10 VDC ANALOG OUTPUT (optional)
- NEMA 4/IP65 SEALED METAL FRONT BEZEL
- DIN STD BEZEL 1.89” (48 mm) x 3.78” (96 mm)

DESCRIPTION

The Apollo Intelligent Serial Slave Display (IMA) accepts ASCII data from either a terminal, host computer, or a Red Lion Controls product with serial communications, and displays the received data. The data may be numeric, alphabetic and/or punctuation, but there are parameters that must be met (this is covered in detail in the manual). Serial communication is accomplished via two 20 mA current loops. The IMA provides two 20 mA current sources. The one source is dedicated to the SO transmit loop (TBA #12) and can power up to seven units on its loop. The other source (TBA #7) is used for SI input loop and can power up to three units on its loop. The peak and valley (max/min) values can be recalled at the touch of a button. A full 6-digit, 7-segment display accommodates virtually any process engineering unit. English-style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data from unauthorized personnel. A programmable remote input (EI-CON) can be utilized for alarm, display hold and reset operations. All set-up data is stored in E²PROM, which will hold data for a minimum of 10 years without power. All values are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many alarm applications.

An optional 4 to 20 mA or 0 to 10 VDC re-transmitted analog output can be scaled by the user to interface with a host of recorders and indicators. The vocabulary set of ASCII characters that the IMA receives and displays as follows:

Numbers: “0-9”


Punctuation: “;” “,” “-” “blank”

Note: Any characters received by the IMA that are not listed above, a blank space is substituted in its place.

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. DISPLAY: 6-digit, 7 segment, 0.56” (14.2 mm) High LED’s.
2. POWER REQUIREMENTS:
   A.C. Power: Switch Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA.
3. CONTROLS: Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.
4. INPUT: Serial ASCII data
   The vocabulary set of ASCII characters that the IMA receives and displays are as follows:
   Numbers: “0-9”
   Punctuation: “;” “,” “-” “blank”
   Note: Any characters received by the IMA that are not listed above, a blank space is substituted in its place.
5. RESPONSE TIME: 70 msec max.
6. 20mA SOURCE (TBA pins 6 & 7): Capable of driving up to three SI input diodes.
7. SERIAL COMMUNICATIONS:
   Type: Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source.)
   Band Rate: programmable 300 to 2400
   Maximum address: 99 (Actual number in a single loop is limited by serial hardware specifications.)
   Data Format: 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit)
   Serial Hardware Specifications:
   SO - Output Transistor Rating: \( V_{\text{max}} = 30 \text{ VDC}, V_{\text{sat}} = 1 \text{ Vmax at 20 mA.} \)
   Note: This will allow up to 28 units max. in each loop.
   SI - Input Diode Rating: \( VF = 1.25 \text{ V}_{\text{typ}}, 1.5 \text{ V}_{\text{max}} \)
   Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

DIMENSIONS “In inches (mm)”

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO-Output Transistor</td>
<td>( 3.62 \pm 0.05 )</td>
</tr>
<tr>
<td>Panel Cut-Out</td>
<td>( 6.65 )</td>
</tr>
</tbody>
</table>

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
SPECIFICATIONS (Cont’d)

8. DISPLAY READING RANGE: -99999 to 999999
9. 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
   Altitude: Up to 2000 meters

10. ALARMS (Optional):
    Solid State: Two, isolated, sinking open collector NPN transistors acting in parallel with relays. Vsat = 1 V @ 100 mA max. Vmax: 30 VDC.
    RELAYS:
    Type: Form C (2)
    Max. Ratings: 5 Amps 120/240 VAC or 28 VDC (resistive load), 1/8 HP 120VAC (inductive load).
    Relay Life Expectancy: 100,000 cycles at Max. Rating. (As load level decreases, life expectancy increases.)

11. ANALOG OUTPUT (Optional):
    4 to 20 mA: Digital scaling and offsetting within a 4 to 20 mA range.
    Accuracy: 0.1% of full scale
    Resolution: 12 bits
    Compliance Voltage: 10 VDC (500 Ω max. loop impedance)
    0 to 10 VDC: Digital scaling and offsetting within a 0 to 10 VDC range.
    Accuracy: ±(0.1% of reading +35 mV)
    Resolution: 12 bits
    Min. Load Resistance: 10 KΩ (1 mA max.)

12. CERTIFICATIONS AND COMPLIANCES:
    EMC EMISSIONS:
    CISPR 11 Radiated and conducted emissions
    EMC IMMUNITY:
    Meets EN 50082-2: Industrial Environment.
    ENV 50140 - Radio-frequency radiated electromagnetic field
    ENV 50141 - Radio-frequency conducted electromagnetic field
    EN 61000-4-2 - Electrostatic discharge (ESD)
    EN 61000-4-3 - Radiated and conducted emissions
    EN 61000-4-4 - Electrical fast transient/burst (EFT)
    Notes:
    1. Unit mounted in a metal panel connected to earth ground (protective earth) with rear cover providing at least 10 dB of shielding effectiveness.
    a. When units are mounted in a metal panel without a rear cover, the process signal can vary as much as 2% from the stated accuracy specification, and the 4 to 20 mA analog output option can vary as much as 16% from the stated accuracy specification.
    2. One ferrite suppression core (Stewart #28-B2025-DA0) placed on the 20 mA serial communications cable at the unit for EMI frequencies above 40 MHz.
    3. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.
    Refer to the EMC Installation Guidelines section of the manual for additional information.

13. CONSTRUCTION:
    Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).

14. CONNECTION:
    Removable terminal blocks

15. WEIGHT:
    1.0 lbs. (0.45 kg)

PEAK/VALLEY

The indicator will record the lowest numeric value (valley) and highest numeric value (peak), automatically, for later recall. This information is valuable in monitoring the limits of the process over any length of time since these values are stored at power-down to span over shifts, days, etc. An external input can be programmed to reset or engage the unit into a peak/valley reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed.

ISOLATED SERIAL COMMUNICATIONS

The serial communication is a half-duplex, two-way, 20 mA current loop that interfaces with a terminal, host computer or a Red lion Controls product equipped with serial communications. Application of the IMA serial slave is advantageous when it is required to observe the same process signal at different locations. The indicator accepts ASCII data, which can (depending on data received) activate alarms, record peak/valley or solely display the data. Two loops are required for most (see application example) hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Multiple units and other Red lion Controls instruments can be serially addressed, up to a maximum of 99 units. (The actual number in a single loop is limited by the Serial Hardware Specifications).

Data transmitted to the IMA for the display can be one of two types, LITERAL or NUMERIC. The format structure for sending data to the IMA is shown below:

```
N xx d1 d2 d3 d4 d5 d6 EOT
```

- **N** - Addresses a particular unit in a multiple loop.
- **xx** - Represents the address
- **d1-d6** - Must be a # for literal data; or omitted for numeric data.

**LITERAL DATA TRANSMISSION**

Data that is preceded by a # character is interpreted as a LITERAL transmission and can contain any character from the IMA vocabulary set. [This will avoid confusion between a literal character (N, T, V or R) and a comman character (N, T, V or R).] Alarm setpoints, analog output and peak/valley readings DO NOT respond to any LITERAL transmission. Any character sent that is NOT in the vocabulary set will be recognized as a blank space and that digit location will be blank. All transmissions must be terminated by an asterisk (*) or a carriage return (CR). The following are examples of LITERAL Transmissions:

<table>
<thead>
<tr>
<th>Transmission</th>
<th>Display Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>N x x t1 d1 d2 d3 d4 d5 d6 EOT</td>
<td>S T A R T 1 * S T A R T 1</td>
</tr>
<tr>
<td># O P E N</td>
<td>O P E N</td>
</tr>
<tr>
<td># S y S / 1 5</td>
<td>S y S / 1 5</td>
</tr>
<tr>
<td># A b 1 2 3 C d</td>
<td>B 1 2 3 C d</td>
</tr>
<tr>
<td>N 5 5</td>
<td>H E L P E</td>
</tr>
</tbody>
</table>

**Note:** Some characters in the vocabulary will display the same when received by the IMA, they are "G-6" "I-1" "O-0" "S-5" .

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
PROGRAMMABLE FUNCTIONS
Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons "UP" and "DOWN", (shown as "arrows" on the front panel) are used to change the data and set-ups, while the "P" button is used to save or enter the data. After pressing "P" which gains entry into the programming mode, the programming modules are identified by the message "Pro" and a number in the display. "UP" and "DOWN" are used to select the desired programming module and "P" is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled "PGM. DIS." must be ungrounded to gain access to programming. The following table lists the programming steps.

"Pro 0" - RETURN TO DISPLAY MODE
"Pro 1" - PROGRAM SERIAL COMMUNICATIONS
  'bAud' - Enter baud rate
  'AddrES' - Enter loop address number (0-99)
  'Print' - Enter print function
  0 - numeric display
  1 - numeric display, peak/valley
  2 - numeric display and alarms
  3 - numeric display, peak/valley, alarm and hysteresis
  FULL - Enable complete or abbreviated printing

"Pro 2" - PROGRAM RE-TRANSMITTED ANALOG OUTPUT
  'AN-Lo' - Enter 4 mA or 0 VDC display value
  'AN-HI' - Enter 20 mA or 10 VDC display value

"Pro 3" - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED
  'dSP AL' - Enable display alarms
  'ENt AL' - Enable enter alarms *
  'dSPHYs' - Enable display hysteresis
  'ENt HYs' - Enable enter hysteresis *
  'rSt AL' - Enable reset latched alarms
  'dSPbUF' - Enable display of peak/valley readings
  'rStbUF' - Enable reset of peak/valley readings *

"Pro 4" - PROGRAM REMOTE INPUT FUNCTION
  'E1 - CON' - Enter function of remote input
  0 - display hold
  1 - reset peak/valley
  2 - reset peak and start peak indicator
  3 - reset valley and start valley indicator
  4 - reset latched alarms
  5 - suppress all alarms

"Pro 5" - PROGRAM ALARM
  'trAc' - Enable alarm value tracking
  'dSp' - Enable display alarm annunciators
  'LAIc-1' - Enable alarm #1 latching
  'AL-1' - Enter alarm #1 value
  'HYs-1' - Enter hysteresis value for alarm #1
  'Act-1' - Enter alarm #1 action (high or low)
  'LAIc-2' - Enable alarm #2 latching
  'AL-2' - Enter alarm #2 value
  'HYs-2' - Enter hysteresis value for alarm #2
  'Act-2' - Enter alarm #2 (high or low)

"Pro 6" - SERVICE OPERATIONS
  (Protected by access codes)
  * This sequence may be subject to being locked-out due to other programmed sequences.

NUMERIC DATA TRANSMISSION
This is data that contains numbers and/or punctuation. Alarm, analog output, and peak/valley readings DO respond to NUMERIC transmission and the unit will react appropriately to this data. If any non-numeric characters are embedded in the transmission they will not be recognized and therefore NOT displayed. A minus sign (-) followed by more than five numbers causes the display of the unit to display ".....". The comma is interpreted and displayed as a period, if more than one period is sent in a transmission only the first period will be recognized. If a unit has a one digit address, a leading zero must be used (ex. N03, N04, etc.). All transmissions must be terminated by an asterisk (*) or carriage return (CR). The following are examples of NUMERIC transmissions:

<table>
<thead>
<tr>
<th>Transmission:</th>
<th>Display Characters:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4.21 C R</td>
<td>3.4.21</td>
</tr>
<tr>
<td>1234 56 C R</td>
<td>1234 56</td>
</tr>
<tr>
<td>JA44 C R</td>
<td>44</td>
</tr>
</tbody>
</table>

ISOLATED ALARM OPTION
The alarm option consists of an additional printed circuit board with nine terminals. Six of these terminals are the two Form-C relays and the other three are the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, and tracking one another, if desired. If the alarms are programmed to latch (manual reset), then they will have to be reset either by the front panel or remote input. The alarms are triggered from the numeric display value, to activate external alarms, control valves, etc. Additionally, the alarms may be programmed to activate an alarm display to alert operators of the condition.

Alarm #1 can be made to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (Alarm #2) automatically changes Alarm #1 so that the offset between Alarm #2 and Alarm #1 remains the same. Alarm and hysteresis values can be modified through the serial communications to provide automatic control.

ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION
4 to 20 mA
The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 mA and 20 mA.

0 to 10 VDC
The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard voltage ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.
APPLICATION EXAMPLE
A GEMINI 2000, used as a rate indicator, requires that the rate be displayed in two different locations. Also, additional alarm outputs would be useful to provide warning indication at the remote location.
An IMA is used for the above requirements.

Communication set-ups:
Gemini 2000: Baud rate 2400 (switches 1 & 2 down), no print ID (switch 3 down) print option set to count (switches 4 & 5 up), transmit count & reset disabled (switch 6 up) and address set to 0 (switches 7, 8, 9 & 10 up).
IMA: Baud rate 2400, address 0, print code and abbreviated transmission not applicable.

Current loop connections and set-up parameters are done so the Gemini 2000 is in the transmit mode only and IMA is receive only. Alarms are programmed in the IMA to activate if the desired rate becomes too “HI” or too “LOW”. Also the rate is recorded on a chart recorder.

Due to communication and processing times, there is a delay response time between units. Response time is the time it takes for the Gemini 2000’s displayed value to be transmitted to the IMA and processed to the IMA’s display and/or alarm outputs. For this particular set-up, the maximum system response time (IMA and Gemini) is 170 msec.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>DUAL ALARM</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMA</td>
<td>INTELLIGENT SERIAL SLAVE DISPLAY</td>
<td>NO</td>
<td>NO</td>
<td>IMA04161</td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
<td>IMA04164</td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

NON-CE MODELS

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>DUAL ALARM</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMA</td>
<td>INTELLIGENT SERIAL SLAVE DISPLAY</td>
<td>NO</td>
<td>4 to 20 mA</td>
<td>IMA04117</td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>4 to 20 mA</td>
<td>IMA04107</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 to 10 VDC</td>
<td>IMA04119</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IMA04109</td>
</tr>
</tbody>
</table>
**MODEL IMD - APOLLO 4½-DIGIT INTELLIGENT METER FOR DECADE VOLT/CURRENT INPUTS**

- **40,000 COUNT MEASUREMENT RESOLUTION**  
  (can be scaled to ±99,999 display)
- **TWO MODELS TO CHOOSE FROM:**  
  IMD1 VOLTAGE METER (accepts ±2 VDC to ±300 VDC input)  
  IMD2 CURRENT METER (accepts ±200 µA DC to ±2 A DC input)
- **MULTIPLE RANGES** (user selectable)
- **EASY ONE-PASS SCALING**
- **STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY**
- **FULL 6-DIGIT, HIGH VISIBILITY, 0.56” (14.2 mm) HIGH RED LED DISPLAY**
- **PROGRAMMABLE FRONT PANEL LOCK-OUT MENU**
- **INTEGRATOR (totalizer) AND LINEARIZER (optional)**
- **PEAK/VALLEY MEMORY AND TARE (re-zero) FUNCTION (optional)**
- **DUAL ALARM RELAY OUTPUTS** (optional)
- **BI-DIRECTIONAL SERIAL COMMUNICATIONS** (optional)
- **4 to 20 mA or 0 to 10 VDC ANALOG OUTPUT** (Optional)
- **NEMA 4/IP65 SEALED METAL FRONT BEzel**

**DESCRIPTION**

The Apollo Intelligent Decade Volt and Current Meters accept a wide range of input signals and precisely scales them into engineering units. The IMD Volt Meter accepts inputs from ±2 VDC to ±300 VDC in one of four ranges. The IMD Current Meter accepts inputs from ±200 µA DC to ±2 A DC in one of five ranges. A full 6-digit display accommodates nearly any engineering unit and holds large totalization values. State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages are available to fulfill many process applications.

Both models feature a choice of two different scaling procedures which greatly simplify initial set-up. Style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data and operation modes from unauthorized personnel.

Programmable digital filtering enhances the stability of the reading. Programmable remote input "E1-CON" pin can be utilized to control a variety of functions, such as totalizing, alarm control, display hold or tare operations. All set-up data is stored in E²PROM, which will hold data for a minimum of 10 years without power.

An optional integrator (totalizer)/linearizer can be used to totalize or integrate signals up to a maximum display value of 999,999. It features independent scaling and a low signal cut-out to suit a variety of signal integration applications. Additionally, nine slopes and offsets can easily be programmed with this option to linearize transducers with non-linear outputs, such as square law devices. Optional programmable remote input "E2-CON" pin can be utilized to control a variety of functions, such as totalizing, alarm control, display hold or tare operations, simultaneously with "E1-CON" pin. Peak/valley (max/min) reading memory, display hold and a signal re-zeroing (tare) function are included with this option and they are easily recalled and controlled by either the front panel or a remote switch. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications. Optional 20 mA loop, bidirectional serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

An optional 4 to 20 mA or 0 to 10 VDC re-transmitted analog output can be scaled by the user to interface with a host of recorders, indicators and controllers. The indicator 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 die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications. Plug-in style terminal blocks simplify installation wiring and change-outs.

**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.

**SPECIFICATIONS**

1. **DISPLAY:** 6-digit, 0.56” (14.2 mm) High LED, minus sign displayed for negative values. "Flashing" display for totalizer overflow. "......" displayed for input display out of range. "OLOLOLO" displayed for input display overload and "ULULUL" for underload (negative overload).

2. **POWER REQUIREMENTS:**
   - **AC Power:** Switch Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA
   - **3. CONTROLS:** Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

**DIMENSIONS “In inches (mm)”**

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.

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**Panel Cut-Out**

---

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
4. INPUT RANGE/RESOLUTION, ACCURACY, INPUT IMPEDANCE AND MAXIMUM INPUT LEVEL:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Accuracy % OF Full Scale</th>
<th>Current Ranges (mA)</th>
<th>Maximum Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>±200.00 mV/1 V DC</td>
<td>0.025%</td>
<td>1 A</td>
<td>70 VDC</td>
</tr>
<tr>
<td>±20.00 mV/10 V DC</td>
<td>0.1%</td>
<td>1 A</td>
<td>300 VDC</td>
</tr>
<tr>
<td>±200.00 mV/100 V DC</td>
<td>0.025%</td>
<td>1 A</td>
<td>300 VDC</td>
</tr>
</tbody>
</table>

5. PROGRAMMABLE DISPLAY READING RANGE: 999999 to 999999

6. READING RATE: 2.5 readings/second

7. RESPONSE TIME: 1 second to settle for step input (increases with programmable digital filtering)

8. TOTALIZER: Front panel button for input/output display select programmable time-base, scale factor (0.001 to 100.000) and low-end cut-out. Response Time = 0.0 sec. max.

9. E1-CON AND E2-CON: External remote inputs which allow activation of various functions (reset total, peak indicator mode, trigger mode, etc.).

10. NORMAL MODE REJECTION: 35 dB @ 50/60 Hz (may be improved by programmable digital filtering)

11. COMMON MODE REJECTION: 120 dB, DC to 50/60 Hz

12. EXCITATION: (Optional): 18 VDC @ 50 mA max.

13. SERIAL COMMUNICATIONS (Optional):
   - Type: Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source.)
   - Baud Rate: programmable 300 to 2400

14. ALARMS (Optional):
   - Solid State: Two, isolated, sinking open collector NPN transistors acting in parallel with relays. Imax: 100 mA @ Vout = 1 V. VMAX: 30 VDC.

15. ANALOG OUTPUT (Optional):
   - 4 to 20 mA: Digital scaling and offsetting within 4 to 20 mA range
   - Accuracy: 0.1% of full scale

16. LINEARIZER/PEAK/VALLEY/TARE/ E2-CON OPTION
   - The major feature of this option is its integrator/totalizer (accumulator). The integrator simply totals (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, by the front panel or through the serial communications loop. Alarms may be triggered to totalizer values, for example to signal total flow for batching operations. A programmable low signal level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

17. CERTIFICATIONS AND COMPLIANCE:
   - ELECTROMAGNETIC COMPATIBILITY
     - Immunity to EN 50082-2
       - Electrostatic discharge: EN 61000-4-2
       - ±10 V DC @ 1500 V
       - ±10 V DC @ 250 V
       - ±55 V DC @ 400 V
   - Power frequency magnetic fields: ENV 50208
     - Level 3: 10 V DC
     - Level 3: 500 Hz, ±5 MHz

18. 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

Notes:
1. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.
2. Self-recoverable loss of EMI during transportation at 10 V/m.
   - Process and analog output signals may deviate during EMI disturbance.

For operation without loss of performance:
- The unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent).
- Refer to the EMI Installation Guidelines in the manual for more information.

EXCITATION OPTION
The excitation option provides a regulated excitation voltage (18 VDC, 60 mA) that can be used to power the transducer.

TOTALIZER/LINEARIZER/PEAK/VALLEY/TARE/ E2-CON OPTION
The major feature of this option is its integrator/totalizer (accumulator). The integrator simply totals (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, by the front panel or through the serial communications loop. Alarms may be triggered to totalizer values, for example to signal total flow for batching operations. A programmable low signal level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

The linearizer feature is a series of programmable scaling points that are used to construct linear segments to linearize the input signal. The most common application would be to interface with square law devices (generally, flow transducers). A maximum of nine segments are available and using nine segments for a square law device would reduce linearity errors to 0.35%.

The other features of this option are peak and valley detection and a re-zero (tare) function. The indicator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable when monitoring the limits of the process over any length of time (shifts, days, etc.) since these values are stored at power-down. Optional E2-CON input pin can be programmed to reset or engage the unit into a peak reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

The re-zero (tare) function can also be controlled externally or by the front panel. This feature can quickly compensate for small shifts or drifts in the input signal or to re-zero every operation, such as batching.

ISOLATED ALARM OPTION
The alarm option consists of an additional printed circuit board with 9 terminals. Six of these terminals are for the two Form-C relays and the other three are for the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total and they can be programmed to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be set to trigger from either the integrator/totalizer or the input display, to actuate external alarms, control valves, etc.

Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking.

This is useful in alarm set-ups where a pre-warning control activates before a shut-off trip value. This information is useful when monitoring the limits of the process over any length of time (shifts, days, etc.) since these values are stored at power-down. Optional E2-CON input pin can be programmed to reset or engage the unit into a peak reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

ISOLATED SERIAL COMMUNICATIONS OPTION
The serial communication option is a half-duplex, two-way 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit input signal. Two loops are required for all hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is
transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are hardware limitations which restrict this to a lower number of units per serial loop.)

**ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION**

**4 to 20 mA**

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

**0 to 10 VDC**

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard voltage ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.

**PROGRAMMABLE FUNCTIONS**

Programming of the IMD is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN” (shown as arrows on the front panel) are used to change the data and set-ups, while the “P” button is used to “save” or “enter” the data. After pressing “P” which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be disconnected from ground to gain access to programming. The following table lists the programming steps.

**“Pro 0” - RETURN TO MEASUREMENT MODE**

**“Pro 1” - SCALE UNIT BY APPLYING SIGNAL**

- dECPN1: Enter decimal point for scaled display
- round: Enter rounding factor and trailing zeros for scaled display
- SCALE: *
- dSP 1: Enter display reading for scaling point #1
- INP 1: Enter signal level for scaling point #1
- dSP 2: Enter display reading for scaling point #2
- INP 2: Enter signal level for scaling point #2
- SEG: *

**“Pro 2” - SCALE UNIT BY KEY-IN SIGNAL LEVEL**

- dECPN1: Enter decimal point for scaled display
- round: Enter rounding factor and trailing zeros for scaled display
- SCALE: *
- dSP 1: Enter display reading for scaling point #1
- INP 1: Enter signal level for scaling point #1
- dSP 2: Enter display reading for scaling point #2
- INP 2: Enter signal level for scaling point #2
- SEG: *

**“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED**

- dSP AL: Enable display alarms
- EN AL: Enable enter alarms
dSPHYS: Enable display hysteresis
ENHYS: Enable enter hysteresis
rST AL: Enable reset latched alarms
dSP/PV: Enable display of peak/valley readings
STbUF: Enable reset of peak/valley readings
SELSP: Enable switching display between input and total
StOt: Enable reset total
IAE: Enable re-zero (tare) of input signal

**“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE input FUNCTION**

- FILtr: Enter level of digital filtering
- 0: no digital filtering
- 1: normal filtering
- 2: increased filtering
- 3: maximum filtering
- E1-CON: Enter function of remote input (Reset/Hold)
- 0: re-zero input
- 1: reset total
- 2: reset and gate totalizer
- 3: gate totalizer
- 4: display hold
- 5: reset peak/valley

**“Pro 9” - SERVICE OPERATIONS (Protected by access code)**

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<th>Function</th>
<th>Description</th>
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<tbody>
<tr>
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<td>- reset peak and start peak indicator</td>
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<tr>
<td>7</td>
<td>- reset valley and start valley indicator</td>
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<td>8</td>
<td>- reset latched alarms</td>
</tr>
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<td>9</td>
<td>- reset all alarms</td>
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<td>- toggle display between input and total</td>
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<td>11</td>
<td>- re-zero input and totalize the tared values</td>
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<td>- display hold with tare</td>
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<tr>
<td>13</td>
<td>- instrument reading synchronization</td>
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<td>14</td>
<td>- print request</td>
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<tr>
<td>E2-CON</td>
<td>- Same function as “E1-CON”</td>
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**“Pro 5” - PROGRAM TOTALIZER**

- dECPN1: Enter decimal point for totalization
dASE: Enter time base
0: second
1: minute
2: hour
SCLFA: Enter multiplying scale factor
Lo-cu: Enter low-signal cut out

**“Pro 6” - PROGRAM ALARMS**

- trAc: Enable alarm value tracking
dSF: Enable display alarm annunciators
LATC: Enter alarm #1 latching
ASN: Enter alarm #1 trigger source (input or total)
AL: Enter alarm #1 value
HYS: Enter hysteresis value for alarm #1
Act: Enter alarm #1 action (high or low)
LA-C: Enable alarm #2 latching
ASN: Enter alarm #2 trigger source (input or total)
AL: Enter alarm #2 value
HYS: Enter hysteresis value for alarm #2
Act: Enter alarm #2 action (high or low)

**“Pro 7” - PROGRAM SERIAL COMMUNICATIONS**

- bAud: Enter baud rate
AddES: Enter loop address number (0-99)
Print: Enter print function, or “P” command function through Serial Option
0: input
1: input, peak/valley, and tare
2: input and alarms
3: input, peak/valley, alarms, hysteresis, and tare
4: total
5: input, total, peak/valley, alarms, hysteresis, and tare
6: input, total, peak/valley, alarms, hysteresis, and tare
7: total and alarms
8: input, total and alarms
9: input, total, peak/valley, alarms, hysteresis, and tare
FULL: Enable complete or abbreviated printing

**“Pro 8” - PROGRAM RE-TRANSMITTED ANALOG OUTPUT**

- ASIN: Select source of analog output (input or total)
AN-Lo: Enter 4 mA or 0 VDC display value
AN-HI: Enter 20 mA or 10 VDC display value

**“Pro 9” - SERVICE OPERATIONS**

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<th>Function</th>
<th>Description</th>
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<tr>
<td>E2-CON</td>
<td>- Same function as “E1-CON”</td>
</tr>
</tbody>
</table>

- * - Entire sequence for this modular step is not shown (see manual for further details).
- † - This sequence may be subject to being locked-out due to other programmed sequences.
BASIC PROGRAMMING STEPS

If Program Select Number Chosen Is:

- 0.0
- 0.1
- 0.0
- Apply 0.000 VDC
- 100.0
- Apply 10.000 VDC
- 1

TOTALIZER SET-UP

With an average signal input which gives a display of 100.0 amps for a 1
hour time period, the following formula applies.

\[ \text{S.F.} = \frac{\text{D.T.}}{\text{P.D.}} \times \frac{\text{T.B.}}{\text{D.T.}} \times \frac{\text{D.T.D.}}{\text{P.D.D.}} \]

- Desired Total For A Fixed Time Duration
- Programmable Time Base
- Programmable Scale Factor
- Process Display Decimal Point

P.D. = Process Display Value
Time = Actual Time Period In Seconds

IMD DECADE VOLT METER TOTALIZER EXAMPLE (Cont’d)

TOTALIZER SET-UP

With an average signal input which gives a display of 100.0 amps for a 1
hour time period, the following formula applies.

\[ \text{S.F.} = \frac{\text{D.T.}}{\text{P.D.}} \times \frac{\text{T.B.}}{\text{D.T.}} \times \frac{\text{D.T.D.}}{\text{P.D.D.}} \]

- Desired Total For A Fixed Time Duration
- Programmable Time Base
- Programmable Scale Factor
- Process Display Decimal Point

P.D. = Process Display Value
Time = Actual Time Period In Seconds

IMD DECADE CURRENT METER APPLICATION EXAMPLE

A manufacturing company is in the process of modernizing and updating their control panels for a more efficient operation. In order to monitor various processes which are being performed, several “old style” analog panel meters are currently being used for display purposes. These meters receive their input from transducers which output 0 to 1 mA. Operators must be very close to the indicator in order to determine exactly where the needle is. Usually a multiplier must be used to obtain final reading. This causes an otherwise simple procedure, such as interpretation of the indicators’ reading to be time consuming and difficult.

The company would like to replace these analog meters with new solid state digital meters capable of operating with the transducers that are currently being used, and is looking for a way to store daily peak readings for later evaluation. Also, future plans call for the linking of these indicators with an existing control system so input and/or peak value may be read from a remote computer terminal if so desired. The Apollo IMD Decade Current Meter with serial communication and totalizer options is suited perfectly for this application.

The ±2 mA range is selected to accept the 0 to 1 mA transducer signal. This signal can easily be scaled 2 to 10 VDC. The ±2 mA range is selected to accept the 0 to 1 mA transducer signal. This signal can easily be scaled 2 to 10 VDC.

** Since the time period is in minutes, the selected T.B. is 3600 (program select value = 2) which equals time base in hours (3600 sec.).

* This value is normally 1, but can be used as a coarse scale factor of 60 or 3600.

** Ordering Information

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IMD DECADE VOLT METER TOTALIZER EXAMPLE

BASIC PROGRAMMING STEPS

If Program Select Number Chosen Is:

- 0.0
- 0.1
- 0.0
- Apply 0.000 VDC
- 100.0
- Apply 10.000 VDC
- 1

TOTALIZER SET-UP

With an average signal input which gives a display of 100.0 amps for a 1
hour time period, the following formula applies.

\[ \text{S.F.} = \frac{\text{D.T.}}{\text{P.D.}} \times \frac{\text{T.B.}}{\text{D.T.}} \times \frac{\text{D.T.D.}}{\text{P.D.D.}} \]

- Desired Total For A Fixed Time Duration
- Programmable Time Base
- Programmable Scale Factor
- Process Display Decimal Point

P.D. = Process Display Value
Time = Actual Time Period In Seconds

IMD DECADE CURRENT METER APPLICATION EXAMPLE

A manufacturing company is in the process of modernizing and updating their control panels for a more efficient operation. In order to monitor various processes which are being performed, several “old style” analog panel meters are currently being used for display purposes. These meters receive their input from transducers which output 0 to 1 mA. Operators must be very close to the indicator in order to determine exactly where the needle is. Usually a multiplier must be used to obtain final reading. This causes an otherwise simple procedure, such as interpretation of the indicators’ reading to be time consuming and difficult.

The company would like to replace these analog meters with new solid state digital meters capable of operating with the transducers that are currently being used, and is looking for a way to store daily peak readings for later evaluation. Also, future plans call for the linking of these indicators with an existing control system so input and/or peak value may be read from a remote computer terminal if so desired. The Apollo IMD Decade Current Meter with serial communication and totalizer options is suited perfectly for this application.

The ±2 mA range is selected to accept the 0 to 1 mA transducer signal. This signal can easily be scaled 2 to 10 VDC. The ±2 mA range is selected to accept the 0 to 1 mA transducer signal. This signal can easily be scaled 2 to 10 VDC.

** Since the time period is in minutes, the selected T.B. is 3600 (program select value = 2) which equals time base in hours (3600 sec.).

* This value is normally 1, but can be used as a coarse scale factor of 60 or 3600.
**MODEL IMH - APOLLO 4½-DIGIT 5 AMP AC INTELLIGENT CURRENT METER**

- 1 mA RESOLUTION (can be scaled to display ±99,999)
- OVER-RANGE INDICATION
- EASY, ONE-PASS SCALING
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56” (14.2 mm) HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- DUAL ALARM RELAY OUTPUTS (optional)
- INTEGRATOR/(totalizer) AND LINEARIZER (optional)
- PEAK/VALLEY MEMORY AND TARE (re-zero) FUNCTION (optional)
- 4 to 20 mA OR 0 to 10 VDC ANALOG OUTPUT (optional)

**DESCRIPTION**

The Apollo Intelligent 5 Amp AC Current Meter (IMH) accepts AC currents up to 5 amps and precisely scales them into engineering units with high resolution. With the use of an external 5 amp AC current transformer, of any ratio, currents of any magnitude can be measured and displayed. The meter is calibrated from the factory to display RMS value of a pure sinusoidal waveform. The input is AC coupled to eliminate any DC effects in the signal. True RMS readings are not obtained from complex waveforms, such as square waves, signals that have been rectified or chopped due to a circuit with an SCR or Triac output. These kinds of complex waveforms will cause average value readings. Examples of such waveforms are shown below.

**Example A** is an undistorted sinewave and the IMH will indicate TRUE RMS. With the complex waveforms shown in examples B and C, the meter will indicate average value.

State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages is available to fulfill many process applications. The indicator features a choice of two different scaling procedures which greatly simplifies initial set-up. A full 6-digit display accommodates virtually any process engineering unit. English-style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data and operation modes from unauthorized personnel. A programmable remote input “E1-CON” can be utilized to control a variety of totalizing, alarm control, peak/valley readings, display hold or tare operations. All set-up data is stored in E²PROM, which will hold data for a minimum of 10 years without power.

An optional integrator (totalizer)/linearizer can be used to totalize or integrate signals up to a maximum display value of 999999. It features independent scaling and a low signal cut-out to suit a variety of signal integration applications. Programmable remote input “E2-CON” pin is included with this option and can be utilized to control a variety of functions, such as totalizing, alarm control, peak/valley readings, display hold or tare operations, simultaneously with “E1-CON” pin. Additionally, nine slopes and offsets can easily be programmed to provide linear indication over the entire range. Peak/valley (max/min) reading memory, and a signal re-zeroing (tare) function are included and they are easily recalled and controlled by the front panel. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications.

1. **DISPLAY**: 6-digit, 0.56” (14.2 mm) High LED. Flashing display during totalizer overflow, and “......” during input display out of range. “OLOLOL” is displayed during input overload, which is any AC current greater than 5.3 amps AC.

2. **POWER**: Switch selectable 115/230 V AC, ±10%, 50/60 Hz, 14 VA.

3. **CONTROLS**: Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

**SPECIFICATIONS**

1. **DISPLAY**: 6-digit, 0.56” (14.2 mm) High LED. Flashing display during totalizer overflow, and “......” during input display out of range. “OLOLOL” is displayed during input overload, which is any AC current greater than 5.3 amps AC.

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3. **CONTROLS**: Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

**DIMENSIONS “In inches (mm)”**

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.3” (140) W.

**PANEL CUT-OUT**

 Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
SPECIFICATIONS (Cont’d)

4. INPUT RANGE: 0.000 to 5.300 AMPS AC @ 25 to 400 Hz.
5. INPUT RESISTANCE: 0.02 Ω; 2 WATTS
6. MAXIMUM SHUNT CURRENT: 50 AMPS for 1 second; 10 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.

7. ACCURACY: (23°C, 85% RH) (45 to 500 Hz) ±(0.5% of reading + 5 digits)

8. RESOLUTION: 1 mA
9. PROGRAMMABLE DISPLAY READING RANGE: -99999 to 999999
10. SIGNAL CONNECTION: 2-Wire
11. READING RATE: 2.5 readings/second
12. RESPONSE TIME: 2 seconds to settle for step input (increases with programmable digital filtering)
13. TOTALIZER: Front panel button for input/display total select. Programmable decimal point, time-base, scale factor (0.001 to 100.000) and low-end cut-out. Response Time = 0.2 sec. max.
14. E1-CON AND E2-CON: External remote inputs that allow activation of various functions (reset total, peak indicator mode, trigger mode, etc.). V_HL = 0.8 V_MAX; V_HH = 2.0 V_MIN. Response Time = 0.2 sec. max.

15. ENVIRONMENTAL CONDITIONS:
   - Operating Range: 0º to 50ºC
   - Storage Range: -40º to 80ºC
   - Temperature Coefficient: ±200 ppm/ºC
   - Relative Humidity: Less than 85% RH (non-condensing)
   - Altitude: Up to 2000 meters.

16. ALARMS (Optional):
   - Solid State: Two, isolated, sinking open collector NPN transistors acting in parallel with relays.
     - I_max: 100 mA; V_SAT = 1 V @ 100 mA; V_MAX: 30 VDC.
   - Relays:
     - Type: Form C (2)
     - Max. Rating: 5 Amps 120/240 VAC or 28 VDC (resistive load), 1/8 HP 120 VAC (inductive load).
   - Relay Life Expectancy: 100,000 cycles at Max. Rating. (As load decreases, life expectancy increases)

17. ANALOG OUTPUT (Optional): Digital scaling and offsetting.
   - 4 to 20 mA:
     - Accuracy: 0.1% of full scale
     - Resolution: 12 bits
     - Compliance Voltage: 10 VDC (500 Ω max. loop impedance)
   - 0 to 10 VDC:
     - Accuracy: ±(0.1% of reading + 35 mV)
     - Resolution: 12 bits
     - Min. Load Resistance: 10 KΩ (1 mA max.)


