MODEL CUB5T - MINIATURE ELECTRONIC PRESET TIMER AND CYCLE COUNTER

- LCD, REFLECTIVE OR RED/GREEN LED BACKLIGHTING
- 0.46” (11.7 mm) HIGH DIGITS
- 7-DIGIT BI-DIRECTIONAL TIMING CAPABILITY
- 6-DIGIT CYCLE COUNTING CAPABILITY
- OPTIONAL RELAY OUTPUT MODULE
- OPTIONAL SERIAL COMMUNICATIONS MODULE (RS232 or RS485)
- SELECTABLE TIMER RANGES AND OPERATING MODES
- ELAPSED TIMER AND PRESET TIMER FUNCTIONALITY
- DISPLAY COLOR CHANGE CAPABILITY AT PRESET OUTPUT
- OPERATES FROM 9 TO 28 VDC POWER SOURCE
- NEMA 4X/IP65 SEALED FRONT BEZEL

GENERAL DESCRIPTION
The CUB5T provides the ultimate in timer flexibility, from its complete user programming to the optional relay output and serial communications capability. The meter functions as an Elapsed Timer or Preset Timer. It also has a built-in Cycle Counter. The display can be toggled either manually or automatically between the Timer and Cycle Counter values. With eight different input operating modes and 18 selectable timer ranges, the meter can be programmed for a wide variety of timing applications.

The CUB5T has an LCD display with 0.46” (11.7 mm) high digits. The LCD is available in two versions, reflective (CUB5TR00) and backlight (CUB5TB00). The backlight version is user selectable for red or green backlighting with variable display intensity.

The Timer has two signal inputs and eight input operating modes. These modes provide level active or edge triggered start/stop operation. A Display Hold mode will display the elapsed time for one cycle, while the next cycle continues timing internally. The Timer Reset modes will automatically reset the timer value when a time start edge is applied to the input. This allows sequential timing cycles without having to manually reset the Timer.

In addition to the Timer inputs, a programmable User Input is available to perform a variety of meter functions. All inputs are current sinking (active low) and accept a variety of logic and open-collector output signal sources. Relay and switch contacts can also be used as signal sources, when the software input debounce filter is enabled.

The capability of the CUB5T can be easily expanded with the addition of a field installable option module. When the CUB5RLY0 relay output module is added, the meter becomes a Preset Timer. The Setpoint Output can be assigned to the Timer or Cycle Counter values, and configured to suit a variety of control and alarm requirements. Serial communications capability for RS232 or RS485 is added with a serial option module (CUB5COM).

The CUB5T can be powered from an optional Red Lion Micro-Line/Sensor Power Supply (MLPS1000), which attaches directly to the back of a CUB5T. The MLPS1 is powered from an 85 to 250 VAC source and provides up to 400 mA to drive the meter and sensors.

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

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

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>CUB5T</td>
<td>CUB5TR</td>
<td>Preset Timer and Cycle Counter with Reflective</td>
<td>CUB5TR00</td>
</tr>
<tr>
<td></td>
<td>CUB5TB</td>
<td>Preset Timer and Cycle Counter with Backlight</td>
<td>CUB5TB00</td>
</tr>
<tr>
<td>Optional</td>
<td>CUB5RLY</td>
<td>Single Relay Option Card</td>
<td>CUB5RLY0</td>
</tr>
<tr>
<td>Plug-in</td>
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</tr>
<tr>
<td>Accessories</td>
<td></td>
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<td>CUB5COM2</td>
</tr>
<tr>
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<td>MLPS1</td>
<td>Micro-Line Power Supply, 85 to 250 VAC</td>
<td>MLPS1000</td>
</tr>
<tr>
<td></td>
<td>CBLPRO</td>
<td>Programming Cable RS232 (RJ11-D9)</td>
<td>CBLPROG0</td>
</tr>
<tr>
<td></td>
<td>CBPRO</td>
<td>Programming Cable RS485 (RJ11-D9)</td>
<td>CBPRO007</td>
</tr>
</tbody>
</table>

**GENERAL METER SPECIFICATIONS**

1. DISPLAY: 8 digit LCD 0.46” (11.7 mm) high digits
   - CUB5TR00: Reflective LCD with full viewing angle
   - CUB5TB00: Selectable transmissive red or green backlight LED with viewing angle optimized. Display color change capability at preset when using a relay module.
2. POWER: Input voltage range is +9 to +28 VDC with short circuit and input polarity protection. Must use an RLC model MLPS1 or a Class 2 or SELV rated power supply.
3. TIMER DISPLAY: 7-digits
   - Display Designator: “t” to the left side of the display
   - Display Range: 0 to 9999999
   - Overflow/Underflow Indication: Display flashes “t OVer”
   - Minimum Digit Resolution: 0.001 Sec.
   - Maximum Single Digit Resolution: 1 Hr.
   - Timing Accuracy: ±0.01%
4. CYCLE Counter DISPLAY: 6-digits, may be disabled if not used
   - Display Designator: “t” to the left side of the display
   - Display Range: 0 to 999999
   - Overflow/Underflow Indication: Display flashes “t Under”
   - Maximum Count Rate:
     - All Count Sources except Input B: 10 Hz
     - Input B Count Source:
       - With Timer Input Filter ON: 10 Hz
       - With Timer Input Filter OFF: 500 Hz
5. TIMER SIGNAL INPUTS (INP A and INP B)
   - Logic Inputs, Current Sinking (active low)
   - Input A:
     - Internal 7.8KΩ pull-up resistor to +9 to 28 VDC
     - Trigger levels: $V_{IL} = 1.25$ V max; $V_{IH} = 2.75$ V min; $V_{MAX} = 28$ VDC
   - Input B:
     - Internal 10KΩ pull-up resistor to +9 to 28 VDC
     - Trigger levels: $V_{IL} = 1.0$ V max; $V_{IH} = 2.4$ V min; $V_{MAX} = 28$ VDC
   - Inputs A and B:
     - Timer Input Pulse Width: 1 msec min.
     - Timer Start/Stop Response Time: 1 msec max.
     - Filter: Software filtering provided for relay or switch contact debounce
     - Filter enabled or disabled through programming. If enabled, results in 50 msec start/stop response time for successive pulses applied to the same input terminal.
6. USER INPUT (USR): Programmable function input
   - Logic Input, Current Sinking (active low)
   - Internal 10KΩ pull-up resistor to +9 to 28 VDC
   - Trigger levels: $V_{IL} = 1.0$ V max; $V_{IH} = 2.4$ V min; $V_{MAX} = 28$ VDC
   - Response Time: 5 msec typ.; 50 msec debounce (activation and release)
7. MEMORY: Nonvolatile E²PROM memory retains all programming parameters and timer/counter values when power is removed.
8. CONNECTIONS: Wire clamping screw terminals
   - Wire Strip Length: 0.3” (7.5 mm)
   - Wire Gauge: 30-14 AWG copper wire
   - Torque: 5 inch-lbs (0.565 N-m) max.
9. ENVIRONMENTAL CONDITIONS:
   - Operating Temperature Range for CUB5TR00: -35 to 75°C
   - Operating Temperature Range for CUB5TB00 depends on display color and intensity level as per below:
     | Display Color | Intensity Level | Temperature |
     |---------------|----------------|-------------|
     | Red Display   | 1 & 2          | -35 to 75°C |
     |               | 3              | -35 to 70°C |
     |               | 4              | -35 to 60°C |
     |               | 5              | -35 to 50°C |
     | Green Display | 1 & 2          | -35 to 75°C |
     |               | 3              | -35 to 63°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)
10. SAFETY
    - UL Listed, File # E137808, UL508, CSA C22.2 No. 14-M95
    - LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards
    - Type 4X Indoor Enclosure rating (Face only), UL50
    - IEC 61010-1-1, 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
        - 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&E power
      - RF conducted interference EN 61000-4-6
        - Criterion A: 3 V/m
        - 30 A/m
      - Power frequency magnetic fields EN 61000-4-8
        - Criterion A: 30 A/m
      - Emissions:
        - EN 55011
        - Class A
    - Notes:
    - 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.
    - WEIGHT: 3.2 oz (100 g)
**Optional Plug-In Cards**

**Adding Option Cards**
The CUB5T meters can be fitted with optional relay card and/or serial communications cards. The details for the plug-in cards can be reviewed in the specification section below. The plug-in cards, that are sold separately, can be installed initially or at a later date.

**Relay Card**
- **Type**: Single FORM-C relay
- **Isolation To Sensor & User Input Commons**: 1400 Vrms for 1 min.
- **Working Voltage**: 150 Vrms
- **Contact Rating**: 1 amp @ 30 VDC resistive; 0.3 amp @ 125 VAC resistive
- **Life Expectancy**: 100,000 minimum operations
- **Response Time**:
  - Turn On Time: 4 msec max.
  - Turn Off Time: 4 msec max.
- **Time Accuracy**: ± 0.01%

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

**RS485 Serial Communications Card**
- **Type**: RS485 multi-point balanced interface (non-isolated)
- **Baud Rate**: 300 to 38400
- **Data Format**: 7/8 bits; odd, even, or no parity
- **Bus Address**: 0 to 99; max 32 meters per line
- **Transmit Delay**: Selectable. 2 msec min. or 50 msec min.

**RS232 Serial Communications Card**
- **Type**: RS232 half duplex (non-isolated)
- **Baud Rate**: 300 to 38400
- **Data Format**: 7/8 bits; odd, even, or no parity

1.0 Installing the Meter

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

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

The DIP switches on the main circuit board are not used with the CUB5T and must be left in the factory set position (all down). Setting any switch to the up position may cause improper operation of the meter.
### 3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased option cards that perform specific functions. The cards plug into the main circuit board of the meter after the rear cover is removed.

**WARNING:** Disconnect all power to the meter before installing Plug-in Card.

### 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.

**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.

### 4.0 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. 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
   - Corcom # 1 VR3
   - Schaffner # FCOR0000
   - Schaffner # LFL0000
   - Schaffner # LFL0000
   - Corcom # 1 VR3
   - Corcom # 1 VR3
   - Note: Reference manufacturer’s instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   - Snubber: RLC# SNUB0000.
4.1 POWER WIRING
DC Power
+9 to +28 VDC: +VDC
Power Common: -VDC

4.2 USER INPUT WIRING
Sinking Logic
INP COMM User Input terminal and Input Common.
The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low.

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

4.4 SETPOINT (OUTPUT) WIRING

4.5 SERIAL COMMUNICATION WIRING
5.0 Reviewing the Front Buttons and Display

<table>
<thead>
<tr>
<th>KEY</th>
<th>DISPLAY MODE OPERATION</th>
<th>ENTERING PROGRAM MODE</th>
<th>PROGRAMMING MODE OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL</td>
<td>Select display (timer or cycle counter)</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>Reset value(s) per Front Panel Reset setting</td>
<td></td>
<td>Advances through the program menu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increments selected parameter value or selection</td>
</tr>
</tbody>
</table>

Operating Mode Display Designators

“t” - To the left of the display is the timer value.
“C” - To the left of the display is the cycle counter value.

If display scroll is enabled, the display will toggle automatically every four seconds between the timer and cycle counter values.

6.0 Programming the Meter

**Overview**

Programming Menu

**Module Entry (SEL & RST Keys)**

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

**Module Menu (SEL Key)**

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

**Selection / Value Entry**

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

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

**Programming Mode Entry (SEL Key)**

It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the SEL key. If it is not accessible, then it is locked by either a security code, or a hardware lock (See Module 3).

**Module Entry (SEL & RST Keys)**

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

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**Programming Mode Exit (SEL Key)**

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

**Programming Tips**

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

**Factory Settings**

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

Pressing the RST key on power-up will load the factory settings and display rESe t. This allows operation in the event of a memory failure or corrupted data.

**Alternating Selection Display**

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter’s Factory Setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.
6.1 MODULE 1 - TIMER INPUT PARAMETERS (I- INPUT)

**PARAMETER MENU**

<table>
<thead>
<tr>
<th>I- INPUT</th>
<th>RANGE</th>
<th>INPUT OP</th>
<th>Filter</th>
<th>T- d r</th>
<th>T- St r</th>
<th>T- Slop</th>
<th>Flash</th>
<th>Run P- Up</th>
<th>Pst P- Up</th>
<th>User IP</th>
<th>User IN</th>
<th>User RN</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**TIMER RANGE**

18 TIMER RANGE SELECTIONS

(£ = SEC; H = MIN; D = DAY)

<table>
<thead>
<tr>
<th>RANGE SELECTION</th>
<th>MAXIMUM DISPLAY</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECONDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSSSSSS</td>
<td>9999999</td>
<td>1 SEC</td>
</tr>
<tr>
<td>SSSSSSS</td>
<td>9999999</td>
<td>0.1 SEC</td>
</tr>
<tr>
<td>SSSSSSS</td>
<td>9999999</td>
<td>0.01 SEC</td>
</tr>
<tr>
<td>SSSSSSS</td>
<td>9999999</td>
<td>0.001 SEC</td>
</tr>
<tr>
<td>MINUTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>1 MIN</td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>0.1 MIN</td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>0.01 MIN</td>
</tr>
<tr>
<td>HOURS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>1 HR</td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>0.1 HR</td>
</tr>
<tr>
<td>HHHHHH</td>
<td>9999999</td>
<td>0.01 HR</td>
</tr>
</tbody>
</table>

**TIMER INPUT OPERATION**

This parameter determines how the Timer Input Signals affect the Run/Stop status of the Timer. Timing diagrams are shown below for level active and edge triggered (1-input or 2-input) operation. For single input modes (Input A only), Input B provides a level active Timer Inhibit function. In the Display Hold mode, the timer display value remains held and only updates when a Timer Start (Input A) or Timer Stop (Input B) edge occurs.

The Timer can also be stopped at a Timer Stop Value or at Setpoint output activation or deactivation. This type of stop condition is cleared when a Timer Reset occurs, or another start edge is applied on the timer input.

For Reset Modes (rSt), the timer is reset at Time Start edge.

**TIMER INPUT FILTER**

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

**TIMING DIRECTION**

Bi-directional timing capability. Select the timing direction desired for the application.

**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. Select YES displays a sub-menu where the Stop Value is entered in the same display format as the Timer Range selected. This stop condition is cleared when a Timer Reset occurs or another start edge is applied on the timer input. Select NO if a Stop Value is not desired.

**FLASH TIMER ANNUNCIATOR**

Select YES to have the timer annunciator (I) flash when the timer is running.

**TIMER RUN STATE AT POWER-UP**

Determines the Run/Stop state of the Timer at Power-up. This parameter does not apply to LEVEL Input Operation.