19. CERTIFICATIONS AND COMPLIANCES
   - EMC EMISSIONS:
     - CISPR 11 Radiated and conducted emissions
   - EMC IMMUNITY:
     - Meets EN 50082-2: Industrial Environment.
     - ENV 50140 - Radio-frequency radiated electromagnetic field
     - ENV 50141 - Radio-frequency conducted electromagnetic field
     - ENV 61000-4-2 - Electrostatic discharge (ESD)
     - ENV 61000-4-4 - Electrical fast transient/burst (EFT)
   - Notes:
     1. No loss of performance during EMI disturbance at 6 V/m.
     2. Permissible loss of performance during EMI disturbance at 10 V/m:
       - Process signal deviation less than 2.5% of full scale.
       - Analog output deviation less than 5% of full scale.
     3. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.

   Refer to the EMC Installation Guidelines section of the manual for additional information.

20. CONSTRUCTION: Die-cast metal front bezel that meets NEMA 4/IP65 requirements for wash-down and/or dusty environments when properly installed. Case body is black, high impact plastic (panel gasket and mounting clips included).

21. CONNECTION: Removable terminal blocks
22. WEIGHT: 1.2 lbs (0.54 Kg).

TOTALIZER/LINEARIZER/PEAK/VALLEY/TARE/E2-CON OPTION

The totalizer simply totals (adds) input readings together using a programmable time base and scaling coefficient. The decimal point position of the totalizer can be programmed independently of the input signal. The totalizer may be reset through a remote input or by the front panel. Alarms may be programmed to trigger from totalizer values. A programmable low signal level disable feature completes the totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

The linearizer feature is a series of programmable scaling points that are used to construct linear segments to linearize the input signal. A maximum of nine segments are available.

The other features of this option are peak/valley detection and a re-zero (tare) function. The indicator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable in monitoring the limits of the process over any length of time since these values are stored at power-down to span over shifts, days, etc. Remote input E2-CON can be programmed to reset or engage the unit into a peak/valley reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed.

The re-zero (tare) function can also be controlled externally or by the front panel. This feature can quickly compensate for small shifts or drifts in the input signal.

ISOLATED ALARM OPTION

The alarm option consists of an additional printed circuit board with nine terminals. Six of these are the two Form-C relays and the other three are the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total, and tracking one another, if desired. If the alarms are programmed to latch (manual reset), then they will have to be reset either by the front panel or remote input. The alarms can be made to trigger from the totalizer instead of the input, to activate external alarms, control valves, etc.

Alarm #1 can be made to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (Alarm #2) automatically changes Alarm #1 so that the offset between Alarm #2 and Alarm #1 remains the same.

ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard current ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.

TOTALIZER EXAMPLE

An IMH is employed to indicate and totalize amp-hours of an electric heater element. A current transformer with a 5 amp AC output and the proper ratio is selected (ex. 30:1). The input is scaled to indicate 0.00 to 50.000 amps AC. Knowing the heater element nominal current draw is 40 amps AC and the element should be serviced every 13,140 amp-hours, the following programming steps are followed:

**BASIC SCALING**

<table>
<thead>
<tr>
<th>Pro 2”.....“dECPNt”</th>
<th>“round”</th>
<th>“dSP 1”</th>
<th>“INP 1”</th>
<th>“dSP 2”</th>
<th>“INP 2”</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
<td>50.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>
**TOTALIZER SET-UP**

With an average signal input of 40 amps AC for the Process Display, the following formula applies:

\[
S.F. = \frac{D.T. \times T.B.}{T.D.P.}
\]

Where:
- \(S.F.\) = Programmable Scale Factor
- \(D.T.\) = Desired Total Value For A Fixed Time Duration
- \(T.B.\) = Programmable Time Base
- \(T.D.P.\) = Desired Total Decimal Point
- \(I.D.D.P.\) = Input Display Decimal Point
- \(I.D.\) = Input Display Value

\[
T.B. = \text{If Program Select Number Chosen Is: Enter In Formula}
\]

- “0” for sec. = “I”
- “1” for min. = “60”
- “2” for hr. = “3600”

\[
I.D. = \text{Actual Time Period In Seconds Enter In Formula}
\]

\[
D.T.P. = \text{Desired Total Decimal Point Enter In Formula}
\]

\[
D.T.P. = \frac{I.D. \times T.B.}{S.F.}
\]

If 
\[
I.D.D.P. = \frac{S.F. \times I.D.D.P.}{T.D.P.} = \frac{D.T. \times T.B.}{T.D.P.}
\]

The totalizer will totalize up to 999999 (999,999 Amp-Hours).

* This value is normally 1, but can be used as a coarse scale factor of 60 or 3600.

** Since the time period is in Hrs., the selected T.B. is 3600 (Program Select Value = 2) which equals per hour (3600 sec.).

---

**PROGRAMMABLE FUNCTIONS**

Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN”, (shown as “arrows” on the front panel) are used to change the data and set-ups, while the “P” button is used to save or enter the data. After pressing “P” which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be ungrounded to gain access to programming. The following table lists the programming steps.

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Pro 0”</td>
<td>“RETURN TO MEASUREMENT MODE”</td>
</tr>
<tr>
<td>“Pro 1”</td>
<td>“SCALE UNIT BY APPLYING SIGNAL”</td>
</tr>
<tr>
<td>“dECPN”</td>
<td>“Enter decimal point for scaled display”</td>
</tr>
<tr>
<td>“round”</td>
<td>“Enter rounding factor and tare for zeroed display”</td>
</tr>
<tr>
<td>“SCALE”</td>
<td>“*”</td>
</tr>
<tr>
<td>“dSP 1”</td>
<td>“Enter display reading for scaling point #1”</td>
</tr>
<tr>
<td>“INP 1”</td>
<td>“Apply signal level for scaling point #1”</td>
</tr>
<tr>
<td>“dSP 2”</td>
<td>“Enter display reading for scaling point #2”</td>
</tr>
<tr>
<td>“INP 2”</td>
<td>“Apply signal level for scaling point #2”</td>
</tr>
<tr>
<td>“SEG”</td>
<td>“*”</td>
</tr>
<tr>
<td>“Pro 2”</td>
<td>“SCALE UNIT BY KEY-IN SIGNAL LEVEL”</td>
</tr>
<tr>
<td>“dECPN”</td>
<td>“Enter decimal point for scaled display”</td>
</tr>
<tr>
<td>“round”</td>
<td>“Enter rounding factor and tare for zeroed display”</td>
</tr>
<tr>
<td>“SCALE”</td>
<td>“*”</td>
</tr>
<tr>
<td>“dSP 1”</td>
<td>“Enter display reading for scaling point #1”</td>
</tr>
<tr>
<td>“INP 1”</td>
<td>“Enter signal level for scaling point #1”</td>
</tr>
<tr>
<td>“dSP 2”</td>
<td>“Enter display reading for scaling point #2”</td>
</tr>
<tr>
<td>“INP 2”</td>
<td>“Enter signal level for scaling point #2”</td>
</tr>
<tr>
<td>“SEG”</td>
<td>“*”</td>
</tr>
<tr>
<td>“Pro 3”</td>
<td>“PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED”</td>
</tr>
<tr>
<td>“dSP AL”</td>
<td>“Enable display alarms”</td>
</tr>
<tr>
<td>“EN1 AL”</td>
<td>“Enable enter alarms”</td>
</tr>
<tr>
<td>“dSPHY”</td>
<td>“Enable display hysteresis”</td>
</tr>
<tr>
<td>“ENHY”</td>
<td>“Enable enter hysteresis”</td>
</tr>
<tr>
<td>“rSt AL”</td>
<td>“Enable reset latched alarms”</td>
</tr>
<tr>
<td>“dSPbUF”</td>
<td>“Enable display of peak/valley readings”</td>
</tr>
<tr>
<td>“rStbUF”</td>
<td>“Enable reset of peak/valley readings”</td>
</tr>
<tr>
<td>“SELdSP”</td>
<td>“Enable switching display between input and total”</td>
</tr>
<tr>
<td>“LSm”</td>
<td>“Enable reset total”</td>
</tr>
<tr>
<td>“tARE”</td>
<td>“Enable re-zero (tare) of input signal”</td>
</tr>
</tbody>
</table>

* Entire sequence for this modular step is not shown (see manual for further details).

** This sequence may be subject to being locked-out due to other programmed sequences.

---

**PROGRAM 4** - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“FLtE”</td>
<td>“Enter level of digital filtering”</td>
</tr>
<tr>
<td>“0”</td>
<td>“no digital filtering”</td>
</tr>
<tr>
<td>“1”</td>
<td>“normal filtering”</td>
</tr>
<tr>
<td>“2”</td>
<td>“increased filtering”</td>
</tr>
<tr>
<td>“3”</td>
<td>“maximum filtering”</td>
</tr>
<tr>
<td>“E1-CON”</td>
<td>“Enter function of remote input”</td>
</tr>
<tr>
<td>“0”</td>
<td>“re-zero input”</td>
</tr>
<tr>
<td>“1”</td>
<td>“reset total”</td>
</tr>
<tr>
<td>“2”</td>
<td>“reset and gate totalizer”</td>
</tr>
<tr>
<td>“3”</td>
<td>“gate totalizer”</td>
</tr>
<tr>
<td>“4”</td>
<td>“display hold”</td>
</tr>
<tr>
<td>“5”</td>
<td>“reset peak/valley”</td>
</tr>
<tr>
<td>“6”</td>
<td>“reset peak and start peak indicator”</td>
</tr>
<tr>
<td>“7”</td>
<td>“reset valley and start valley indicator”</td>
</tr>
<tr>
<td>“8”</td>
<td>“reset latched alarms”</td>
</tr>
<tr>
<td>“9”</td>
<td>“reset all alarms”</td>
</tr>
<tr>
<td>“10”</td>
<td>“toggle display between input and total”</td>
</tr>
<tr>
<td>“11”</td>
<td>“re-zero input and totalize the tared values”</td>
</tr>
<tr>
<td>“12”</td>
<td>“display hold with tare”</td>
</tr>
<tr>
<td>“13”</td>
<td>“instrument reading synchronization”</td>
</tr>
<tr>
<td>“E2-CON”</td>
<td>“Same function as E1-CON”</td>
</tr>
</tbody>
</table>

---

**PROGRAM 5** - PROGRAM TOTALIZER

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“dECPN”</td>
<td>“Enter decimal point for totalizer”</td>
</tr>
<tr>
<td>“tBASE”</td>
<td>“Enter time base”</td>
</tr>
<tr>
<td>“0”</td>
<td>“second”</td>
</tr>
<tr>
<td>“1”</td>
<td>“minute”</td>
</tr>
<tr>
<td>“2”</td>
<td>“hour”</td>
</tr>
<tr>
<td>“SCLFAC”</td>
<td>“Enter multiplying scale factor”</td>
</tr>
<tr>
<td>“Lo-cut”</td>
<td>“Enter low-signal cut out”</td>
</tr>
</tbody>
</table>

---

**PROGRAM 6** - PROGRAM ALARMS

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“tRAc”</td>
<td>“Enable alarm value tracking”</td>
</tr>
<tr>
<td>“dSP”</td>
<td>“Enable display alarm annunciators”</td>
</tr>
<tr>
<td>“LAc-1”</td>
<td>“Enable alarm #1 latching”</td>
</tr>
<tr>
<td>“ASN-1”</td>
<td>“Enter alarm #1 trigger source (input or total)”</td>
</tr>
<tr>
<td>“AL-1”</td>
<td>“Enter alarm #1 value”</td>
</tr>
<tr>
<td>“HYS-1”</td>
<td>“Enter hysteresis value for alarm #1”</td>
</tr>
<tr>
<td>“Act-1”</td>
<td>“Enter alarm #1 action (high or low)”</td>
</tr>
<tr>
<td>“LAc-2”</td>
<td>“Enable alarm #2 latching”</td>
</tr>
<tr>
<td>“ASN-2”</td>
<td>“Enter alarm #2 trigger source (input or total)”</td>
</tr>
<tr>
<td>“AL-2”</td>
<td>“Enter alarm #2 value”</td>
</tr>
<tr>
<td>“HYS-2”</td>
<td>“Enter hysteresis value for alarm #2”</td>
</tr>
<tr>
<td>“Act-2”</td>
<td>“Enter alarm #2 action (high or low)”</td>
</tr>
</tbody>
</table>

---

**PROGRAM 7** - NOT USED

---

**PROGRAM 8** - PROGRAM RE-TRANSMITTED ANALOG OUTPUT

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“ASIN”</td>
<td>“Select source of analog output (input or total)”</td>
</tr>
<tr>
<td>“ANLo”</td>
<td>“Enter 4mA or 0 VDC display value”</td>
</tr>
<tr>
<td>“ANHi”</td>
<td>“Enter 20mA or 10 VDC display value”</td>
</tr>
</tbody>
</table>

---

**PROGRAM 9** - SERVICE OPERATIONS (Protected by access codes)
MOTOR MONITORING EXAMPLE

An IMH is employed to monitor AC current of a single-phase 10 horsepower 115 V AC motor. Also, the meter will be used to total current for preventative maintenance purposes. Knowing the maximum full load current is 100 amps AC, a current transformer (CT) of 100:5 ratio is selected.

The IMH is scaled to indicate 0.00 at an input of 0.000 amps AC and 100.00 at 5.000 amps AC. Alarm #1 is programmed to activate if the motor current exceeds 84.00 amps AC, which is a 40% increase in current draw from the nominal of 60 amps AC. Alarm #1 is disabled by external control pin during motor start-up due to current surges. Peak and valley (max/min) reading for each day are to be recorded.

The amount of current drawn by an electric motor gives a good indication of the overall condition of the motor. Using the totalizer to total current and knowing the nominal current draw is 60 amps AC, preventive maintenance can be performed on total amp-hours. Alarm #2 is programmed to latch when the predetermined amount of total amp-hours is reached (ex. 4320 amp-hours). Totalization is disabled if the input is below 30 amps AC.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO</th>
<th>DESCRIPTION</th>
<th>TOTALIZER/ LINEARIZER/ PEAK/VALLEY TARE/ECON</th>
<th>DUAL ALARMS</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMH</td>
<td>5 AMP AC Intelligent Current Meter</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMH40060</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>IMH40062</td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>IMH43060</td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>YES</td>
<td>4 to 20 mA</td>
<td>IMH43066</td>
</tr>
<tr>
<td></td>
<td></td>
<td>YES</td>
<td>YES</td>
<td>0 to 10 VDC</td>
<td>IMH43068</td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.
MODEL IMI - APOLLO 6 DIGIT INTELLIGENT METER FOR RATE INPUTS

- 6-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAY
- ACCEPTS INPUT RATES UP TO 50 KHz
- SECONDARY DISPLAY INDICATES TOTALIZATION or EFFICIENCY
- 0.01% ACCURACY
- PEAK/VALLEY INDICATION & MEMORY
- PROGRAMMABLE FRONT PANEL LOCK-OUT
- SENSOR EXCITATION SUPPLY
- DUAL ALARM RELAY OUTPUTS (Optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (Optional)
- 4 to 20 mA or 0 to 10 VDC ANALOG OUTPUT (Optional)

GENERAL DESCRIPTION

The Apollo Intelligent Meter for Digital Rate Inputs (IMI) accepts frequencies up to 50 KHz which can be scaled to any desired engineering units. The sensor input is user configurable and allows for a wide selection of compatible sensors. The adjustable minimum and maximum update times provide optimal display response at any input frequency.

The IMI provides two display functions in a single package. The display can indicate the input rate and then be toggled to display either totalization or efficiency. The max. display for all functions is 999,999. The totalizer features independent scaling and a low signal cut-out to suit a variety of applications. The efficiency feature can display the input rate in percent of target (process efficiency). Additionally, nine segments can easily be programmed to linearize transducers with non-linear outputs, such as square law devices.

The indicator features a choice of two different scaling procedures for the rate display, which greatly simplifies initial set-up. English-style display prompts and front panel buttons aid the operator in set-up and operation. A front panel programmable lock-out menu used with the program disable input protects setup data and guarantees no unwanted changes occur during operation. Programmable digital filtering enhances the stability of the reading. Programmable remote inputs “E1-CON” and “E2-CON” can be used to control a variety of functions, such as totalizing, alarm control, display hold or triggered input. All setup data is stored in nonvolatile memory.

The IMI has several built-in diagnostic functions to alert operators of most malfunctions. Extensive testing of noise interference mechanisms and full burn-in make the indicator extremely reliable in industrial environments. The die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications, when properly installed. Plug-in style terminal blocks simplify installation and wiring change-outs.

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.

SPECIFICATIONS

1. DISPLAY: 6-digit, 0.56” (14.2 mm) High Red LED, programmable decimal points, maximum display 999,999. Flashing display during totalizer overflow. “———” displayed during rate/efficiency display out of range.
2. POWER REQUIREMENTS:
   A.C. Power: Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA
3. CONTROLS: Three front panel push buttons for modifying alarm values and indicator set-up. Three external inputs; one for disabling the front panel, two for programmable function inputs.
4. SIGNAL INPUT: Switch selectable to accept signals from a wide variety of sensors.

Max. Input Frequency: 50 KHz, 50% Duty Cycle.
Max. Input Voltage & Current: With NPN O.C. switch OFF; ±50 V peak, ±5 mA.
Input Impedance: With MAG. PKUP. & NPN O.C. switches OFF; 1 MΩ.

DIMENSIONS “In inches (mm)”

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3)H x 5.5” (140)W.

Panel Cut-out

1.85 (47.0)
3.42 (87.0)
1.75 (44.5)
3.80 (96.5)
1.95 (49.5)
3.00 (76.2)
1.1 (2.5)
4. SIGNAL INPUT: (Cont’d)  

**SWITCHES:**

- **MAG PKUP:** Connects a 0.1 µF input damping capacitor.  
  Sensitivity: 125 mV peak (typical @ 12 VDC)  
  Hysteresis: 30 mV  
  Input Impedance: 26.5 KΩ @ 60 Hz  
  Max. Input Voltage: ±50 V peak  
  LOGIC: Sets input trigger level.  
  Trigger Level: +2.5 V with 30 mV hysteresis.  
  NPN O.C.: Provides internal 3.9 KΩ pull-up resistor to +12 VDC.  
  ISK = 3 mA MAX @ 12 VDC  
  VMAX IN = 28 VDC.

**5. DISPLAY COMBINATIONS:** Rate/Total or Rate/Efficiency.  
**6. RATE/EFFICIENCY:**  
Accuracy: 0.01% ± 1 digit  
Min. Input Frequency: 0.01 Hz  
Programmable Update Time Range: 0.2 secs to 100.0 secs.  
**7. TOTALIZER:** Programmable time-base, scale factor (0.001 to 100000) and low-end cutout. Max. response time 0.2 secs.  
**8. PROGRAM DISABLE (PGM.DIS.):** Used with programmable lockout menus to limit operator input when active. Connect to common (TBA #7) to activate.  
**9. E1-CON & E2-CON:** External remote inputs which allow activation of various functions (reset total, peak indicator mode, trigger mode, etc.).  
  \[ V_{IL} = 0.8 \times V_{MAX} \quad V_{IH} = 2.0 \times V_{MIN} \quad \text{Response Time} = 0.2 \text{ sec max.} \]  
**10. 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.  
  **Altitude:** Up to 2000 meters  
  **11. DC OUT:** +12 VDC ±25% @ 60 mA max.  
**12. SERIAL COMMUNICATIONS (Optional):**  
  **Type:** Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source).  
  **Baud Rate:** programmable 300 to 9600  
  **Maximum address:** 99 (Actual number in a single loop is limited by serial hardware specifications).  
**Data Format:** 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit).  
**Serial Hardware Specifications:**  
**SO - Output Transistor Rating:**  
  \[ V_{MAX} = 30 \text{ VDC} \quad V_{SAT} = 1 \times V_{MAX} \text{ at 20 mA.} \]  
  Note: This will allow up to 28 units max. in each loop.  
  **SI - Input Diode Rating:**  
  \[ V_{CE} = 1 \times V_{MAX} \text{ at 100 mA max.; } V_{OH} = 30 \text{ VDC max.} \]  
**Relays:**  
Type: Form C (2)  
Max. Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.  
**Relay Life Expectancy:** 100,000 cycles at Max. load Rating. (As load level decreases, life expectancy increases.)

**13. ALARMS (Optional):**  
  **Response Time:** 0.2 sec min.  
  **Solid State:** Two, isolated, sinking open collector NPN transistors acting in parallel with relays.  
  \[ V_{CC} = 1 \times V_{MAX} \text{ at } 100 \text{ mA max.; } V_{OH} = 30 \text{ VDC max.} \]  
  **Relays:**  
  **Type:** Form C (2)  
  **Max. Rating:** 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.  
  **Relay Life Expectancy:** 100,000 cycles at Max. load Rating. (As load level decreases, life expectancy increases.)

**14. ANALOG OUTPUT (Optional):**  
4 to 20 mA: Digital scaling and offsetting within 4 to 20 mA range.  
Accuracy: 0.1% of full scale  
Resolution: 12 bits  
**Compliance Voltage:** 10 VDC (500 ma max. loop impedance)  
0 to 10 VDC: Digital scaling and offsetting within 0 to 10 VDC range.  
Accuracy: ±0.1% of reading ±35 mV  
Resolution: 12 bits  
Min. Load Resistance: 10 KΩ (1 mA max.)

**15. LINEARIZER/PEAK & VALLEY DETECTION:**  
- 9-segment multiple slope scaling for non-linear inputs. Peak and Valley recording.  
**16. CERTIFICATIONS AND COMPLIANCES:**  
**EMISSIONS:**  
CISPR 11 Radiated and conducted emissions  
**EMC IMMUNITY:**  
Meets EN 50082:2: Industrial Environment.  
**ENV 61000-4-2 - Electrostatic discharge (ESD)**  
**ENV 61000-4-4 - Electrical fast transient/burst (EFT)**  
**ENV 61000-4-8 - Power frequency magnetic field**

**Notes:**  
1. Units with Analog Output Option  
   Permissible loss of performance during EMI disturbance at 10V/m.  
   Analog Output Deviation: Less than 27% of full scale  
   For operation without loss of performance:  
   a. Install power line filter, RLC #LFIL0000 or equivalent.  
   b. Install unit in a Buckeye SM 7013-0 enclosure or equivalent.  
   c. Install all I/O cables connecting to the unit in metal conduit that is connected to the enclosure at one end, and earth ground at the opposite end.  
2. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel. Mounting panel connected to earth ground (protective earth).  
3. Refer to the EMC Installation Guidelines section of the manual for additional information.

**17. CONSTRUCTION:** Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).  
**18. CONNECTION:** Removable terminal blocks.  
**WEIGHT:** 1.2 lbs (0.5 kg)

**SECONDARY DISPLAY TOTALIZATION OR EFFICIENCY**  
The secondary display can be programmed to indicate either totalization or input rate efficiency.  
The Totalizer totals (adds) input pulses and displays the result according to the programmable time base and scale factor values. A low-end cutout can be programmed to stop totalization if desired. The Efficiency display will indicate the current percentage of the input signal as compared to the programmed target value.

The decimal point position of the totalizer or efficiency display is programmed independent of the input rate signal. The totalizer may be reset via a remote input (E1-CON or E2-CON) or by the front panel buttons. At loss of power to the indicator, the contents of the totalizer are saved.

**LINEARIZER/PEAK & VALLEY DETECTION**  
The linearizer feature is a series of programmable scaling points that are used to construct linear segments to linearize the input signal. A maximum of nine segments are available.

The peak/valley detection feature will indicate and record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable in monitoring the limits of the process over any length of time since these values are stored at power-down to span over shifts, days, etc. An external input can be programmed to reset or engage the unit into a peak/valley reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed.

**ISOLATED SERIAL COMMUNICATIONS OPTION**  
The serial communication option is a half-duplex, two-way 20 mA current loop that can be connected to a printer, a computer, a terminal, or a controller to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, which include change alarm value, reset totalizer, and transmit input rate value. Two loops are required for all hook-ups, a transmit loop and a receive loop. An internal 20 mA source is provided with the serial option. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units.

**ISOLATED ALARM OPTION**  
The alarm option consists of an additional printed circuit board with nine terminals. Six of these are for the two Form-C relays and the other three are the two end-of-conductor transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, ON/OFF delay, auto or manual reset, triggering from input rate or total/effectiveness, and tracking one another, if desired. If the alarms are programmed to latch (manual reset), then they will have to be reset either by the front panel buttons or remote input (E1-CON or E2-CON). The alarms can be made to activate external alarms, control valves, etc.

**Alarm #1 can be made to track Alarm #2 by enabling alarm tracking.** This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shutdown trip value (Alarm #2) automatically changes Alarm #1 so that the offset between Alarm #2 and Alarm #1 remains the same.
ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 mA and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC signal to drive chart recorders, remote indicators and controllers. Non-standard voltage ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 0 VDC and 10 VDC.

PROGRAMMABLE FUNCTIONS

Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel “UP” and “DOWN” buttons (shown as “arrows” on the front panel) are used to change the data and set-ups, while the “P” button is used to save or enter the data. After pressing “P”, the user gains entry into the programming mode. The programming modules are identified by the message “Pro” and a module number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM.DIS.” must be inactive (ungrounded) to gain access to programming. The following table lists the programming steps.

**“Pro 0” - RETURN TO MEASUREMENT MODE**

**“Pro 1” - SCALE UNIT BY APPLYING SIGNAL**

dECPNt - Enter decimal point for scaled input display
“round” - Enter rounding factor and trailing zeros for scaled input display
“Lo-udt” - Enter low update time for rate display updates
“Hi-udt” - Enter high update time for rate display updates
SCALE - Select desired display as totalizer or efficiency totalizer
“dESP” - Enter display reading for scaling point #1
“SEGI” - Enter decimal point for scaling point #1

**“Pro 2” - SCALE UNIT BY KEY-IN SIGNAL LEVEL**

dECPNt - Enter decimal point for scaled input display
“round” - Enter rounding factor and trailing zeros for scaled input display
“Lo-udt” - Enter low update time for rate display updates
“Hi-udt” - Enter high update time for rate display updates
SCALE - Select desired display as totalizer or efficiency totalizer
“dESP” - Enter display reading for scaling point #1
“SEGI” - Enter decimal point for scaling point #1

**“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED**

dSP AL - Enter display alarms
“dSPhYS” - Enable display hysteresis
“ENTHYS” - Enter display hysteresis
“rSL AL” - Disable reset, latch alarms
“dSPbUF” - Enable display of peak/valley readings
“rStbUF” - Enable reset of peak/valley readings
“SCLtS” - Enable switch over display between input and total/efficiency
“rStOt” - Enable reset total

**“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE INPUT (E-1 CON & E-2 CON) FUNCTION**

“FILTER” - Enter level of digital filtering
0 - No digital filtering
1 - Normal level
2 - Increased level
3 - Maximum level
“E1-CON” - Enter function of remote input
0 - Re-start time measurement for input
1 - Reset total
2 - Reset and gate totalizer
3 - Gate totalizer
4 - Display hold
5 - Reset peak/valley
6 - Reset peak and start peak indicator
7 - Reset peak and start peak level indicator
8 - Reset latch alarms
9 - Reset all alarms
10 - Toggle display between input rate and total or efficiency
11 - Input rate as a triggered rate meter
12 - Display request
“E2-CON” < E-2 CON has the same programmable functions as E-1 CON.

**“Pro 5” - PROGRAM SECOND DISPLAY AS TOTALIZER OR EFFICIENCY TOTALIZER**

dISP - Select desired display (Total or Efficiency)
“dSChSE” - Enter display reading for scaling point #2
“SEGl” - Enter decimal point for scaling point #2

**“Pro 6” - PROGRAM ALARMS**

“TrAc” - Enter alarm trigger source (input or total/eff.)
“AL-1” - Enter alarm #1 or #2
dEBE - Enter alarm #1 or #2 (high or low)
“OnDE1” - Enable delay ON action for alarm #2
“OnDE2” - Enable delay OFF action for alarm #2

**“Pro 7” - PROGRAM SERIAL Communications**

“Baud” - Enter baud rate
“AddrES” - Enter loop address number (0-99)
“Print” - Enter print function
0 - Rate
1 - Rate, peak, valley
2 - Rate, alarm 1, alarm 2
3 - Rate, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley
4 - Totalizer/efficiency
5 - Rate, totalizer/efficiency
6 - Rate, totalizer/efficiency, peak, valley
7 - Totalizer/efficiency, alarm 1, alarm 2
8 - Rate, totalizer/efficiency, alarm 1, alarm 2
9 - Rate, totalizer/efficiency, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley
“FULL” - Enable/Disable abbreviated printing

**“Pro 8” - PROGRAM RE-TRANSMITTED ANALOG OUTPUT**

“ASln” - Select source of analog output (input or total/eff.)
“AN-L0” - Enter 4 mA or 0 VDC display value
“AN-Hi” - Enter 20 mA or 10 VDC display value

**“Pro 9” - FACTORY SERVICE OPERATIONS**

(Protected by access codes)

- This sequence may be locked-out due to other programmed sequences.
- Entire sequence for this modular step is not shown (see manual for further details).
PROGRAMMING EXAMPLE

An IMI is used to monitor web speed of a textile machine. A display of the web speed in FPM and efficiency is also desired. Underspeed and overspeed protection is required in addition to an analog output to a chart recorder. The optimum speed of the web is 1100 FPM. The absolute maximum speed equals 120% of the optimum speed and the absolute minimum speed equals 70% of the optimum speed. If the web speed exceeds these limits, the appropriate alarm will latch and shut-down the machine. The “on” delay feature is used for both setpoints to allow the textile machine five seconds to reach operating speed during start-up and also allow for temporary over or underspeed situations. The analog output will monitor the efficiency and provide 4 mA @ 0.00% and 20 mA @ 120.00% A proximity sensor is used to sense a key-way on an idler roll and produces 565 Hz @ 1100 FPM. Reset of the latched alarms and peak/valley buffers is accomplished via a key switch connected to inputs E1-CON and E2-CON.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>OPTIONS</th>
<th>PART NUMBERS</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>DUAL ALARM</td>
<td>SERIAL COMMUNICATIONS</td>
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MODEL IMP - APOLLO 4½-DIGIT DC INTELLIGENT METER FOR PROCESS INPUTS

- 40,000 COUNT MEASUREMENT RESOLUTION (Can be scaled to ±99,999 display)
- ACCEPTS STANDARD PROCESS SIGNAL CURRENTS (4 to 20 & 10 to 50 mA DC; Automatic Ranging)
- EASY, ONE-PASS SCALING
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- TRANSDUCER EXCITATION SUPPLY (Optional)
- INTEGRATOR (Totalizer) AND LINEARIZER (Optional)
- PEAK/VALLEY MEMORY AND TARE (Re-zero) FUNCTION (Optional)
- DUAL ALARM RELAY OUTPUTS (Optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (Optional)

DESCRIPTION

The Apollo Intelligent Process Meter accepts standard process signals and precisely scales them into engineering units. One model covers any current range within 0 to 50 mA. A full 6-digit display accommodates nearly any engineering units and holds large totalization values. State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages are available to fulfill many process applications.

The indicator features a choice of two different scaling procedures which greatly simplifies initial set-up. English Style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data and operation modes from unauthorized personnel. Programmable digital filtering enhances the stability of the reading. Programmable remote input “E1-CON” pin can be utilized to control a variety of functions, such as totalizing, alarm control, display hold or tare operations. All set-up data is stored in E²PROM, which will hold data for a minimum of 10 years without power.

An optional integrator (totalizer)/linearizer can be used to totalize or integrate signals up to a maximum display value of 999,999. It features independent scaling and a low signal cut-out to suit a variety of signal integration applications. Programmable remote input “E2-CON” pin is included with this option, and can control a variety of functions, such as totalizing, alarm control, display hold or tare operations, simultaneously with “E1-CON” pin. Additionally, nine slopes and offsets can easily be programmed with this option to linearize transducers with non-linear outputs, such as square law devices. Peak/valley (max/min) reading memory, display hold and a signal re-zeroing (tare) function are included with this option and they are easily recalled and controlled by either the front panel or a remote input. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications. Optional 20 mA loop, bi-directional serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

An optional 4 to 20 mA or 0 to 10 VDC re-transmitted analog output can be scaled by the user to interface with a host of recorders, indicators and controllers. The indicator 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 die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications. Plug-in style terminal blocks simplify installation wiring and change-outs.

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.

SPECIFICATIONS

1. DISPLAY: 6-digit, 0.56" (14.2 mm) High LED, minus sign displayed for negative values. “Flashing” display for totalizer overflow. “.....” displayed for input display out of range. “OLOLOL” displayed for input display overload and “ULULUL” for underload (negative overload).

2. POWER REQUIREMENTS:

A.C. Power: Switch Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 V A

3. CONTROLS: Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

4. SIGNAL INPUT RANGE: 0 to 50 mA DC (4 to 20 mA, 10 to 50 mA)

DIMENSIONS “In inches (mm)”

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
SPECIFICATIONS (Cont’d)

5. INPUT IMPEDANCE: 10 Ω, 0.2 VDC @ 20 mA  
Max. Input Current: 200 mA DC (continuous)

6. ACCURACY AND RESOLUTION:
   Resolution: 1/40,000
   Accuracy: ±(0.02% of full scale + 1 digit)

7. PROGRAMMABLE DISPLAY RANGE: -999999 to +999999
   Readings can be programmed.

8. READING RATE: 2.5 readings/second

9. RESPONSE TIME: 2 seconds to settle for step input (increases with programmable digital filtering)

10. NORMAL MODE REJECTION: 40 dB at 50/60 Hz (may be improved by programmable digital filtering)

11. COMMON MODE REJECTION: 120 dB, DC to 50/60 Hz

12. TOTALIZER/LINERIZER: Front panel button for input/display total select. External totalizer reset/enable. Programmable time-base, scale factor (0.001-100.000) and low-end cut-out. 9-segment multiple slope scaling for non-linear inputs. Response Time = 0.2 sec max.

13. E1-CON & E2-CON: External remote inputs that allow activation of various functions (reset total, peak indicator mode, alarm control, etc.)
   VIL = 0.8 VMAX; VIH = 2.0 VMIN; Response Time = 0.2 sec max.

14. EXCITATION (Optional): Regulated 18 VDC @ 60 mA max.

15. SERIAL COMMUNICATIONS (Optional):
   Type: Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source.)
   Band Rate: programmable 300 to 2400
   Maximum address: 99 (Actual number in a single loop is limited by serial hardware specifications.)
   Data Format: 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit.

16. SERIAL HARDWARE SPECIFICATIONS:
   SO - Output Transistor Rating: VMAX = 30 VDC
   Note: Will allow up to 28 units max. in each loop.
   SI - Input Diode Rating: VF = 1.25 VTyp; 1.5 VMAX
   Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

17. ALARMS (Optional):
   Solid State: Two, isolated, sinking open collector PNP transistors acting in parallel with relays.
   IMax: 100 mA. VSUB = 1 V @ 100 mA. VMAX = 30 VDC.
   Relays:
   Type: Form C (2)
   Max. Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 hp @ 120 VAC (inductive load).
   Relay Life Expectancy: 100,000 cycles at max. rating. (As load decreases, life expectancy increases.)

18. ANALOG OUTPUT (Optional):
   4 to 20 mA: Digital scaling and offsetting within a 4 to 20 mA range
   Accuracy: ±0.1% of full scale
   Resolution: 12 bits
   Compliance Voltage: 10 VDC (500 µA max. loop impedance)
   0 to 10 VDC: Digital scaling and offsetting within a 0 to 10 VDC range
   Accuracy: ±(0.1% of reading +35 mV)
   Resolution: 12 bits
   Min. Load Resistance: 10 KΩ (1 mA max.)

19. PEAK/VALLEY/TARE (Optional): Peak and Valley recording. Signal re-zero (tare).

20. ELECTROMAGNETIC COMPATIBILITY:
   Immunity to EN 50082-2
   Electrostatic discharge
   EN 61000-4-2 Level 2; 4 kv contact 1 Level 3; 8 kvair
   EN 61000-4-3 Level 3; 10 V/m 2 80 MHz - 1 GHz
   Fast Transients (burst)
   EN 61000-4-4 Level 4; 2.5 kV OVP
   RF Conducted Interference
   Level 3; 10 V/m 150 kHz - 80 MHz
   Level 4; 50 V/m
   Power Frequency Magnetic Fields
   EN 61000-4-6 Level 3; 10 V/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. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.
   2. Self-recovery limit of performance during EMI disturbance at 10 V/m:
      Process and analog output signals may deviate during EMI disturbance. For operation without loss of performance:
      Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent)
      Refer to the EMC Installation Guidelines in the manual for more information.

   21. ENVIRONMENTAL CONDITIONS:
      Operating Temperature Range: 0° to 50°C
      Storage Temperature Range: -40° to 85°C
      Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0 to 50°C.
      Span Temperature Coeff.: 100 ppm°C/C max; 40 ppm°C typ.
      Zero Temperature Coeff.: ±1 µV/C typ.

22. CONSTRUCTION:
   CONSTRUCTION: Die-cast metal front bezel that meets NEMA 4P/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).

23. CONNECTION:
   Removeable terminal blocks

24. WEIGHT:
   1.2 lbs (0.54 Kg)

EXCITATION OPTION

The excitation option provides a regulated excitation voltage (18 VDC, 60 mA) that can be used to power the transducer.