SLOP - Timer Stopped at power-up, regardless of prior Run/Stop state
SAVE - Timer assumes the Run/Stop state it was in prior to power-down

For LEVEL Input Operation, select YES to have the timer display value (D) flash when the timer is running.

For Edge Triggered Operation (1-input) and Bi-directional Timing Mode (dn), select YES to have the timer annunciator (I) flash when the timer is running.

For Level Active (Gated) Operation and Bi-directional Timing Mode (dn), select YES to have the timer annunciator (I) flash when the timer is running.

For Hold Active (Level Active) and Bi-directional Timing Mode (dn), select YES to have the timer annunciator (I) flash when the timer is running.
The Timer can be programmed to Reset at each meter power-up.

**USER INPUT FUNCTION**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>No Function</td>
<td>User Input disabled.</td>
</tr>
<tr>
<td>Pro Loc</td>
<td>Program Mode Lock-out</td>
<td>See Programming Mode Access chart (Module 3).</td>
</tr>
<tr>
<td>d-SELECT</td>
<td>Display Select (Edge triggered)</td>
<td>Toggle display with each activation.</td>
</tr>
<tr>
<td>r-SELECT</td>
<td>Maintained Reset</td>
<td>Level active reset of the selected value(s).</td>
</tr>
<tr>
<td>d-HOLD</td>
<td>Display Hold</td>
<td>Freeze display for the selected value(s) while allowing time or counts to accumulate internally.</td>
</tr>
<tr>
<td>hOId d-rST</td>
<td>Hold and Reset</td>
<td>Edge triggered reset of the selected value(s) after storing the time or count.</td>
</tr>
</tbody>
</table>

**USER INPUT ASSIGNMENT**

The User Input Assignment only applies if the cycle counter is enabled and a selection of reset, display hold, hold and reset, inhibit, or print and reset is selected in the User Input Function menu.

**USER INPUT FUNCTION (Cont’d)**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Inhibit</td>
<td>Inhibit timing or counting for the selected value(s).</td>
</tr>
<tr>
<td>d-LEVEL</td>
<td>Display Intensity Level (Edge Triggered)</td>
<td>Increase intensity one level for each activation. (backlight version only)</td>
</tr>
<tr>
<td>Pr mAT</td>
<td>Print Request</td>
<td>Serial transmit of the active parameters selected in the Print Options menu (Module 5).</td>
</tr>
<tr>
<td>Prnt-rSt</td>
<td>Print and Reset</td>
<td>Same as Print Request followed by a momentary reset of the selected value(s).</td>
</tr>
<tr>
<td>rSt oUt</td>
<td>Reset Output</td>
<td>Edge triggered deactivation of the Setpoint Output.</td>
</tr>
</tbody>
</table>

**6.2 MODULE 2 - CYCLE COUNTER PARAMETERS (Count)**

**PARAMETER MENU**

- **Cycle Counter Enable**
  - When set to NO, the remaining Cycle Counter parameters are not accessible.

- **Cycle Counter Count Source**
  - This parameter selects the source from which the Cycle Counter derives counts. The Timer Reset (t-RESET) selection generates a count when either a manual or automatic timer reset occurs (See Module 4 for programming Automatic Reset). The Input B (t-INP) selection generates a count each time Input B is activated. This selection overrides the timer inhibit function of Input B, when the timer is programmed for Level or Edge-1 operating mode (See Module 1 for Timer Input Operating Modes).
  - The User Input (USr1NP) selection generates a count each time the User Input is activated. When selected as the count source, the User Input can still be set to perform a User Function described in Module 1. In this case, the Cycle Counter will count the number of times the selected User Function occurred. The Output ON/OFF selections generate a count when the Setpoint output either activates or deactivates. These selections will only generate counts when an optional Setpoint module is installed.

- **Cycle Counter Counting Direction**
  - Bi-directional counting capability. Select the counting direction desired for the application.

- **Cycle Counter Start Value**
  - The Cycle Counter returns to this value whenever a Counter Reset occurs. Non-zero values are normally used for “down counting” applications, but can also provide an offset value when counting up.

- **Cycle Counter Reset At Power-Up**
  - The Cycle Counter can be programmed to Reset at each meter power-up.
6.3 MODULE 3 - DISPLAY AND FRONT PANEL KEY PARAMETERS (3-dSPLAY)

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

<table>
<thead>
<tr>
<th>SEL Enb</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

The YES selection allows the SEL button to toggle between the timer and cycle counter displays.

**FRONT PANEL RESET ENABLE (RST)**

<table>
<thead>
<tr>
<th>Rst Enb</th>
<th>YES</th>
<th>NO</th>
<th>both</th>
<th>L-VALUE</th>
<th>E-VALUE</th>
</tr>
</thead>
</table>

The YES selection allows the RST button to reset the selected value(s). The shaded selections only appear if the cycle counter is enabled.

**DISPLAY SCROLL ENABLE**

<table>
<thead>
<tr>
<th>d-ScroLL</th>
<th>NO</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

The YES selection allows the display to automatically scroll between the timer and cycle counter values. The scroll rate is about every 4 seconds.

**DISPLAY COLOR (BACKLIGHT UNIT ONLY)**

<table>
<thead>
<tr>
<th>d-COLDr</th>
<th>rEd</th>
<th>Grn</th>
</tr>
</thead>
</table>

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

**DISPLAY INTENSITY LEVEL (BACKLIGHT UNIT ONLY)**

<table>
<thead>
<tr>
<th>d-LEVEL</th>
<th>1 to 5</th>
</tr>
</thead>
</table>

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**

<table>
<thead>
<tr>
<th>Pro Code</th>
<th>0 to 999</th>
</tr>
</thead>
</table>

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

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the Setpoint values and Timer Stop value to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the Pro Code prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the Pro Code prompt appears (see chart).

<table>
<thead>
<tr>
<th>USER INPUT FUNCTION</th>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN &quot;SEL&quot; KEY IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>not Pro Loc</td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
<td></td>
</tr>
<tr>
<td>1-99</td>
<td>Quick Programming</td>
<td>After Quick Programming with correct code entry at Pro Code prompt *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-999</td>
<td>Pro Code prompt</td>
<td>With correct code entry at Pro Code prompt *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pro Loc</td>
<td>Active</td>
<td>0</td>
<td>Programming Lock</td>
<td>No Access</td>
</tr>
<tr>
<td>1-99</td>
<td>Quick Programming</td>
<td>No Access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-999</td>
<td>Pro Code prompt</td>
<td>With correct code entry at Pro Code prompt *</td>
<td></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.

**LOAD FACTORY DEFAULT SETTINGS**

<table>
<thead>
<tr>
<th>FACE SEL</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
</table>

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

Pressing the RST key on power-up will load the factory settings and display rESet. This allows operation in the event of a memory failure or corrupted data.
### 6.4 Module 4 - Setpoint Output Parameters (4-SETPL)

The Setpoint Output Parameters are only active when the optional relay module is installed in the meter. Some parameters will not appear depending on the Setpoint Assignment and Setpoint Output Action selected.

#### Setpoint Assignment

**SPt ASN**

Select the display for Setpoint assignment.

**SPt VAL**

This parameter selects the action of the Setpoint output as shown below.

<table>
<thead>
<tr>
<th>SPt Action</th>
<th>Description</th>
<th>Output Activates</th>
<th>Output Deactivates</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATCH</td>
<td>Latched Output Mode</td>
<td>When Time or Count = Setpoint On value</td>
<td>At Manual Reset (if SPt ( \neq 0 ))</td>
</tr>
<tr>
<td>Time</td>
<td>Timed Output Mode</td>
<td>When Time or Count = Setpoint On value</td>
<td>After Setpoint Output Timeout</td>
</tr>
<tr>
<td>On-Off</td>
<td>On-Off Output Mode</td>
<td>When Time or Count = Setpoint On value</td>
<td>When Time or Count = Setpoint Off value</td>
</tr>
</tbody>
</table>

**Setpoint On**

This parameter determines when the Setpoint output will activate. The output can activate at a programmed Setpoint Value or can be set to activate when the Timer starts (\( \leq \text{Val} \)) or stops (\( \geq \text{Val} \)).

Selecting **VAL** displays a sub-menu where the Setpoint Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

**Setpoint Off**

The Setpoint Off parameter only appears if the Setpoint Action is set to On-Off Output mode (\( \text{On-Off} \)). In this mode, the Setpoint OFF parameter determines when the Setpoint Output will deactivate. The output can be programmed to deactivate at a Setpoint Off Value or can be set to deactivate when the Timer starts (\( \leq \text{Val} \)) or stops (\( \geq \text{Val} \)).

Selecting **VAL** displays a sub-menu where the Setpoint Off Value is entered. If the Setpoint is assigned to the Timer, the value is entered in the same display format as the selected Timer Range.

#### Setpoint Output Time-Out

**SPt EAVE**

This parameter is only active if the Setpoint Action is set to Timed Output mode (\( \text{t-Out} \)). Enter the time duration the Setpoint Output will remain ON once it is activated. This value is always entered in minutes, seconds, and hundredths of seconds format. The maximum value is 99 minutes 59.99 seconds.

#### Stop Timer

**STOP T**

Stops the Timer when the Setpoint output activates (\( \text{Out-Off} \)) or deactivates (\( \text{Out-On} \)). Select **NO** if the output should not affect the Timer Run/Stop status.

The Timer Stop condition is cleared when a Timer Reset occurs, or a Time Start edge is applied on the Timer input.

#### Timer/Counter Auto Reset

**AUTO CST**

Automatically resets the Setpoint Assigned display value when the Setpoint Output activates (\( \text{Out-On} \)) or deactivates (\( \text{Out-Off} \)). Select **NO** if the output should not cause a display reset.

#### Setpoint Output Reset With Display Reset

**SPt RSET**

Select **YES** to have the Setpoint Output deactivate (reset) when the Setpoint Assigned display resets. Reset can occur by the RST button or the User Input, if programmed for that function. Select **NO** if the Setpoint output should not reset when the display resets.

#### Change Display Color w/ Setpoint Output State

**Ch-COL**

This parameter enables the backlight CUBAST to switch the display color when the Setpoint output activates. When the output deactivates, the display color will revert to the normal operating mode color. This parameter is only active for the backlight version.

#### Setpoint Output Power-Up State

**SPt P-UP**

Select **ON** to power up the output at power up. **OFF** will deactivate the output at power up. This parameter is not active when the Setpoint Action is set to timed output mode.

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Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Module 5 is the programming module for the Serial Communications Parameters. These parameters are used to match the serial settings of the CUB5T with those of the host computer or other serial device. The Serial Setup Parameters are only accessible when an optional RS232 or RS485 serial communications module is installed in the meter.

This section replaces the bulletin shipped with the RS232 and RS485 serial communications plug-in cards. Discard the separate bulletin when using those serial plug-in cards with the CUB5T.

### BAUD RATE

![Baud Rate Menu]

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

### DATA BIT

![Data Bit Menu]

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

### PARITY BIT

![Parity Bit Menu]

This parameter only appears when the Data Bit parameter is set to a 7-bit data word length. Set the parity bit to match that of the other serial equipment on the serial link. The meter ignores parity when receiving data and sets the parity bit for outgoing data. If parity is set to 0, an additional stop bit is used to force the frame size to 10 bits.

### METER ADDRESS

![Meter Address]

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

### ABBREVIATED PRINTING

![Abbreviated Printing Menu]

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

### PRINT OPTIONS

![Print Options]

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

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

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

Note: Inactive parameters will not be sent regardless of the print option setting. For example, the Cycle Counter and Cycle Counter Start values will only be sent when the Cycle Counter is enabled. If disabled, these parameters are inactive and will not be transmitted. Likewise, the Setpoint parameters will not be sent unless an optional setpoint card is installed in the meter.
Sending Serial Commands and Data
When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character, * or $.

Command Chart

<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 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 a 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 a register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a value or the output. Must be followed by a register ID character</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers in the print block are selected in Print Options.</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 all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See timing diagram figure for differences in meter response time when using the * and $ terminating characters.

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

Full Field Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>2 byte Node address [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; 9 bytes for number and three bytes 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 meter address. If the address assigned is 0, two spaces are substituted. A space follows the meter address field. The next three characters are the register mnemonic, as shown in the Register Identification Chart.

The numeric data is transmitted next. The numeric field (bytes 7 to 18) is 12 characters long. When a display overflow exists for a requested timer or cycle counter value, an * (used as an overflow character) replaces a space in byte 7. Byte 8 is always a space.

The remaining ten positions of this field consist of seven positions for the requested value with decimal points positioned for the selected timer range. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

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

Abbreviated Transmission

<table>
<thead>
<tr>
<th>Byte</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>12 byte data field, 9 bytes for number and three 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 node address and register mnemonic, leaving only the numeric part of the response.

Meter Response Examples:
1. Node address = 17, full field response, Cycle Counter = 875
   17 CNT
   875 <CR><LF>
2. Node address = 0, full field response, Setpoint On value = 250.5
   SPT
   250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint On value= 250, last line of block print
   250<CR><LF><SP><CR><LF>
**Command Response Time**

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

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

$$t_1 = \frac{10 \times \text{# of characters}}{\text{baud rate}}$$

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

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

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

At the beginning of time interval $t_4$, the meter responds with the first character of the reply. As with $t_1$, the time duration of $t_4$ is dependent on the number of characters and baud rate of the channel. At the end of $t_4$, the meter is ready to receive the next command.

At the start of time interval $t_5$, the meter starts the interpretation of the command and when complete, performs the command function. This time interval $t_5$ varies. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval $t_5$ is controlled by the use of the command terminating character. The ‘*’ terminating character results in a response time of 50 msec. minimum. This allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with ‘$’ results in a response time ($t_5$) of 2 msec. minimum. The faster response time of this terminating character requires that sending drivers release within 2 msec. after the terminating character is received.