TOTALIZER/LINERIZER/PEAK/VALLEY/TARE/ E2-CON OPTION

The major feature of this option is its integrator/totalizer (accumulator). The integrator simply totals (adds) input readings along with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input (E2-CON), by the front panel or through the serial communications loop. Alarms may be programmed to trigger from totalizer values, for example to signal total flow thresholds for batching operations. A programmable low signal level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

The re-zero (tare) function is a feature in a series of programmable scaling points that are used to construct linear segments to linearize the input signal. The most common application would be to interface with square law devices (generally, flow transducers). A maximum of nine segments are available and using nine segments for a square law device would reduce linearity errors to 0.35%.

The other features of this option are peak and valley detection and a re-zero (tare) function. The indicator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable when monitoring the limits of the process over any length of time which can span over shifts, days, etc. (These values are stored at power-down).

A remote input (E1-CON or E2-CON pin) can be programmed to reset or engage the unit into a peak reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

The re-zero (tare) function can also be controlled via a remote input or by the front panel. This feature can quickly compensate for small shifts or drifts in the input signal or can re-zero every operation, such as batching.

ISOLATED ALARM OPTION

The alarm option consists of an additional printed circuit board with 9 connections. Six of these are for the two F-B-C relays and the other three are for the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total and they can be made to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be made to trigger from either the integrator/totalizer or the input display, to activate external alarms, control valves, etc.

Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process. Changing the shut-off trip value (alarm #2) automatically changes the pre-warn value (alarm #1) an equal amount. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control.

ISOLATED SERIAL COMMUNICATIONS OPTION

The serial communication option is a half-duplex, two-way 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit input signal. Two loops are required for all hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are serial hardware limitations which restrict this to a lower number of units per serial loop.)

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
PROGRAMMABLE FUNCTIONS

Programming of the IMP is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN”, (shown as “arrows” on the front panel) are used to change the data and setups, while the “P” button is used to save or enter the data. After pressing “P” which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be ungrounded to gain access to programming. The following table lists the programming steps.

“Pro 0” - RETURN TO MEASUREMENT MODE

“Pro 1” - SCALE UNIT BY APPLYING SIGNAL

dECPNI - Enter decimal point for scaled display
round - Enter rounding factor and trailing zeros for scaled display
“SCALE” - *
dSP 1 - Enter display reading for scaling point #1
“INP 1” - Apply signal level for scaling point #1
dSP 2 - Enter display reading for scaling point #2
“INP 2” - Apply signal level for scaling point #2
“SEGt” - *

“Pro 2” - SCALE UNIT BY KEY-IN SIGNAL LEVEL

dECPNI - Enter decimal point for scaled display
round - Enter rounding factor and trailing zeros for scaled display
“SCALE” - *
dSP 1 - Enter display reading for scaling point #1
“INP 1” - Apply signal level for scaling point #1
dSP 2 - Enter display reading for scaling point #2
“INP 2” - Apply signal level for scaling point #2
“SEGt” - *

“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED

dSP AL - Enable display alarms
“ENT AL” - Enter enable alarms ➤
dSPHYS - Enable display hysteresis
“ENHyS” - Enable enter hysteresis ➤
rSt AL - Enable reset latched alarms
dSPvUF - Enable display of peak valley readings
*rStbUF - Enable reset of peak valley readings ➤
“SELdSP” - Enable switching display between input and total
“SEnHOn” - Enable reset total
“ARtE” - Enable re-zero (tare) of input signal

“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION

“FILThr” - Enter level of digital filtering
“0” - no digital filtering
“1” - normal filtering
“2” - increased filtering
“3” - maximum filtering

“E1-CON” - Enter function of remote input
“0” - re-zero input
“1” - reset total
“2” - reset and gate totalizer
“3” - gate totalizer
“4” - display hold
“5” - reset peak/valley
“6” - reset peak start peak indication
“7” - reset valley and start valley indication
“8” - reset latched alarms
“9” - reset all alarms
“10” - toggle display between input and total
“11” - re-zero input and totalize the tared values
“12” - display hold with tare
“13” - instrument reading synchronization
“14” - print request

“E2-CON” - Same function as “E1-CON”

“Pro 5” - PROGRAM TOTALIZER

dECPNI - Enter decimal point for totalization
“tCol” - Enable enter totalizers ➤
“FULL” - Enable full or abbreviated transmission

“Pro 6” - PROGRAM ALARMS

“ASIN” - Select source of analog output
“FULL” - Enable full or abbreviated transmission
“FULL” - Enable full or abbreviated transmission
“AddrE” - Enter loop address number
“bAud” - Enter baud rate
“Act-2” - Enter alarm #2 action
“AL-2” - Enter alarm #2 value
“ASN-2” - Enter alarm #2 trigger source
“LAtC-2” - Enable alarm #2 latching
“dISP” - Enable display alarm annunciators
“trAc” - Enable alarm value tracking
“dISP” - Enable display alarm annunciators
“ASIN” - Select source of analog output

“Pro 7” - PROGRAM SERIAL COMMUNICATIONS

“bAud” - Enter baud rate
“AddE” - Enter loop address number (0-99)
“Act-2” - Enter alarm #2 action
“AL-2” - Enter alarm #2 value
“dISP” - Enable display alarm annunciators
“trAc” - Enable alarm value tracking
“ASIN” - Select source of analog output
“ASN” - Enable alarm #2 trigger source (input or total)
“ACL-2” - Enable alarm #2 latching
“HYS-2” - Enable hysteresis value for alarm #2

“Pro 8” - PROGRAM RE-TRANSMITTED ANALOG OUTPUT

“ASIN” - Select source of analog output
“FULL” - Enable full or abbreviated transmission
“FULL” - Enable full or abbreviated transmission
“dISP” - Enable display alarm annunciators
“trAc” - Enable alarm value tracking
“ASIN” - Select source of analog output

“Pro 9” - SERVICE OPERATIONS (Protected by access code)

ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard current ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.

* - Entire sequence for this modular step is not shown (see manual for further details).
† - This sequence may be subject to being locked-out due to other programmed sequences.
**TOTALIZER EXAMPLE**

A milk producer requires that the flow rate of a pump be monitored in 10ths of gallons per minute. Also, a running total of the number of gallons that has been pumped is needed for accounting/storage purposes. The IMP meets all of these needs. A flow sensor with a 4-20 mA output that corresponds to 0 to 175 gallons per minute is used. The input is scaled to read in tenths of gallons per minute and the totalizer will display gallons. The following programming steps are performed.

**BASIC SCALING**

<table>
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<tr>
<th>Signal Input</th>
<th>Excitation</th>
<th>Tare/Valley</th>
<th>Peak/Valley</th>
<th>Line/2</th>
<th>Totalizer/Alarm</th>
<th>Lead/Zone</th>
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</table>

**TOTALIZER SET-UP**

With an average input of 175.0 gallons, the totalizer is to display in gallons per minute. The following formula applies:

\[
S.F. = D.T. \times \left[ \frac{T.B.}{T.D.D.P.} \right] \times D.T.D.P. / T.D.D.P.
\]

**TOTALIZER EXAMPLE**

An IMP indicator is installed as a monitoring device for pressure levels within an industrial boiler. A pressure transducer with a range of 0-1500 PSI and a corresponding 4-20 mA output is selected. The maximum allowable pressure of the boiler is 1200 PSI, and at which time a pressure relief valve will operate (this makes the system inherently safe). In addition, when the relief valve trips, fuel delivery to the boiler must be stopped. The relay option of the indicator is employed to turn off the fuel at 1200 PSI. To provide for fail-safe operation, operator intervention is required to reset the latched relay in order to re-start the boiler. The indicator’s other output is used to signal operators with a warning bell when high pressures exist (1100 PSI), so that they may take action to prevent boiler shut-down. The alarm/set point values are made to track, so changing the cut-off alarm changes the other an equal amount. Additionally, the indicator is programmed to provide a display alarm in both cases. Key switches are installed in the panel to lock-out the front panel from operators and to provide the means to reset the latched relay to re-start the boiler. The linearizer/totalizer option is specified to integrate the average boiler pressure over discrete time periods (i.e. overnight, during peak use, start-up, etc). Peak pressures are automatically stored with this option.

Programming module #5 (Pro 5) is used to set up the integrator. The re-transmitted analog output is also specified to drive a chart recorder with 4-20 mA for a hard copy of pressure profiles for later evaluation.

Scaling of the indicator is done by programming module #1 (Pro 1). For dSP 1, 0 PSI is key-ed in. For INP 1, the transmitter is powered and connected to the indicator and the boiler is at 0 PSI. The indicator then measures the output from the transmitter. For dSP 2, 1000 PSI is key-ed in. Prior to INP 2, the boiler is fired and brought to 1000 PSI as checked by a reference pressure gage. Once stabilized, the indicator is allowed to measure the output of the transducer for INP 2. Since there are no span/zero interactions, scaling is complete.

**ORDERING INFORMATION**

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<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>+18 VDC EXCITATION</th>
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<th>SERIAL OUTPUT</th>
<th>ANALOG OUTPUT</th>
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For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.
MODEL IMR - APOLLO INTELLIGENT METER FOR RTD INPUTS

- ACCEPTS STANDARD, 3-WIRE 100 Ω RTD SENSORS (ALPHA = 0.00385 or ALPHA = 0.00392) F OR C, 0.1 OR 1 DEGREE RESOLUTION
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56" HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- INTEGRATOR (Totalizer) (Optional)
- PEAK/VALLEY MEMORY (Optional)
- DUAL ALARM RELAY OUTPUTS (Optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (Optional)
- 4 to 20 mA OR 0 to 10 VDC ANALOG OUTPUT (Optional)

DESCRIPTION

The Apollo Intelligent RTD Meter accepts standard RTD inputs and precisely linearizes them into temperature readings. A full 6-digit display accommodates a wide range of temperature inputs and holds large totalization values. State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages are available to fulfill many process applications.

The indicator features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree of resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data and operation modes from unauthorized personnel. Programmable digital filtering enhances the stability of the reading and remote input "E1-CON" can be utilized to control a variety of totalizing, display hold, set point and peak/valley reading operations. All set-up data is stored in E2PROM, which will hold data for a minimum of 10 years without power.

An optional integrator (totalizer) can be used to totalize or integrate temperatures up to a maximum display value of 999,999. It features independent scaling, decimal point, and a low temperature cut-out to suit a wide variety of temperature integration/totalization applications. Programmable remote input "E2-CON" pin is included with this option and can be utilized to control a variety of functions, such as integrating/totalizing, alarm control, peak/valley readings, display hold or temperature offset operations, simultaneously with "E1-CON" pin. Peak/valley (max/min) reading memory and programmable temperature offset functions are included with this option and they are easily recalled and controlled by either the front panel or a remote input. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications.

Optional 20 mA loop, bi-directional serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

SPECIFICATIONS

1. DISPLAY: 4-digit with F/C indication, 0.56" (14.2 mm) high LED, minus sign displayed for negative temperatures. 6-digits for integrator/totalizer, "Flashing" display during totalizer overflow. "OLOL F" displayed during temperature display out of range (positive). "ULUL F" displayed during temperature display out of range (negative). "SHORT" displayed for shorted input and "OPEN" displayed for unconnected input.

2. POWER REQUIREMENTS:
   A.C. Power: Select switchable 115/230 VAC, ±10%, 50/60 Hz, 14 VA
   Max. Input Signal Voltage: ±15 VDC.

3. CONTROLS:
   Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

4. SIGNAL INPUT:
   3-Wire: 100 Ω platinum RTD, alpha = 0.00385 (DIN 43760) or alpha = 0.00392. 4-Wire sensors: Fourth wire unconnected.
   Excitation: 0.25 mA

5. OPEN RTD DETECTION:
   Display: "OPEN"
   Setpoint Outputs: Disabled (Deactivated)
   Serial Outputs: "OPEN" in data field
   Integration/Totalization: Disabled

DIMENSIONS "In inches (mm)"

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.3) H x 5.5" (140) W.
### SPECIFICATIONS (Cont’d)

6. **RANGE:**
   - 
   - 0.1º res: -99.9º to 850.0ºC (-99.9º to 999.9ºF)
   - 1º res: 20º to 850ºC (-32ª to 1562°F)
   - Decimal Point Dependent.

7. **RESOLUTION:** 0.1 or 1 degree.

8. **LEAD RESISTANCE EFFECT:** 20 Ω max., 2.5C/Ω error for V exc. and common lead unbalance.

9. **ACCURACY:** 0.3ºC, @ 23ºC and 20 min. warm-up.

10. **READING RATE:** 1.25 readings/second

11. **RESPONSE TIME:** 2 seconds to settle for step input (increases with programmable digital filtering)

12. **INTEGRATOR/TOTALIZER:** Front panel button for input/total display select. External integrator>Totalizer/resetenable. Programmable time-base, scale factor (0.001-100,000) and low-temp. cut-out. Response Time = 0.2 sec. max.

13. **E1-CON & E2-CON:** External remote inputs that allow activation of various functions. (Reset total, peak indicator mode, trigger mode, etc.)\[ V_{IL} = 0.8 \ V_{MAX}, \ V_{IH} = 2.0 \ V_{MIN}, \ Response \ Time = 0.2 \ sec. \ max. \]

14. **NORMAL MODE REJECTION:** 40 dB at 50/60 Hz (may be improved by programmable digital filtering)

15. **COMMON MODE REJECTION:** 50 dB, DC to 50/60 Hz

16. **ENVIRONMENTAL CONDITIONS:**
   - **Operating Range:** 0 to 50ºC
   - **Storage Range:** -40 to 80ºC
   - **Span Drift:** ±0.01ºC/ºC
   - **Zero Drift:** ±0.001ºC/ºC
   - **Operating and Storage Humidity:** 85% max. (non-condensing) from 0 to 50ºC.
   - **Altitude:** Up to 2000 meters

17. **SIGNAL COMMUNICATIONS (Optional):**
   - **Type:** Bi-directional 20 mA current loop, 20 mA source provided on transmit loop.
   - **Powers up to 7 units in a loop with internal current source.**
   - **Baud Rate:** programmable 300 to 2400
   - **Maximum Address:** 99 (Actual number in a single loop is limited by serial hardware specifications.)
   - **Data Format:** 10 bit frame, Odd parity (one start bit, 7 data bits, one odd parity bit, and one stop bit.)

18. **SERIAL HARDWARE SPECIFICATIONS:**
   - **SO - Output Transistor Rating:** V\(_{MAX}\) = 30 VDC, V\(_{SAT}\) = 1 V\(_{MAX}\) at 20 mA.
   - **SL - Input Diode Voltage:** V\(_{F}\) = 1.25V\(_{Typ}^\) = 1.5V\(_{MAX}\)
   - **Note:** This compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

19. **ALARMS (Optional):**
   - **Solid State:** Two, isolated, sinking open collector NPN transistors acting in parallel with relays. V\(_{SAT}\) = 1V @ 100 mA max., V\(_{MAX}\) = 30 VDC.

20. **RELAYS:**
   - **Type:** Form C (2)
   - **Max. Rating:** 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1.8 hp @ 120 VAC (inductive load).
   - **Relay Life Expectancy:** 100,000 cycles at max. rating. (As load level decreases, life expectancy increases.)

21. **ANALOG OUTPUT (Optional):**
   - **4 to 20 mA:** Digital scaling and offsetting within 4 to 20 mA range!
   - **Accuracy:** 0.1% of full scale
   - **Resolution:** 12 bits
   - **Compliance Voltage:** 10 VDC (500 Ω max. loop resistance)
   - **0 to 10 VDC:** Digital scaling and offsetting within 0 to 10 VDC range
   - **Accuracy:** ±0.1% of reading +35 mV)
   - **Resolution:** 12 bits
   - **Min. Load Resistance:** 10 KΩ (1 mA max.)

22. **PEAK/VALLEY (Optional):**
   - **Peak and Valley recording.** Programmable temperature offset and slope.

23. **CERTIFICATIONS AND COMPLIANCES:**
   - **EMC EMISSIONS:**
     - ENV 50141 - Radio-frequency field emissions of electromagnetic radiation
     - EN 61000-6-4: Electromagnetic immunity (Finnell)
   - **Certifications:** International.

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**TOTALIZER/PEAK/VALLEY/TEMPERATURE OFFSET AND SLOPE OPTION**

The major feature of this option is its integrator/totalizer (accumulator). The integrator simply totals (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, from the front panel or through the serial communications loop. Alarms may be programmed to trigger from totalizer values or input values. A programmable low temperature level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

Other features of this option are peak and valley detection. The integrator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable when monitoring the limits of the process over any length of time which can span over shifts, days, etc. (these values are stored at power-down.) A remote input can be programmed to reset or engage the unit into a peak reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

The programmable temperature offset feature allows the operator to shift the display temperature reading. The operator may utilize this feature, for example, if switching RTD probes, to compensate for differences in RTD probe accuracy from one manufacturer to another. The displayed temperature reading can be offset either positive or negative to the actual measured temperature. Programming a positive number for the offset value increases the display value. Programming a negative number for the offset value decreases the display value. For example, programming +10 for the offset value will increase the displayed value by 10 throughout the entire range, or programming -10 for the offset value will decrease the display value by 10 throughout the entire range.

**ISOLATED ALARM OPTION**

The alarm option consists of an additional printed circuit board with 9 connections. Six of these terminals are for the two Form-C relays and the other three are for two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total and they can be made to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be made to trigger from either the integrator/totalizer or the input display, to actuate external alarms, control valves, etc.

Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (alarm #2) automatically changes the pre-warn value (alarm #1) an equal amount. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control.
**ISOLATED SERIAL COMMUNICATIONS OPTION**

The serial communication option is a half-duplex, two-way 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit temp (input) signal. Two loops are required for all hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are serial hardware limitations which restrict this to a lower number of units per serial loop.)

**ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION**

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard voltage ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.

**PROGRAMMABLE FUNCTIONS**

Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN” (shown as “arrows” on the front panel) are used to change the data and set-ups, while the “P” button is used to save or enter the data. After pressing “P”, which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be ungrounded to gain access to programming. The following table lists the programming steps.

**Pro 0** - RETURN TO MEASUREMENT MODE

**Pro 1** - PROGRAM RTD TYPE, TEMPERATURE SCALE AND DECIMAL POINT POSITION

- “rtdtyP” - Select RTD type (385/392)
- “SCALE” - Enter either degree (F or C)
- “dECPN” - Enter resolution (0 or 0.1)

**Pro 2** - PROGRAM TEMPERATURE SLOPE AND OFFSET

- “SLOPE” - Enter display slope (0.0001 to 9.9999)
- “OFFSET” - Enter offset (-999 to 9999)

**Pro 3** - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED

- “dsp AL” - Enable display alarms
- “ENT AL” - Enable enter alarms
- “dPSHY” - Enable display hysteresis
- “ENHYS” - Enable hysterisis
- “rs1 AL” - Enable reset latched alarms
- “dSPtUF” - Enable display of peak/valley readings
- “StB UF” - Enable reset of peak/valley readings
- “SeldSp” - Enable switching display between input and total
- “rStoF” - Enable reset total
- “dSOFF” - Enable display offset value
- “ENOFF” - Enable enter offset value

**Pro 4** - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION

- “Filt” - Enter level of digital filtering
- “.” - No digital filtering
- “2” - Normal filtering
- “3” - Increased filtering
- “4” - Maximum filtering
- “E1-CON” - Enter function of remote input
- “0” - Offset temperature reading to zero
- “1” - Reset totalizer
- “2” - Reset peak and valley
- “6” - Reset peak and start peak indicator
- “7” - Reset valley and start valley indicator
- “8” - Reset latched alarms
- “9” - Reset all alarms
- “10” - Toggle display between input and totalizer
- “11” - Offset input to zero and totalize the offset values
- “12” - Display hold with offset
- “13” - Instrument reading synchronization
- “14” - Print request
- “E2-CON” - Same functions as E1-CON

**Pro 5** - PROGRAM TOTALIZER

- “dEPN” - Enter decimal point for totalizer
- “tBAS” - Enter time base
- “0” - second
- “1” - minute
- “2” - hour
- “SCLFA” - Enter multiplying scale factor
- “Lo-cut” - Enter low-signal cut out

**Pro 6** - PROGRAM ALARMS

- “rA” - Enable alarm value tracking
- “dSP” - Enable display alarm annunciators
- “LAIC-1” - Enable alarm #1 latching
- “ASN-1” - Enable alarm #1 trigger source (input or total)
- “AL-1” - Enable alarm #1 value
- “HYS-1” - Enable hysteresis value for alarm #1
- “Act-1” - Enable alarm #1 action (high or low)
- “LAIC-2” - Enable alarm #2 latching
- “ASN-2” - Enable alarm #2 trigger source (input or total)
- “AL-2” - Enable alarm #2 value
- “HY-S-2” - Enable hysteresis value for alarm #2
- “Act-2” - Enable alarm #2 action (high or low)

**Pro 7** - PROGRAM SERIAL COMMUNICATIONS

- “bAud” - Enter baud rate
- “tAddES” - Enter loop address number (0-99)
- “Print” - Enter print function, or “P” command function through Serial Option
- “。” - temp.
- “1” - temper., peak/valley and offset
- “2” - temper. and alarms
- “3” - temp., peak/valley, alarm value, hysteresis, and offset
- “4” - integrator/totalizer
- “5” - temp. and integrator/totalizer
- “6” - temp., integrator/totalizer, peak/valley, and offset
- “7” - integrator/totalizer and alarms
- “8” - temp., integrator/totalizer, and alarms
- “9” - temp., integrator/totalizer, peak/valley, alarms, hysteresis, and offset
- “FULL” - Enable complete or abbreviated printing

**Pro 8** - PROGRAM RE-TRANSMITTED ANALOG OUTPUT

- “ASIN” - Select source of analog output (input or total)
- “AN-Lo” - Enter 4 mA or 0 VDC display value
- “AN-HI” - Enter 20 mA or 10 VDC display value

**Pro 9** - SERVICE OPERATIONS (Protected by access code)

† - This sequence may be subject to being locked-out due to other programmed sequences.
TOTALIZER EXAMPLE/RTD STERILIZATION APPLICATION

A 100Ω Platinum RTD element is employed to monitor the temperature of a sterilization bath used to sterilize equipment in the production of drugs at a pharmaceutical company. The sterilization bath varies in temperature with the amount of equipment in the bath and therefore, longer soak intervals may be required to ensure complete sterilization. The optional totalizer of the IMR is used to integrate a time-temperature profile of the sterilization process and the setpoint alarm option is used to alert operators when the totalizing temperature has exceeded the required value, signaling that sterilization is complete. The temperature of the bath can fluctuate from 150 to 200°F and the additional alarm is used to activate if the bath falls below 140°F.

In order to effect sterilization, the equipment must be in the bath for 1500 degree-minutes (150°F for 10 minutes, 200°F for 7.5 minutes, etc.) as long as the temperature remains above 140°F. The totalizer is programmed for a “1 minute” timebase to provide direct readout in degree-minutes. Alarm #1 is programmed to trigger from the integrator and is set to activate at a value of 1500. Alarm #2 is programmed to trigger directly from the temperature and is assigned to be low-acting (when the temperature falls below 140°F) and is programmed to latch at 140°F. Remote input “E1-CON” (TBA #4) is programmed to reset the totalizer after each sterilization operation. The display can be switched between temperature and totalizer readout from the front panel by using the “up” and “down” buttons. The optional 4 to 20 mA retransmitted output is used to provide a temperature profile of the bath on a chart recorder. The output is digitally scaled to retransmit 4 mA at 100°F and 20 mA at 250°F. An external key switch is connected from TBA #3 (Program Disable) to ground. With this terminal grounded, unauthorized modification of the programmed data is prevented.

TEMPERATURE LIMIT CONTROLLER EXAMPLE

An IMR is used as a fail safe temperature limit controller to back up a critical chemical temperature control loop. The loop is being controlled by a multi-zoned PID controller and in the event of its failure, significant product and equipment damage will occur. Due to the reliability and low cost of the IMR, along with output options, the indicator suits this application well.

The IMR is specified with the dual alarm/relay option to interrupt power to the heaters when the maximum safe temperature (325°F) is exceeded. To provide for fail safe operation, operator intervention is required to reset the latched relay in order to return power to the heater. (Use the Normally Open output, and program the alarm for low-acting operation.) The indicator’s other output is used to signal operators with a warning bell when high temperatures exist (300°F), so that they may take action to prevent heater shut-down. The alarm/set point values are made to track, so changing the cut-off alarm changes the other an equal amount. Additionally, the indicator is programmed to display alarms in both cases. Key switches are installed in the panel to lock-out the front panel from operators and to provide the means to reset the latched relay to re-power the heater. The re-transmitted analog output is also specified to drive a chart recorder with 4 to 20 mA for a hard copy of temperature profiles for later evaluation.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>TOTALIZER/PURK/WALL/PEAK/SLOPE/OFFSET/E2-CON</th>
<th>DUAL ALARMS</th>
<th>SERIAL OUTPUT</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS</th>
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<tr>
<td>IMR</td>
<td>Intelligent Process Meter for RTD</td>
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<td>YES</td>
<td>YES</td>
<td>0 to 10 VDC</td>
<td>IMR02169</td>
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</tbody>
</table>

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
MODEL IMS - APOLLO 4½ DIGIT INTELLIGENT STRAIN GAGE METER

- 40,000 COUNT MEASUREMENT RESOLUTION (can be scaled to ±99,999 display)
- ACCEPTS LOW LEVEL INPUTS FROM 20 mV to 200 mV FULL SCALE
- USER SELECTABLE BRIDGE EXCITATION (5 VDC or 10 VDC)
- EASY ONE-PASS SCALING
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56” (14.2 mm) HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- INTEGRATOR (totalizer) AND LINEARIZER
- DIGITAL TARE (re-zero) AND PEAK/VALLEY (max/min) RECORDING
- DUAL ALARM RELAY OUTPUTS (optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (optional)
- 4 to 20 mA or 0 to 10 VDC ANALOG OUTPUT (optional)
- NEMA 4/IP65 SEALED METAL FRONT BEZEL

DESCRIPTION

The Apollo Intelligent Strain Gage Meter (IMS) accepts low level signals from a variety of bridge-type transducers, such as load cells, pressure transducers, torque transducers, etc. User selectable low (20 mV) and high (200 mV) input ranges and a stable, bridge excitation voltage, that is user selectable 5 V or 10 V at 60 mA, is provided. A two Hz, two pole, low pass filter coupled with programmable digital filtering can be tuned to match the characteristics of most processes. A digital tare (re-zero) operation can be performed at a touch of a button along with recall of process peak and valley (max/min) values. State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages are available to fulfill many process applications.

The indicator features a choice of two different scaling procedures which greatly simplifies initial set-up. A full 6-digit display accommodates virtually any process-engineering unit. English Style display prompts aid the operator greatly simplifies initial set-up. A full 6-digit display accommodates virtually any process-engineering unit. English Style display prompts aid the operator.

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.

SPECIFICATIONS

1. DISPLAY: 6-digit, 0.56” (14.2 mm) High LED, minus sign displayed for negative values. Flashing display during totalizer overflow. “......” displayed for input out of range. “OLOLOL” displayed for input overload and “ULULUL” displayed for underload (negative overload).

2. POWER REQUIREMENTS:
   - A.C. Power: Switch Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA.

3. CONTROLS:
   - Three front panel push buttons for modifying alarm values and indicator set-up. Two external inputs for disabling the front panel and controlling programmable functions.

4. SIGNAL INPUT RANGE: Max. common mode voltage swing with respect to signal ground, 0 to 7 V.

   Note: Absolute max. voltage that can be applied between the two input terminals or between input and signal common is 75 VDC.

5. JUMPER SELECTABLE: ±20 mV or ±200 mV.

6. DEADLOAD RANGES: -100%, +5% of range selected.

DIMENSIONS “In inches (mm)”

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
SPECIFICATIONS (Cont’d)

6. BRIDGE EXCITATION:
   - Jumper selectable: 5 VDC or 10 VDC @ 60 mA max., overload protected.
   - Drift: -50 ppm/°C, non-ambient.

7. LINEARITY, ACCURACY AND RESOLUTION:
   - Linearity: 0.03% FS
   - Accuracy: 20 mV range; 0.03% FS.
   - 200 mV range; 0.5% FS Nominal, may be calibrated to 0.03% FS.
   - Resolution: 140,000 counts.
   - Relative Humidity: Less than 85% RH

8. PROGRAMMABLE DISPLAY READING RANGE: -99999 to 999999

9. SIGNAL CONNECTION: 4-Wire

10. INPUT RESISTANCE: 100 MΩ

11. READING RATE: 2.5 readings/second

12. RESPONSE TIME: 2 seconds to settle for step input (increases with programmable digital filtering)

13. TOTALIZER:
   - Front panel button for input/total display select. Programmable time-base, scale factor (0.001 to 100,000) and low-end cut-out. Response Time = 0.2 secs. max.

14. E1-CON AND E2-CON:
   - External remote inputs which allow activation of various functions. (Reset total, peak indicator mode, trigger mode, etc.)
   - VIL = 0.8 VMAX, VIL = 2.0 VMAX. Response Time = 0.2 sec. max.

15. NORMAL MODE REJECTION: 80 dB at 50/60 Hz (may be improved by programmable digital filtering)

16. COMMON MODE REJECTION: 120 dB, DC to 50/60 Hz, with respect to earth common.

17. ENVIRONMENTAL CONDITIONS:
   - Operating Temperature Range: 0 to 50°C
   - Storage Temperature Range: -40 to 80°C
   - Span Temperature Coeff.: 70ppm/°C
   - Zero Temperature Coeff.: 1µV/°C
   - Operating and Storage Humidity: 85% (non-condensing) from 0 to 50°C
   - Altitude: Up to 2000 meters.

18. SERIAL COMMUNICATIONS (Optional): Type:
   - Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source.)
   - Baud Rate: Programmable 300 to 2400

19. Maximum address: 99 (Actual number in a single loop is limited by serial hardware specifications.)

20. Data Format:
   - 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit).

21. Serial Hardware Specifications:
   - SO - Output Transistor Rating: VMAX = 30 VDC,
     - Vsat = 1 VMAX at 20 mA.
   - SI - Input Diode Rating:
     - VF = 1.25 V Typy, 1.5 VMAX
   - Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

22. ALARMS (Optional):
   - Solid State: Two, isolated sinking open collector NPN transistors acting in parallel with relays.
   - VSAT = 1V @ 100 mA max, VMAX = 30 VDC.
   - Relays:
     - Type: Form C (2)
     - Max. 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. (As load level decreases, life expectancy increases.)

23. ANALOG OUTPUT:
   - Digital scaling and offsetting.
   - 4 to 20 mA:
     - Accuracy: 0.1 of full scale
     - Resolution: 12 bits
     - Compliance Voltage: 10 VDC (500 W max. loop impedance)
   - 0 to 10 VDC:
     - Accuracy: ± (0.1% of reading +35 mV)
     - Resolution: 12 bits
     - Min. Load Resistance: 10 KW (1 mA max.)

24. LINEARIZER/PEAK/VALLEY/TARE:
   - 9-segment multiple slope scaling for non-linear inputs. Peak and valley recording, signal and reset (tare)

25. CERTIFICATIONS AND COMPLIANCES:
   - EMC EMISSIONS:
     - CISPR 11 Radiated and conducted emissions
   - EMC IMMUNITY:
     - Meets EN 50082-2: Industrial Environment.

   EN 61000-4-2 - Electrostatic discharge (ESD)
   EN 61000-4-4 - Electrical fast transient/burst (EFT)
   EN 61000-4-8 - Power frequency magnetic field

Notes:
1. Unit complies with listed specifications at 10 V/m and 10 Vrms when installed as follows:
   - a. Install power line filter, RLC #LFIL0000 or equivalent.
   - b. Install unit in a Buckeye SM 7013-0 enclosure or equivalent.
   - c. Install all I/O cables connecting to the unit in metal conduit that is connected to the enclosure at one end, and earth ground at the opposite end.

2. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.

Refer to the EMC Installation Guidelines section of the manual for additional information.

23. CONSTRUCTION:
   - Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).

24. CONNECTION:
   - Removable terminal blocks.

25. WEIGHT:
   - 1.2 lbs (0.54 kg).

TOTALIZER/LINEARIZER/PEAK/VALLEY/TARE:
   - This integrator program feature simply totals (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, by the front panel or through the serial communications loop. Alarms may be programmed to trigger from totalizer values, for example to signal total weight thresholds for batching operations. A programmable low signal level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

   The linearizer feature is a series of programmable scaling points that are used to construct linear segments to linearize the input signal. The most common application would be to interface with square law devices. A maximum of nine segments are available and using nine segments for a square law device would reduce linearity errors to less than 0.5%.

   The other features are peak and valley detection and a re-zero (tare) function. The indicator will record the lowest reading (valley) and the highest reading (peak) automatically, for later recall. This information is valuable when monitoring the limits of the process over any length of time (shifts, days, etc.) since these values are stored at power-down. An external input can be programmed to reset or engage the unit into a peak or valley reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

   The re-zero (tare) function can also be controlled externally or by the front panel. This feature can quickly compensate for small shifts or drifts in the input signal or can be used to re-zero after every operation, such as batching.

ISOLATED ALARM OPTION:
   - The alarm option consists of an additional printed circuit board with 9 connectors. Six of these terminals are for the two Form-C relays and the other three are for the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total, and they can be programmed to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be set to trigger from either the integrator/totalizer or the input display, such as actuating external alarms, control valves, etc.

   Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (alarm #2) automatically changes the pre-warning value (alarm #1) an equal amount. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control.

ISOLATED SERIAL COMMUNICATIONS OPTION:
   - The serial communication option is a half-duplex, two-way 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit input signal. Two loops are required for all hook-ups; a transmit (output) data loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are hardware limitations which restrict this to a lower number of units per serial loop.)
**ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION**

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard current ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 VDC and 10 VDC.

**PROGRAMMABLE FUNCTIONS**

Programming of the IMS is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN” (shown as arrows on the front panel) are used to change the data and set-ups, while the “P” button is used to “save” or “enter” the data. After pressing “P” which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be disconnected from ground to gain access to programming. The following table lists the programming steps.

<table>
<thead>
<tr>
<th>“Pro”</th>
<th>- RETURN TO MEASUREMENT MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Pro 0”</td>
<td>- RETURN TO MEASUREMENT MODE</td>
</tr>
<tr>
<td>“Pro 1”</td>
<td>- SCALE UNIT BY APPLYING SIGNAL</td>
</tr>
<tr>
<td>“dECPN1”</td>
<td>- Enter decimal point for scaled display</td>
</tr>
<tr>
<td>“roun1”</td>
<td>- Enter rounding factor and trailing zeros for scaled display</td>
</tr>
<tr>
<td>“SCALE”</td>
<td>- *</td>
</tr>
<tr>
<td>“dSP 1”</td>
<td>- Enter display reading for scaling point #1</td>
</tr>
<tr>
<td>“INP 1”</td>
<td>- Apply signal level for scaling point #1</td>
</tr>
<tr>
<td>“dSP 2”</td>
<td>- Enter display reading for scaling point #2</td>
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<tr>
<td>“INP 2”</td>
<td>- Apply signal level for scaling point #2</td>
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<tr>
<td>“SEG1”</td>
<td>- *</td>
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<tr>
<td>“Pro 2”</td>
<td>- SCALE UNIT BY KEY-IN SIGNAL LEVEL</td>
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<tr>
<td>“dECPN1”</td>
<td>- Enter decimal point for scaled display</td>
</tr>
<tr>
<td>“roun1”</td>
<td>- Enter rounding factor and trailing zeros for scaled display</td>
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<tr>
<td>“SCALE”</td>
<td>- *</td>
</tr>
<tr>
<td>“dSP 1”</td>
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<td>“INP 1”</td>
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<td>“dSP 2”</td>
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<td>“SEG1”</td>
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<td>“Pro 3”</td>
<td>- PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED</td>
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<td>“dSP AL”</td>
<td>- Enable display alarms</td>
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<td>“ENI AL”</td>
<td>- Enable enter alarms</td>
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<td>“dSPHYSS”</td>
<td>- Enable display hysteresis</td>
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<td>“ENIHYS”</td>
<td>- Enable enter hysteresis</td>
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<tr>
<td>“tRST”</td>
<td>- Enable reset alarmed alarms</td>
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<tr>
<td>“dSPhIU”</td>
<td>- Enable display of peak/valley readings</td>
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<tr>
<td>“rTbU”</td>
<td>- Enable reset of peak/valley readings</td>
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<td>“SELdSP”</td>
<td>- Enable switching display between input and total</td>
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<td>“tRth”</td>
<td>- Enable reset total</td>
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<tr>
<td>“tArE”</td>
<td>- Enable re-zero (tare) of input signal</td>
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<tr>
<td>“Pro 4”</td>
<td>- PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION</td>
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<td>“FILter”</td>
<td>- Enter level of digital filtering</td>
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<td>- no digital filtering</td>
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<tr>
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<td>- normal level</td>
</tr>
<tr>
<td>2</td>
<td>- increased level</td>
</tr>
<tr>
<td>3</td>
<td>- maximum level</td>
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</table>

* - Entire sequence for this modular step is not shown (see manual for further details).
† - This sequence may be subject to being locked-out due to other programmed sequences.
**IMS FORMULA BATCHING APPLICATION**

An IMS is used to display the weight of the contents of a hopper used to formulate dry soap mixes. A hopper weighing 1100 lb. is required to produce batches of 600 lb. A total of 1700 lb. must be supported. Therefore, two 1000 lb., 350 Ω compression load cells are used. The sensitivities of the load cells are 2 mV/V and the excitation voltage is 10 volts, producing a signal output of 11 mV when the hopper is empty and 17 mV when full. The 20 mV input range is selected, and display resolution is 0.5 lbs.