---

**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 $\infty$). 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 CUB5T meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

**Stop Bit**

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

- RATE INDICATION
- 6-DIGIT, 0.56" (14.2 mm) HIGH LED DISPLAYS
- INPUT RATES UP TO 25 KHZ
- ACCEPTS A WIDE VARIETY OF SENSORS
- PROGRAMMABLE SCALING
- PROGRAMMABLE UPDATE TIME
- PROGRAMMABLE DECIMAL POINTS
- NEMA 4X/IP65 SEALED FRONT BEZEL

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 2.11” (53.4) H x 5” (127) W.
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## 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.
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 $V_{IL} = 1.5$ V max.; $V_{IH} = 3.75$ V min. 
   - Current Sinking: Internal 7.8 KΩ pull-up to +12 VDC, $I_{MAX} = 1.9$ mA
   - Current Sourcing: Internal 3.9 KΩ pull-down, 8 mA max. @ 30 VDC max.
   - MAGNETIC PICK-UP:
     - Sensitivity: 200 mV peak
     - Hysteresis: 100 mV
     - Input impedance: 3.9KΩ @ 60 Hz
   - Maximum input voltage: ±40 V peak, 30 Vrms
6. INPUT FREQUENCY RANGE:
   - Max Frequency: 25 KHz
   - Min Frequency: 0.01 Hz
   - Accuracy: ±0.01%
7. MEMORY: Nonvolatile 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
   - ELECTROMAGNETIC COMPATIBILITY
     - Emissions: EN 55011
     - 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
       - Voltage dip/interruptions: EN 61000-4-11, Criterion A
   - Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.
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.
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 panel 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.

Set-Up DIP Switches

A DIP switch is located at the rear of the meter, and is fully accessible when the unit is in the case. It is used for the selection of the input parameters and program disable.

### SWITCH 1

**SNK:** Adds internal 7.8 KΩ pull-up resistor to + 12 VDC, \( I_{\text{MAX}} = 1.9 \text{ mA} \).

**SRC:** Adds internal 3.9 KΩ pull-down resistor, 8 mA max. @ 30 VDC max.

### SWITCH 2

**Factory Setting**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SNK</td>
<td>Pull-up</td>
</tr>
<tr>
<td>2</td>
<td>SRC</td>
<td>Pull-down</td>
</tr>
<tr>
<td>3</td>
<td>LO Freq.</td>
<td>LO Freq.</td>
</tr>
<tr>
<td>4</td>
<td>MAG</td>
<td>MAG</td>
</tr>
<tr>
<td>5</td>
<td>LOGIC</td>
<td>LOGIC</td>
</tr>
<tr>
<td>6</td>
<td>EN PGM</td>
<td>EN PGM</td>
</tr>
<tr>
<td>7</td>
<td>DIS PGM</td>
<td>DIS PGM</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 the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

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

**EMC INSTALLATION GUIDELINES**

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

1. The meter should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the meter and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:
   - Ferrite Suppression Cores for signal and control cables:
     - Fair-Rite # 0443167251 (RLC# FCOR0000)
     - TDK # ZCAT3035-1330A
     - Steward # 28B2029-0A0
   - Line Filters for input power cables:
     - Schaffner # FN610-1/07 (RLC# LFIL0000)
     - Schaffner # FN670-1/8.07
     - Corcom # 1 VR3
   - Note: Reference manufacturer’s instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI. Snubber: RLC# SNUB0000.
3.1 POWER WIRING

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

DC Power
- Terminal 3: +VDC
- Terminal 4: COMM

3.2 INPUT WIRING

- **Magnetic Pickup**

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

- **Two Wire Proximity, Current Source**

- **Current Sinking Output**

- **Current Sourcing Output**

- **Interfacing With TTL**

- **Emitter Follower; Current Source**

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

5.0 SCALING THE METER

RATE SCALING
To scale the Rate, enter a Scaling Display value with a corresponding Scaling Input value. These values are internally plotted to a Display value of 0 and Input value of 0 Hz. A linear relationship is formed between these points to yield a rate display value that corresponds to the incoming input signal rate. The location of the scaling point should be near the process end limit for the best possible accuracy. The PAXLR is capable of showing a rate display value for any linear process.

SCALING CALCULATION
If a display value versus input signal (in pulses per second) is known, then those values can be entered into Scaling Display (SUE41) and Scaling Input (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 (rt - d5P)</th>
<th>INPUT (rt - 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 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 “OL OL OL” to indicate an overflow condition.

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

The Rate Indicator has five programmable parameters which are entered in the sequence shown above, using the front panel push buttons.

Before programming, refer to the section on Scaling the Meter to determine the Rate Scaling Display Value and Rate Scaling Input Value to use for the specific application.

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

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

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

DECIMAL POSITION

Enter the desired Rate Display value to be shown for the corresponding Rate Input value entered below. 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 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 ESE 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 PAX - 1/8 DIN DIGITAL INPUT PANEL METERS

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

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

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

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

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

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

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

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

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

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

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

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

CAUTION: Risk of electric shock.

DIMENSIONS In inches (mm)

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

Meter Part Numbers

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>PAX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>Counter/Dual Counter</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Rate Meter</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Counter/Dual Counter/Rate Meter/Slave Display</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Red, Sunlight Readable Display</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Green Display</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0 - 85 to 250 VAC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1 - 11 to 36 VDC, 24 VAC</td>
<td></td>
</tr>
</tbody>
</table>

### Option Card and Accessories Part Numbers

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

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

Shaded areas are only available for the PAXI!
GENERAL METER SPECIFICATIONS

1. DISPLAY: 6 digit, 0.56” (14.2 mm) red sunlight readable or standard green LED

2. POWER:
   AC Versions:
   AC Power: 85 to 250 VAC, 50/60 Hz, 18 VA
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs. (300 V working)
   DC Versions:
   DC Power: 11 to 36 VDC, 14 W
   (derate operating temperature to 40°C if operating <15 VDC and three plug-in option cards are installed)
   AC Power: 24 VAC, ± 10%, 50/60 Hz, 15 VA
   Isolation: 500 Vrms for 1 min. to all inputs and outputs (50 V working).

3. SENSOR POWER:
   12 VDC, ±10%, 100 mA max. Short circuit protected

4. KEYPAD: 3 programmable function keys, 5 keys total

5. USER INPUTS: Three programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Commons: Not isolated
   Logic State: Jumper selectable for sink/source logic
   Response Time: 6 msec. typical; function dependent. Certain resets, stores and inhibits respond within 25 µsec if an edge occurs with the associated counter or within 6 msec if no count edge occurs with the associated counter. These functions include \( \text{I>}_{\text{SL, SI}}, \text{I>}_{\text{ST, ST}}, \text{I+}_{\text{SL, SI}}, \text{I+}_{\text{ST, ST}}, \text{I>}_{\text{I>}}, \text{S}_{\text{I>}}, \text{I+}_{\text{I+}}, \text{S}_{\text{I+}} \). 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
   - 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

   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.

<table>
<thead>
<tr>
<th>Function Questions</th>
<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>
<td>N</td>
</tr>
<tr>
<td>Is Counter C used?</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

### Count Mode:
- **Count x1**: 34
- **Count x2**: 17, 13, 9
- **Quadrature x1**: 22, 19, 12, 10
- **Quadrature x2**: 17, 13, 9
- **Quadrature x4**: 8, 6, 4

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

## Model PAXR - 1/8 DIN Rate Meter

### PAXR Specifications

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

#### Rate Display:
- Accuracy: ±0.01%
- Minimum Frequency: 0.01 Hz
- Maximum Frequency: 34 KHz
- Maximum Display: 5 Digits: 99999
- Adjustable Display (low) Update: 0.1 to 99.9 seconds
- Over Range Display: **S 0-0-**

## 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 KΩ pull-up to +12 VDC, $I_{MAX} = 1.9 \text{ mA.}$
- Current sourcing: Internal 3.9 KΩ 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.

## 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.

#### Functions:
- **5-Digit LED Display**
- **Rate Indication**
- **Minimum/Maximum Rate Displays**
- **Setpoint Alarm Outputs** (W/Plug-in card)

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

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Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
**PA XI SPECIFICATIONS**

**MAXIMUM SIGNAL FREQUENCIES TABLE**

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

<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COUNTER MODE</th>
<th>(Values are in KHz)</th>
<th>(Values are in KHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count x1</td>
<td>34 25 21 17</td>
<td>18 15 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>12 10 11 10</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>
</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.)

**ANNUNCIATORS:**

- A - Counter A
- B - Counter B
- C - Counter C
- r - Rate
- H - Maximum (High) Rate
- L - Minimum (Low) Rate
- DF - 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.
- Adjustable Display (low) Update: 0.1 to 99.9 seconds
- Over Range Display: “r DF 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 KΩ pull-up to +12 VDC, $I_{MAX} = 1.9 \text{ mA}$
- Current sourcing: Internal 3.9 KΩ 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 KΩ @ 60 Hz

**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: $I_{SNK} = 100 \text{ mA max. @ } V_{OE} = 1 \text{ VDC max.}$ $V_{OH} = 30 \text{ VDC max.}$ With duty cycle of 25% min. and 50% max.
Optional Plug-in Output Cards

Warning: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards
The PAX and MPAX series meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at one time.

The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

PAXI Communication Cards (PAXCDC)
A variety of communication protocols are available for the PAX and MPAX series. Only one of these cards can be installed at a time. When programming the unit via Crimson, a Windows® based program, the RS232 or RS485 Cards must be used.

- PAXCDC10 - RS485 Serial (Terminal)
- PAXCDC30 - DeviceNet
- PAXCDC1C - RS485 Serial (Connector)
- PAXCDC40 - Modbus (Terminal)
- PAXCDC20 - RS232 Serial (Terminal)
- PAXCDC4C - Modbus (Connector)
- PAXCDC2C - RS232 Serial (Connector)
- PAXCDC50 - Profibus-DP

Serial Communications Card
- Type: RS485 or RS232
- Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
  - Working Voltage: 50 V. Not isolated from all other commons.
- Data: 7/8 bits
- Baud: 300 to 19,200
- Parity: no, odd or even
- Bus Address: Selectable 0 to 99, Max. 32 meters per line (RS485)
- Transmit Delay: Selectable for 2 to 50 msec or 50 to 100 msec (RS485)

DeviceNet™ Card
- Compatibility: Group 2 Server Only, not UCMM capable
- Baud Rates: 12.5 kbaud, 250 kbaud, and 500 kbaud
- Bus Interface: Phillips K2C250 or equivalent with MIS wiring 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 ASCII
- 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.

Programmable 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 µsec; 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 NPN transistors.
- Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
  - Working Voltage: 50 V. Not isolated from all other commons.
- Rating:
  - Internal supply: 24 VDC ± 10%, 30 mA max. total
  - External supply: 30 VDC max., 100 mA max. each output
- Response Time: Counter = 25 µsec; Rate = Low Update time
- 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.

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.
- 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 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 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.

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

2.2 Setting the Input DIP Switches

The meter has six DIP switches for Input A and Input B terminal set-up that must be set before applying power. NOTE: The PAXR only uses switches 1-3.

Switches 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, VMAX = 30 VDC.
SNK: Adds internal 7.8 KΩ pull-up resistor to +12 VDC, IMAX = 1.9 mA.

Switches 1 and 4
LOGIC: Input trigger levels VIH = 1.5 V max.; VIL = 3.75 V min.
MAG: 200 mV peak input (must also have SRC on). Not recommended with counting applications.
3.0 Installing Plug-In Cards

The Plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The Plug-in cards have many unique functions when used with the PAX. The literature that comes with these cards should be discarded, unless it specifically states in the Plug-in Card literature that the information applies to the PAX. Note: The PAXC and PAXR only use the setpoint option card.

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

To Install:

1. With the case open, locate the Plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.*

2. Install the Plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the Plug-in card rests in the alignment slot on the display board.

3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.

4. Apply the Plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

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 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.

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.
4.3 INPUT WIRING

**CAUTION:** Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltage; or input common must be at protective earth ground potential. If not, hazardous voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth ground; and the common of the isolated plug-in cards with respect to input common.

If you are wiring Input B, connect signal to Terminal 6 instead of 5, and set DIP switches 4, 5, and 6 to the positions shown for 1, 2, and 3.

Switch position is application dependent.

Shaded areas not recommended for counting applications.

4.4 SETPOINT (ALARMS) WIRING

**SETPOINT PLUG-IN CARD TERMINALS**

**DUAL RELAY PAXCDS10**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>COMMON</td>
</tr>
<tr>
<td>21</td>
<td>RLY1</td>
</tr>
<tr>
<td>22</td>
<td>RLY2</td>
</tr>
<tr>
<td>23</td>
<td>RLY3</td>
</tr>
<tr>
<td>24</td>
<td>RLY4</td>
</tr>
<tr>
<td>25</td>
<td>COMMON</td>
</tr>
</tbody>
</table>

**QUAD RELAY PAXCDS20**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>COMMON</td>
</tr>
<tr>
<td>21</td>
<td>RLY1</td>
</tr>
<tr>
<td>22</td>
<td>RLY2</td>
</tr>
<tr>
<td>23</td>
<td>RLY3</td>
</tr>
<tr>
<td>24</td>
<td>RLY4</td>
</tr>
</tbody>
</table>

**QUAD SINKING PAXCDS30**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>COMMON</td>
</tr>
<tr>
<td>21</td>
<td>O1 SNK.</td>
</tr>
<tr>
<td>22</td>
<td>O2 SNK.</td>
</tr>
<tr>
<td>23</td>
<td>O3 SNK.</td>
</tr>
<tr>
<td>24</td>
<td>O4 SNK.</td>
</tr>
<tr>
<td>25</td>
<td>COMMON</td>
</tr>
</tbody>
</table>

**QUAD SOURCING PAXCDS40**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>COMMON</td>
</tr>
<tr>
<td>21</td>
<td>O1 SRC.</td>
</tr>
<tr>
<td>22</td>
<td>O2 SRC.</td>
</tr>
<tr>
<td>23</td>
<td>O3 SRC.</td>
</tr>
<tr>
<td>24</td>
<td>O4 SRC.</td>
</tr>
<tr>
<td>25</td>
<td>COMMON</td>
</tr>
</tbody>
</table>

**SOURCING OUTPUT LOGIC CARD**

**SINKING OUTPUT LOGIC CARD**
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.

4.5 PAXI SERIAL COMMUNICATION WIRING

4.6 PAXI ANALOG OUTPUT WIRING

ANALOG OPTION CARD FIELD TERMINALS

- 0–10V ANALOG OUTPUT
  - 16 + 17 -
- 0–20mA ANALOG OUTPUT
  - 18 + 19 -

4.7 PAXI PRESCALER OUTPUT WIRING

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

Counter Readout Legends*

<table>
<thead>
<tr>
<th>KEY</th>
<th>DISPLAY MODE OPERATION</th>
<th>PROGRAMMING MODE OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSP</td>
<td>Index display through the selected displays.</td>
<td>Quit programming and return to Display Mode</td>
</tr>
<tr>
<td>PAR</td>
<td>Access Programming Mode</td>
<td>Store selected parameter and index to next parameter</td>
</tr>
<tr>
<td>F1♀</td>
<td>Function key 1; hold for 3 seconds for Second Function 1 **</td>
<td>Increment selected parameter value or selections</td>
</tr>
<tr>
<td>F2♀</td>
<td>Function key 2; hold for 3 seconds for Second Function 2 **</td>
<td>Decrement selected parameter value or selections</td>
</tr>
<tr>
<td>RST</td>
<td>Reset (Function key) ***</td>
<td>Advances digit location in parameter values</td>
</tr>
</tbody>
</table>

* 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 dSP-F2 (Reset Display).
6.0 Programming the Meter

OVERVIEW

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 (F1S and F2T) 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 (F1S and F2T) are used to move through the selections/values for that parameter. Pressing the PAR key, stores and activates the displayed selection/value. This also advances the meter to the next parameter.