The load cells are connected to the IMS. Scaling procedure “PRO 1” is used by emptying the hopper and keying in a display value of “0.0” lbs. Then 600 lbs. of material is emptied into the hopper and “600.0” lbs. is entered. Scaling is completed, including compensation for the weight of the hopper.

Batching is accomplished by wiring a switch to the remote input E1-CON of the indicator. As each ingredient is mixed in, its weight is displayed. The display can be re-zeroed by the switch, allowing the next ingredient to be mixed into the batch. When the formula is complete, the mixing hopper is emptied and re-zeroed, ready for the next batch.

**BASIC PROGRAMMING STEPS (Unit set-up)**

“PRO 1”......“dECPNt” - 0.0
“round” - 0.5
“SCALE” - YES
“dSP 1” - 0.0 (lbs.)
“INP 1” - Empty hopper, input 11 mV DC from transducer
“dSP 2” - 600.0 (lbs.)
“INP 2” - Fill hopper, input 17 mV DC from transducer
“SEGt” - 1

THIS COMPLETES BASIC SET-UP PROGRAMMING FOR THE ABOVE EXAMPLE.

**STEAM PRESSURE MONITOR/DISPLAY APPLICATION**

An IMS is used to monitor and display the steam pressure within an oil-fired generating station. A pressure transducer with a 3 mV/V output over a 0 to 2500 psi range is used. The 5 volt excitation supply is selected, resulting in a 15 mV full scale output. The 20 mV input range of the IMS is used. After connecting the transducer, scaling is accomplished by entering into the “PRO-1” mode and entering in “0” psi when the line pressure is 0, and entering in the exact line pressure, when pressure is taken at full scale (± 2500 psi).

During operation, the tare function can be used to re-zero the display to compensate for small shifts in the transducer. The optional dual alarms are used as high/low pressure limit detectors. The indicator’s max/min signal recording is used as an aid for unattended operation. The 4 to 20 mA re-transmitted analog output drives a second, remotely located display and is also looped with a hard-copy chart recorder for process analysis.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>DUAL ALARM</th>
<th>OPTIONS</th>
<th>SERIAL COMMUNICATIONS</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
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<td>Intelligent Strain Gage Meter</td>
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<td>IMS03168</td>
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</tbody>
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For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.
MODEL IMT - APOLLO INTELLIGENT THERMOCOUPLE METER

- USER PROGRAMMABLE T/C TYPE (T,E,K,R,S,B,N or mV SCALE)
- SELECTABLE °F OR °C WITH 0.1 OR 1 DEGREE DISPLAY RESOLUTION
- STATE OF THE ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56" (14.2 mm) HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- PROGRAMMABLE TEMPERATURE OFFSET (optional)
- INTEGRATOR (totalizer) AND PEAK/VALLEY (max/min) MEMORY (optional)
- DUAL ALARM RELAY OUTPUTS (optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (optional)
- 4 to 20 mA OR 0 to 10 VDC RE-TRANSMITTED ANALOG OUTPUT (optional)
- NEMA 4/IP65 SEALED METAL FRONT BEZEL

DESCRIPTION

The Apollo Intelligent Thermocouple Meter (IMT) accepts inputs from standard thermocouples and precisely linearizes them. A full 6-digit display accommodates a wide range of temperature inputs and holds large totalization values. State of the art digital circuitry virtually eliminates errors due to drift. If the unit automatically compensates for cold junction, NBS linearity and the meter’s zero and span. A full complement of option packages are available to fulfill many process applications.

The indicator features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree of 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 engaged as a millivolt meter by programming “mV” for thermocouple type (enter 8 in “Pro 1”). This mode is useful in monitoring and displaying the actual voltage produced at the thermocouple probe junction as an aid in troubleshooting a faulty thermocouple probe. A front panel lock-out menu protects set-up data and operation modes from unauthorized modification. Programmable digital filtering enhances the stability of the reading.

Programmable remote input “E1-CON” pin can be utilized to control a variety of functions, such as totalizing, alarm control, peak/valley readings, display hold, or temperature offset operations. All set-up data is stored in E2PROM, which will hold data for a minimum of 10 years without power.

An optional integrator/totalizer can be used to totalize or integrate temperatures up to a maximum display value of 999,999. It features independent scaling, decimal point, and a low temperature cut-out to suit a wide variety of temperature integration/totalization applications. Programmable remote input “E2-CON” pin is included with this option and can be utilized to control a variety of functions, such as integrating/totalizing, alarm control, peak/valley readings, display hold or temperature offset operations, simultaneously with “E1-CON” pin. Peak/valley (max/min) reading memory and programmable temperature offset functions are included with this option and are easily recalled and controlled by either the front panel or remote input. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a variety of modes to suit many control or alarm applications.

Optional 20 mA loop, bidirectional serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

An optional 2 to 20 mA or 0 to 10 VDC re-transmitted analog output can be scaled by the user to interface with a host of recorders, indicators and controllers. The indicator 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 die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications.

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)”

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.

PANEL CUT-OUT

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
SERIAL COMMUNICATIONS (Optional): 18.

RESOLUTION: 1 degree for all types, or 0.1 degree for T, E, J, and N only.

INPUT IMPEDANCE: 20 MΩ, all types.

LEAD RESISTANCE EFFECT: 20 µV/350 Ω

Max Input Voltage Protection: 70 VDC continuous.


Analog Output: 20 mA

COLD JUNCTION COMPENSATION: Automatic, 0.02 degree/degree. Disabled for linear mV scale.

READING RATE: 2.5 readings/second

RESPONSE TIME: 2 seconds to settle for step input (increases with programmable digital filtering).

NORMAL MODE REJECTION: 45 dB at 50/60 Hz (may be improved by programmable digital filtering).

COMMON MODE REJECTION: 120 dB, DC to 50/60 Hz

INTEGRATOR/TOTALIZER: Front panel button for input/total display select. External integrator/totalizer reset/enable. Programmable time-base, scale factor (0.001-999.999) and low-temp cutout. Response Time = 0.2 sec. max.

E1-CON & E2-CON: External remote inputs which allow activation of various functions. (Reset total, peak indicator mode, trigger mode, etc.)

VIL = 0.8 VMAX; VIH = 2.0 VMIN. Response Time = 0.2 sec. max.

ENVIRONMENTAL CONDITIONS:

Operating Temperature Range: 0 to 50°C

Storage Temperature Range: -40 to 80°C

Operator and Storage Humidity: 85% max (non-condensing) from 0 to 50°C

Span Drift: 40 ppm/°C

Zero Drift: 1 µV/°C

Altitude: Up to 2000 meters

SERIAL COMMUNICATIONS (Optional):

Type: Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source.)

Baud Rate: programmable 300 to 2400

Maximum address: 99 (Actual number in a single loop is limited by serial hardware specifications).

Data Format: 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit.)

Serial Hardware Specifications:

SO - Output Transistor Rating: VMAX = 30 VDC; VSOH = 1 VMAX at 20 mA.

Note: This will allow up to 28 units max. in each loop.

SI - Input Diode Rating: VIH = 1.25 VLSAT; 1.5 VMAX

Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically, a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

ALARMS (Optional):

Solid State: Two, isolated sinking open collector NPN transistors acting in parallel with relays. VSAT = 1 V @ 100 mA max. Vmax: 30 VDC.

Relays:

Type: Form C (2)

Rating: 5 Amps @ 120/240 VAC or 28 VDC resistive, 1/8 hp @ 120 VAC (inductive load).

Relay Life Expectancy: 100,000 cycles at max. rating. (As load level decreases life expectancy increases.)

ANALOG OUTPUT (Optional):

4 to 20 mA: Digital scaling and offsetting within 4 to 20 mA range.

Accuracy: 0.1% of full scale

Resolution: 12 bits

Compliance Voltage: 10 VDC (500 Ω max. loop impedance)

0 to 10 VDC: Digital scaling and offsetting within 0 to 10 VDC range.

Accuracy: ±0.1% of reading +35 mV

Resolution: 12 bits

Min. Load Resistance: 10 KΩ (1 mA max.)

PEAK/VALLEY/SLOPE/OFFSET (Optional):

Peak and Valley recording. Programmable temperature offset and slope.

CERTIFICATIONS AND COMPLIANCES:

EMC EMISSIONS:


CISPR 11 Radiated and conducted emissions

EMC IMMUNITY:

Meets EN 50082-2: Industrial Environment.

ENV 50141 - Radio-frequency conducted electromagnetic field

ENV 50141 - Radio-frequency conducted electromagnetic field

EN 61000-4-2 - Electrostatic discharge (ESD)

EN 61000-4-4 - Electrical fast transient/burst (EF)

Notes:

1. Unit complies with listed specifications at 10 V/m, with unit installed in a metal panel, rear of the unit covered with a metal enclosure providing at least 5 dB of shielding effectiveness and mounted to an aluminum rack connected to earth ground (protective earth). All I/O cables routed through metal conduit that is connected to earth ground at both ends.

2. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.

CONNECTION: Refer to the EMC Compliance Installation section of the manual for additional information.

CONSTRUCTION: Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black high impact plastic (panel gasket and mounting clips included).

STARTER/EVENTS: Fixed and removable terminal blocks.

WEIGHT: 1.2 lbs (0.54 kg).

THERMOCOUPLE RANGE AND ACCURACY TABLE

<table>
<thead>
<tr>
<th>TC TYPE</th>
<th>PROJ 1 CODE</th>
<th>RANGE</th>
<th>ACCURACY</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/0</td>
<td>-200 to +400°C</td>
<td>0.8% blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>328 to +752°F</td>
<td>1.4°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/1</td>
<td>-200 to +1000°C</td>
<td>0.5% purple</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>328 to +1832°F</td>
<td>1.4°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J/2</td>
<td>-200 to +760°C</td>
<td>0.8% white</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>328 to +1400°F</td>
<td>1.4°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K/3</td>
<td>-200 to +1250°C</td>
<td>0.5% yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>328 to +2282°F</td>
<td>1.4°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/5</td>
<td>0 to +1768°C</td>
<td>2.1% black</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>3.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B/6</td>
<td>+150 to +1820°C</td>
<td>2.5% black</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+302 to +3308°F</td>
<td>3.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/7</td>
<td>-200 to +1300°C</td>
<td>0.5% orange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>328 to +2372°F</td>
<td>1.4°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mV/8</td>
<td>-10.00 to +80.00 mV</td>
<td>0.01%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTEGRATOR (TOTALIZER) / PEAK/VALLEY / TEMPERATURE OFFSET AND SLOPE OPTION

The major feature of this option is its integrator/totalizer (accumulator). The integrator/totalizer simply sums (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, by the front panel or through the serial communications loop. Alarms may be programmed to trigger from integrator/totalizer values or input values. A programmable low temperature/signal level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the integrator are saved.

Another feature of this option is peak and valley detection. The indicator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable to the salesperson. The integrator/totalizer may be reset and viewed from the front panel, if so programmed, and viewed and reset through the serial communications loop.

The programmable temperature offset feature allows the operator to shift the displayed temperature reading. The operator may utilize this feature, for example, if switching thermocouple probes, to compensate for differences in thermocouple probe accuracy from one manufacturer to another. The displayed temperature reading can be offset either positive or negative to the actual measured temperature. Programming a positive number for the offset value increases the display value. Programming a negative number for the offset value...
decreases the display value. For example, programming +10 for the offset value will increase the displayed value by 10 throughout the entire range, or programming -10 for the offset value will decrease the display value by 10 throughout the entire range.

**ISOLATED ALARM OPTION**
The alarm option consists of an additional printed circuit board with 9 connections. Six of these terminals are for the two Form-C relays and the other three are for the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total and they can be programmed to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be programmed to trigger from either the integrator/totalizer or the input display, to actuate external alarms, control valves, etc.

Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (alarm #2) automatically changes the pre-warn value (alarm #1) an equal amount. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control.

**ISOLATED SERIAL COMMUNICATIONS OPTION**
The serial communication option is a half-duplex, two-way 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit input signal. Two loops are required for all hook-ups; a transmit (outgoing data) loop and a receive (incoming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are hardware limitations which restrict this to a lower number of units per serial loop.)

**ISOLATED RE-TRANSMITED ANALOG OUTPUT OPTION**
4 to 20 mA
The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is ±10 V. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC
The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard voltage ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values to 0 and 10 VDC.

### PROGRAMMABLE FUNCTIONS

Programming of the IMT is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN” are used to change the data and set-ups, while the “P” button is used to ‘save’ or ‘enter’ the data. After pressing “P” which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM. DIS.” must be ungrounded to gain access to programming.

The following table lists the programming steps.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>“Pro 0” - RETURN TO MEASUREMENT MODE</td>
</tr>
<tr>
<td>1</td>
<td>“Pro 1” - PROGRAM THERMOCOUPLE TYPE, SCALE AND RESOLUTION</td>
</tr>
<tr>
<td>2</td>
<td>“Pro 2” - PROGRAM TEMPERATURE DISPLAY SLOPE AND OFFSET</td>
</tr>
<tr>
<td>3</td>
<td>“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED</td>
</tr>
<tr>
<td>4</td>
<td>“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION</td>
</tr>
<tr>
<td>5</td>
<td>“Pro 5” - PROGRAM TOTALIZER</td>
</tr>
<tr>
<td>6</td>
<td>“Pro 6” - PROGRAM ALARMS</td>
</tr>
<tr>
<td>7</td>
<td>“Pro 7” - PROGRAM SERIAL COMMUNICATIONS</td>
</tr>
<tr>
<td>8</td>
<td>“Pro 8” - PROGRAM RE-TRANSMITED ANALOG OUTPUT</td>
</tr>
<tr>
<td>9</td>
<td>“Pro 9” - SERVICE OPERATIONS (Protected by access code)</td>
</tr>
</tbody>
</table>

### PROGRAMMABLE OPTIONS

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>“OFF”</td>
<td>Instrument reading synchronization</td>
</tr>
<tr>
<td>“UP”</td>
<td>Enable enter offset</td>
</tr>
<tr>
<td>“DOWN”</td>
<td>Enable alarms</td>
</tr>
<tr>
<td>“OFS”</td>
<td>Enter offset (-999 to 9999)</td>
</tr>
<tr>
<td>“SCL”</td>
<td>Enter multiplying scale factor</td>
</tr>
<tr>
<td>“Lo-cut”</td>
<td>Enter low-signal cut out</td>
</tr>
<tr>
<td>“FULL”</td>
<td>Enable complete or abbreviated printing</td>
</tr>
<tr>
<td>“ASIN”</td>
<td>Select source of analog output</td>
</tr>
<tr>
<td>“AN-HI”</td>
<td>Enter 20 mA or 10 VDC display value</td>
</tr>
<tr>
<td>“AN-LO”</td>
<td>Enter 4 mA or 0 VDC display value</td>
</tr>
<tr>
<td>“AN-HI”</td>
<td>Enter 20 mA or 10 VDC display value</td>
</tr>
<tr>
<td>“AN-LO”</td>
<td>Enter 4 mA or 0 VDC display value</td>
</tr>
</tbody>
</table>

**“Pro 0” - RETURN TO MEASUREMENT MODE**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>- offset temperature to zero</td>
</tr>
<tr>
<td>1</td>
<td>- reset totalizer</td>
</tr>
<tr>
<td>2</td>
<td>- reset and gate totalizer</td>
</tr>
<tr>
<td>3</td>
<td>- gate totalizer</td>
</tr>
<tr>
<td>4</td>
<td>- display hold</td>
</tr>
<tr>
<td>5</td>
<td>- reset peak/valley</td>
</tr>
<tr>
<td>6</td>
<td>- reset peak/peak indicator</td>
</tr>
<tr>
<td>7</td>
<td>- reset valley/valley indicator</td>
</tr>
<tr>
<td>8</td>
<td>- reset latched alarms</td>
</tr>
</tbody>
</table>

**“Pro 1” - PROGRAM THERMOCOUPLE TYPE, SCALE AND RESOLUTION**

- “type” - Enter thermocouple type (T=0; E=1; J=2; K=3; R=4; S=5; B=6; N=7; mV=8)
- “SCALE” - Enter temperature scale (F or C)
- “dECPI” - Enter resolution (0 or 0.0)

**“Pro 2” - PROGRAM TEMPERATURE DISPLAY SLOPE AND OFFSET**

- “SLOPE” - Enter display slope (0.0001 to 9.9999)
- “OFFSET” - Enter offset (-999 to 9999)

**“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED**

- “dSP AL” - Enable display alarms
- “EN AL” - Enable enter alarms
- “dSPHY” - Enable display hysteresis
- “ENHY” - Enable enter hysteresis
- “ySI AL” - Enable reset latched alarms
- “ySPH” - Enable display of peak/valley readings
- “yStB” - Enable reset of peak/valley readings
- “ySEL” - Enable switching display between input and total
- “ySTOR” - Enable reset total
- “ySPD” - Enable display offset
- “ENB” - Enable enter offset

**“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION**

- “FIL” - Enter level of digital filtering
- “0” - no digital filtering
- “1” - normal filtering
- “2” - increased filtering
- “3” - maximum filtering
- “E1-CON” - Enter function of remote input
- “0” - offset temperature reading to zero
- “1” - reset totalizer
- “2” - reset and gate totalizer
- “3” - gate totalizer
- “4” - display hold
- “5” - reset peak/valley
- “6” - reset peak/peak indicator
- “7” - reset valley/valley indicator
- “8” - reset latched alarms

9 - reset all alarms
10 - toggle display between input and totalizer
11 - offset input to zero and totalize the offset values
12 - display hold with offset
13 - instrument reading synchronization
14 - print command
15 - “E2-CON” - Same functions as E1-CON

**“Pro 5” - PROGRAM TOTALIZER**

- “dECPI” - Enter decimal point for totalizer
- “tBASE” - Enter time base
- “0” - second
- “1” - minute
- “2” - hour
- “SCLFAC” - Enter multiplying scale factor
- “Lo-cut” - Enter low-signal cut out

**“Pro 6” - PROGRAM ALARMS**

- “trAc” - Enable alarm value tracking
- “dSI” - Enable display alarm annunciators
- “la1C” - Enable alarm #1 latching
- “AS” - Enable alarm #1 trigger source (input or total)
- “AL” - Enable alarm #1 value
- “HS” - Enter hysteresis value for alarm #1
- “Act” - Enable alarm #1 action (high or low)
- “la2C” - Enable alarm #2 latching
- “AS2” - Enter alarm #2 trigger source (input or total)
- “AL2” - Enable alarm #2 value
- “HS2” - Enter hysteresis value for alarm #2
- “Act2” - Enable alarm #2 action (high or low)

**“Pro 7” - PROGRAM SERIAL COMMUNICATIONS**

- “bAud” - Enter baud rate
- “Addr” - Enter loop address number (0-99)
- “Prnt” - Enter print function, or “P” command function through Serial Option
- “0” - temp.
- “1” - temp.,peak/valley and offset
- “2” - temp. and alarms
- “3” - temp.,peak/valley, alarm, hysteresis and offset
- “4” - integrator/totalizer
- “5” - temp. and integrator/totalizer
- “6” - temp.,integrator/totalizer, peak/valley and offset
- “7” - integrator/totalizer and alarms
- “8” - temp.,integrator/totalizer and alarms
- “9” - temp.,integrator/totalizer, peak/valley, alarms, hysteresis and offset

- “FULL” - Enable complete or abbreviated printing

**“Pro 8” - PROGRAM RE-TRANSMITED ANALOG OUTPUT**

- “ASIN” - Select source of analog output (input or total)
- “AN-L” - Enter 4 mA or 0 VDC display value
- “AN-H” - Enter 20 mA or 10 VDC display value

**“Pro 9” - SERVICE OPERATIONS (Protected by access code)**

- This sequence may be subject to being locked-out due to other programmed sequences.
**TEMPERATURE MONITOR/LIMIT CONTROLLER EXAMPLE**

Several IMT’s are used as temperature indicator/limit controllers for motor bearings at a manufacturing plant. The bearings must be kept lubricated to prevent heat and friction, maximizing the life of the bearings. The normal operating temperature of the bearings depends upon the size of the motor, motor speed, load, etc. Normally, the temperature of the bearings will rise from approximately room temperature at start-up and then level off. A sudden increase in the temperature would signal that the bearing has begun to reach the end of its life.

The IMT’s are selected with integrator/totalizer/peak/valley/temperature offset/slope/E2-CON and dual alarm/relay options. By utilizing the integrator/totalizer option, the bearing temperatures can be integrated (added) on a per-hour basis (“degree-hours”). When the integrator/totalizer reaches a preset value (i.e. 64,000), alarm #1 relay activates a warning signal to alert personnel that maintenance (lubrication, etc.) is due. After maintenance, the contents of the integrator/totalizer is reset to 0 and integration/totalization for the next period begins. The low temperature cut-out is programmed to disable integration/totalization at start-up temperatures (90°F) or when the motor is not running. Alarm #2 is set to latch and is used to shut down the motor and alert operators in the event of a sudden increase in the temperature of the bearings (160°F). Daily high (peak) temperatures can be viewed by displaying the contents of the peak buffer.

Programming of the IMT is as follows:

- **“Pro 1”...“TYPE”** - 0 Type “T”
- **“SCALE”** - F Degrees Fahrenheit
- **dECPT** - 0 1 degree resolution
- **“Pro 2”...“SLOPE”** - 1,000 No offset
- **“OFFSET”** - 0 No offset
- **“Pro 3”...“dSP AL”** - YES Check alarms
- **“ENT Al”** - NO No modify alarms
- **dSPHYS** - NO No display hysteresis
- **“rST AL”** - YES Manual reset
- **“dSPeUF”** - YES Display peak/valley
- **“rStBUF”** - YES Enable reset peak/valley
- **SELdSP** - YES Allow display mode switching
- **“rSTDH”** - NO Reset by remote switch only
- **dSPoff** - NO 0 offset programmed
- **“Pro 4”...“FILE/Er”** - 1 Set digital filter to normal
- **“E1-CON”** - 1 Reset totalizer from remote input
- **“E2-CON”** - N/A
- **“Pro 5”...“dECPT”** - 0 Display total in “degree hours”
- **“tBASE”** - 2 Set the integrator time base for “1-hour”
- **SCLFAC** - 90 F Disable integration under 90°F
- **“Lo-cut”** - 90 F Disable integration under 90°F
- **“Pro 6”...“trAc”** - NO No alarm tracking
- **“dISP”** - YES Display annunciation of alarm status
- **“LAC-1”** - NO No alarm will reset when integrator/totalizer reset
- **“ASN-1”** - toAL Triggers from integrator/totalizer
- **“AL-1”** - 64,000 Alarm #1 Trigger value
- **“HYS-1”** - 1 Deadband range (not critical)
- **“Act-1”** - HI Triggers when above 64,000 (Integrator)
- **“LAC-2”** - YES Latch over-temperature alarm
- **“ASN-2”** - InPut Triggers from temperature (Input)
- **“AL-2”** - 160 Alarm #2 trigger value
- **“HYS-2”** - N/A
- **“Act-2”** - HI Triggers when above 160°F

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>TOTALIZER/PEAK/VALLEY/SLOPE/OFFSET/E2-CON</th>
<th>DUAL ALARM</th>
<th>SERIAL OUTPUT</th>
<th>ANALOG OUTPUT</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMT</td>
<td>Intelligent Meter for Thermocouple Inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00060</td>
<td>No</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMT00060</td>
</tr>
<tr>
<td>00062</td>
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<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMT00062</td>
</tr>
<tr>
<td>02060</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMT02060</td>
</tr>
<tr>
<td>02061</td>
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<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMT02061</td>
</tr>
<tr>
<td>02062</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IMT02062</td>
</tr>
<tr>
<td>02063</td>
<td>NO</td>
<td>NO</td>
<td>4 to 20 mA</td>
<td>NO</td>
<td>NO</td>
<td>IMT02063</td>
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<tr>
<td>02067</td>
<td>YES</td>
<td>YES</td>
<td>4 to 20 mA</td>
<td>NO</td>
<td>NO</td>
<td>IMT02067</td>
</tr>
<tr>
<td>02069</td>
<td>YES</td>
<td>YES</td>
<td>0 to 10 VDC</td>
<td>NO</td>
<td>NO</td>
<td>IMT02069</td>
</tr>
</tbody>
</table>

For more information on pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.
MODEL IMY - APOLLO INTELLIGENT METER FOR THERMISTOR INPUTS

- ACCEPTS 2252 Ω “400 SERIES” AND THERMOLINEAR™, “700 SERIES” THERMISTORS
- STATE-OF-THE-ART DIGITAL ELECTRONICS FOR GREATER ACCURACY AND RELIABILITY
- FULL 6-DIGIT, HIGH VISIBILITY, 0.56” HIGH RED LED DISPLAY
- PROGRAMMABLE FRONT PANEL LOCK-OUT MENU
- INTEGRATOR (Totalizer) (Optional)
- PEAK/VALLEY MEMORY (Optional)
- DUAL ALARM RELAY OUTPUTS (Optional)
- BI-DIRECTIONAL SERIAL COMMUNICATIONS (Optional)
- 4 to 20 mA OR 0 to 10 VDC ANALOG OUTPUT (Optional)
- NEMA 4/IP65 SEALED METAL FRONT BEZEL

DESCRIPTION

The Apollo Intelligent Thermistor Meter (IMY) accepts standard Thermistor inputs and precisely linearizes them for temperature readings. Like an RTD, a thermistor is also a temperature sensitive resistor, but the thermistor provides a much larger resistance change per degree. Since thermistors provide a large resistance change, significant errors from long lead lengths or switches are eliminated. Other advantages of using a thermistor are accuracy, repeatability, long term stability, and sensor cost. A full 6-digit display accommodates a wide range of temperature inputs and holds large totalization values. State-of-the-art digital circuitry virtually eliminates errors due to drift. A full complement of option packages is available to support many process applications.

The IMY supports two popular thermistor series – the 400 Series 2,252 Ohm thermistor, and the 700 Series Thermolinear™ thermistor. Selection of the type is done in Programming Module #1.

The indicator features a readout choice of either Fahrenheit or Celsius with 0.1 or 1 degree of resolution. English Style display prompts and front panel buttons aid the operator through set-up and operation. A front panel lock-out menu protects set-up data and operation modes from unauthorized personnel. Programmable digital filtering enhances the stability of the reading. Remote input “E1-CON” can be utilized to control a variety of functions including, totalizing, display hold, set point and peak/valley reading operations. All set-up data is stored in E² PROM, which will hold data for a minimum of 10 years without power.

An optional integrator (totalizer) can be used to totalize or integrate temperatures up to a maximum display value of 999,999. It features independent scaling, decimal point selection, and a low temperature cut-out to suit a wide variety of temperature integration/totalization applications. Programmable remote input “E2-CON” is included with this option and can be utilized to control a variety of functions, such as integrating/totalizing, alarm control, peak/valley readings, display hold or temperature offset operations, simultaneously with remote input “E1-CON”. Peak/valley (max/min) reading memory and programmable temperature offset functions are included with this option and they are easily recalled and controlled by either the front panel or a remote input. All readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications. Optional 20 mA loop, bi-directional serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

An optional 4 to 20 mA or 0 to 10 VDC re-transmitted analog output can be scaled by the user to interface with a host of recorders, indicators and controllers. The indicator has several built-in diagnostic functions to alert operators to any malfunction. Extensive testing of noise interference mechanisms and a full burn-in make the indicator extremely reliable in industrial environments. The die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications. Plug-in style terminal blocks simplify installation wiring and change-outs.

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.

SPECIFICATIONS

1. DISPLAY: 4-digit with F/C indication, 0.56” (14.2 mm) high LED, minus sign displayed for negative temperatures. 6-digits for totalizer, “Flashing” display during totalizer overflow. “ULULUL” displayed during temperature display out of range (positive). “ULULUL” displayed during temperature display out of range (negative). “SHORT” displayed for shorted input and “ULULUL” displayed for unconnected input.

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
SPECIFICATIONS (Cont’d)

2. POWER REQUIREMENTS:
   A.C. Power: Switch Selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA or 230 VAC, ±10%, 50/60 Hz, 14 VA

3. CONTROLS: Three front panel push buttons for modifying alarm values and indicator set-up. Three external inputs; one for disabling the front panel, and two for programmable function inputs.

4. SIGNAL INPUT: 2-Wire, 400 Series 2,252 Ω Thermistor; or 3-wire, 700 Series Thermistores™ thermistor.
   Max. Input Signal Voltage: ±15 VDC.

5. OPEN THERMISTOR DETECTION:
   Display: “ULULUL”
   Setpoint Outputs: Disabled (Deactivated)
   Serial Outputs: “ULULUL” in data field
   Integration/Totalization: Disabled
   Analog Output: 4 mA
   RANGE: 400 Series -40.0°C to 257.0°C (-40.0°F to 482.6°F) 700 Series -20.0°C to 100.0°C (-22.0°F to 212°F).
   RESPONSE TIME: 0.1 or 1 degree.
   ACCURACY: ±0.2°C (0.36°F) ±1/2 LSD, @ 23°C and 10 min. warm-up.
   READING RATE: 2.5 readings/second

6. RESPONSE TIME: 2 seconds to settle for step input (increases with programmable digital filtering)

10. TOTALIZER:
    Front panel button for input/display select. External totalizer reset/enable. Programmable time-base, scale factor (0.001-100,000) and low-temp. cut-out. Response Time = 0.2 sec. max.

11. E1-CON & E2-CON:
    External remote inputs that allow activation of various functions. (Reset total, peak indicator mode, trigger mode, etc.) VIL = 0.8 VMAX; VIH = 2.0 VMIN. Response Time = 0.2 sec. max.

12. NORMAL MODE REJECTION:
    40 dB at 50/60 Hz (may be improved by programmable digital filtering)

13. COMMON MODE REJECTION:
    120 dB, DC to 50/60 Hz

14. NORMAL MODE REJECTION:
    40 dB at 50/60 Hz

15. COMMUNICATIONS (Optional):
    Type: Bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source).
    Baud Rate: programmable 300 to 2400
    Maximum address: 99 (Actual number in a single loop is limited by serial hardware specifications.)

    Data Format: 10 bit frame, Odd parity (one start bit, 7 data bits, one odd parity bit, and one stop bit).
    Serial Hardware Specifications:
    SO - Output Transistor Rating: VMAX = 30 VDC, VSAT = 1 VMAX at 20 mA
    Note: This will allow up to 28 units max. in each loop.
    SI - Input Diode Rating: VI = 1.25 VTP = 1.5 VMAX
    Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

17. ALARMS (Optional):
    Solid State: Two, isolated, sinking open collector NPN transistors acting in parallel with relays. VSAT = 1 V @ 100 mA max., VMAX = 30 VDC.
    Relays:
    Type: Form C (2)
    Max. Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1.8 hp @ 120 VAC (inductive load).
    Relay Life Expectancy: 100,000 cycles at max. rating. (As load level decreases, life expectancy increases.)

18. ANALOG OUTPUT (Optional):
    4 to 20 mA: Digital scaling and offsetting within a 4 to 20 mA range
    Accuracy: 0.1% of full scale
    Resolution: 12 bits
    Compliance Voltage: 10 VDC (500 μA max. loop resistance)
    to 10 VDC: Digital scaling and offsetting within a 0 to 10 VDC range
    Accuracy: ±0.1% of reading +35 mV
    Resolution: 12 bits
    Min. Load Resistance: 10 kΩ (1 mA max.)

19. PEAK/VALLEY/SLOPE/OFFSET (Optional):
    Peak and Valley recording. Programmable temperature offset and slope.

20. CERTIFICATIONS AND COMPLIANCES:
    EMC EMISSIONS:
    Meets EN 50082-2: Industrial Environment.
    ENV 50140 - Radio-frequency radiated electromagnetic field
    ENV 50141 - Radio-frequency conducted electromagnetic field
    EN 61000-4-2: Electrostatic discharge (ESD)
    EN 61000-4-4: Electrical fast transient/burst (EFT)

    Notes:
    1. Unit complies with listed specifications at 10 V/m, with unit installed in a metal panel, rear of the unit covered with a metal enclosure providing at least 5 dB of shielding effectiveness and mounted to an aluminum rack connected to earth ground (protective earth). All I/O cables routed through metal conduit that is connected to earth ground at both ends.
    a. Unit complies with listed specifications at 6 V/m, with unit installed in a metal panel mounted to an open aluminum rack connected to earth ground.
    b. At 10 V/m, with unit installed in a metal panel mounted to the open aluminum rack, the process signal and 4 to 20 mA analog output option can vary out of range from specifications.
    2. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.

    Refer to the EMC Compliance Installation section of the manual for additional information.

21. CONSTRUCTION:
    Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).

22. CONNECTION:
    Removable terminal blocks

23. WEIGHT: 1.2 lbs (0.5 kg)

ISOLATED RE-TRANSMITTED ANALOG OUTPUT OPTION

4 to 20 mA

The re-transmitted analog output option transmits a digitally programmable 4 to 20 mA current to drive chart recorders, remote indicators and controllers. The compliance is 10 VDC. Non-standard current ranges within the 4 to 20 mA range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 and 20 mA.

0 to 10 VDC

The re-transmitted analog output option transmits a digitally programmable 0 to 10 VDC output signal to drive chart recorders, remote indicators and controllers. Non-standard current ranges within the 0 to 10 VDC range can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 0 and 10 VDC.

TOTALIZER/PEAK/VALLEY/TEMPERATURE OFFSET AND SLOPE OPTION

The major feature of this option is its integrator/totalizer (accumulator). The integrator simply totals (adds) input readings with a programmable time base and scaling coefficient. The integrator/totalizer may be reset via a remote input, by the front panel or through the serial communications loop. Alarms may be programmed to trigger from totalizer values or input values. A programmable low temperature level disable feature completes the integrator/totalizer features. At loss of power to the indicator, the contents of the totalizer are saved.

Other features of this option are peak and valley detection. The indicator will record the lowest reading (valley) and the highest reading (peak), automatically, for later recall. This information is valuable when monitoring the limits of the process over any length of time which can span shifts, days, etc. (these values are stored at power-down) . A remote input can be programmed to reset or engage the unit into a peak reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and viewed and reset through the serial communication option.

The programmable temperature offset feature allows the operator to shift the displayed temperature reading. The operator may utilize this feature, for example, if switching probes, to compensate for differences in thermistor probe accuracy from one manufacturer to another. The displayed temperature reading can be offset either positive or negative to the actual measured temperature. Programming a positive number for the offset value increases the display value. Programming a negative number for the offset value decreases the display value.

For example, programming +10 for the offset value will increase the displayed value by 10 throughout the entire range, or programming -10 for the offset value will decrease the display value by 10 throughout the entire range.
**ISOLATED ALARM OPTION**

The alarm option consists of an additional printed circuit board with nine connections. Six of these terminals are for the two Form-C relays and the other three are for two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, auto or manual reset, triggering from input or total and they can be made to track each other, if desirable. If the alarms are programmed to latch (manual reset), then they can be reset either by the front panel or a remote input. The alarms can be made to trigger from either the integrator/totalizer or the input display, to actuate external alarms, control valves, etc.

Alarm #1 can be programmed to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process when tracking is programmed. Changing the shut-off trip value (alarm #2) automatically changes the pre-warning value (alarm #1) an equal amount. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control.

**ISOLATED SERIAL COMMUNICATIONS OPTION**

The serial communication option is a half-duplex, two-wire 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit temp (input) signal. Two loops are required for all hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. A built-in 20 mA source is provided in the transmit loop. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, with a maximum address capability of 99 units. (Note: There are serial hardware limitations which restrict this to a lower number of units per serial loop.)

**PROGRAMMABLE FUNCTIONS**

Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel buttons “UP” and “DOWN” (shown as “arrows” on the front panel) are used to change the data and set-ups, while the “P” button is used to save or enter the data. After pressing “P”, which gains entry into the programming mode, the programming modules are identified by the message “Pro” and a number in the display. “UP” and “DOWN” are used to select the desired programming module and “P” is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled “PGM DIS.” must be ungrounded to gain access to programming. The following table lists the programming steps.

<table>
<thead>
<tr>
<th>“Pro 0” - RETURN TO MEASUREMENT MODE</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>“Pro 1” - PROGRAM THERMISTOR TYPE, TEMPERATURE SCALE AND DEcimal POINT POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>“TYPE” - Select Thermistor type (400/700)</td>
</tr>
<tr>
<td>“SCALE” - Enter either degree (F or C)</td>
</tr>
<tr>
<td>“dECPNt” - Enter resolution (0 or 0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 2” - PROGRAM TEMPERATURE SLOPE AND OFFSET</th>
</tr>
</thead>
<tbody>
<tr>
<td>“SLOPE” - Enter display slope (0.0001 to 9.9999)</td>
</tr>
<tr>
<td>“OFFSET” - Enter offset (-999 to 9999)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 3” - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED</th>
</tr>
</thead>
<tbody>
<tr>
<td>“dSP AL” - Enable display alarms</td>
</tr>
<tr>
<td>“ENI AL” - Enable enter alarms</td>
</tr>
<tr>
<td>“dSPHYbS” - Enable display hysteresian</td>
</tr>
<tr>
<td>“ENHYbS” - Enable enter hysteresian</td>
</tr>
<tr>
<td>“rSPbS” - Enable display of peak/valley readings</td>
</tr>
<tr>
<td>“dSPbUF” - Enable display of peak/valley readings</td>
</tr>
<tr>
<td>“rStC-2” - Enable reset latched alarms</td>
</tr>
<tr>
<td>“rStC-1” - Enable reset latched alarms</td>
</tr>
<tr>
<td>“rStC-0” - Enable reset total</td>
</tr>
<tr>
<td>“dSPOFP” - Enable display offset value</td>
</tr>
<tr>
<td>“rStf” - Enable reset latched alarms</td>
</tr>
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<table>
<thead>
<tr>
<th>“Pro 4” - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>“FbEIr” - Enter level of digital filtering</td>
</tr>
<tr>
<td>0 - No digital filtering</td>
</tr>
<tr>
<td>1 - Normal filtering</td>
</tr>
<tr>
<td>2 - Increased filtering</td>
</tr>
<tr>
<td>“MAX” - Maximum filtering</td>
</tr>
<tr>
<td>“ENt CON” - Enter function of remote input</td>
</tr>
<tr>
<td>0 - Offset temperature reading to zero</td>
</tr>
<tr>
<td>1 - Reset totalizer</td>
</tr>
<tr>
<td>2 - Reset and gate totalizer</td>
</tr>
<tr>
<td>3 - Gate totalizer</td>
</tr>
<tr>
<td>4 - Display hold</td>
</tr>
<tr>
<td>5 - Reset peak/valley</td>
</tr>
<tr>
<td>6 - Reset peak and start peak indicator</td>
</tr>
<tr>
<td>7 - Reset valley and start valley indicator</td>
</tr>
<tr>
<td>8 - Reset latched alarms</td>
</tr>
<tr>
<td>9 - Reset all alarms</td>
</tr>
<tr>
<td>10 - Toggle display between input and totalizer</td>
</tr>
<tr>
<td>11 - Offset input to zero and totalize the offset values</td>
</tr>
<tr>
<td>12 - Display hold with offset</td>
</tr>
<tr>
<td>13 - Instrument reading synchronization</td>
</tr>
<tr>
<td>14 - Print request</td>
</tr>
<tr>
<td>“E2-CON” - Same functions as E1-CON</td>
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</table>

<table>
<thead>
<tr>
<th>“Pro 5” - PROGRAM TOTALIZER</th>
</tr>
</thead>
<tbody>
<tr>
<td>“dECPNt” - Enter decimal point for totalizer</td>
</tr>
<tr>
<td>“tBase” - Enter time base</td>
</tr>
<tr>
<td>0 - second</td>
</tr>
<tr>
<td>1 - minute</td>
</tr>
<tr>
<td>2 - hour</td>
</tr>
<tr>
<td>“SCLFAC” - Enable multiplying scale factor</td>
</tr>
<tr>
<td>“Lo-cut” - Enable low-signal cut out</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 6” - PROGRAM ALARMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>“tAc” - Enable alarm value tracking</td>
</tr>
<tr>
<td>“dISp” - Enable display alarm announcators</td>
</tr>
<tr>
<td>“LAIC-1” - Enable alarm #1 latching</td>
</tr>
<tr>
<td>“ASP-1” - Enable alarm #1 trigger source (input or total)</td>
</tr>
<tr>
<td>“ASL-1” - Enable alarm #1 value</td>
</tr>
<tr>
<td>“HYs-1” - Enter hysteresis value for alarm #1</td>
</tr>
<tr>
<td>“Act-1” - Enable alarm #1 action (high or low)</td>
</tr>
<tr>
<td>“LAIC-2” - Enable alarm #2 latching</td>
</tr>
<tr>
<td>“ASIN-2” - Enable alarm #2 trigger source (input or total)</td>
</tr>
<tr>
<td>“AL-2” - Enable alarm #2 value</td>
</tr>
<tr>
<td>“HYs-2” - Enter hysteresis value for alarm #2</td>
</tr>
<tr>
<td>“Act-2” - Enable alarm #2 action (high or low)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 7” - PROGRAM SERIAL COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>“bAud” - Enter baud rate</td>
</tr>
<tr>
<td>“AddrES” - Enter loop address number (0-99)</td>
</tr>
<tr>
<td>“Print” - Enter print function, or “P” command function through Serial Option</td>
</tr>
<tr>
<td>0 - temp.</td>
</tr>
<tr>
<td>1 - temp., peak/valley and offset</td>
</tr>
<tr>
<td>2 - temp. and alarms</td>
</tr>
<tr>
<td>3 - temp., peak/valley, alarms, hysteresian, and offset</td>
</tr>
<tr>
<td>4 - integrator/totalizer</td>
</tr>
<tr>
<td>5 - temp. and integrator/totalizer</td>
</tr>
<tr>
<td>6 - temp., integrator/totalizer, peak/valley, alarms, hysteresis, and offset</td>
</tr>
<tr>
<td>7 - integrator/totalizer, peak/valley, alarms, hysteresis, and offset</td>
</tr>
<tr>
<td>8 - temp., integrator/totalizer, peak/valley, alarms, hysteresis, and offset</td>
</tr>
<tr>
<td>9 - temp., integrator/totalizer, peak/valley, alarms, hysteresis, and offset</td>
</tr>
<tr>
<td>“FULL” - Enable complete or abbreviated printing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 8” - PROGRAM RE-TRANSMITTED ANALOG OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>“ASIN” - Select source of analog output (input or total)</td>
</tr>
<tr>
<td>“AN-Lo” - Enter 4 mA or 0 VDC display value</td>
</tr>
<tr>
<td>“AN-HI” - Enter 20 mA or 10 VDC display value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“Pro 9” - SERVICE OPERATIONS (Protected by access code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- This sequence may be subject to being locked-out due to other programmed sequences.</td>
</tr>
</tbody>
</table>
TOTALIZER EXAMPLE STERILIZATION
APPLICATION

A 400 Series 2,252 Ω thermistor is employed to monitor the temperature of a sterilization bath used to sterilize equipment in the production of drugs at a pharmaceutical company. The sterilization bath varies in temperature with the amount of equipment in the bath and therefore, longer soak intervals may be required to ensure complete sterilization. The optional totalizer of the IMY is used to integrate a temperature-time profile of the sterilization process and the setpoint/alarm option is used to alert operators when the totalizing temperature has exceeded the required value, signaling that sterilization is complete. The temperature of the bath can fluctuate from 150 to 200°F and the additional alarm is used to activate if the bath falls below 140°F.

In order to effect sterilization, the equipment must be in the bath for 1500 degree-minutes (150°F for 10 minutes, 200°F for 7.5 minutes, etc.) as long as the temperature remains above 140°F. The totalizer is programmed for a “1-minute” timebase to provide direct readout in degree-minutes. Alarm #1 is programmed to trigger from the integrator and is set to activate at a value of 150°F. Alarm #2 is programmed to trigger directly from the temperature and is assigned to be lo-acting (when the temperature falls below 140°F) and is programmed to latch at 140°F. Remote input “E1-CON” (TBA #4) is programmed to reset the totalizer after each sterilization operation. The display can be switched between temperature and totalizer readout from the front panel by using the “up” and “down” buttons. The optional 4 to 20 mA retransmitted output is used to provide a temperature profile of the sterilization process on a chart recorder. An external key switch is connected from TBA #3 (Program Disable) to ground. With this terminal grounded, unauthorized modification of the programmed data is prevented.

TEMPERATURE MONITORING EXAMPLE

An IMY is installed as a monitoring device and back-up controller for a freezer storage facility. Normally, the freezer temperature is maintained at about -29°C ±2°C. The absolute maximum allowable temperature of the freezer is 0°C. In the event of a system failure, alarm output #1 of the IMY is programmed to start a secondary cooling system should the temperature reach 0°C. The additional alarm of the IMY is used to signal personnel with a warning bell when the temperature rises above -17°C (indicating a possible failure of the main cooling system). This alarm is programmed to latch in order to assure that personnel inform maintenance of a possible problem. Key switches are installed to lock out the front panel from unauthorized personnel and to provide the means to reset the latched alarm. The integrator/totalizer option is specified to store peak and valley temperatures overnight, weekly, etc. Programming module #5 (Pro 5) is used to set up the integrator. The re-transmitted analog output is specified to drive a chart recorder with 4 to 20 mA for a hard copy of temperature profiles for later evaluation.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>TOTALIZER/PEAK/VALLEY/SLOPE/OFFSET/EZ-CON</th>
<th>DUAL ALARM</th>
<th>SERIAL OUTPUT</th>
<th>ANALOG OUTPUT</th>
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**DUAL RANGE, 4 to 20 mA or 10 to 50 mA**

**3 1/2-DIGIT, 0.56" (14.2 mm) HIGH LED READOUT**

**SEALED METAL FRONT BEZEL (NEMA 4/IP65)**

**24 VDC EXCITATION SUPPLY (Optional)**

**WIDE RANGE SPAN & OFFSET SCALING**

**FRONT ACCESS TO CALIBRATION TRIM CONTROLS**

**OVER-RANGE INDICATION**

**PLUG-IN TERMINAL STRIPS**

**SELECTABLE DECIMAL POINTS**

* Also adapts to 0 to 50, 0 to 20, 0 to 10, 1 to 5 mA ranges as well as bi-polar inputs.

**DESCRIPTION**

The premium features of the Apollo Series can now be applied to measurement of process variables. With its high sensitivity and programmability, the Apollo Current-Loop Indicator (APLCL) can be set up for a wide variety of applications. In most plants the APLCL can be used for 90 to 95% of current-loop indicator needs for readout of pressure, flow, temperature, level and other variables.

The rugged construction and sealed metal front bezel meet the requirements of NEMA 4/IP65, when properly installed. This allows the APLCL to be used in dirty, hostile environments and in wash-down areas. In addition, the attractive flat-black and brushed aluminum front dresses up any control panel.

**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. **DISPLAY:** 3 1/2-digit (1999), 0.56" (14.2 mm) L.E.D., minus sign displayed on negative current flow. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP programming switches.

2. **POWER:** Available for 115 or 230 V AC ±10%, 50/60 Hz, 6 VA.

3. **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)

4. **COMPLIANCE:** Voltage drop across input at max. signal current, less than 600 mV for both 4 to 20 and 10 to 50 mA ranges.

5. **INPUT RESISTANCE:**
   - 4 to 20 mA - 29.2 Ω
   - 10 to 50 mA - 11.8 Ω

6. **SCALING RANGE:**
   - SPAN: 32 coarse steps (binary progression with 5 DIP switches, rear access). 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. Fine adjust (front access) brackets the coarse step increments.
   - OFFSET: 16 coarse steps (binary progression with 4 DIP switches, rear access) 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. Front access fine control brackets the steps.

7. **LINEARITY:** ±(0.05% ±1 digit)

8. **READING RATE:** 2 1/2 updated readings/second, nominal.

9. **RESPONSE TIME:** 1 second to settle for step change.

10. **NORMAL MODE REJECTION:** 63 dB, 50/60 Hz.

11. **COMMON MODE REJECTION:** 100 dB, DC to 50/60 Hz.

12. **ENVIRONMENTAL CONDITIONS:**
    - Operating Range: 0° to 60°C
    - Storage Temperature: -40° to 80°C
    - Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C
    - Span Temperature Coeff: 100 PPM/°C
    - Offset Temperature Coeff: 100 PPM/°C
    - Altitude: Up to 2000 meters

13. **EXCITATION SUPPLY (Optional):** 24 VDC @ 60 mA max. Regulated and isolated (floating). (See Ordering Information.)

14. **CONSTRUCTION:** Die cast metal front bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for indoor use when properly installed. (Panel gasket and mounting clips included.) Installation Category II, Pollution Degree 2

15. **CONNECTIONS:** Plug-in, compression type barrier terminal strip.

16. **WEIGHT:** 1.2 lbs (0.54 Kg).

**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 5.5" (140) W.
DESCRIPTION OF OPERATION

The Apollo Current-Loop Indicator (APLCL) consists of a digital voltmeter 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 (V1) 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 Apollo Current-Loop Indicators 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 (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 Apollo Current-Loop Indicator can be set up over a very wide span range by means of the coarse DIP switches S6-S10 (on the rear), and the fine screwdriver adjustment pot, located behind the sealing screw on the front bezel (left side). 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 front panel 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 Apollo Current-Loop Indicator 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 Apollo Current-Loop Indicator, 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 (at the rear) 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 control (front panel right) has a numerical readout range of ±100 and brackets all the coarse switched ranges.
CALIBRATION

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 APLCL 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, 2 and 3 the unit is “nullled” to zero readout with zero input signal current. In Steps 4 and 5, the span adjustments are made to establish the required slope of the transfer curve. Then in Step 6, the transfer curve is shifted up or down as required by setting the offset adjustments. In Step 7, the final “tweaking” adjustments are made at minimum and maximum signal current. Setting the decimal points in Step 8 completes the calibration.

Before calibrating, the READOUT SPAN (RS), SWING CURRENT (IS) must be determined.

Example: Readout is to be 5.00 @ 4 mA and 15.00 @ 20 mA.

READOUT SPAN (RS) = 1500 = 500 = 1000
SWING CURRENT (IS) = 20 mA – 4 mA = 16 mA

ADJUSTMENTS

1. Turn off all coarse offset and span adjustment switches (S2-S10 down). S1 has no effect when zeroing and can be in either position.
2. Apply zero current by opening the external zero current switch. Adjust the indicator to read zero using the fine offset adjustment (R.H. side, front panel).
3. Close the external zero current switch and set the SWING CURRENT, IS, (16 mA in the example) by adjusting the power supply voltage and the external fine adjust pot. Then, turn the fine span control (front, left) to get a near zero reading (Adjustment fully CCW)
4. With the SWING CURRENT IS, applied to the input, set up a combination of coarse span adj. switches (S5-S10) to obtain a display readout closest to the READOUT SPAN desired (1000 in the example).
5. Set the exact READOUT SPAN with the fine span adj. (front, left).
6. After the span has been adjusted, set the signal current to the minimum level (4 mA in example). Then set the offset add/subtract switch (S1), the coarse offset switches (S2-S5) and the fine offset control (front, right) to obtain the readout corresponding to this minimum current level.
7. Adjust the input signal current to its maximum value to see if the proper readout is obtained (1500 @ 20 mA in example). If the readout is slightly off, adjust the fine span (front, left) to obtain the true reading. Then, recheck the reading at minimum input current (4 mA) and readjust fine offset (front, right) if necessary. Repeat the maximum and minimum readout adjustments until the unit displays the proper readout at both extremes.
8. Set decimal points as desired using the three switches on the side of the case and replace the front panel sealing screws. The unit can now be installed.

APPLICATION EXAMPLES

Example 1: An APLCL 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)

A Null the unit to zero readout @ 0 current per Steps 1, 2, and 3.
B Set the coarse and fine span adjustments to get a readout of 1375 @ 40 mA for Steps 4 and 5. Note: With the full standard swing of 40 mA, the coarse span switch reference markings can be used to determine settings as follows:
C Set offset to readout 0 @ 10 mA per Step 6. Note: The readout 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.
D Check readout at max. (50 mA) and min. (10 mA) and fine tune (tweak) as required per Step 7.

Example 2 (Negative Slope): A measuring device puts out 6 mA when a storage tank is full and 15 mA when the tank is empty. The APLCL 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

A Null the unit per Steps 1, 2 and 3.
B Set the coarse and fine span adjustments to get readout of +900 @ -9 mA per Steps 4 and 5.
C Move transfer curve up by applying (+) offset per Step 6 until readout is -900 @ -6 mA.
D Check extreme readings per Step 7. 0 readout @ -15 mA and +900 readout @ -6 mA.
E Set D.P. Switch S1 and replace front panel sealing screws.

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

A Null the unit per Steps 1, 2, and 3.
B Set transfer curve slope with span adjustments per Steps 4 and 5, to get a readout of +1500 @ 8 mA.
C Apply (-) offset per Step 6 to get a reading of -1500 @ 4 mA.
D Check min. and max. extremes and tweak if required to get desired readout @ 4 and 20 mA per Step 7.
1. When shielded wire leads are used, connect the shield to Terminal 3 at the indicator 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.

**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.

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**Installation**

The Apollo Current-Loop Indicator is designed to be panel-mounted into an enclosed panel with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. The APLCL meets NEMA 4/IP65 requirements for indoor use when properly installed. (Recommended minimum panel thickness is 1/8”.)

Cut the panel opening to the specified dimensions. Remove burrs and clean around the panel opening. Slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side.

Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

**Caution:** Only minimum pressure is required to seal panel. Do NOT overtighten screws.

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**TROUBLESHOOTING**

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

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**ORDERING INFORMATION**

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<th>DESCRIPTION</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
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<td>APLCL410</td>
<td>Apollo Current-Loop Indicator w/24 VDC Excitation Supply</td>
<td>APLCL411, APLCL401</td>
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*For information on Pricing, Enclosures, & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.*

**Units are shipped calibrated to read 000.0 to 100.0 with 4 to 20 mA input.**

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
**MODEL APLHV - APOLLO AC POWER-LINE MONITOR**

- **3-DIGIT, 0.56" (14.2 mm) HIGH LED DISPLAY**
- **AUTO ZEROING CIRCUIT**
- **FRONT PANEL CALIBRATION ADJUSTMENT**
- **NEMA 4/IP65 SEALED METAL FRONT BEZEL**

**DESCRIPTION**

The Model APLHV is designed for AC power-line monitoring. The half-wave rectified input signal is calibrated to indicate the RMS value of a pure sinusoidal wave-form. The die-cast front metal bezel meets NEMA 4/IP65 requirements for indoor use, when properly installed.

**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.

- 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:** 3-digit, 0.56" (14.2 mm) high character, 7-segment Red LED.
2. **POWER:** Available in either 115 V AC or 230 V AC versions. Allowable power line variation: ±10%, 50/60 Hz, 6 VA. Installation Category II, Pollution Degree 2.
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 V AC max. @ 45 to 500 Hz. Installation Category I, Pollution Degree 2.
6. **RESOLUTION:** 1 V AC
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) from 0°C to 50°C.
   - Temperature Coefficient: ±150 PPM/°C
   - 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:**
    - **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 Vrms 150 KHz - 80 MHz Level 3; 10 V/m 900 MHz ± 5 MHz 200 Hz, 50% duty cycle
        - 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 B Power mains class B
      - Notes:
        1. Self-recoverable loss of performance during EMI disturbance at 10 V/rms: Measurement error exceeds unit specifications
        2. For operation without loss of performance:
           - Install power line filter to unit input power (Terminals 1 and 2), RLC#LFIL0000 or equivalent
        3. Refer to the EMC Installation Guidelines section of this bulletin for additional information.

11. **CONSTRUCTION:** Metal die-cast front bezel with black plastic case. Front panel meets NEMA 4/IP65 requirements when properly installed (panel gasket and mounting clips included).
12. **WEIGHT:** 1.2 lbs. (0.54 Kg)

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<tr>
<td>APLHV</td>
<td>Apollo AC Power Line Monitor</td>
<td>APLHV410</td>
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For more information on pricing, Enclosures, & Panel Mount Kits see the RLC Catalog or contact your local RLC distributor.
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.
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 #28B2029-0A
   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 must 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 APLHV, all connections are made on the double-spaced terminal block located at the rear of the unit.

POWER CONNECTIONS

Primary AC power is connected to terminal 1 and 2 (Marked A.C. 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.

INPUT CONNECTIONS

Input connections are made on terminal 3 and 4. When powering the APLHV with the same voltage that is being measured, terminal 3 (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.

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 unit meets NEMA 4/IP65 requirements for indoor use when properly installed. The units are intended to be mounted into an enclosed panel, with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8" (3.2 mm)).

After the panel cut-out has been completed and deburred, carefully slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. Install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side.

Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

Caution: Only minimum pressure is required to seal panel. Do NOT overtighten screws.

TROUBLESHOOTING

For further technical assistance, contact technical support at the appropriate company numbers listed.
MODEL APLI - APOLLO CURRENT METERS & MODEL APLV - APOLLO VOLTMETERS

- FOUR MULTI-RANGE UNITS COVER:
  199.9 µA to 1.999 A, 199.9 mV *(A.C. or D.C.)
  1.999 V to 300 V (A.C. or D.C.)
- 3 1/2-DIGIT, 0.56” (14.2 mm) HIGH LED DISPLAY W/ POLARITY
- BUILT-IN SCALING PROVISIONS
- SELECTABLE DECIMAL POINT LOCATION
- AUTO ZEROING CIRCUITS
- FRONT PANEL CALIBRATION ADJUSTMENT
- OVER-RANGE INDICATION
- NEMA 4/IP65 SEALED FRONT METAL BEZEL

* Accessory Shunts Available For Higher Current Ranges.

DESCRIPTION
Apollo Volt and Current 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 units offer the ultimate in application flexibility. Just four basic models, off-the-shelf, from your local distributor, cover your voltage and current indicator needs, as well as your requirements for direct readout from pressure, speed or flow transducers, or any other variable that can be translated to voltage or current.

The attractive die-cast metal bezel of the Apollo not only enhances the appearance of any panel, it can also be sealed in the front panel for use in washdown areas and tough, dirty industrial environments. 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 LED’s for easy reading. Also featured are removable terminal blocks on the rear that facilitate installation wiring and change-outs.

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. DISPLAY: 3 1/2-digit, 0.56” (14.2 mm) high, 7-segment 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: Available in either 115 V AC or 230 V AC versions. Allowable power line variation ±10%, 50/60 Hz, 6 VA.
3. INPUT RANGES: (Selectable by input and jumper connections.)

<table>
<thead>
<tr>
<th>A.C. Voltmeters</th>
<th>A.C. Current Meters</th>
<th>D.C. Voltmeters</th>
<th>D.C. Current Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1.999 Volts</td>
<td>0-199.9 µA (microamps)</td>
<td>±1.999 Volts</td>
<td>±199.9 µA (microamps)</td>
</tr>
<tr>
<td>0-19.99 Volts</td>
<td>0-1.999 mA (milliamps)</td>
<td>±19.99 Volts</td>
<td>±1.999 mA (milliamps)</td>
</tr>
<tr>
<td>0-199.9 Volts</td>
<td>0-19.99 mA</td>
<td>±199.9 Volts</td>
<td>±19.99 mA</td>
</tr>
<tr>
<td>0-300 Volts</td>
<td>0-199.9 mV (basic range)</td>
<td>±300 Volts</td>
<td>±199.9 mV (basic range)</td>
</tr>
</tbody>
</table>

4. ACCURACY:
DC Volts - ±(0.1% of Reading + 1 digit)
AC Volts - ±(0.1% of Reading + 2 digits) (45-500 Hz)
DC Current
199.9 µA, 1.999 mA, 19.99 mA: ±(0.1% of Reading + 1 digit)
19.99 mA: ±(0.15% of Reading + 1 digit)
1.999 A: ±(0.5% of Reading + 1 digit)

AC Current (45-500 Hz)
199.9 µA, 1.999 mA, 19.99 mA: ±(0.1% of Reading + 2 digits)
19.99 mA: ±(0.15% of Reading + 2 digits)
1 A: ±(0.5% of Reading + 2 digits)

5. OVER-RANGE INDICATION: on all modes is indicated by blanking 3 least significant digits.
6. MAX. VOLTAGE ON BASIC RANGE INPUTS: 75 VAC or DC (Term. 8 to 3 on voltmeters, Term. 9 to 3 on current meters).
7. MAX. VOLTAGE ON TERMINAL BLOCK: 300 VAC or DC (Both voltmeters and current meters).

DIMENSIONS “In inches (mm)”
Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
8. MAX. SHUNT CURRENTS (ON CURRENT METERS):
   199.9 µA through 19.99 mA: 10 x max. range current
   199.9 mA: 1 amp
   1.999 amp: 3 amps

   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:

<table>
<thead>
<tr>
<th>Component</th>
<th>Temperature Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltmeters</td>
<td>D.C.: ±100 PPM/°C</td>
</tr>
<tr>
<td></td>
<td>A.C.: ±200 PPM/°C</td>
</tr>
<tr>
<td></td>
<td>D.C.: ±75 PPM/°C</td>
</tr>
<tr>
<td></td>
<td>A.C.: ±150 PPM/°C</td>
</tr>
</tbody>
</table>

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) from 0°C to 50°C.
   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 (D.C. units only)

14. COMMON MODE REJECTION: 110 dB D.C. or 50/60 Hz (D.C. units only)

15. COMMON MODE VOLTAGE (COMM. TO EARTH): 350 volt peak

16. CERTIFICATIONS AND COMPLIANCES:

   ELECTROMAGNETIC COMPATIBILITY:
   Immunity to EN 50082-2
   Electrostatic discharge
   EN 61000-4-2
   Level 2: 2 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 EO
   Level 3: 2 kV power
   RF conducted interference
   EN 61000-4-6
   Level 3: 10 V/m 2
   150 KHz - 80 MHz
   Power frequency magnetic fields
   EN 61000-4-8
   Level 4: 30 A/m
   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
   Power mains class A

   Notes:
   1. Self-recoverable loss of performance during EMI disturbance at 10 V/m:
      Process signal may deviate during EMI disturbances.
      For operation without loss of performance:
      Unit is mounted in a grounded metal enclosure (Buckeye SM7013-0 or equivalent)
      I/O and power cables are routed in metal conduit connected to earth ground.
   2. Self-recoverable loss of performance during EMI disturbance at 10 V/m:
      Process signal may deviate during EMI disturbances.
      For operation without loss of performance:
      Install power line filter, RLC #LFIL0000 or equivalent
      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
   As depicted in the drawing of the Apollo Unit, all connections are made to a removable terminal block for ease of installation.
   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.
   To remove the block, pull from the back of the block until it slides clear of the terminal block shroud. Caution: Terminal block should NOT be removed with power applied to the unit.

   POWER WIRING
   Primary AC power is connected to Terminals 1 and 2 (Marked A.C. 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.

   SIGNAL WIRING
   Input connections and range configuration jumpers are made on Terminals 3 through 10 or 11. If AC signal current greater than 5 amps is going to be applied, the appropriate size slow blow fuse should be installed. (For detailed information, see “Inputs and Applications”.)

   DECIMAL POINT SELECTION
   The Apollo Volt and Current meters have DIP switches located on the side of the unit for the selection of 1 of 3 decimal points for display.

   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.
   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. 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.

   Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
**APOLLO VOLTMETER INPUTS & CONFIGURATIONS** (Applies to both Apollo A.C. & D.C. voltmeters)

The simplified schematic (left) shows all of the features that permit the Apollo Voltmeter to cover 95% of all in-plant voltage related measurements. The basic voltmeter range is 0 to 1.999 V. For higher voltage readout, a multi-tap precision voltage divider can be connected to extend the range up to 300 V. A built-in scale adj. pot. extends the capability of Apollo Voltmeters even further to provide direct readout from transducers that generate signal voltage outputs proportional to RPM, PSI, FPM, etc. Note: When used to readout in scaled units other than voltage, the front panel adjustment can be used as a fine trim scaling adjustment.

**SCALING FOR DIRECT READOUT OF OTHER VARIABLES**

In many industrial applications, a voltage sensing instrument is required to display a reading in terms of PSI, RPM, or some other variable. The signal voltage being measured is normally generated by a transducer which senses the variable and delivers a linearly proportional output voltage.

The multi-tap divider and the scale adj. pot. of the Apollo Voltmeters can be connected in tandem (series) to scale (divide) virtually any signal voltage up to 300 V max. down to the basic 0 to 1.999 V input range to get the desired reading. The multi-tap voltage divider provides coarse ranges of division and the scaling pot. provides continuous selection of division factors between the taps.

**USING THE FORMULA:**

\[ \frac{VT \times D.D.P}{D.R.} = D.F. \]

**WHERE:**
- VT = Maximum Transducer Output
- D.D.P = Display Decimal Point
- D.R. = Desired Reading
- D.F. = Division Factor

Then we connect the divider and pot. to obtain the adjustable division range we need to bracket the proper division factor (See “Scaling Connection Diagrams” below).

**EXAMPLE 1:** A pressure transducer delivers a 5.5 V signal @ 120.0 PSI maximum.

\[ \frac{VT \times D.D.P}{D.R.} = \frac{5.5 \times 100}{120.0} = 4.58 \text{ D.F.} \]

This division factor falls between 1 and 12, so connect per “Diagram A” below. Calibrate by adjusting the scaling pot. to get the proper readout at a known pressure.

**EXAMPLE 2:** A D.C. tachometer generator delivers 210 V at maximum machine speed which is to be indicated as 575 FPM on an Apollo Voltmeter.

\[ \frac{210 \text{ V (Max. from tach gen.)} \times 1000 \text{ (D.P.P.)}}{575 \text{ (Desired Readout)}} \]

This division factor falls between 105 and 1005, so connect per “Diagram C” above. Calibrate by adjusting the scaling pot. to get the proper readout at a known speed.
CURRENT METER SCALING

The numerical current value displayed by the Apollo current meter can be scaled down to almost any lower numerical value by connecting the scale adj. pot. This pot can be set to divide the normal numerical current reading by any division factor between ÷1 and ÷13. In addition, the shunt resistance chosen can be reduced by connecting the current lead to a lower resistance (higher range tap).

EXAMPLE

In the diagram (left), the Apollo Current Meter has been connected to measure a circuit current to 120.0 mA maximum. However, in this application, the readout is to be in percent of load current, with 120.0 mA being equivalent to 100.0% readout. The scale adj. pot. connected as shown can be adjusted to reduce the normal 120.0 mA display to the 100.0% display desired. The input current leads could also be connected to 4 and 3 instead of 5 and 3 as shown, and this would yield a readout to 100% and allow the decimal point and least significant digit (0.1%) to be dropped.

Scaling to obtain a numerical readout higher than the numerical value of the current can also be done in most cases by simply feeding the current input into a lower range. However, at the higher current range (1.999 A) and with external shunts, care should be taken to avoid exceeding maximum shunt current.

For example, if the unit is measuring a maximum current of 1.3 amps (current flowing between terminals 3 and 4), the numerical current value will be 1.300 displayed. Here, it is impossible to increase the numerical scaled value to say 1.500 by connecting to the next sensitivity (199.9 mA) since the 1.3 amp actual current exceeds the maximum current rating of this range (See “Specifications” for maximum current.)

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 unit meets NEMA 4/IP65 requirements for indoor use when properly installed. The units are intended to be mounted into an enclosed panel.

Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8”.)

After the panel cut-out has been completed and deburred, carefully slide the gasket over the rear of the unit to the panel. Insert the unit into the panel.

As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side.

Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case.

Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

Caution: Only minimum pressure is required to seal panel. Do NOT overtighten screws.
TEMPERATURE MONITORING IN A BISCUIT BAKING OPERATION

A biscuit baker has temperature controllers on his ovens that have a dial for setting the temperature of his ovens. He would like to have a digital display of his temperature for ease of monitoring. He has determined, by talking to the temperature controller manufacturer, there is a 0 to 10 VDC voltage available from the controller, that represents a temperature of approximately 0 to 600°F. An Apollo DC voltage indicator is ideally suited to this application. It is apparent that a standard range will not satisfy this requirement; therefore, field scaling is required. The first thing that must be done is to determine what division factor is required. Use the equation discussed in the text.

\[
\text{Division Factor} = \frac{\text{Maximum Output} \times \text{D.P.}}{\text{Desired Display}} = \frac{10 \times 1000}{600} = 16.7 \text{ (D.F.) Factor}
\]

It can be seen that the division factor falls between 12 and 105 (See “Scaling Connection Diagrams”). This is accomplished by connecting a jumper between “÷10” (Terminal 6) and Terminal 10 (the 1.999 V basic input), and a jumper between Terminal 9 and Terminal 8. Then, using 2 conductor shielded wire to minimize noise pickup, the common of the temperature controller output is connected to “COMM.” (Terminal 3) and the “HIGH” side of the output of the temperature controller is connected to “VIN” (Terminal 7). The shield is also connected to “COMM.” (Terminal 3). The Apollo is now ready to be calibrated. The baker has access to a portable digital thermometer. So in this case, calibration will be accomplished by causing the Apollo indicator to agree with the portable digital thermometer. The baker sets his oven to his normal baking temperature of 375°F. He installs the temperature probe in the oven and waits for it to reach equilibrium. After the oven has stabilized, at its operating temperature, the baker simply adjusts the “coarse” scaling adjustment, located at the rear of the unit, until the display is close in value to that indicated on the digital thermometer. He then removes the “fine” scaling access plug and adjusts the “fine” scaling adjustment until the display agrees with the digital thermometer. He replaces the access plug to keep dust out of the Apollo. The Apollo voltmeter now indicates the oven temperature and the baker can monitor his temperature precisely.

VOLUME INDICATION

A manufacturer who uses vats of chemicals in his process has been using the output of load cells, connected to a circuit that in turn drives a 1 mA DC analog meter movement to display how full the vat is. The meter dial is calibrated 0 to 1500 gallons.

An Apollo DC current indicator is ideally suited to this application. It is apparent that a standard range will not satisfy this requirement and field scaling is required.

It can be seen that the 1 mA for 1500 gallons can not be accomplished using the 1.999 mA range; however, the maximum input of 1mA does not exceed the maximum input on the 199.9 µA range, so this range is selected. This is accomplished by connecting the jumpers as described in the “Scaling” section [e.g. from “199.9 µA” (Terminal 8) to Terminal 11 and a jumper between Terminal 10 and the “199.9 mV” basic input (Terminal 9)]. Then, the Apollo is connected in the circuit to replace the analog meter by connecting the “199.9 µA” (Terminal 8) where the “+” terminal of the analog meter was connected, and connecting the “COMM.” (Terminal 3) where the “-” terminal of the analog meter was connected.

The Apollo is now ready to be calibrated. The operator fills the vat until it is completely full and he knows he has 1500 gallons. He then adjusts the coarse scaling adjustment on the rear of the Apollo indicator until the display reads approximately 1500. He then removes the “fine” scaling adjustment access plug and adjusts the “fine” scaling adjustment until the display reads exactly 1500. He replaces the access plug to keep dust and water out of the Apollo. The Apollo current meter now indicates the exact number of gallons in the vat. No decimal point is selected because the resolution is 1 gallon.
It is desired to monitor the power supply voltage and load current of a 120 volt DC motor. The maximum load current is 100 amps.

The Apollo DC Voltmeter, Model APLVD, is configured for the 199.9 V calibrated range by connecting the “÷100” (Terminal 5) to the 1.999 V basic input (Terminal 8). The “COM.” (Terminal 3) is connected to the negative terminal of the power supply and the “V IN” input (Terminal 7) is connected to the positive terminal of the power supply. The resolution of the display is 0.1 V, therefore “D.P.1” is selected.

The Apollo DC Current Meter, Model APLID, is configured by simply connecting the “COM.” (Terminal 3) and the “199.9 mV” basic input (Terminal 9) to the sense terminals of the external 100 amp current shunt (APSCM-100). The external shunt is then connected in series with the negative terminal of the power supply. The resolution of the display is 0.1 amp, therefore “D.P.1” is selected.

The Apollo volt and current meters will now indicate the power supply voltage and load current of the DC motor precisely.

**Note:** For high AC currents, it is recommended that the Model APLIT be used with a current transformer.

**TROUBLESHOOTING**

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

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>230 VAC</th>
<th>115 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APLVD</strong></td>
<td>Apollo DC Voltmeter</td>
<td>APLVD410</td>
<td>APLVD400</td>
</tr>
<tr>
<td><strong>APLVA</strong></td>
<td>Apollo AC Voltmeter</td>
<td>APLVA410</td>
<td>APLVA400</td>
</tr>
<tr>
<td><strong>APLID</strong></td>
<td>Apollo DC Current Meter</td>
<td>APLID410</td>
<td>APLID400</td>
</tr>
<tr>
<td><strong>APLIA</strong></td>
<td>Apollo AC Current Meter</td>
<td>APLIA410</td>
<td>APLIA400</td>
</tr>
<tr>
<td>*</td>
<td>+10 amp Current Shunt</td>
<td>APSCM010</td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>+100 amp Current Shunt</td>
<td>APSCM100</td>
<td></td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures, & Panel Mount Kits, refer to the RLC Catalog or contact your local RLC distributor.

* Voltage drop at full current = 100.0 mV maximum. Continuous current should not exceed 115% of rating.

* Units are shipped calibrated to the following readings:

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DISPLAY @ INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>APLVD</td>
<td>1999 @ 1.999 VDC</td>
</tr>
<tr>
<td>APLVA</td>
<td>1999 @ 1.999 VAC</td>
</tr>
<tr>
<td>APLID</td>
<td>1999 @ 199.9 mVDC</td>
</tr>
<tr>
<td>APLIA</td>
<td>1999 @ 199.9 mVAC</td>
</tr>
</tbody>
</table>
**DESCRIPTION**
The Model APLIT Apollo 5 amp AC Current Meter provides the capability of measuring large AC currents. The internal current shunt in the APLIT 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 APLIT can be scaled, using the coarse scaling potentiometer, to display between 200 and 1,999 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 attractive die-cast metal bezel of the Apollo not only enhances the appearance of any panel, it can be sealed in the front panel for use in washdown areas and tough, dirty industrial environments. The 3 1/2-digit display features 0.56" (14.2 mm) high, 7-segment LED’s for easy reading. Also featured is a removable terminal block on the rear that facilitates installation wiring and change-outs.