For numeric values, the RST key may be used to select a specific digit to be changed. Once a digit is selected, the arrow keys are used to increment or decrement that digit to the desired number.

PROGRAMMING MODE EXIT (DSP KEY or at 1SP /0 PAR KEY)
The Programming Mode is exited by pressing the DSP key (from anywhere in the Programming Mode) or the PAR key (with 1SP /0 displayed). This will commit any stored parameter changes to memory and return the meter to the Display Mode. If a parameter was just changed, the PAR key should be pressed to store the change before pressing the DSP key. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)

PROGRAMMING TIPS
It is recommended to start with Module 1 for counting and Module 4 for rate. If lost or confused while programming, press the DSP key and start over. When programming is complete, it is recommended to record the parameter programming on the Parameter User Chart and lock out parameter programming with a user input or lock-out code.

FACTORY SETTINGS
Factory Settings may be completely restored in Module 9. This is a good starting point for programming problems. Most parameters can be left at their Factory Settings without affecting basic start-up. These parameters are identified throughout the module explanations.

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

6.1 Module 1 - Count A & B Input Parameters (1-1NP)

Module 1 is the programming for Counter A, Counter B and the Prescaler Output. Counter B parameters follow the Prescaler parameters. For maximum input frequency, the counters should be set to mode NONE and the Prescaler to NO when they are not in use. When set to NONE or NO, the remaining related parameters are not accessible. A corresponding annunciator indicates the counter being shown in the Display Mode. An Exchange Parameter Lists feature for scale factors and count load values is explained in Module 2.
COUNTER A OPERATING MODE

- **SELECT**
  - **CNT**: Count X1
  - **cntud**: Count X1 w/direction
  - **dctud**: Count X2 w/direction
  - **qAd1**: Quad X1
  - **qAd2**: Quad X2
  - **qAd4**: Quad X4
  - **dquAd1**: Quad X1
  - **dquAd2**: Quad X2
  - **cnt**: Does not count.
  - **cnt0d**: Count X1
  - **dct0d**: Count X2

Select the operating mode for Counter A.

### MODE

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>Count X1</td>
</tr>
<tr>
<td>cntud</td>
<td>Count X1 w/direction</td>
</tr>
<tr>
<td>dctud</td>
<td>Count X2 w/direction</td>
</tr>
<tr>
<td>qAd1</td>
<td>Quad X1</td>
</tr>
<tr>
<td>qAd2</td>
<td>Quad X2</td>
</tr>
<tr>
<td>qAd4</td>
<td>Quad X4</td>
</tr>
<tr>
<td>dquAd1</td>
<td>Quad X1</td>
</tr>
<tr>
<td>dquAd2</td>
<td>Quad X2</td>
</tr>
<tr>
<td>cnt</td>
<td>None</td>
</tr>
<tr>
<td>cnt0d</td>
<td>Count X1</td>
</tr>
<tr>
<td>dct0d</td>
<td>Count X2</td>
</tr>
</tbody>
</table>

### DESCRIPTION

- **CNT**: Adds Input A falling edge.
- **cntud**: Adds Input A falling edge if Input B is high. Subtracts Input A falling edge if Input B is low.
- **dctud**: Adds Input A rising edge when Input A is high. Subtracts Input A rising edge when Input A is low.
- **qAd1**: Adds Input A rising edge when Input B is high. Subtracts Input A rising edge when Input B is low.
- **qAd2**: Adds Input A rising edge when Input B is high and Input A falling edge when Input B is low. Subtracts Input A falling edge when Input B is high and Input A rising edge when Input B is low.
- **qAd4**: 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. Subtracts Input A falling edge when Input B is high, Input A rising edge when Input B is low, Input B rising edge when Input A is high, and Input B falling edge when Input A is low.
- **dquAd1**: Adds Input A rising edge when User 1 is high. Subtracts Input A falling edge when User 1 is high.
- **dquAd2**: Adds Input A rising edge when User 1 is high and Input A falling edge when User 1 is low. Subtracts Input A falling edge when User 1 is high and Input A rising edge when User 1 is low.
- **cnt2**: Adds Input A rising and falling edges.
- **cntud2**: Adds Input A rising and falling edges if Input B is high. Subtracts Input A rising and falling edges if Input B is low.
- **dctud2**: Adds Input A rising and falling edges if User 1 is high. Subtracts Input A rising and falling edges if User 1 is low.

COUNTER A 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 only the scale factor affecting the display. (Details on scaling calculations are explained at the end of this section.)

COUNTER A COUNT LOAD VALUE *

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

COUNTER A RESET POWER-UP *

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

COUNTER A DEcimal POSITION *

This selects the decimal point position for Counter A and any setpoint value assigned to Counter A. The selection will also affect Counter A scale factor calculations.

COUNTER A SCALE FACTOR *

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.)

* Factory Setting can be used without affecting basic start-up.
## COUNTER B OPERATING MODE

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>cnt</td>
<td>Count X1</td>
</tr>
<tr>
<td></td>
<td>cntw</td>
<td>Count X1 w/direction</td>
</tr>
<tr>
<td></td>
<td>dqud</td>
<td>Quad X1</td>
</tr>
<tr>
<td></td>
<td>dqkd</td>
<td>Quad X2</td>
</tr>
<tr>
<td></td>
<td>c2</td>
<td>Count X2</td>
</tr>
<tr>
<td></td>
<td>dctu</td>
<td>Count X2 w/direction</td>
</tr>
</tbody>
</table>

Select the operating mode for Counter B.

## COUNTER B 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. (Details on scaling calculations are explained at the end of this section.)

### General Rules on Scaling
1. It is recommended that, the scale factor be as close as possible to, but not exceeding 1.00000. This can be accomplished by increasing or decreasing the counter decimal point position, using the scale multiplier, or selecting a different count mode.
2. To double the number of pulses per unit, use counter modes direction X2 or quad X2. To increase it by four times, use counter mode quad X4. Using these modes will decrease the maximum input frequency.
3. A scale factor greater than 1.00000 will cause Counter display rounding. In this case, digit jumps could be caused by the internal count register rounding with “DF” in the display. If the display exceeds ±99999999 the display will rollover 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-ENk), scale factor (xSEFAC), scale multiplier (xSEFAC1) and decimal point (xSEFAC2). The scale factor is calculated using:

\[
 SF (xSEFAC) = \frac{\text{Desired Display Decimal DDD}}{\text{(Number of pulses per 'single' unit x CM x SM)}}
\]

Where:
- Desired Display Decimal DDD
- Number of pulses per 'single' unit
- CM: Counter Mode (x-ENk) times factor of the mode 1.2 or 4.
- SM: Scale Multiplier (xSEFAC1) selection of 1, 0.1 or 0.01.