**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. **DISPLAY:** 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment LED. Decimal points inserted before the 1st, 2nd, or 3rd least significant digits by DIP switch selection.
2. **POWER:** Available in either 115 VAC or 230 VAC versions. Allowable power line variation ±10%, 50/60 Hz, 6 V A.
   - Isolation: 2300 Vrms for 1 min. between inputs and supply (300 V working voltage).
3. **ACCURACY:** ±0.5% of reading + 5 digits.
4. **SIGNAL INPUT:**
   - **Range:** 0 to 5 Amps AC @ 25 to 400 Hz
   - **Resolution:** 2.5 mA
5. **OVER-RANGE INDICATION:** 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
   - **Temperature Coefficient:** ±200 PPM/°C
   - **Operating and Storage Humidity:** 85% max. relative humidity (non-condensing) from 0°C to 50°C.
   - **Altitude:** Up to 2000 meters
8. **RESPONSE TIME TO STEP CHANGE INPUT:** 1 sec. nominal
9. **READING RATE:** 2.5 readings/sec., nominal
10. **CONSTRUCTION:** Metal die-cast front bezel with black, high impact plastic insert case. This unit is rated for NEMA 4/IP65 indoor use when properly installed (panel gasket and mounting clips included). Installation Category II, Pollution Degree 2.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NUMBER</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>APLIT</td>
<td>Apollo 5 amp AC Current Meter</td>
<td>APLIT415</td>
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<td>APLIT405</td>
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</table>

For more information on Pricing, Enclosures, & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

**DIMENSIONS In inches (mm)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Width</td>
<td>Height</td>
</tr>
<tr>
<td></td>
<td>3.80 (96.5)</td>
<td>3.30 (8.3)</td>
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<tr>
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<td>1.95 (49.5)</td>
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<td>1.75 (44.5)</td>
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<tr>
<td></td>
<td>1.1 (27.5)</td>
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</tr>
<tr>
<td></td>
<td>4.20 (106.7)</td>
<td></td>
</tr>
</tbody>
</table>

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

**CE**

Bulletin No.  APLIT-G
Drawing No.  LP0149
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11. CERTIFICATIONS AND COMPLIANCES: 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 180 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/μs 2 150 KHz - 80 MHz
- Power frequency magnetic fields: EN 61000-4-8 Level 4; 30 A/m
- Simulation of cordless telephone: ENV 50204 Level 3; 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:
   - Process signal may deviate during EMI disturbances.
   - For operation without loss of performance:
     - Unit is mounted in a grounded metal enclosure (Buckeye SM7013-0 or equivalent)
     - I/O and power cables are routed in metal conduit connected to earth ground.
2. Self-recoverable loss of performance during EMI disturbance at 10 V/μms:
   - Process signal may deviate during EMI disturbances.
   - For operation without loss of performance:
     - Install power line filter, RLC#FIL0000 or equivalent
     - Refer to the EMC Installation Guidelines section of this bulletin for additional information.

12. WEIGHT: 1.2 lbs. (0.54 Kg)

FACTORY CALIBRATION
When the unit is shipped from the factory, it is calibrated to read 1,999 with 5 amps AC current input.

SCALING
The numerical current value displayed by the Apollo can be scaled down to almost any numerical value. The rear panel coarse scale potentiometer can be adjusted to divide the numerical current reading by any division factor between ±1 and ±10. The front panel fine scale potentiometer can be adjusted for fine trim scaling.

DECIMAL POINT SELECTION
The Apollo 5 amp Current Meter has 3 DIP switches located on the side of the unit for the selection of 1 of 3 decimal points for display.

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. 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.
2. If shielded (screened) cable is used for Signal input, ensure the proper voltage and current ratings are adhered to. 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.
3. Never run Signal cable 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 cable 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 cable 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 #28B2029-040
   - 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
As depicted in the installation drawing showing the rear view of the Apollo 5 amp current meter, there is a terminal block where all wiring connections are made.

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.

Remove the block for easier access to the terminal screws. To remove the block, pull from the back of the block until it slides clear of the terminal block shroud.

CAUTION: Disconnect power to all unit terminals before removing terminal blocks. This includes deenergizing the current transformer primary circuit.

POWER Wiring
Primary AC power is connected to Terminal 1 and 2 (marked A.C. 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 that also power loads that cycle on and off, should be avoided.
**APOLLO 5 AMP AC CURRENT METER INPUTS**

**Signal Wiring**

AC signal wires are connected to Terminals 3 and 4.

**CAUTION:** Use without a current transformer will place the meter at the measured circuit's potential. Meter signal input is not isolated from the front panel fine scale adjustment, rear coarse scale adjustment or the selectable decimal point DIP switches. In order to preserve the safety of the meter application, the signal input must be limited to 30 VRMS, 42.4 V peak non-hazardous live voltages with respect to protective earth ground.

**CAUTION:** It is recommended that the current transformer be internally protected or to provide a voltage clamping circuit preventing dangerous high voltage across the CT secondary windings in case of accidental opening of the secondary output leads when the primary is energized. If this protection is not provided when connecting CT secondary to ground, then it must be done at the meter.

**MOTOR CURRENT MEASUREMENT USING A CURRENT TRANSFORMER**

The Apollo 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 “D.P.1” is selected.

The Apollo meter is now ready to be calibrated. The installer has access to a calibrated portable digital current meter capable of measuring the motor current. Calibration will be accomplished by causing the Apollo indicator 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 “Coarse” scaling adjustment, located at the rear of the unit, until the display is close in value to that indicated on the portable current meter. He then removes the “fine” scaling access plug and adjusts the “fine” scaling adjustment until the display agrees with the portable current meter. He then replaces the access plug to keep dust out of the Apollo. The Apollo 5 amp Current Meter will now indicate the load current of the motor precisely.

**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 unit meets NEMA 4/IP65 requirements for indoor use when properly installed. The units are intended to be mounted into an enclosed panel. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8”.)

After the panel cut-out has been completed and deburred, carefully slide the gasket over the rear of the unit to the panel. Insert the unit into the panel. As depicted in the drawing, install the screws into the clips until the pointed end just protrudes through the other side. Install each of the two mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

**Caution:** Only minimum pressure is required to seal panel. Do NOT over tighten screws.

**TROUBLESHOOTING**

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

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LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

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MODELS APLPT - APOLLO PROCESS TIME INDICATOR AND PBLPT - 4/5 DIGIT MODULE FOR USE WITH THE LARGE DIGIT DISPLAY (LDD)

- Displays inverse of input rate
- 2 Models: 9999 & 999-59
- 0.56” (14.2 mm) High LED Display (APLPT)
- Easy selection of display & scale multiplier values
- Programmable input circuit. Accepts outputs from a wide variety of sensors
- Decimal mode select (9999 Model Only)
- Power-up self-test
- 0.02% accuracy
- Input rate 0.05 CPS to 10,000 CPS
- 8 pulse moving window average below 3 CPS (selectable)
- NEMA 4/IP65 Sealed front metal bezel

DESCRIPTION

The Apollo Process Time Indicator (Model APLPT) and Module (Model PBLPT) displays a value representing the time between a beginning and end point of a process, such as a conveyor oven.

The unit’s display will update inversely in relation to the input signal frequency. As input frequency increases (representing speed), the APLPT/PBLPT time display decreases, indicating a reduction in the duration of process time. For example, the baking time through an oven is inversely proportional to the conveyor speed.

The APLPT/PBLPT is available in two versions: The Decimal Point version, APLPT4/PBLPT4, that has 4 digits with different modes that provide for decimal points; and the chronometer display version, APLPT5/PBLPT5, which will show as its maximum value, 999-59.

The units have a feature called “moving window average”. This allows one time disturbances, or irregularly spaced items to be averaged over eight input pulses, thus keeping display fluctuations to a minimum while still updating the display on every input pulse. This feature can be enabled or disabled by a side panel DIP switch.

The units can accommodate magnetic pickups, logic sensors, and NPN open collector sensors, as well as switch contact closure sensors.

These units have a self-test feature, which checks all the micro-processor and display driver circuitry at power-up (if enabled). This self-test can also be used to test display and scale multiplier select DIP switches to make certain all switches are functioning properly.

Power and input connections are made via a removable terminal strip, located at the rear of the unit. This strip can accept one #14 AWG wire. DIP switches at the side of the unit are used to program the input configuration and to set the scale multiplier value.

The Model APLPT has a sealed metal die-cast bezel which meets NEMA 4/IP65 specifications for wash-down and/or dust, when properly installed. Two mounting clips are provided for easy installation. The Model APLPT has a 0.56” high LED display, which is readable to 23 feet (7 M).

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.

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.
**SPECIFICATIONS**

1. **DISPLAY:** 4 or 5-digit, 0.56” (14.2 mm) high LED, display. (APLPT)
2. **POWER REQUIREMENTS:**
   - **APLPT**
     - **AC Operation:** Available in two voltage ranges. 115 VAC (±10%) or 230 VAC (±10%), 50/60 Hz, 10 VA for 4-digit, 15 VA for 6-digit (including LDD).
     - **DC Operation:** 11 to 14 VDC @ 0.6A max.
   - **PBLPT**
     - **AC Operation:** Switch selected via the LDD power supply board, 115/230 VAC (±10%), 50/60 Hz, 10 VA for 4-digit, 15 VA for 6-digit (including LDD).
     - **3. SENSOR POWER:** +12 VDC. ±25% @ 100 mA max.
     - **4. OPERATING FREQUENCY RANGE:** 0.05 pulse/sec. to 10,000 pulse/sec.

5. **POWER REQUIREMENTS:**
   - **SENSOR POWER:** +12 VDC, ±25% @ 100 mA max.

6. **DISPLAY MULTIPLIER INCREMENT TOTAL, SELECTION RANGE:**
   - From 1 to 16,383.

7. **SCALE MULTIPLIER VALUES:**
   - 1, 10, 100, 1000.

8. **DISPLAY UPDATE TIME:** The display will update every 0.65 sec. plus one input pulse rate when the input pulse rate is 1.54 PPS or higher. When the input pulse rate is below 1.54 PPS, the display will update on every input pulse.

9. **MAXIMUM INPUT VOLTAGE AND CURRENT:**
   - When the “SIG. IN” (Terminal 5) is driven from external signal voltages, maximum allowable voltage swing is ±50 V peak. Input voltage can be dropped by an external series resistance that limits input current to ±5 mA. (These ratings are for S3 “OFF”.)

10. **INPUT IMPEDANCE:** When S1 and S3 “OFF”, the resistive input impedance exceeds 1 megohm as long as the “SIG. IN” (Terminal 5) input voltage is between zero and +12 VDC. Beyond these levels, the high and low clamping diode will start to conduct, thus decreasing the input impedance. With S3 “ON” the maximum input voltage to Terminal 5 must be limited to 28 VDC.

11. **PARALLELING WITH APOLLO TOTALIZER INPUTS (RLC standard count input):** Apollo Process Time Indicators may be parallel connected with counters having the RLC standard count input circuitry. These can operate from a common current sink or source sensor by connecting the appropriate terminals in common. S3 on the APLPT/PBLPT should be turned “OFF” since pull-up or pull-down resistors are already present in the counter. The unit will not add appreciable sensor load with this arrangement.

12. **INPUT AND POWER CONNECTIONS:**
    - Notes for APLPT only:
      1. Metal bezel of unit connected to earth ground (protective earth) at the mounting panel.
      2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000). Refer to the EMC Installation Guidelines section of this bulletin for additional information.

13. **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 4 Enclosure rating (Face only), UL50

    - **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
      - Power frequency magnetic fields EN 61000-4-8 Level 4; 10 A/m
      - 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
        - Power mains class A

Notes for APLPT only:

1. Metal bezel of unit connected to earth ground (protective earth) at the mounting panel.
2. EMI filter placed on the DC power supply, when DC powered: Corcom #1VB3 or Schaffner #FN610-1/07 (RLC #LFIL0000).

Refer to the EMC Installation Guidelines section of this bulletin for additional information.

14. **ENVIRONMENTAL CONDITIONS**
    - **Operating Temperature Range:** 0 to 50°C
    - **Storage Temperature Range:** -40 to 70°C
    - **Operating and Storage Humidity:** 85% max. relative humidity (non-condensing) from 0°C to 50°C.
    - **Altitude:** Up to 2000 meters

15. **CONSTRUCTION:** Die-cast metal front bezel with black, high impact plastic insert. Front panel meets NEMA 4/Ip65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. (Panel gasket and mounting clips included with unit.)

16. **WEIGHT:**
    - APLPT: 1.5 lbs. (0.8 Kg)
    - PBLPT: 0.4 lbs (0.18 Kg)

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**BLOCK DIAGRAM**

* Transformer for the PBLPT is located in the LDD.

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INPUT SET-UP
The selection of input set-up is accomplished by the first three DIP switches, located along the side of the unit. DIP switches 1-3 are used to configure the input. Each of these switches are discussed below.

Note: Rate type indicators frequently use magnetic pickups for input devices. Consequently, there are basic differences between counter and rate-indicator input circuits. In the Model APLPT/PBLPT input circuit, the hysteresis level is quite small and the bias levels are significantly different to accommodate both magnetic pickup inputs, as well as the +5 V and higher logic levels. The APLPT/PBLPT can work with switch contact closures because of the low count rate capability. S1 should be closed when switch contact closures are used as inputs to the unit.

S1 - ON [MAG.PKUP]: Connects a 0.1μf damping input capacitor from input to common. This capacitor is commonly used with magnetic pickup inputs and serves to filter out high frequency noise. It can also be used to filter switch contact closures.

Note: If excessive contact “bounce” or system “noise” is encountered, an additional external filter capacitor may be necessary. Reed switches, mercury wetted contacts, snap action limit switches, and silver alloy relay contacts with wiping action are usually satisfactory for generating count input signals. Motor starter contacts, tungsten contacts, and brush type contacts should not be used.

S2 - ON [LOGIC]: Sets the bias reference so that input logic signals trigger count pulses as they cross a level of approximately +2.5 V.

OFF: Sets the bias reference so that a signal of 150 millivolts or more will trigger count pulses. This provides the sensitivity required for low speed magnetic pickup sensors.

Note: Hysteresis for both S2 “ON” and “OFF” conditions is about 25 milliseconds. This means the difference between Vih and Vilo with logic inputs (S2) is almost insignificant and only a very small signal swing about the 2.5 V bias level will trigger the input.

S3 - ON [NPN O.C.]: Connects a 3.9 K pull-up load resistor for sensors or circuits with current sink outputs. Sensor output must sink 4 mA @ Vilo of 1V or less.

SCALE MULTIPLIER SELECTION
The selection of the scale multiplier value is accomplished by DIP switches 4 and 5. The table at right shows what combination of switches is needed to obtain the desired value.

MODE SELECT
(Decimal Point Selection For 9999 unit only)
The selection of a decimal point location using DIP switches 7 and 8 is shown in the table at right. (This feature is available only on the APLPT4/PBLPT4.) In the APLPT4/PBLPT4, the proper DIP switches must be selected before the unit is powered up. To change a decimal point location, the unit must be powered down, the DIP switches changed, then powered up. The decimal point will appear as soon as the display reappears.

MOVING WINDOW AVERAGING AND SELF-TEST
DIP switch 6, the S.T./AVG. switch, serves a dual function of disabling or enabling the “moving window average” (MWA) function and the self-test function. When the switch is up, MWA and self-test are both disabled. When the switch is down, MWA and self-test are both enabled.

MOVING WINDOW AVERAGING
This allows the unit to “collect” and average the last eight input pulses which is continually updated whenever a new pulse occurs. The oldest input data is discarded and replaced with the new input data.

SELF-TEST
This unit has a built-in self-test feature which can only be activated immediately after power-up (the unit will not measure time while in self-test). To activate self-test, set the S.T./AVG. DIP switch (D.S. 6) to the enable position. Then apply power to the unit. With this test, all digits are cycled through starting with a string of zeros. This will be shown for about half a second, then a string of ones will appear for about the same duration. Following these, a string of twos and so on, up to nines will be displayed. After the nines are shown, a string of decimal points will appear. Next, an interlace pattern of 1, 0, 1, 0, (1, 0,) then 1, 2, 1, 2, (1, 2,) and so on, until all digits from zero to nine have been displayed.

The next portion of self-test will display four groups of zeros and/or ones. (The first two digits from the left, in each group, will always show zeros if it is an APLPT5/PBLPT5. If it is an APLPT4/PBLPT4, the first two digits will be blank.) In the first group, the third digit represents the 13th (X4096) DIP switch setting. The fourth and fifth digits show the setting for the Scale Multiplier switch. (The fourth position digit represents DIP switch 4 and the fifth position digit represents DIP switch 5.) The state of these digits coincides with the table listed under the “Scale Multiplier Selection” section. The last digit will always show a one for the APLPT5/PBLPT5. But for the APLPT4/PBLPT4, if both switches 7 and 8 are off, it will then display a zero.

The next three groups are shown on the right, and correspond to the DIP switch shown directly above it. (Note: The first two digits in each group are always shown as zeros or blanks.)

The X’s represent a zero or one (depending on the setting of the DIP switch) in the display. Self-test is automatically exited 8 seconds after the last DIP switch is changed.
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 installation 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.
   b. 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.
   c. 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.
   d. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
   e. 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 # ZCAT3035-1300A
      - Steward #32B2029-0A0
      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.
   f. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

As depicted in the drawing showing the rear view of the Apollo Process Time Indicator, there is a terminal block where all wiring connections are made. 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. Remove the block for easy access to the terminal screws. To remove the block, pull from the back of the block until it slides clear of the terminal block shroud.

Enclosed with the PBLPT module is an adhesive backed label(s) showing the terminal block pin-out. This label is for wiring reference only, do not use for specifications. This label should be applied to the appropriate location by the user.

CAUTION: The terminal block should NOT be removed with power applied to the unit. The module should not be removed from the LDD with power applied to the LDD or the module.

INPUT & POWER CONNECTIONS

Primary AC power is connected to Terminals 1 and 2 (marked A.C. Power, located on the left-hand side of the 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.

Terminal 3 is the “DC” (+12 V) terminal. This terminal is for sensor supply and can provide up to 100 mA of current. An external +11 V to +14 VDC can also be applied to this terminal to power the unit in the absence of A.C. power. Terminal 4 is the “COMM.” (common) terminal, which is the common line to which the sensor and other input commons are connected. Terminal 5 is the “SIG. IN” (signal in) terminal. When the signal at this terminal goes low, a count will be registered in the unit. (See “Input Ratings” under “Specifications” section.)

REAR PANEL DIP SWITCHES

As can be seen from the rear of the unit, there is a row of 14 DIP switches located beside the input and power terminal block. All of these DIP switches are Display Multiplier Increment Total (DMIT) switches. When the switch is “ON”, it will multiply the measured time between input pulses by the display multiplier it represents.
**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**

PBLPT installation information is contained in the LDD Bulletin. Refer to that bulletin for instructions on installing the module.

The unit meets NEMA 4/IP65 requirements for indoor use, when properly installed. The Apollo Indicators are intended to be mounted into an enclosed panel with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8”.)

After the panel cut-out has been completed and deburred, carefully slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips.

Thread the screws into the clips until the pointed end just protrudes through the other side. Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case.

Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

**CAUTION:** Only minimum pressure is required to seal panel. Do NOT overtighten screws.

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**CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS**

- **MAGNETIC PICKUPS**
  - Use 2-wire shielded cable for magnetic pickup signal leads.

- **INPUT FROM CONTACT CLOSURES**
  - **SENSORS WITH CURRENT SINK OUTPUT (PNP O.C.)**
    - Includes ASTC, LMPC, PSAC, RPGC, (RPGB, RPGH)*, LSC
  - **SENSORS WITH CURRENT SOURCE OUTPUT (NPN O.C.)**
    - Includes ASTC, LMPC, PSAC, RPGC, (RPGB, RPGH)*, LSC

- **TWO WIRE PROXIMITY SENSORS**

- **SENSORS WITH -EF OUTPUT**

- **A.C. INPUTS FROM TACH. GENERATORS, INVERTERS, ETC.**

- **INPUT FROM CMOS & OTHER BI-POLAR OUTPUTS**

- **INPUT FROM TTL**
DISPLAY MULTIPLIER SELECTION PROCEDURE

The APLPT/PBLPT has a Display Multiplier Selection range from 1 to 16,383. For the minimum scaled reading, the X1 DIP switch would be set to “ON”. For the maximum scaled reading (16,383 times the measured time between input pulses), all of the rear panel DMIT DIP switches would be turned “ON”. Therefore, a specific Display Multiplier Increment Total is achieved by adding up the appropriate individual display multiplier values.

Also available are four scale multiplier (SM) values of X1, X10, X100, and X1000, which are controlled by DIP switches 4 and 5 on the side of the unit. The X10, X100, and X1000 scale multiplier values can be used when the required DMIT exceeds 16,383. Note: Always use the smallest SM value possible. Below is a formula to compute the DMIT. Note: This same basic formula applies to all units. However, for the APLPT5/PBLPT5 the D.R. must be converted to a base unit of measurement.

DMIT = D.R. x P.P.S.
DMIT = Display Multiplier Increment Total
DR = Desired Reading (in hrs., mins., sec., days, etc.)
PPS = Pulses Per Second (input)

NOTES:
1. For the APLPT5/PBLPT5, the display value must be converted to its base units. To do this, multiply the value to the left of the dash by 60 and add it to the value to the right of the dash.
2. If the required DMIT value exceeds 16,383, then a scale multiplier value greater than 1 will be needed. But always use the smallest SM possible.

EXAMPLE 1 (for APLPT4):

DESIRED READING = 18 minutes
PULSES PER SECOND = 450 pulses per second
DMIT = 18 x 450 P.P.S.
= 8100
DMIT = 8100

The required DMIT does not exceed 16,383, therefore, use a value of 1 for the S.M. The appropriate display multiplier switches (which together add up to 8100), are then set to “ON”. Start by selecting the first increment which is greater than half the desired DMIT, and add subsequent increments that are more than half the difference needed.

Vertical Placement of DIP Switches
DIP switch 13 . . . . . - 4096 Needed = 4004
DIP switch 12 . . . . . - 2048 Needed = 1956
DIP switch 11 . . . . . - 1024 Needed = 932
DIP switch 10 . . . . . - 512 Needed = 420
DIP switch 9 . . . . . - 256 Needed = 164
DIP switch 8 . . . . . - 128 Needed = 36
DIP switch 7 . . . . . - 64 Needed = 9
DIP switch 4 . . . . . - 8 Needed = 1
DIP switch 1 . . . . . - 1

Therefore, DIP switches 3, 6, 8, 9, 10, 11, 12, and 13 would be set to “ON”. Note: If the desired reading is 18.0, the SM can be set for a value of 10. (To get the D.P. required, the unit must be powered down, then switches 7 and 8 set appropriately, then powered back up.)

EXAMPLE 2 (for APLPT5):

DESIRED READING = 2 hours and 23 minutes (2-23)
PULSES PER SECOND = 230 pulses per second

First convert the D.R. to its base units.
D.R. = 2 (hours) x 60 + 23 DMIT = 143 x 230 PPS
= 120 + 23 DMIT = 32,890
= 143 DMIT = 32,890 ÷ 10
= 3,289

* Since the required DMIT does exceed 16,383, a value of 10 is used for the S.M.

DMIT = 3289
DIP switch 12 . . . . . - 2048 Needed = 1241
DIP switch 11 . . . . . - 1024 Needed = 217
DIP switch 8 . . . . . - 128 Needed = 89
DIP switch 7 . . . . . - 64 Needed = 25
DIP switch 5 . . . . . - 16 Needed = 9
DIP switch 4 . . . . . - 8 Needed = 1
DIP switch 1 . . . . . - 1

Therefore, DIP switches 1, 4, 5, 7, 8, 11, and 12 would be set to “ON” for a display of 2-23. DIP switch 4 on the side panel must be set to “ON” to obtain the S.M. value of 10.

BREAD BAKING APPLICATION

Loaves of bread are being baked in a continuous baking oven. It has been determined that 10 minutes and 30 seconds is normally required for a loaf to progress through the oven (this provides enough time for the loaves to be baked). An RPGC, with 60 PPR, is attached to one of the conveyor belt shafts. When the conveyor belt moves at the 10 min.-30 sec. rate, the shaft turns at 35 RPM. An APLPT5 is used to display the value of 10 min. and 30 sec. Using the formula, the required DIP switch settings are obtained.

PPS = 60 PPR x 35 RPM = 2100 PPM ÷ 60
PPS = 630 P.P.S.


DMIT = D.R. x P.P.S.
DMIT = Display Multiplier Increment Total
DR = Desired Reading (in hrs., mins., sec., etc.)
PPS = Pulses Per Second (input)

NOTES:
1. For the APLPT5/PBLPT5, the display value must be converted to its base units. To do this, multiply the value to the left of the dash by 60 and add it to the value to the right of the dash.
2. If the required DMIT value exceeds 16,383, then a scale multiplier value greater than 1 will be needed. But always use the smallest SM possible.

EXAMPLE 1 (for APLPT4):

DESIRED READING = 18 minutes
PULSES PER SECOND = 450 pulses per second
DMIT = 18 x 450 P.P.S.
= 8100
DMIT = 8100

The required DMIT does not exceed 16,383, therefore, use a value of 1 for the S.M. The appropriate display multiplier switches (which together add up to 8100), are then set to “ON”. Start by selecting the first increment which is greater than half the desired DMIT, and add subsequent increments that are more than half the difference needed.

Vertical Placement of DIP Switches
DIP switch 13 . . . . . - 4096 Needed = 4004
DIP switch 12 . . . . . - 2048 Needed = 1956
DIP switch 11 . . . . . - 1024 Needed = 932
DIP switch 10 . . . . . - 512 Needed = 420
DIP switch 9 . . . . . - 256 Needed = 164
DIP switch 8 . . . . . - 128 Needed = 36
DIP switch 7 . . . . . - 64 Needed = 9
DIP switch 4 . . . . . - 8 Needed = 1
DIP switch 1 . . . . . - 1

Therefore, DIP switches 3, 6, 8, 9, 10, 11, 12, and 13 would be set to “ON”. Note: If the desired reading is 18.0, the SM can be set for a value of 10. (To get the D.P. required, the unit must be powered down, then switches 7 and 8 set appropriately, then powered back up.)

EXAMPLE 2 (for APLPT5):

DESIRED READING = 2 hours and 23 minutes (2-23)
PULSES PER SECOND = 230 pulses per second

First convert the D.R. to its base units.
D.R. = 2 (hours) x 60 + 23 DMIT = 143 x 230 PPS
= 120 + 23 DMIT = 32,890
= 143 DMIT = 32,890 ÷ 10
= 3,289

* Since the required DMIT does exceed 16,383, a value of 10 is used for the S.M.

DMIT = 3289
DIP switch 12 . . . . . - 2048 Needed = 1241
DIP switch 11 . . . . . - 1024 Needed = 217
DIP switch 8 . . . . . - 128 Needed = 89
DIP switch 7 . . . . . - 64 Needed = 25
DIP switch 5 . . . . . - 16 Needed = 9
DIP switch 4 . . . . . - 8 Needed = 1
DIP switch 1 . . . . . - 1

Therefore, DIP switches 1, 4, 5, 7, 8, 11, and 12 would be set to “ON” for a display of 2-23. DIP switch 4 on the side panel must be set to “ON” to obtain the S.M. value of 10.
**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
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</thead>
<tbody>
<tr>
<td>APLPT</td>
<td>Apollo 4-Digit Process Time Indicator</td>
<td>APLPT410  APLPT400</td>
</tr>
<tr>
<td></td>
<td>Apollo 5-Digit Process Time Indicator</td>
<td>APLPT510  APLPT500</td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

**PERSONALITY MODULE**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBLPT *</td>
<td>Apollo 4-Digit Process Time Module for use with the 4 digit Large Digit Display</td>
<td>PBLPT400</td>
</tr>
<tr>
<td></td>
<td>Apollo 5-Digit Process Time Module for use with the 6 digit Large Digit Display</td>
<td>PBLPT500</td>
</tr>
</tbody>
</table>

* Requires an LDD for use.

**TROUBLESHOOTING**

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

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL APLPV - APOLLO PROCESS VOLTMETER

- 3 1/2 DIGIT, 0.56" (14.2 mm) LED READOUT
- SEALED METAL FRONT BEZEL (NEMA 4/IP65)
- 12 VDC EXCITATION SUPPLY (Optional)
- WIDE RANGE SPAN & OFFSET SCALING (Covers 1 to 5 VDC Process Input)
- FRONT ACCESS TO CALIBRATION TRIM CONTROLS
- OVERRANGE INDICATION
- PLUG-IN TERMINAL STRIPS
- SELECTABLE DECIMAL POINTS
- ±25 VOLT DC MAXIMUM INPUT

DESCRIPTION
The premium features of the Apollo series can now be applied to measurement of process variables. With its high sensitivity and programmability, the Apollo Process Voltmeter can be set up for a wide variety of applications.

The rugged construction and sealed metal front bezel meet the requirements of NEMA 4/IP65, when properly installed. This allows the APLPV to be used in dirty, hostile environments and in wash-down areas. In addition, the attractive die-cast metal bezel enhances the appearance of any control panel.

SPECIFICATIONS
1. DISPLAY: 3 1/2 digit (1999), 0.56" (14.2 mm) L.E.D., minus sign displayed for negative values. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP programming switches.
2. POWER: Available for 115 or 230 VAC ±10%, 50/60 Hz., 6 VA.
3. INPUT SENSITIVITY: (Numerical Readout Change/Volt) Adjustable from 40 units/volt to 1000 units/volt. Max. allowable input voltage, ±25 volts DC.
4. INPUT RESISTANCE: 1 MΩ
5. SCALING RANGE:
   Span - 32 coarse steps (binary progression with 5 DIP switches, rear access).
   Each step providing approximately 40 numerical units/volt/step sensitivity. Fine adjust (front access) brackets the coarse step increments.
   Offset - 16 coarse steps (binary progression with 4 DIP switches, rear access) 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. Front access fine control brackets the steps.
6. LINEARITY: ±(0.05% ± 1 digit)
7. READING RATE: 2 1/2 updated readings/second, nominal.
8. RESPONSE TIME: 1 second to settle for step change.
9. NORMAL MODE REJECTION: 63 dB, 50/60 Hz.
10. COMMON MODE REJECTION: 100 dB, DC to 50/60 Hz.
11. TEMPERATURE EFFECTS:
    Operating Range - 0° to +60° C
    Storage Range - -40° to +80° C
    Span Temperature Coeff. - 100 ppm/°C
    Offset Temperature Coeff. - 100 ppm/°C
12. EXCITATION SUPPLY (Optional): 12 VDC @ 60 mA max. Regulated and isolated (floating). (See Ordering Information).
13. CONSTRUCTION: Die cast metal front bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for wash-down and dusty environments when properly installed. (Panel gasket and mounting clips included.)
15. WEIGHT: 1.2 lb (0.54 Kg)

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.
DESCRIPTION OF OPERATION

The Apollo Process Voltmeter (APLV) consists of a digital voltmeter combined with an analog scaling circuit (shown above). The 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 Apollo Process Voltmeters 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 voltage 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 or 1000 - (-250) = 1250. (Note: the terms “GAIN”, “SCALE”, and “SENSITIVITY” are also frequently used interchangeably with the term “SPAN”.)

The Apollo Process Voltmeter can be set up over a very wide span range by means of the coarse DIP switches S6-S10 (on the rear), and the fine screwdriver adjustment pot, located behind the sealing screw on the front bezel (left side). 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 voltage 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 front panel 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 fine control has a continuous span range of approximately 0-45.

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 voltage 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 Apollo Process Voltmeter 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 Apollo Process Voltmeter, 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 (at the rear) 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 control (front panel, right) has a numerical readout range of +/-100 and brackets all the coarse switched ranges.

CALIBRATION

Direct calibration using the process signal voltage 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 APLPV can be quickly and easily bench calibrated using a commercially available voltage source.
**CALIBRATION PROCEDURE**

The procedure outlined on the following page minimizes span/offset interaction and simplifies calibration. In Steps 1 and 2 the unit is “nulled” to zero readout with zero input signal voltage. In Steps 3, 4, and 5, the span adjustments are made to establish the required slope of the transfer curve.

Then in Step 6, the transfer curve is shifted up or down as required by setting the offset adjustments. In Step 7, the final “tweaking” adjustments are made at minimum and maximum signal voltage. Setting the decimal points in Step 8 completes the calibration.

Before calibrating, the READOUT SPAN (Rs), SWING VOLTAGE (Vs), and SPAN PER VOLT (Rs/Vs) must be determined.

Rs = (Max. Numerical Display) - (Min. Numerical Display) (Disregard Decimal Points)
Vs = (Voltage @ Max. Display) - (Voltage @ Min. Display)
Rs/Vs = READOUT SPAN (Rs)/SWING VOLTAGE (Vs)

**Example: Readout is to be 5.00 @ 1 V and 15.00 @ 5 V.**

READOUT SPAN (Rs) = 1500 - 500 = 1000
SWING VOLTAGE (Vs) = 5 V - 1 V = 4 V
SPAN PER VOLT (Rs/Vs) = 1000 / 4 V = 250

**ADJUSTMENTS**

1. Turn off all coarse offset and span adjustment switches (S2-S10 down).
2. Apply zero volts to the signal input. Adjust the indicator to read zero using the fine offset (front, right), then repeat Step 4.
3. Select a combination of coarse span switches (S6-S10) to obtain a value closest to SPAN PER VOLT (the coarse span switch reference markings correspond numerically with SPAN PER VOLT). From example:
   \[ \text{SPAN PER VOLT} = 250 \]
   \[ S8 (140) + S9 (75) + S10 (40) = 255 \text{ span set with switches} \]
4. With the SWING VOLTAGE, Vs, applied to the input, adjust the display readout to the exact READOUT SPAN (1000 in the example) with the fine span adj. (front, left).
5. Repeat Step 2 to see if the zero value has shifted. If it has, re-zero with fine offset (front, right), then repeat Step 4.
6. After the span has been adjusted, set the signal voltage to the minimum level (1 V in example). Then set the offset add/subtract switch (S1), the coarse offset switches (S2-S5) and the fine offset control (front, right) to obtain the readout corresponding to this minimum voltage value (500 in the example).
7. Adjust the input signal voltage to its maximum value to see if the proper readout is obtained (1500 @ 5 V in the example). If the readout is slightly off, adjust the fine span (front, left) to obtain the true reading. Then, recheck the reading at minimum input voltage (1 V) and readjust fine offset (front, right) if necessary. Repeat the maximum and minimum readout adjustments until the unit displays the proper readout at both extremes.
8. Set decimal points as desired using the three switches on the side of the case and replace the front panel sealing screws. The unit can now be installed.

---

**APPLICATION EXAMPLES**

**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 @ 1 V - (-1500) @ 6 V
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**

1. Null the unit to zero readout @ 0 V per Steps 1 and 2 of the calibration procedure.
2. Set transfer curve slope with span adjustments per Steps 3, 4, and 5 to get a readout of +1500 @ 2.5 V (SPAN PER VOLT = 600).
3. Apply (+) offset per Step 6 to get a reading of -1500 @ 1 V.
4. Check min. and max. extremes and tweak if required to get desired readout @ 1 V and 6 V per step 7. Set D.P. switch S2 and replace front panel sealing screws.

**Example 2 (Positive Offset):** An APLPV 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**

1. Null the unit per Steps 1 and 2 of the calibration procedure.
2. Set the coarse and fine span adjustments to get a readout of 610 @ 5 V (SPAN PER VOLT = 122) per Steps 3, 4, and 5.
3. Set offset to readout 40 @ 0 V per Step 6.
4. Check the readout @ max. (5 V) and min. (0 V) and fine tune (tweak) as required per Step 7.

**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 APLPV is to readout 100.0 when the tank is full and zero when the tank is empty.

**READOUT SPAN (Rs) = 1000 @ 0 - 0 @ 1100**

**SWING VOLTAGE (Vs) = 11 V (max) - 0 V (min) = 11 V**

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**

1. Null the unit per Steps 1 and 2 of the calibration procedure.
2. Set the coarse and fine span adjustments to get a readout of -100 @ -100V (SPAN PER VOLT = -100) per Steps 3, 4, and 5.
3. Move the transfer curve up by applying (+) offset per Step 6 until readout is +1000 @ -1 V.
4. Check extreme readings per Step 7, 0 readout @ -11 V and +1000 @ -1 V. Set D.P. switch S1 and replace front panel sealing screws.
**FLOW RATE INDICATION APPLICATION**

A milk producer wants to know the rate, in Gallons Per Minute (GPM), at which their milk tanks are being filled. A flowmeter, with an analog output voltage of 1 V at 0 GPM and 6 V at 170 GPM, is installed at the tank inlet.

The Model APLPV can be easily calibrated to readout 00.0 at 0 GPM and 170.0 at 170 GPM:

\[
\begin{align*}
\text{READOUT SPAN (Rs)} &= 1700 - 000 = 1700 \\
\text{SWING VOLTAGE (Vs)} &= 6 V - 1 V = 5 V \\
\text{SPAN PER VOLT (Rs/Vs)} &= 1700/5 V = 340
\end{align*}
\]

**ZERO THE UNIT:**
1. Turn off all of the coarse offset and span switches.
2. Apply zero volts to the signal input. Adjust the indicator to read zero using the fine offset adjustment (R.H. side, front panel).

**SET THE SPAN:**
3. Select the combination of coarse span switches to obtain a value just below 340 (SPAN PER VOLT):
   \[ S7 (275) + S10 (40) = 315 \text{ span set with switches.} \]
4. With S7 & S10 “ON”, and 5 V (SWING VOLTAGE) applied to the input, adjust the display readout to 1700 (READOUT SPAN) with the fine span adjust (front, left).
5. Repeat Step 2 to see if the zero value has shifted. If it has, re-zero with the fine offset adjust (front, right), then repeat Step 4.

**ADD IN THE OFFSET:**
6. After the span has been adjusted, set the signal voltage to 1 V (the minimum level). Since the desired readout is 000 at 1 V, and the current readout is 340 at 1 V, it can be seen that an offset of -340 is required. Turn “ON” S1 to achieve the negative offset, and select the combination of coarse offset switches to obtain the value nearest to 340:
   \[ S4 (350) = 350 \text{ offset set with switches.} \]
   With S1 & S4 “ON”, the fine offset control (front, right), can be adjusted to obtain a readout of 000 @ 1 V.

**CHECK MAXIMUM AND MINIMUM SETTINGS:**
7. Adjust the input signal voltage to 6 V (the maximum level), the readout should be 1700. If the readout is slightly off, adjust the fine span (front, left) to obtain the true reading. Then, adjust the signal input voltage to 1 V (the minimum level), the readout should be 000. If the readout is slightly off, adjust the fine offset (front, right). Repeat the maximum and minimum readout adjustments until the unit displays the proper readout at both extremes.

**FINAL SET-UP:**
8. The resolution of the display is 0.1 GPM, therefore “D.P.1” is selected. After replacing the front panel sealing screws, the unit is ready to be installed.

**ORDERING INFORMATION**

<table>
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<tr>
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<th>AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>++APLPV</strong></td>
<td>Apollo Process Voltmeter w/o Excitation</td>
<td>APLPV410</td>
</tr>
<tr>
<td>APLPV410</td>
<td>Apollo Process Voltmeter w/12 VDC Excitation Supply</td>
<td>APLPV411</td>
</tr>
</tbody>
</table>

For information on Pricing, Enclosures, & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

** - Units are shipped calibrated to read 00.0 @ 1.0 VDC, 100.0 @ 5.0 VDC.
MODELS APLR - APOLLO 6-DIGIT RATE INDICATOR [TIME BASE] AND PBLR - 4/6 DIGIT MODULE FOR USE WITH THE LARGE DIGIT DISPLAY (LDD)

- 6-DIGIT, 0.56" (14.2 mm) HIGH LED DISPLAY (APLR)
- CRYSTAL-CONTROLLED TIME-BASE PROGRAMMABLE UP TO 32.764 SECONDS PROVIDES DIRECT-READING FOR ANY RATE UNITS
- 0.02% ACCURACY
- PROGRAMMABLE DECIMAL POINTS
- FREQUENCY DOUBLING
- PROGRAMMABLE INPUT CIRCUIT, ACCEPTS OUTPUTS FROM A WIDE VARIETY OF SENSORS
- LEADING ZERO BLANKING
- POWER-UP SELF-TEST
- NEMA 4/IP65 SEALED FRONT METAL BEZEL

DESCRIPTION

The Apollo Time Base Rate Indicators (Model APLR) and Module (Model PBLR), provide the versatility and flexibility needed to accommodate virtually any rate measuring need. Based on Micro-processor technology, this unit represents the optimum in cost/performance ratio.

This unit 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/hour, or whatever units are needed in plant operations. The APLR/PBLR can provide this capability through its settable time base, programmable decimal points, and frequency doubling functions.

The APLR/PBLR can also accommodate magnetic pickups, as well as logic (sourcing output) sensors and NPN open collector (sinking output) sensors.

Power and input connections are made via a removable terminal block, located at the rear of the unit. Each terminal can accept one #14 AWG wire. DIP switches at the side of the unit are used to program the input configuration.

The Apollo Rate Indicator has a sealed metal die-cast bezel which meets NEMA 4/IP65 specifications for wash-down and/or dust, when properly installed. Two mounting clips are provided for easy installation. The Time Base Rate Indicator uses a 6-digit, 0.56" (14.2 mm) high LED display, which is readable to 23 feet (7 M).

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. DISPLAY: 6-Digit, 0.56" (14.2 mm) high LED display. (APLR)

2. POWER REQUIREMENTS:

APLR
AC Operation: Available in two voltages.
115 V AC, ±10%, 50/60 Hz, 14 V A or
230 V AC, ±10%, 50/60 Hz, 14 VA
DC Operation:
24 VDC, 10% @ 0.6A max.
Note: All available units can be powered at Terminal #3 from a 11 to 14 VDC, 0.6 A max. power supply.

PBLR
AC Operation: Switch selected via the LDD power supply board, 115/230 (+/-10%), 50/60 Hz, 10 VA for 4-digit, 15 VA for 6 digit (including LDD).

3. SENSOR POWER: +12 VDC, ±25% @ 100 mA max.

4. MAXIMUM OPERATING FREQUENCY: 10 KHz, 50% duty cycle.
10,000 cps with min. pulse width “ON” and “OFF” times of 50 µsec.

5. TIME BASE SELECTION RANGE: 0.004 to 32.764 seconds.

6. ACCURACY: 0.02%

7. MAXIMUM INPUT VOLTAGE AND CURRENT: When the “SIG. IN” (Terminal 5) is driven from external signal voltages, max. voltage swing is ±50 V peak. Input voltage can be dropped by an external series resistance that limits input current to ±5 mA. (These ratings are for S3 “OFF”.)

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.

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

CAUTION: Risk of electric shock.
8. **INPUT IMPEDANCE:** With S1 and S3 “OFF”, the resistive input impedance exceeds 1 megohm as long as the “SIG. IN” (Terminal 5) input voltage is between zero and +12 VDC. Beyond these levels, the high and low clamping diode will start to conduct, thus decreasing the input impedance. With S3 “ON” the maximum input voltage to Terminal 5 must be limited to 28 VDC.

9. **PARALLELING WITH APOLLO TOTALIZER (RLC standard count input) INPUTS:** Apollo Rate Indicators may be parallel connected with counters having the RLC standard count input circuitry. These can operate from a common current sink or source sensor, by connecting the appropriate terminals in common. S3 on the Rate Indicator should be turned “OFF” since pull-up or pull-down resistors are already present in the counter. The Rate Indicator will not add appreciable sensor load with this arrangement. Note: Rate Indicator cannot be operated in parallel with standard input counters when 2-wire proximity sensors are used.

10. **INPUT AND POWER CONNECTIONS:** There is a plug-in, compression-type, terminal block located at the rear of the unit. This block can be removed from the rear of the unit for ease of wiring. After wiring is complete, the connector can be plugged back onto the unit.

11. **CERTIFICATIONS AND COMPLIANCES:**

   **ELECTROMAGNETIC COMPATIBILITY**

<table>
<thead>
<tr>
<th>Immunity to EN 50082-2</th>
<th>EN 61000-4-2</th>
<th>Level 2; 4 Kv contact&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 3; 8 Kv air</td>
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</table>

<table>
<thead>
<tr>
<th>Electromagnetic RF fields</th>
<th>EN 61000-4-3</th>
<th>Level 3; 10 V/m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80 MHz - 1 GHz</td>
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</tr>
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<table>
<thead>
<tr>
<th>Fast transients (burst)</th>
<th>EN 61000-4-4</th>
<th>Level 4; 2 Kv I/O&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 3; 2 Kv power</td>
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</table>

<table>
<thead>
<tr>
<th>RF conducted interference</th>
<th>EN 61000-4-6</th>
<th>Level 3; 10 V/μm</th>
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<td>150 KHz - 80 MHz</td>
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<tr>
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<th>Level 4; 10 A/m</th>
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</thead>
<tbody>
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<td></td>
<td>150 KHz - 80 MHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simulation of cordless telephone</th>
<th>ENV50204</th>
<th>Level 3; 10 V/m</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>900 MHz ± 5 MHz</td>
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</table>

<table>
<thead>
<tr>
<th>Emissions to EN 50081-2</th>
<th>EN 55011</th>
<th>Enclosure class A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power mains class A</td>
<td></td>
</tr>
</tbody>
</table>

   **Notes for APLR only:**

   1. Metal bezel of unit connected to earth ground (protective earth) at the mounting panel.

   2. EMI filter placed on the DC power supply, when DC powered: Corcom #1V43 or Schaffner #F610-1/07 (RLC #LFL0000).

   Refer to the EMC Installation Guidelines section of this bulletin for additional information.

12. **ENVIRONMENTAL CONDITIONS:**

   **Operating Temperature Range:** 0 to 50°C

   **Storage Temperature Range:** -40 to 70°C

   **Operating and Storage Humidity:** 85% max. relative humidity (non-condensing) from 0°C to 50°C.

   **Altitude:** Up to 2000 meters

13. **CONSTRUCTION:** Die-cast metal front bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. (Panel gasket and mounting clips included with unit.)

14. **WEIGHT:**

   - APLR: 1.5 lbs (0.8 Kgs)
   - PBLR: 0.4 lbs (0.18 Kgs)

---

**INPUT SET-UP**

The selection of input set-up is accomplished by the first three of six DIP switches, located along the side of the unit. DIP switches 1-3 are used to configure the input. Each of these switches are discussed below.

**Note:** Rate indicators frequently use magnetic pickups for input devices, while contact input is never used due to speed and contact bounce limitations. Consequently, there are basic differences between counter and rate-indicator input circuits. In the Model APLR/PBLR input circuit, the hysteresis level is quite small and the bias levels are significantly different to accommodate both magnetic pickup inputs, as well as the ±5 V and higher logic levels.

**S1 - ON [MAG.PKUP.]:** Connects a 0.1 μf damping input capacitor from input to common. This capacitor is used only with magnetic pickup inputs and serves to filter out high frequency noise. S1 should be set in the “OFF” position when using inputs other than magnetic pickups.

**S2 - ON [LOGIC]:** Sets the bias reference so that input logic signals trigger count pulses as they cross a level of approximately +2.5 V.

**OFF:** Sets the bias reference so that a signal of 150 mV or more will trigger count pulses. This provides the sensitivity required for low speed magnetic pickup sensors.

**Note:** Hysteresis for both S2 “ON” and “OFF” conditions is about 25 mV. This means the difference between V<sub>IL</sub> and V<sub>IH</sub> with logic inputs (S2) is almost insignificant and only a very small swing about the 2.5 V bias level will trigger the input.

**S3 - ON [NPN O.C.]:** Connects a 3.9 K pull-up load resistor for sensors or circuits with current sink output. Sensor output must sink 4 mA @ V<sub>OL</sub> of 1 V or less.

---

**DECIMAL POINT SELECTION**

The selection of Decimal Point is accomplished by DIP switches 4 and 5. The table at the right shows what combination of switches is needed to obtain the desired decimal point location. The unit always has leading zero blanking. Note: D.P. will change only at the normal display update time of the unit.

**REAR PANEL DIP SWITCHES**

As can be seen from the rear of the unit, there is a row of 14 DIP switches located beside the input and power terminal block. DIP switches 1 through 13 are Time Base Increments. When the switch is “ON”, it will add time to the Time Base Increment total.

DIP switch 14 is the Frequency Doubling DIP switch. When it is “ON”, twice the number of input pulses are registered in the unit. Doubling the input rate allows the Time Base Increment total to be halved, thus allowing faster update times with the same value displayed.

**SELF-TEST**

This unit has a built-in self-test feature which can only be activated immediately after power-up (the unit will not count while in self-test). To activate self-test, set the self-test DIP switch (D.S. 6) to the enable position. Then power the unit up. With this test, all digits are cycled through starting with a string of six zeros. This will be shown for about half a second, then a string of ones will appear for about the same time duration. Following these, a string of twos and so on, up to nines will be displayed. After the nines are shown, a string of decimal points will appear. Next an interlace pattern of 1, 0, 1, 0, 1, 0, then 1, 2, 1, 2, 1, 2, and so on, until all digits from zero to nine have been displayed.

The next portion of self-test will display four groups of zeros and/or ones. (The first two digits from the left, in each group, will always show a zero.) In
the first group, the third digit represents the 13th (X4096) DIP switch setting. The fourth and fifth digits show the setting for the Decimal Point select DIP switches. (The fourth position digit represents DIP switch 4 and the fifth position digit represents DIP switch 5.) The state of these digits coincide with the table under the “Decimal Point Selection” section. The last digit will always show a one.

The next three groups are shown on the right, and correspond to the DIP switch shown directly above it. (Note: The first two digits in each group are always shown as zeros.)

The X’s represent a zero or one (depending on the setting of the DIP switch) in the display. Self-test is initiated by pressing the “Self Test” button on the front panel of the unit. If the state of the DIP switches is changed during a self-test, the display is cleared. The next three groups are shown directly above it. (Note: The first two digits in each group are always shown as zeros.)

The X’s represent a zero or one (depending on the setting of the DIP switch) in the display. Self-test is automatically exited 8 seconds after the last DIP switch change is made.

**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. 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.
   b. Connect the shield to earthing 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 #1VB3
     - 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**

As depicted in the drawing showing the rear view of the Apollo Rate Indicator, there is a terminal block where all wiring connections are made. 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. Remove the block for easy access to the terminal screws. To remove the block, pull from the back of the block until it slides clear of the terminal block shroud.

Enclosed with the PBLR module is an adhesive backed label(s) showing the terminal block pin-out. This label is for wiring reference only, do not use for specifications. This label should be applied to the appropriate location by the user.

**CAUTION:** The terminal block should NOT be removed with power applied to the unit. The module should not be removed from the LDD with power applied to the LDD or the module.

Terminal 3 is the ”DC” (+12 V) terminal. This terminal is for sensor supply and can provide up to 100 mA of current. An external +11 V to +14 VDC can also be applied to this terminal to power the unit in the absence of A.C. power.

Terminal 4 is the “COMM.” (common) terminal, which is the common line to which the sensor and other input commons are connected.

Terminal 5 is the “SIG. IN” (signal in) terminal. When the signal at this terminal goes low, a count will be registered in the unit. (See “Input Ratings” under “Specifications” section.)

**POWER WIRING (A.C. Version)**

Primary AC power is connected to Terminals 1 and 2 (marked V AC 50/60 Hz, located on the left-hand side of the 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.

**POWER WIRING (APRL D.C. Version only)**

The DC Version unit will operate from a 24 VDC power supply. The positive wire of the DC power source connects to Terminal #1 and the minus “-” to Terminal #2.
CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS

COUNT SWITCH OR ISOLATED TRANSISTOR OUTPUTS

RECOMMENDED RULES FOR MAGNETIC PICKUP CONNECTIONS

1. Use 2-wire shielded cable for magnetic pickup signal leads.
2. Never run signal cable in conduit, troughs, or cable bundles with power carrying conductors.
3. Connect the shield to the common Terminal “4” at the input of the instrument. Do NOT connect the shield at the pickup end, leave it “open” and insulate the exposed shield to prevent electrical contact with the frame or case. (Shielded cable, supplied on most RLC magnetic pickups, has open shield on pickup end.)

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

PBLR installation information is contained in the LDD bulletin. Refer to that bulletin for instructions on installing the module.

The unit meets NEMA 4/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8”.)

Cut the panel opening to the specified dimensions. Remove burrs and clean around the panel opening. Slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side. Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case.

Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal. CAUTION: Only minimum pressure is required to seal panel. Do NOT overtighten screws.
**TIME BASE SETTING PROCEDURE**

The Apollo Time Base Rate Indicator has a time base selection range of 0.004 sec. to 32.764 sec. For a minimum time base (0.004 sec.), the X1 DIP switch is set to “ON”. For the maximum time base, all the DIP switches would be set to “ON” (these add up to 8191). Therefore, a specific time base is achieved by adding up the appropriate individual time base increments.

The time base increment total is computed according to the following formula:

\[
\text{TIME BASE INCREMENT} = \frac{(\text{Display Readout Desired}) \times \text{DDP} \times (15,000)}{[(\text{Known RPM}) \times (\text{Known PPR})]} \times \text{TOTAL (TBIT)}
\]

* - Input Pulse Rate Per Minute.

**DDP**: Use one of the following numbers in the above formula for the Display Decimal Point (DDP) position.

- 0 = 1
- 0.0 = 10
- 0.00 = 100

**DISPLAY READOUT DESIRED** = 1800 (Direct Readout in RPM)

**REVOLUTIONS PER MINUTE** = 1800

**PULSES PER REVOLUTION** = 60

\[
\text{TBIT} = \frac{1,800 \times 1 \times 15,000}{1,800 \times 60} = 250 \text{ [round to the nearest whole number]}
\]

The appropriate Time Base switches, which together add up to 250, are then set “ON”. Start by selecting the first increment which is greater than half the desired TBIT, and add subsequent increments that are more than half the difference needed.

- TBIT = 250
- DIP switch 8 . . . . . - 128 Needed = 122
- DIP switch 7 . . . . . - 64 Needed = 58
- DIP switch 6 . . . . . - 32 Needed = 26
- DIP switch 5 . . . . . - 16 Needed = 10
- DIP switch 4 . . . . . - 8 Needed = 2
- DIP switch 2 . . . . . - 2

As shown above, DIP switches 2 and 4-8 are all set to “ON”. If it is desired to know what the time is in seconds, multiply 250 x 0.004 sec. = 1 sec.

*Note: This is the set-up for a one-second time base, which allows for direct readout of RPM.*

---

**FLOW RATE INDICATION APPLICATION**

A positive displacement pump is driven by a gear reducer and an AC motor. An ARCI NEMA C FLANGE is mounted to the end of this AC motor.

The magnetic pickup (which senses the gear) of the ARCI adapter kit feeds pulses to the APLR. The sensing gear, in combination with the pump and reducer, provides 560 pulses for every gallon of fluid passing through the pump. The Model APLR is used to read directly in tenths of gallons/min. in flow rates up to 45 gallons/min. The following logical steps can be used to determine the time base value required for direct readout. At 45 GPM, the number of output pulses would be as follows:

- 45 gallons/min. x 560 pulses/gallon = 25,200 pulses/min.

Using the TBIT formula:

\[
\text{TBIT} = \frac{(45) \times (10)^* \times 15,000}{25,200} \text{** round to the nearest whole number}
\]

**DDP** = 268

- DIP switch 9 . . . . . - 256 Needed = 12
- DIP switch 4 . . . . . - 8 Needed = 4
- DIP switch 3 . . . . . - 4

From the above calculation, DIP switches 3, 4, and 9, would be set to the “ON” position. The tenths position decimal point must also be set to “ON”. So the display will show 45.0 when 45 gallons are passing through the pump every minute.

---

*Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com*
WEB SPEED INDICATION APPLICATION

A newspaper publishing company wants to know the rate at which their printing press is operating. A fifty-tooth timing sprocket is mounted to the shaft of one of the press rollers. An MP-62TA magnetic pickup is used to sense the moving teeth. Direct readout is obtained by setting the time base to a period in which the number of teeth passing the pickup is numerically equal to the desired readout. Using the TBIT formula, the following calculations are performed:

\[
\text{TIME BASE INCREMENT} = \frac{(\text{Display Readout Desired} \times (15,000))}{(\text{Known RPM}) \times (\text{Known PPR})} = \frac{(632) \times (15,000)}{(1419) \times (50)} = 133.6 \ \text{[round to the nearest whole number]}
\]

* - Input Pulse Rate Per Minute.

DIP switches 2, 3, and 8, are set to “ON”. If the rounding error introduced above is unacceptable, the display could be scaled up by a factor of 10 and then a decimal point turned on in the tens position. The calculations would be as follows:

\[
\text{TBIT} = (\text{Display Readout Desired} \times 10) \times 15,000
\]

\[
\frac{(6320) \times (15,000)}{(1419) \times (50)} = 1336
\]

DIP switch 11 . . . . . - 1024 Needed = 312
DIP switch 9 . . . . . - 256 Needed = 56
DIP switch 6 . . . . . - 32 Needed = 24
DIP switch 5 . . . . . - 16 Needed = 8
DIP switch 4 . . . . . - 8

Now DIP switches, 4, 5, 6, 9, and 11, are set to “ON”. Also, the tenths position decimal point would be set to “ON”. (Note: If the time base is now too long, approximately 5.3 sec. the “FRQ. DBL.” DIP switch can be set to “ON”, then only half the time base will be necessary.

\[
\text{TBIT} = \frac{(6320) \times (15,000)}{(1419) \times (2) \times (50)} = 668
\]

DIP switch 10 . . . . . - 512 Needed = 156
DIP switch 8 . . . . . - 128 Needed = 28
DIP switch 5 . . . . . - 16 Needed = 12
DIP switch 4 . . . . . - 8 Needed = 4
DIP switch 3 . . . . . - 4

DIP switches 3, 4, 5, 8, and 10, are all set to “ON” along with the tens position decimal point. The time base, in seconds, is 668 x 0.004 = 2.67 sec.

TROUBLESHOOTING

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

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>APLR</td>
<td>Apollo Time Base Rate Indicator</td>
<td>APLR0610, APLR0600, APLR0630</td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

PERSONALITY MODULE

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS</th>
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<tbody>
<tr>
<td>PBLR *</td>
<td>Apollo Time Base Rate Module for use with the 4 or 6 digit Large Digit Display</td>
<td>PBLR0600</td>
</tr>
</tbody>
</table>

* Requires an LDD for use.
MODEL APLSG - APOLLO STRAIN-GAGE INDICATOR/MILLIVOLT INDICATOR

- 3½-DIGIT, 0.56” (14.2 mm) HIGH LED READOUT
- SEALED METAL FRONT BEZEL (NEMA 4/IP65)
- HIGH SENSITIVITY, 10 mV FULL SCALE
- WIDE RANGE GAIN AND OFFSET ADJUSTMENTS
- BUILT-IN EXCITATION (1.3 to 10 VDC @ 120 mA)
- APPLICABLE AS REGULAR MILLIVOLT INDICATOR (Single-ended or Differential Input)
- SELECTABLE DECIMAL POINTS
- PLUG-IN TERMINAL STRIPS
- OVER-RANGE INDICATION

DESCRIPTION
The Model APLSG expands the APOLLO 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 adjustable over a 1.3 to 10 VDC range @ 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 APLSG is also ideal for single-ended or differential millivolt input applications with full-scale input ranges from 0 to 10 mV to 0 to 2 VDC, and where adjustable scaling and offset are required to give a direct readout in engineering units.

SPECIFICATIONS
1. DISPLAY: 3½-digit, (1999), 0.56” (14.2 mm) LED, minus sign displayed for negative voltage indication. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP programming switches. Overrange blanks first 3 digits.
2. POWER: Available for 115 or 230 VAC ±10%, 50/60 Hz, 6 VA.
3. 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 75 VDC.

4. INPUT IMPEDANCE: 100 Megohms minimum.
5. LINEARITY: ±(0.05% of Reading, +1 digit)
6. TEMPERATURE COEFFICIENTS: 100 ppm/°C (Applies to Gain, Offset, and Excitation Voltage)
7. NOISE REJECTION: (@ 50/60 Hz) Normal Mode, -84 dB Common mode, -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 UPDATE TIME: Displays updated every 0.4 seconds.
10. EXCITATION SUPPLY: Adjustable from 1.3-10 VDC. Max. output current 120 mA. Excitation supply is regulated.
11. MAXIMUM TEMPERATURES:
   Operating Range: -40°C to +80°C
   Storage Temperature: -40°C to +80°C
13. CONSTRUCTION: Die-cast metal front bezel with black, high impact plastic insert. Front panel meets NEMA 4/IP65 requirements for wash-down and dusty environments when properly installed. (Panel gasket and mounting clips included.)
14. WEIGHT: 1.2 lbs (0.54 Kg).

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.
DESCRIPTION OF OPERATION

The Apollo Strain-Gage Indicator (APLSG) 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 that can be adjusted over a 1.3 to 10 VDC range, and 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 summing amplifier, K4, through coarse and fine adjustable summing resistors. These adjustable resistors 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 (as shown above) and is expressed in Units/mV.

\[
GAIN = \frac{(\text{Max. Num. Readout}) - (\text{Min. Num. Readout})}{(\text{Max. mV Input Sig.}) - (\text{Min. mV Input Sig.})}
\]

(Disregarded Decimal Points in Readout)

For example, if an APLSG is to display 50.0 @ 2 mV (min.) and 169.0 @ 19 mV (max.), the required gain will be:

\[
GAIN = \frac{1690 \text{ Units} - 500 \text{ Units}}{19 \text{ mV} - 2 \text{ mV}} = 70 \text{ Units/mV}
\]

(Remember, display decimal points are disregarded)

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 adjust resistors that increase gain with clockwise rotation. The Coarse adjustment has a 2:1 range and is located on the rear of the unit. The Fine adjustment has a range of 5-10% (depending on the setting of the Coarse adjustment), and is located behind the sealing screw on the L.H. side of the front panel.

OFFSET ADJUSTMENTS

Offset adjustments move the transfer curve up-and-down, along the vertical axis without changing the slope (Gain), as shown above. 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 adjust potentiometer, located behind the sealing screw on the R.H. side of the front panel. 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.
SET-UP AND CALIBRATION
There are three different methods that can be used to calibrate the APLSG, 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 APLSG is then adjusted to provide the proper readout.

SYSTEM CALIBRATION:
In this method, the transducer is connected to the input of the APLSG 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 APLSG 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 APLSG 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 problem.

VOLTAGE CALIBRATION
“Voltage Calibration” can be easily performed for any application, using the calibration circuit (shown lower left) together with the following procedure. However, before starting the procedure, the Input Swing Voltage (V_in), the Readout Span (RS) and the required GAIN must be determined.

RS = (Max. Numerical Display) - (Min. Numerical Display)

Gain = RS/V_S = 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

V_S = 18 mV - 2 mV = 16 mV

Gain = 1000/16 = 62.5 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. R_S and V_S 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. Connect the unit to the Calibration Circuit as shown.
2. Set the Coarse Gain Select Switches, S5 through S9 to establish a maximum gain 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.
3. Turn power on to the unit and allow 10 minutes of warm-up time for stabilization. Then set the excitation voltage accurately to the required level. (10VDC in the example given.)
4. Close the “Zero Switch” of the calibration circuit to obtain zero input voltage. Adjust the fine offset control (R.H. side, Front Panel) to get a zero readout. All offset switches, S2, 3, and 4, should be off.
5. Open the “Zero Switch” of the calibrating circuit and set the input voltage to the calculated swing voltage, V_S. (V_S is 16 mV in the example given.)
6. Now, adjust the Coarse Gain Control (on the back) and the Fine Control (L.H. side, Front Panel) to get a readout equal to the Readout Span. (R_S = 1000 Units in the example given.)
7. 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.
8. 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). Replace sealing screws covering the fine gain and offset adjustments on the front panel.

Caution: Do NOT over-torque. The unit is now ready for installation.

* - Steps 7 and 8 are not required in zero-based applications.

---

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 Ω). 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.
**INSTALLATION**

The Apollo Strain-Gage Indicator is designed to be panel-mounted with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8”.)

After the panel cut-out has been completed and deburred, carefully apply the gasket to the panel. **DO NOT APPLY THE ADHESIVE SIDE OF THE GASKET TO THE BEZEL.** Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side.

Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

**Caution:** Only minimum pressure is required to seal panel. **Do NOT overtighten screws.**

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**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>APLSG</td>
<td>Apollo Strain-Gage Indicator</td>
<td>APLSG410 APLSG400</td>
</tr>
</tbody>
</table>

For information on Pricing, Enclosures, & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

**NOTES:**
1. Units are shipped calibrated to read 000.0 to 100.0 with 0 to 20 mV input, and with excitation set at 10 VDC.
2. The APLSG may be used for process weighing applications, however it does not meet the applicable specifications for commercial weighing.
DESCRIPTION

The Apollo Slave Display converts numerical BCD data supplied by equipment such as programmable controllers, into seven segment LED display information. The Slave Display is available in 3, 4, 5 and 6 digit versions, in either a 5 VDC or 10 to 28 VDC (3 and 5-digit versions have a “-” sign). The unit has three DIP Switch selectable decimal points for displaying in tenths, hundredths and thousandths. Other DIP Switches allow selection of 0 or 1 true logic and pull-down or pull-up resistors for both the Data and Strobe inputs. The unit can display the numbers 0-9 by sending the corresponding BCD information. Individual digits can be blanked by sending a Binary Code greater than 9. For the 3 and 5-digit versions, the minus sign is activated by applying the selected logic true level to the terminal marked “(-) sign” then strobing the terminal marked “(-) STR”.

Four optional accessory boards provide terminal blocks for easy wire hook-up and DIP sockets to cascade the BCD lines to other units. Models ATB1 (3 and 4-digit) and ATB3 (5 and 6-digit) contain all terminal block positions and are used when hooking up one Slave Display or as the first in a series of cascaded displays. Models ATB2 (3 and 4-digit) and ATB4 (5 and 6-digit) do not have the terminal blocks for the 16 and 24 BCD data inputs. These boards are available for use in cascaded systems where the ACA1 DIP Plug Cable Assembly is used to connect the data inputs.

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: Power supply must be Class 2 or SELV rated.
   APLSP3A, APLSP4A: 5 VDC ±20% @ 200 mA max.
   APLSP5A, APLSP6A: 5 VDC ±20% @ 235 mA max.
   APLSP3B, APLSP4B: 10 to 28 VDC @ 200 mA max.
   APLSP5B, APLSP6B: 10 to 28 VDC @ 235 mA max.

2. INPUT IMPEDANCE (ALL Inputs):
   100 KΩ

3. INPUT TRIGGER LEVELS:
   5 V Versions: VIL = 1.0 V , VIH = 4.0 V , max. input voltage = 28 VDC
   10 to 28 V Version: VIL = 3.0 V , VIH = 10.0 V , max. input voltage = 28 VDC

4. 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 4 Enclosure rating (Face only), UL50

   ELECTROMAGNETIC COMPATIBILITY:
   Immunity to EN 50082-2
   Electrostatic discharge EN 61000-4-2 Level 2; 4 Kv contact Level 3; 8 Kv air
   Level 3; 10 V/m
   80 MHz – 1 GHz
   Fast transients (burst) EN 61000-4-4 Level 4; 2 Kv J/O Level 3; 2 Kv power
   Level 3; 10 V/m
   150 KHz – 80 MHz
   RF conducted interference EN 50081-2 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 B
   Power mains class B

   Refer to the EMC Installation Guidelines section of this bulletin for additional information.

5. ENVIRONMENTAL CONDITIONS:
   Operating Temperature: 0 to 50°C
   Storage Temperature: -40 to 70°C
   Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C.
   Altitude: Up to 2000 meters

6. CONSTRUCTION: This unit is rated for NEMA 4/IP65 indoor use.
   Installation Category I, Pollution Degree 2

7. WEIGHT: 0.9 lbs (0.41 Kg)

DIMENSIONS  In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1” (53.3) H x 5.5” (140) W.
LOGIC TRUE SELECTION
The Apollo Slave Display has four DIP switch positions used to set the unit to be compatible with the logic convention of the output device (programmable controller, etc.). DIP switch A (SWA) has two switch positions which provide pull-up (SNK) or pull-down (SRC) resistors on all Data and Strobe inputs. Position 1 and 2 of DIP switch B (SWB) select the logic true state of the “DATA” and “STROBE” inputs. A “0” logic true level for the “STROBE” lines indicates that it is necessary to pull the “STROBE” lines low to allow the data to be strobed in and displayed. A “1” logic true level for the “DATA” inputs indicate that to activate the 1, 2, 4, or 8 data inputs, they must be pulled low. For example, a 9 is entered by pulling the 1 and 8 data inputs low and strobing the digit. A “1” logic true condition indicates that the line must be brought high to be activated. When setting up the DIP switches to a logic true level, both “DAT” or both “STR” switches on “SWA” and “SWB” should be in the same position (0 or 1).

NON-MULTIPLEXED (Input Following) OPERATION
Non-multiplexed operation can be used when the BCD input information for each digit is available all of the time. In this mode of operation, the strobe inputs are set in their logic true state. When this is done the data sent to the unit will be displayed immediately. In setting up the DIP switches for this mode, the “STR” position on “SWA” is set opposite to the “STR” position on “SWB”. Both “DAT” switch positions should be set to the same state depending on the logic (0 or 1).

MULTIPLEXED (Strobed) OPERATION
When BCD lines are multiplexed among digits, a total of only four BCD lines are required, however, a separate strobe line is needed for each digit. The four data lines are connected in parallel to each individual digit of the display/s.
In full parallel multiplexed operation, there are four separate BCD input lines per digit. All BCD data information is available to the Slave Display at the same time and only one “STROBE” line is required for each Slave Display (all “STROBE” lines are tied together).
When setting up the Dip switches for the proper logic convention, both “DAT” switch positions should be set to the same state and both “STR” switch positions should be set the same.

CASCADE DISPLAYS
It is possible to “share” the 16/24 BCD Data lines (16 lines for 4 digit, 24 lines for six digit) among several Slave Displays. To accomplish this, each Slave Display must have its data strobed in at different times which requires multiplexed operation and a separate strobe line or lines for each display. If data can be strobed into each display, four or six digits at a time, only one strobe line is required for each additional unit cascaded. If only four BCD data lines are available from the output device, they must be paralleled with the other digits and four or six strobe lines would be required for each additional Slave Display.
The number of Slave Displays that can be cascaded (i.e. BCD Data or Strode input lines per output) is limited by the drive capabilities of the output device. The Slave Display has one 100 KΩ pull-up (to the unit supply) or pull-down resistor on each BCD Data or Strobe input when set up switches are in the SNK or SRC position respectively.
The connection diagrams below show “full parallel” and “4-bit multiplexed” cascaded systems using the optional accessory boards, ATB3 and ATB4. In each diagram the ACA1 DIP Plug Cable Assembly parallels the BCD data lines to the second display. Additional units can be added in a “daisy chain” configuration by utilizing additional cable assemblies and plugging them into the unused DIP sockets. The pin 1’s of the cable assembly must be connected to the corresponding pin 1’s of the DIP socket.
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 or a troublesome installation. Listed below are some additional 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.
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 #28B2029-0A
   - 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.

DIP SWITCH POSITIONS

These Data (DAT) and Strobe (STR) switch positions are normally set to the same position on SWA and SWB.

**SWA:**
1) Internally connects a 100 KΩ pull-down (SRC) or pull-up (SNK) resistor to each of the BCD data inputs.
2) Internally connects a 100 KΩ pull-down (SRC) or pull-up (SNK) resistor to each of the STR inputs.

**SWB:**
1) Selects a 0 or 1 logic true level for BCD data inputs.
2) Selects a 0 or 1 logic true level for strobe inputs.
3) Tenths Decimal Point.
4) Hundreths Decimal Point.
5) Thousandths Decimal Point.
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.

There are several different ways to make connections to the Slave Display. Four optional accessory boards (Model ATB1, ATB2, ATB3 and ATB4) provide screw clamp terminals for easy wire termination and DIP sockets for ease of cascading displays. Models ATB1 and ATB3 have screw clamp terminations for all input connections. Models ATB2 and ATB4 have screw clamp terminations for all inputs except the BCD Data Inputs. ATB2 and ATB4 are used when the BCD data lines are to be cascaded to other units using the DIP Plug Cable Assembly. The preceding drawings show all accessory boards being utilized in a system.

An optional 24-pin (Model ACE1) for 3 and 4 digit slaves and 24 & 12-pin (Model ACE4) for 5 and 6 digit slaves, provide another way to make connection. These edgecard connectors have 0.156" center to center spacing and require the soldering of the wires to the connector for wire termination. The diagram above shows edgecard connectors being used with the Slave Display.
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 unit meets NEMA 4/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a watertight seal. (Recommended minimum panel thickness is 1/8”.)

After the panel cut-out has been completed and deburred, slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side.

Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal. CAUTION: Only minimum pressure is required to seal panel. Do NOT overtighten screws.

ACCESSORY BOARD POWER CONNECTIONS

The DC power to the unit is applied between “V1” or “V2” and “COMMON” of Terminal Block A (TBA). The voltage applied to the terminals depends on the “Voltage Version” that is being installed. Check to be sure that you have the proper unit for your application. Refer to the preceding diagrams to determine which terminal is to be used.

ACCESSORY BOARD INSTALLATION

The optional accessory board (ATB) is mounted directly to the rear of the Apollo Slave Display. The accessory board can be installed before or after the unit has been installed into the panel. Install the four self-retaining spacers into the four holes on the accessory board as shown in the diagram. Mount the accessory board onto the Slave Display. Install the four screws through the spacers and carefully tighten them until they are snug.
ORDERING INFORMATION

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<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
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<td>APLSP6B0</td>
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<tr>
<td>ATB1</td>
<td>Accessory Board w/Terminal Block For 16 BCD Data Inputs</td>
<td>ATB10000</td>
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<td>ATB2</td>
<td>Accessory Board w/o Terminal Block For 16 BCD Data Inputs</td>
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<td>Accessory Board w/Terminal Block For 24 BCD Data Inputs</td>
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<td>ATB4</td>
<td>Accessory Board w/o Terminal Block For 24 BCD Data Inputs</td>
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<td>ACA10000</td>
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<td>Edgecard Connector w/Solder Eyelets 3 &amp; 4-Digit</td>
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<td>ACE4</td>
<td>Edgecard Connector w/Solder Eyelets 5 &amp; 6-Digit</td>
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For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC Distributor.

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
**MODEL APLTC - APOLLO THERMOCOUPLE INDICATOR**

- MICROPROCESSOR CONTROLLED, NO POTS OR DIP SWITCHES
- USER PROGRAMMABLE T/C TYPE (T, E, J, K, R, S or B)
- SELECTABLE °F OR °C DISPLAY
- FULL 4-DIGIT, 0.56" (14.2 mm) RED LED READOUT
- FAULT DETECTION FOR THERMOCOUPLE BURNOUT
- OPTIONAL ISOLATED ANALOG OUTPUT
- OPTIONAL ISOLATED SERIAL COMMUNICATIONS
- OPTIONAL ISOLATED TEMPERATURE ALARM OUTPUT
- NEMA 4/IP65 SEALED METAL FRONT BEZEL

**DESCRIPTION**
The Apollo Thermocouple Indicator is a high accuracy, microprocessor based instrument designed for low cost temperature measurement and control. The microprocessor automatically compensates for cold junction, NBS linearity, and the meter’s zero and span. *(One model accepts all thermocouple types by simple programming)*. There is no need to recalibrate when changing input types. Isolated analog output, serial communications, and temperature alarms are available as low cost options.

The NEMA 4/IP65 designed, die-cast metal bezel of the Apollo can be sealed in the front panel for use in wash-down and other tough industrial environments. The full 4-digit display features large 0.56" (14.2 mm) red LEDs for easy reading.

**SPECIFICATIONS**
1. **DISPLAY:** 4-digit (9999), 0.56" (14.2 mm) high LED, minus sign displayed when temperature is negative
2. **RESOLUTION:** 1 degree
3. **POWER:** Available in two voltage ranges 115 or 230 VAC, ±10%, 50/60 Hz, 8 VA
4. **THERMOCOUPLE TYPES:** T, E, J, K, R, S and B
5. **INPUT IMPEDANCE:** 10 MΩ (protected from 115 VAC faults)
6. **LEAD RESISTANCE EFFECT:** 20 µV/350 Ω
7. **OPEN THERMOCOUPLE INDICATION:** Display: "OPEN"
   Analog Output: -500 mV output
   Serial Output: "OPEN" in data field
8. **COLD JUNCTION COMPENSATION ERROR:** 0.02 degree/degree
9. **READING RATE:** 2.5 readings/second
10. **RESPONSE TIME:** 2 seconds for step change

11. **NORMAL MODE REJECTION:** 40 dB at 50/60 Hz
12. **COMMON MODE REJECTION:** 110 dB, DC OR 50/60 Hz
13. **TEMPERATURE EFFECTS:**
   - **Operating Range:** 0° to +50°C
   - **Storage Range:** -40° to +80°C
   - **Relative Humidity:** Less than 85% R.H.
   - **Span Temperature Coeff.:** ±60 ppm/°C
   - **Zero Temperature Coeff.:** ±0.3 µV/°C
14. **SERIAL COMMUNICATIONS (optional):** 20 mA current loop
    - **Data Format:** 10 Bit Frame, Odd Parity
    - **Baud Rates:** 300, 600, 1200, 2400
15. **ALARMS (Optional):** (2) isolated (output COMM. common with analog output COMM.), solid-state, current sinking NPN open collector transistors.
    - **Resolution:** 1 degree
    - **Hysteresis:** programmable, min. 1 degree
    - **Imax:** 100 mA @ V_SA = 1 V
    - **Vmax:** 30 VDC (Zener protected)
    - **Connections:** 5-position, removable terminal block
16. **ANALOG OUTPUT (Optional):** 1 mV/degree, bipolar, 10 mA max.
    - **Isolated (analog output COMM. common with alarm output COMM.):**
    - **Accuracy:** ±6 mV
    - **Adjustments:** zero and span pots
    - **Connections:** 5-position, removable terminal block
17. **CONSTRUCTION:** Die-cast metal front bezel that meets NEMA 4/IP65 requirements for wash-down and/or dusty environments when properly installed. Case body is black high impact plastic (panel gasket and mounting clips included).
18. **CONNECTION:** 6-position terminal block
19. **WEIGHT:** 1.2 lbs. (0.6 kg)

**DIMENSIONS**
```
<table>
<thead>
<tr>
<th>In inches (mm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>6.85  (174)</td>
</tr>
<tr>
<td>Height</td>
<td>3.80 (96.5)</td>
</tr>
<tr>
<td>Depth</td>
<td>0.3    (7.6)</td>
</tr>
<tr>
<td>X Location</td>
<td>3.62   (92.5)</td>
</tr>
<tr>
<td>Y Location</td>
<td>1.75   (44.5)</td>
</tr>
<tr>
<td>Z Location</td>
<td>0.1    (2.5)</td>
</tr>
</tbody>
</table>
```

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

(All errors include NBS conformity, cold junction effect and A/D conversion errors at 25°C after 10 minutes warm-up.)

<table>
<thead>
<tr>
<th>TC TYPE</th>
<th>RANGE</th>
<th>ACCURACY (ALL +/- 4 LSD)</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>-200 to +400°C</td>
<td>1.0°C</td>
<td>blue</td>
</tr>
<tr>
<td></td>
<td>-328 to +752°F</td>
<td>1.8°F</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-200 to +1000°C</td>
<td>1.0°C</td>
<td>purple</td>
</tr>
<tr>
<td></td>
<td>-328 to +1832°F</td>
<td>1.8°F</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>-200 to +760°C</td>
<td>1.0°C</td>
<td>white</td>
</tr>
<tr>
<td></td>
<td>-328 to +1400°F</td>
<td>1.8°F</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-200 to +1250°C</td>
<td>1.0°C</td>
<td>yellow</td>
</tr>
<tr>
<td></td>
<td>-328 to +2282°F</td>
<td>1.8°F</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0 to +1768°C</td>
<td>2.3°C</td>
<td>black</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>4.1°F</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0 to +1768°C</td>
<td>2.3°C</td>
<td>black</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>4.1°F</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>+150 to +1820°C</td>
<td>2.5°C</td>
<td>grey</td>
</tr>
<tr>
<td></td>
<td>+32 to +3214°F</td>
<td>4.5°F</td>
<td></td>
</tr>
</tbody>
</table>

---

**OPERATION**

The Apollo indicator employs a microprocessor to automatically compensate for zero, span and cold junction effects. A high accuracy voltage-to-frequency converter is used to convert the thermocouple voltage into digital words for precise linearization and digital display.

The thermocouple inputs are protected from overvoltage faults and are filtered for noise rejection. A non-volatile EEPROM memory device provides permanent data retention for microprocessor variables. The display consists of 5 solid state LEDs for temperature and units readout. The serial communication option is isolated from the meter and features a 20 mA source and bidirectional operation. The alarm option employs optical isolation, a 12-bit DAC and externally-accessible zero and span adjustments. The alarm option is also isolated and has open collector transistors capable of driving relays. Isolation eliminates errors due to groundloops and provides a good measure of noise immunity.

---

**SET-UP AND CALIBRATION**

Connect a “Calibration” and “Select” switch, as indicated in the figure below, to facilitate programming. If instrument calibration is to be undertaken, an appropriate calibrator and thermometer should be connected as shown.

---

**INPUT CONNECTIONS**

Remove power and connect the negative thermocouple lead (always red) to TC- and the positive lead to TC+. Be certain that connections are clean and tight.

When connecting and installing the input wires, the following guidelines should be observed. (This is especially true in “electrically noisy” environments.)

A) Never run thermocouple wires in the same conduit or raceways with conductors feeding motors, solenoids, SCR controls, heaters, etc. Ideally, signal wires should be run by themselves in a separate conduit.

B) Thermocouple wires within electrical enclosures should be routed as far from contactors, motor starters, control relays, transformers, and other components as possible.

C) When shielded wire is used, connect the shield to the TC-terminal of the indicator and leave the other end of the shield unconnected and insulated from machine ground.

D) The Input Common may be connected to machine ground (earth) only at one point, preferably a single, direct connection between a known good, earth ground and the Input Common Terminal.

In order to maintain rated temperature accuracy of the indicator, the rear of the unit must not be exposed to heat sources (either radiated or convected) or excessive air currents which cycle in temperature frequently. Special consideration should be given when the unit is installed adjacent to ovens, furnaces, etc., to preclude such a situation.

---

**CONNECTIONS**

**POWER CONNECTIONS**

Primary AC power is connected to Terminal 1 and 2 (Marked VAC 50/60 Hz, 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.

---

**MAIN MENU**

<table>
<thead>
<tr>
<th>MAIN MENU</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL 0</td>
<td>Starting and exiting point for set-up and calibration programming. Pressing and holding the CAL button until CAL 0 appears (approximately 10 seconds) enters the programming mode. The programming mode can be exited at any time CAL 0 is displayed by pressing the CAL button.</td>
</tr>
<tr>
<td>CAL 1</td>
<td>Initial set-up programming.</td>
</tr>
<tr>
<td>CAL 2</td>
<td>Alarm programming.</td>
</tr>
<tr>
<td>CAL 3</td>
<td>Serial communication programming.</td>
</tr>
<tr>
<td>CAL 4</td>
<td>Zero and Span Calibration.</td>
</tr>
<tr>
<td>CAL 5</td>
<td>Cold Junction Compensation Entry.</td>
</tr>
</tbody>
</table>

---

**BLOCK DIAGRAM**

The diagram illustrates the internal connections and operation of the Apollo indicator. The thermocouple inputs are protected from overvoltage faults and are filtered for noise rejection. A non-volatile EEPROM memory device provides permanent data retention for microprocessor variables. The display consists of 5 solid state LEDs for temperature and units readout. The serial communication option is isolated from the meter and features a 20 mA source and bidirectional operation. The alarm option employs optical isolation, a 12-bit DAC and externally-accessible zero and span adjustments. The alarm option is also isolated and has open collector transistors capable of driving relays. Isolation eliminates errors due to groundloops and provides a good measure of noise immunity.
FACTORY CONFIGURATION

The following chart lists the programming of the unit when shipped from the factory.

- Cal 1 - °F or °C - F
- Type X - (J)
- Cal 2 - AL-H - 50
- AL-L - 400
- HYS - 1
- Cal 3 - baud - 3 (1200)
- Addr - 0
- PSEL - 1 (print TC temp.)

INITIAL SET UP

Before installing the indicator, it must be configured to the thermocouple type and temperature scale (°F or °C) desired. Following the procedure outlined in SET-UP and CALIBRATION, press the buttons indicated in the following chart and observe the indicated display.

<table>
<thead>
<tr>
<th>STEP</th>
<th>CAL. BUTTON</th>
<th>SEL. BUTTON</th>
<th>DISPLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X 10 secs.</td>
<td>X</td>
<td>CAL 6</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>X</td>
<td>CAL 1</td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td>F or Cx (Current Scale)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>X</td>
<td>F or Cx (Desired Scale)</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td>TYPEx (Current Type)</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td>TYPEx (Desired Type)</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>X</td>
<td></td>
<td>CAL 0</td>
</tr>
<tr>
<td>H</td>
<td>X</td>
<td></td>
<td>888.88 Then TC Disp.*</td>
</tr>
</tbody>
</table>

* It is not necessary to exit to the thermocouple display if further set-up or calibration are required. Just press the "SEI" button while in CAL 0, select the desired CAL #.

ALARM OPTION

The Apollo Thermocouple Indicator alarm option has isolated open collector outputs for the control of temperature baths, environmental ovens, furnaces and other industrial processes where operation within a temperature range must be maintained. Independently programmable high and low alarm values with programmable hysteresis (deadband) can be adapted to any requirement. With the serial communication option, the alarm values may be remotely set or interrogated by a programmable logic controller or computer. The graph depicts how the alarms activate with hysteresis.

The Apollo display will, if selected, indicate when an alarm output is ON. If the Alarm Display is programmed to be ON (d ON), the Apollo’s display will alternate between the T/C temperature and “LO on” or “HI on” during the time that the respective output is ON (the temperature is displayed for 4 seconds and then “XX on” is displayed for 1 second). If the Alarm Display is programmed to be OFF (d OFF), the Apollo display will not indicate alarms.

The alarm option terminal block is located at the rear of the unit in the upper right-hand corner. Terminals 1, 2, and 3 are used for the outputs of the alarm option. Terminal 1 is used for the high (HI) alarm output. Terminal 2 is used for the COMM. [Note: The Alarm COMM. terminal is NOT isolated from the Analog output VOLT- (COMM.) terminal] Terminal 3 is the low (LO) alarm output.

EXAMPLE

Alarm High Value = 500°
Alarm Low Value = 470°
Hysteresis Value = 4° (effectively 5°)

SERIAL COMMUNICATIONS OPTION DESCRIPTION

The Apollo Thermocouple Indicator Serial Communication option allows half-duplex (two-way) communication links to a variety of printers, controllers, computers and terminals in order to monitor or control a temperature process. Interrogation of thermocouple temperature, reference (cold) junction temperature, and the two alarm values along with the modification of the two alarm values provide complete remote operation. Two loops can be established; one for sending commands to the Apollo and one for receiving data from it. Additionally, multiple Apollos can be serially looped and assigned address numbers. The implementation of the interface is a 20 mA loop and it is isolated from instrument ground. This provides a high degree of noise immunity and prevents ground loops.

An optional 20 mA to RS232C converter (GCM232) can be used to convert the 20 mA loop to RS232C voltage levels.

FORMAT

Data is sent by switching current on and off in the loop and is received by monitoring the switching action and interpreting the codes that are transmitted. In order for data to be correctly interpreted, there must be identical formats and baud rates. The only format available with the Apollo is 1 start bit, 7 data bits, 1 odd parity bit and 1 stop bit. The selectable baud rates are 300, 600, 1200, and 2400. These values are programmed into the Apollo. (see programming).

FIG. 1: DATA FORMAT-10 BIT FRAME [300, 600, 1200, 2400 Baud]
SERIAL PROGRAMMING

Before communication can take place, the Apollo must be programmed to the same baud rate as the connected equipment. In addition, a loop address and print options, if the print request terminal is to be used, may be programmed. If only one Apollo is being used, an address of zero may be used. If more than one Apollo is being used, assignment of unique addresses, other than zero, for each Apollo is recommended. Valid addresses of 0 to 9 may be assigned, however, the Apollo’s internal current source is capable of driving only 7 units on the loop. Additional drive capability may be afforded by an external current source with a higher voltage compliance (ie. >15VDC).

Following the procedure outlined in SET-UP and CALIBRATION, press the buttons indicated in the following chart and observe the indicated display.

<table>
<thead>
<tr>
<th>STEP</th>
<th>CAL. BUTTON</th>
<th>SEL. BUTTON</th>
<th>DISPLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>X</td>
<td>CAL 0</td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td>X</td>
<td>CAL 3</td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td>baudX</td>
<td>(Current Rate)</td>
</tr>
<tr>
<td>D</td>
<td>X</td>
<td>baudX</td>
<td>(Desired Rate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BAUD RATE CODE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - Disable Comm.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 - 300, 2 - 600</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 - 1200, 4 - 2400</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td>AddrX</td>
<td>(Current Addr.)</td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td>AddrX</td>
<td>(desired Addr. 0 thru 9)</td>
</tr>
<tr>
<td>G</td>
<td>X</td>
<td>PSELX</td>
<td>(Current PCode)</td>
</tr>
<tr>
<td>H</td>
<td>X</td>
<td>PSELX</td>
<td>(Desired PCode)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - No Print</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 - Print TC Temp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 - Print Cold Junction Temp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 - Print Alarm Values</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 - Print TC Temp., Cold Junction Temp &amp; Alarm Values</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 - Print TC Temp., and Alarm Values</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 - Print TC Temp., Alarm Values, &amp; Hysteresis</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>X</td>
<td>CAL 0</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>X</td>
<td>888.88 Then TC Disp.*</td>
<td></td>
</tr>
</tbody>
</table>

* It is not necessary to exit to the thermocouple display if further set-up or calibration are required, just press the “SEL” button. While in CAL, select the desired CAL #.

SENDING COMMANDS TO THE APLTC

When sending commands to the Apollo, a command string must be constructed. The command string may consist of command codes, value identifiers and numerical data. Below is a table outlining the codes and identifiers the Apollo will recognize.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(T)</td>
<td>transmits the requested information specified by identifier</td>
</tr>
<tr>
<td>(V)</td>
<td>change the requested value specified by identifier (C, D, &amp; E)</td>
</tr>
<tr>
<td>(N)</td>
<td>address a particular Apollo in a multiple unit loop</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VALUE IDENTIFIER</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>T/C temperature</td>
</tr>
<tr>
<td>B</td>
<td>Cold jc. temp.</td>
</tr>
<tr>
<td>C</td>
<td>Alarm high</td>
</tr>
<tr>
<td>D</td>
<td>Alarm low</td>
</tr>
<tr>
<td>E</td>
<td>Hysteresis</td>
</tr>
<tr>
<td>P</td>
<td>Print Select</td>
</tr>
</tbody>
</table>
RECEIVING DATA FROM THE APLTC

Data is transmitted from the Apollo whenever a T (transmit command) is received or the hardware print request terminal is activated. The five possible responses and a typical transmission is shown below.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blank</td>
<td>3</td>
<td>Blank</td>
<td>T</td>
<td>C</td>
<td>Blank</td>
<td>Blank</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>C</td>
<td>CR</td>
<td>LF</td>
</tr>
</tbody>
</table>

Unit Address Space Mnemonics Blank Space

NOTE: *A decimal point will be placed in this position for cold junction.

Display X X

The first character transmitted is the unit address number; unless it is zero, in which case it will be left blank. Then two blank spaces. The next two characters are the abbreviation for the values, followed by three blanks (two for cold junction). The actual data values are transmitted next. The field is right justified with leading zeros (not blanks) and negative values have a minus sign in position 9. A plus sign for positive values is not used and note that the field for cold junction has a decimal point. The message “OPEN” will appear in the data field of the thermocouple temperature transmission whenever the indicator senses a thermocouple break. After the data field, an F or C character is transmitted depending on the indicator’s current units, followed by carriage return and line feed.

SERIAL TERMINAL DESCRIPTION

Note: The numbers in parentheses refer to the position numbers labeled on the terminal block.

SL+ (1) - Serial In (): Current flows into the Apollo’s receive channel.

SL- (2) - Serial In (): Current flows out of the Apollo’s receive channel.

SO+ (3) - Serial Out (): Current flows into the Apollo’s transmit channel.

SO- (4) - Serial Out (): Current flows out of the Apollo’s transmit channel.

20 mA- (5) - 20 mA current source for either receive or transmit loop current. Current flows into this pin.

20 mA+ (6) - 20 mA current source for either receive or transmit loop current. Current flows out of this pin.

When wiring the 20 mA Serial Loop, remove the 6-position terminal block on the right side of the bottom board. Strip 1/4" off each wire and connect each wire into the proper location of the terminal block. Re-install the connector and be sure that the wires are strain-relieved.

ANALOG OUTPUT OPTION

The Apollo Thermocouple Indicator Analog Output Option provides an isolated 1mV/degree output to drive chart recorders, controllers, data loggers and slave displays. The output corresponds to the displayed temperature and increments in discrete steps. Although the option is calibrated at the factory, user accessible zero and span adjustments are provided for minor adjustments. These are located adjacent to the output connections. Recalibration is recommended after 1 year of use.

The analog output option terminal block is located at the rear of the unit in the upper right-hand corner. Terminal 4 is the VOLT+, and terminal 5 is the VOLT-/COMM.) (Note: The alarm COMM. terminal and the analog output VOLT- terminal are internally connected.)

To check for accuracy, connect a voltmeter to the output and the reading should be +1mV per degree of displayed reading (+/- 6 degrees). If calibration should be necessary, connect the indicator as shown in the set-up and calibration section.

1. Apply an arbitrary voltage so that the indicator displays a negative temperature (-100,-200, etc.). Adjust the zero potentiometer (right side) so that the readings from the voltmeter and the indicator correspond.

2. Apply an arbitrary voltage so that the indicator displays a large positive temperature (+1500, +2000, etc.). Adjust the span potentiometer (left side) so that the reading from the voltmeter and the indicator correspond.

3. Repeat steps 1 and 2 until both points are correct. Calibration is complete.

TROUBLESHOOTING

A functional test can be performed by connecting a wire jumper between the thermocouple inputs. When power is applied, the display will briefly show “888.88” to test the LEDs and then indicate the cold junction temperature at the rear of the unit. Verify that all display segments illuminate and the temperature indicated is near ambient temperature. The indicator has several special display modes which indicate faults within the meter or external connections. The table illustrates these and the most common causes.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PROBABLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>“OPEN”</td>
<td>- broken or burned-out thermocouple</td>
</tr>
<tr>
<td></td>
<td>- excessive thermocouple voltage</td>
</tr>
<tr>
<td>“888.88” Or “...”</td>
<td>- incorrect power up/down due to voltage spike</td>
</tr>
<tr>
<td>“EEEE”</td>
<td>- excessive negative thermocouple voltage (usually due to reversed T/C connections) defect in analog circuit</td>
</tr>
</tbody>
</table>

CALIBRATION

The Apollo thermocouple indicator has been calibrated at the factory using precision instruments and was designed not to require frequent recalibration. However, as part of a regular maintenance program or after 1 year of use, recalibration by authorized personnel is recommended.

Recalibration consists of applying accurate voltages to the indicator and setting the cold junction temperature with an accurate thermometer. A precision thermometer (RTD, thermistor or similar type) (accuracy of ±0.3°C) and an accurate voltage source (0.01%) are required. Do not use thermocouple wire on making connections.

Allow 30 minutes warm-up time before calibration is attempted.

If long thermocouple runs are present in the application (>300 ft.), significant offset errors may exist due to the input bias current of the indicator. To correct for this effect, insert a fixed resistance in series with the positive leg of the millivolt source which is equal to the thermocouple wire resistance and proceed with calibration as normal. In most thermocouple applications this error is insignificant and may be ignored.

Following the procedure outlined in SET-UP and CALIBRATION, press the buttons indicated in the following charts and observe the indicated display.

In steps D and E of CAL 4, a voltage applied that is not within the calibration range of the instrument will cause the calibration process to be aborted after 20 seconds and return the display to CAL 0. Check the calibration set-up before attempting to recalibrate.

In step C, of CAL 4, the display will first indicate what the display is and after 2 seconds indicate the current value.

In step D, of CAL 4, when the Select button is pressed, the display will increment first slowly and then more rapidly. The button can be released and pressed again to increment slowly when the desired value is approached.

### CAL 4 ZERO AND SPAN CALIBRATION

<table>
<thead>
<tr>
<th>STEP</th>
<th>CAL BUTTON</th>
<th>SEL BUTTON</th>
<th>DISPLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X 10 secs.</td>
<td>X</td>
<td>CAL 0</td>
</tr>
<tr>
<td>B</td>
<td>X</td>
<td>X</td>
<td>CAL 4</td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td>In-0</td>
<td>Apply 0 millivolts +/-3 µV</td>
</tr>
<tr>
<td>D</td>
<td>X</td>
<td>In-5</td>
<td>Apply 50 millivolts +/-5 µV</td>
</tr>
<tr>
<td>E</td>
<td>X</td>
<td>X</td>
<td>CAL 0</td>
</tr>
<tr>
<td>F</td>
<td>X</td>
<td>888.88*</td>
<td>Then TC Disp.*</td>
</tr>
</tbody>
</table>

* It is not necessary to exit to the thermocouple display if further set-up or calibration are required, just press the "SEL" button. While in CAL 4, select the desired CAL #.

 Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
COLD JUNCTION TEMPERATURE CALIBRATION

1. Set the panel meter to read in the Fahrenheit temperature scale. 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 thermistor to the measuring end of the thermocouple.

3. From the normal indicator display mode, compare the display temperature to that of the reference thermistor. Allow 10 minutes for the temperature to equalize. The meter and the reference thermistor should agree to within 1°F.

4. If cold junction re-calibration is necessary (temperature out of tolerance), enter the new cold junction temperature according to the formula:

\[
\text{New Cold Junction Reading} = \text{Old Cold Junction Reading} + \text{Difference} \\
\text{Difference} = \frac{\text{Reference Thermometer Temperature} - \text{Display Temperature}}{\text{Meter Temperature - Reference Temperature}}
\]

5. Check results by repeating steps 1, 2, and 3.

APPLICATIONS CONNECTING TO A PRINTER

The drawing shows the thermocouple indicator with the 20 mA serial communication option set-up with an RLC Model DMPC printer. An external current source is required to implement the printer’s busy signal to the Apollo’s receive loop, which prevents overruns. The “Print Switch” is a momentary-contact, pushbutton type connected between the print request terminal and the thermocouple negative input (-). The print function must be programmed into the Apollo, along with baud rate.

ALARM, SERIAL, & ANALOG APPLICATION

A heat treating furnace is used to anneal alloys. In order to properly anneal all types of alloys, specific peak temperatures and cool off rates must be maintained. Also, a temperature versus time plot of each treatment is needed for verification purposes. An Apollo Thermocouple Indicator is used with analog output, serial communication and alarm output options to measure and control this process. Working through the serial communications, a microcomputer remotely sets the alarm values for the Apollo to control the temperature of the annealing crucible and the computer provides the proper timing for temperature soak and ramp. The Apollo’s analog output is used to drive relays which switch 220 VAC power to the crucible’s electric heating elements. The Apollo’s analog output is used to drive a chart recorder for graphing of the entire process.

As an example, to anneal one type of alloy, it must be brought to 700°F and left to soak for 2 hours after which it must cool at the rate of 100°/hour until it reaches 500° where it must stay for 1 hour and then allowed to air cool. To achieve a mean temperature of 700°F, the system’s bandwidth (deadband) is added to the low alarm set point value. In this case, the deadband is 20°F to avoid unnecessary relay operation. The graph depicts the soak interval at 700°F. After the initial soak period, the setpoint alarm is reprogrammed in a succession of steps to obtain the gradual 100°/hr cool-off to 500°. After a one hour period at 500°, the crucible is then allowed to air cool. The chart recorder provides a graph of the entire process.
**PANEL INSTALLATION**

The Apollo Indicators are designed to be panel-mounted with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8" [3.2 mm].)

After the panel cut-out has been completed and deburred, carefully slide the panel gasket over the rear of the unit to the back of the bezel. Insert the unit into the panel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side. Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.

**CAUTION:** Only minimum pressure is required to seal panel. Do NOT overtighten screws.

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**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>OPTIONS</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
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<tr>
<td>APLTC</td>
<td>Apollo Thermocouple Indicator</td>
<td>W/ALARM W/ANALOG OUTPUT W/ SERIAL 230 VAC 115 VAC</td>
<td>APLTC410 APLTC400 APLTC411 APLTC401 APLTC412 APLTC402 APLTC413 APLTC403 APLTC414 APLTC404 APLTC415 APLTC405</td>
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<td>GCM232</td>
<td>Serial Converter Module</td>
<td>N/A N/A YES</td>
<td>GCMM23201</td>
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</tbody>
</table>

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

*Units are shipped calibrated and programmed to accept Type “J” thermocouple and indicate in degrees fahrenheit.*

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LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to one year from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company’s liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company’s option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, death, property damage, lost profits, and other matters which RLC, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637, as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company’s products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.
MODEL PBLSP - APOLLO 4/6-DIGIT BCD SLAVE DISPLAY MODULE FOR USE WITH THE LARGE DIGIT DISPLAY (LDD)

DESCRIPTION
The Model PBLSP Apollo Slave Display Module is a P.C. Board assembly that is to be installed in an RLC Large Digit Display product (See LDD Bulletin). The module converts BCD data to numerical data for each digit of the LDD display. The BCD data can be supplied by various equipment such as programmable controllers, RLC Series 600 units, etc. The unit can display the numbers from 0 to 9 by sending the correct BCD information. Individual digits can be blanked by sending a Binary Code number greater than 9.

The PBLSP has three DIP Switch selectable decimal points for displaying in 10ths, 100ths and 1000ths. In addition, DIP switches allow a minus sign "-" to be displayed in any of the digit positions with the appropriate BCD input. This "-" may be used as a negative polarity indicator or as a separating dash between numeric information. Only one "-" may be displayed at any given time.

Other DIP Switches allow selection of positive or negative true logic and pull-up or pull-down resistors for both the Data and Strobe inputs. Individual Strobe inputs are provided for each digit to accommodate both multiplexed (strobed) and full parallel data input applications. The module is powered from either a 4-digit or a 6-digit LDD (see Ordering Information).

LOGIC TRUE LEVEL SELECTION
The PBLSP module has four DIP switch settings which insure compatibility with the hardware and logic convention of the output device (programmable controller, etc.). The two position DIP switch SWA, configures the input circuitry to accept signals from sourcing or sinking outputs. This is done internally by connecting pull-up (SNK) or pull-down (SRC) resistors on all Data and Strobe inputs.

Positions 1 and 2 of DIP switch SWB select the Logic True Level of the BCD DATA and DIGIT STROBE inputs. SWB1 in the down (0) position selects a "LOW" (Negative) logic true level for the BCD Data Inputs. This means that the "1, 2, 4, or 8" data input lines must be pulled low to be active. For example, a BCD "9" code is entered by pulling the 1 and 8 data inputs low and then strobing that digit. SWB1 in the up (1) position selects a "HIGH" (Positive) logic true level and indicates that the lines must be pulled high to be active.

SWB2 in the down position selects a "LOW" (Negative) logic true level for the Strobe Inputs. This indicates those lines must be pulled low to allow data to be strobed in for the display. SWB2 in the up position selects a "HIGH" (Positive) logic true level, which requires the strobe lines be pulled high to strobe in data for the display.

FULL PARALLEL OPERATION
Full parallel operation requires the use of four separate BCD input lines per digit (16 total data lines for 4-digit, 24 lines for 6-digit). The Digit Strobe terminals may or may not require external connections depending on whether the BCD data is constantly available at the data input terminals, or is multiplexed among more than one BCD input device. This leads to the two basic types of full parallel operation as described below.

FULL PARALLEL NON-MULTIPLEXED (Input Following) OPERATION
Full parallel non-multiplexed operation is used when the BCD information for each digit is constantly available at the Data Input terminals. In this mode of operation, the Strobe inputs are permanently set in their ACTIVE logic state via DIP switches and no external connections to the Strobe Inputs are required. With this set-up, any BCD data sent to the unit will be displayed immediately and the module’s internal BCD latches will appear transparent to the input data. In setting the DIP switches for this mode, the “DIGIT STROBES” switch on SWA is set opposite to the “DIGIT STROBES” switch on SWB. This will internally set all digit strobes to a constantly ACTIVE logic state. The “DATA INPUTS” switches on SWA and SWB should both be set to the same position depending on the logic convention of the output device (0 or 1).

SPECIFICATIONS
1. POWER REQUIREMENTS:
   AC Operation - Switch selected via the LDD Power Supply Board, 115/230 VAC ±10%, 50/60 Hz, 10 VA for 4-digit and 15 VA for 6-digit (including LDD).
2. INPUT IMPEDANCE (All Inputs): 100 KΩ
3. INPUT TRIGGER LEVELS (All Inputs):
   - V humiliation (Vih) = 1.0 V; Vlih = 4.0 V; Max. input voltage = ±28 VDC
4. INPUT DATA SCAN RATE: 100 KHz max.
5. OPERATING TEMPERATURE: 0°C to 50°C
6. STORAGE TEMPERATURE: -40°C to 70°C
7. WEIGHT: 0.4 lbs (0.18 Kg)
**FULL PARALLEL MULTIPLEXED OPERATION**

Full parallel multiplexed operation normally occurs in systems which share the same BCD digit data lines among more than one Slave Display module or other BCD input devices (See CASCADING DISPLAYS). All BCD data information is simultaneously available to each device in a BUS configuration, and only one device is activated at any given time through the use of strobe lines.

In this mode of operation, all the Digit Strobe terminals on a given module are wired together into a common "Display Strobe" line. For the Slave Display to function properly, the Display Strobe must be activated only when the respective BCD data for the module being strobed is present on the BCD Data Lines. The data is then stored in the module’s internal BCD latches and constantly displayed until new information is strobed into the unit.

When setting the DIP switches for this mode, both "DIGIT STROBES" switches on SWA and SWB should be set to the same position depending on the logic convention of the output device. This manner, all digit strobes will be in a normally INACTIVE logic state and will only become ACTIVE when the Display Strobe line is toggled. The "DATA INPUTS" switches on SWA and SWB should both be set to the same position depending on the logic convention of the output device.

**CASCADING DISPLAYS**

It is possible to “share” the 16/24 BCD Data lines (16 lines for 4 digit, 24 lines for six digit) among several Slave Display modules. To accomplish this, each Slave Display must have its data strobed in at different times, which requires multiplexed operation and a separate strobe line or lines for each module.

If data can be strobed into each display, four or six digits at a time (full parallel multiplexed operation), only one strobe line is required for each additional unit cascaded. If only four BCD data lines are available from the output device (digit multiplexed operation), they must be paralleled with the other digits and four or six strobe lines would be required for each additional Slave Display module.

The number of Slave Displays that can be cascaded (i.e. BCD Data or Strobe Input lines per output) is limited by the drive capabilities of the output device. The Slave Display module has a 100 K pull-up (to +5 VDC) or pull-down resistor on each BCD Data or Strobe Input when set up switches are in the SNK or SRC position respectively.

**DIP SWITCH SET-UP**

DIP SWITCH SWA: Input Hardware Configuration. These switch positions are normally set in the same direction as the corresponding DIP switch positions on SWB.

SWA1 DATA INPUTS SNK/SRC:
Connects an internal 100 K pull-up (SNK) or pull-down (SRC) resistor to each of the BCD Data Inputs.

SWA2 DIGIT STROBES SNK/SRC:
Connects an internal 100 K pull-up (SNK) or pull-down (SRC) resistor to each of the Digit Strobe Inputs.

SWB3: D.P. OFF/0000.0 - Tenths Decimal Point.
SWB4: D.P. OFF/0000.00 - Hundredths Decimal Point.
SWB5: D.P. OFF/000.000 - Thousandths Decimal Point.

DIP SWITCH SWB: Input Logic True Level and Decimal Point Selection.

SWB1 DATA INPUTS LOGIC TRUE LEVEL:
Selects Negative (0) or Positive (1) Logic True Level for all BCD Data Inputs.

SWB2 DIGIT STROBES LOGIC TRUE LEVEL:
Selects Negative (0) or a Positive (1) Logic True Level for all Digit Strobe Inputs.

DIP SWITCH SWC: Minus Sign Selection.

SWC1 - SWC6:
Selects the Digit (1-6) in which a minus sign or dash may be displayed in place of numeric BCD data. A minus sign “-” will be displayed in the appropriate digit location when BCD bit “8” of the selected digit is in the ACTIVE logic state (Regardless of the logic states of bits 1, 2, and 4). If bit “8” of the selected digit is in the INACTIVE logic state, the appropriate digit will be blank.

Note: ONLY ONE DIGIT MAY BE SELECTED TO DISPLAY A MINUS SIGN “-” AT ANY GIVEN TIME.

**STROBED (Digit Multiplexed) OPERATION**

Multiplexing BCD data lines for all the digits within a module requires a total of only four data lines, connected in parallel to each individual digit of the display (all “1” bits tied together, all “2” bits tied, etc.). However, in this mode of operation a separate Digit Strobe line is needed for each digit. As each digit of BCD information is placed on the four data lines, the appropriate Digit Strobe line is activated to latch the data into the module. Each digit is successively strobed until the display has been fully updated. The data stored in the module’s internal latches will be constantly displayed until new information is strobed in on one or more digits.

When setting the DIP switches for this mode, both “DIGIT STROBES” switches on SWA and SWB should be set to the same position (0 or 1) depending on the logic convention of the output device. In this manner, all digit strobes will be in a normally INACTIVE logic state and will only become ACTIVE as each individual Digit Strobe line is toggled. The “DATA INPUTS” switches on SWA and SWB should both be set to the same position depending on the logic convention of the output device.

**TIMING SPECIFICATIONS FOR STROBE & DATA INPUTS**

`Note: Specifications shown are based on a sourcing input with V_H = +5 VDC and V_L = 0 VDC.`
CONNECTIONS

POWER and DIGIT STROBES (TBA)

AC POWER:
AC Power connections are made at TBA #1 and TBA #2. For best results, the AC power should be relatively “clean” and within the specified +/-10% variation limits. Connecting the unit to power sources that are from heavily loaded circuits, or from circuits that also power loads that cycle on and off, should be avoided.

Note: Power should NOT be applied until all wiring is complete and the module is properly installed into the Large Digit Display (LDD).

LAMPTEST (LT):
Connecting terminal TBA #3 to “COMM.” will light all segments on the display to verify proper illumination, regardless of any input or logic switch settings. Decimal points will NOT light via LAMPTEST, but can be individually turned on by using DIP switches SWB3, 4, & 5. LAMPTEST is intended primarily for troubleshooting and is generally not used during normal operation of the module.

COMMON:
TBA #4 is circuit common, to which all input voltage levels are referenced.

STROBE INPUTS:
The Strobe Inputs, TBA #5 through TBA #10, function as enable lines to latch information, into the module’s display buffers, that is present on the BCD Data Input terminals. The Strobe Inputs may be configured to accept signals from sourcing or sinking output devices using DIP switch SWA2. In addition, Positive or Negative true logic for the Strobe Inputs may be selected using DIP switch SWB2.

BCD DATA INPUTS FOR DIGITS 1 through 4 (TBB):
The BCD Data Inputs, TBB #1 through TBB #16, accept standard 4-bit BCD information to be displayed in the corresponding digit location. Digit 1 is the Least Significant Digit of the display. Like the Strobe Inputs, the BCD Data Inputs are compatible with sourcing or sinking output devices using DIP switch SWA1 and will accept Positive or Negative true logic using DIP switch SWB1.

BCD DATA INPUTS FOR DIGITS 5 and 6 (TBC):
BCD Data Inputs, TBC #1 through TBC #8, are functionally the same as terminal TBB, for Digits 5 and 6. For applications using a 4-digit LDD, these terminals will NOT be used and should be left disconnected.

INSTALLATION

The Model PBLSP Apollo Slave Display Module is a P.C. Board Assembly that is to be installed into an RLC 6-digit or 4-digit Large Digit Display (See LDD Bulletin). To place the PBLSP Module into the LDD, first remove the rear cover by unscrewing the two captive fasteners. Place the PBLSP Module on the plastic standoffs. Push on the four posts until the carrier snaps into place.

Note: Power should NOT be applied until all wiring is complete and the module is properly installed into the Large Digit Display (LDD).

Select the proper voltage by setting the switch on the Large Digit Display to either 115 or 230 VAC. Connect the display and power cables on the module to the appropriate connectors on the power supply board (see drawing below).

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
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<tbody>
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<td>PBLSP</td>
<td>Apollo BCD Slave Display Module for use with 4-digit Large Digit Display or 6-digit Large Digit Display</td>
<td>PBLSP600</td>
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