### Example:
1. Show feet to the hundredths (0.00) with 100 pulses per foot:
   Scale Factor would be 100 / (100 x 1 x 1) = 1
   (In this case, the scale multiplier and counter mode factor are 1)
2. Show feet with 120 pulses per foot: Scale Factor would be 1 / (120 x 1 x 1) = 0.0083333.
   (In this case, the scale multiplier of 0.01 could be used: 1 / (120 x 1 x 0.01) = 0.83333) or show to tenths (0.00): 100 / (120 x 1 x 1) = 0.83333.

## COUNTER B 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 only the scale factor affecting the display. (Details on scaling calculations are explained at the end of this section.)

## COUNTER B COUNT LOAD VALUE *

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

## COUNTER B RESET POWER-UP *

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

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

## COUNTER B SCALE MULTIPLIER *

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 tenths (0.00): 100 / (120 x 1 x 1) = 0.83333.

### General Rules on Scaling
1. It is recommended that, the scale factor be as close as possible to, but not exceeding 1.00000. This can be accomplished by increasing or decreasing the counter decimal point position, using the scale multiplier, or selecting a different count mode.
2. To double the number of pulses per unit, use counter modes direction X2 or quad X2. To increase it by four times, use counter mode quad X4. Using these modes will decrease the maximum input frequency.
3. A scale factor greater than 1.00000 will cause Counter display rounding. In this case, digit jumps could be caused by the internal count register rounding the display. The precision of a counter application cannot be improved by using a scale factor greater than 1.00000.
4. The number of pulses per single unit must be greater than or equal to the process (i.e. # of pulses per foot) divided by the desired display decimal point position. This is accomplished by the counter mode (x-ENk), scale factor (xSEFAC), scale multiplier (xSEFAC1) and decimal point (xSEFAC2). The scale factor is calculated using:

\[
 SF (xSEFAC) = \frac{\text{Desired Display Decimal DDD}}{\text{(Number of pulses per 'single' unit x CM x SM)}}
\]

Where:
- Desired Display Decimal DDD
- Number of pulses per 'single' unit
- CM: Counter Mode (x-ENk) times factor of the mode 1.2 or 4.
- SM: Scale Multiplier (xSEFAC1) selection of 1, 0.1 or 0.01.

### Example:
1. Show feet to the hundredths (0.00) with 100 pulses per foot:
   Scale Factor would be 100 / (100 x 1 x 1) = 1
   (In this case, the scale multiplier and counter mode factor are 1)
2. Show feet with 120 pulses per foot: Scale Factor would be 1 / (120 x 1 x 1) = 0.0083333.
   (In this case, the scale multiplier of 0.01 could be used: 1 / (120 x 1 x 0.01) = 0.83333) or show to tenths (0.00): 100 / (120 x 1 x 1) = 0.83333.

## COUNTER B DECIMAL POSITION

This selects the decimal point position for Counter B and any setpoint value assigned to Counter B. The selection will also affect Counter B scale factor calculations.

## COUNTER B RESET ACTION

When Counter B is reset, it returns to zero or Counter B count load value. This reset action affects all Counter B resets, except the Setpoint Counter Auto Reset Action in Module 6.

## 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 “DF” in the display. If the display exceeds ±99999999 the display will rollover 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.

### 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 “DF” in the display. If the display exceeds ±99999999 the display will rollover 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.

## COUNTER B OPERATING MODE

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>cnt</td>
<td>Count X1</td>
</tr>
<tr>
<td></td>
<td>cntw</td>
<td>Count X1 w/direction</td>
</tr>
<tr>
<td></td>
<td>dqud</td>
<td>Quad X1</td>
</tr>
<tr>
<td></td>
<td>dqkd</td>
<td>Quad X2</td>
</tr>
<tr>
<td></td>
<td>c2</td>
<td>Count X2</td>
</tr>
<tr>
<td></td>
<td>dctu</td>
<td>Count X2 w/direction</td>
</tr>
</tbody>
</table>

Select the operating mode for Counter B.

## COUNTER B 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 only the scale factor affecting the display. (Details on scaling calculations are explained at the end of this section.)

## COUNTER B COUNT LOAD VALUE *

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 key. The function will only be performed for the parameters entered as YES. If a user input or function key is configured for a function with a sublist, then that sublist will need to be scrolled through each time to access the following user inputs or function keys parameters.

**NO FUNCTION**

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.

Two lists of values are available for SP - 1, SP - 2, SP - 3, SP - 4, MSCFAC, MSFAC, ECFAC, RCCFAC, RCFFAC, RCCFFAC, RCCFFAC, ECFAC. If any other parameters are changed then the other list values must be reprogrammed.

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.

**EXCHANGE PARAMETER LISTS**

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 mosec.), 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**

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 mosec.), 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.

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>R CNF</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>B CNF</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>C CNF</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>H I</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>L D</td>
<td>Minimum</td>
<td>NO</td>
</tr>
</tbody>
</table>
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 CNt</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CNt</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>C CNt</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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 CNt</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CNt</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>C CNt</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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 CNt</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CNt</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>C CNt</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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 CNt</td>
<td>Counter A</td>
<td>NO</td>
</tr>
<tr>
<td>b CNt</td>
<td>Counter B</td>
<td>NO</td>
</tr>
<tr>
<td>C CNt</td>
<td>Counter C</td>
<td>NO</td>
</tr>
<tr>
<td>HI</td>
<td>Maximum</td>
<td>NO</td>
</tr>
<tr>
<td>LO</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-&7) parameter also appears whenever Quick Programming Mode is enabled, and the security code is greater than zero.

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

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

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 000. 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.

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

**PAXI: RATE ASSIGNMENT**

For measuring the rate (speed) of pulses on Input A, select r LE A. For Input B select r LE b. This assignment is independent of the counting modes.

**LOW UPDATE TIME (DISPLAY UPDATE)**

The Low Update Time is the minimum amount of time between display updates for the Rate display. Values of 0.1 and 0.2 seconds will update the display correctly but may cause the display to appear unsteady. The factory setting of 1.0 will update the display every second minimum.

**HIGH UPDATE TIME (DISPLAY ZERO)**

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

**RATE DECIMAL POSITION**

This selects the decimal point position for Rate, Minimum and Maximum rate displays and any setpoint value assigned to these displays. This parameter does not affect rate scaling calculations.

**PAXI: LINEARIZER SEGMENTS**

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 S 65: 0 (factory setting). For non-zero based 2 scaling point application, set S 65: 1, to enter both the zero segment (r IMP 0 & r dSP 0) and segment 1 (r IMP 1 & r dSP 1).

**Non-linear Application – Up to 10 Scaling Points**

Non-linear processes may utilize up to nine segments (ten scaling points) to provide a piece-wise linear approximation representing the non-linear function. The Rate display will be linear throughout each individual segment (i.e. between sequential scaling points). Thus, the greater the number of segments, the greater the conformity accuracy. Several linearization equations are available in the SPPAX software.

**About Scaling Points**

Each Scaling Point is specified by two programmable parameters: A desired Rate Display Value (r dSP) 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 S 65: 0, automatically factory sets the first scaling point to 0.0 for typical single segment, zero based applications. When multiple segments are used, the upper scaling point for a given segment becomes the lower scaling point for the next sequential segment. Thus, for each additional segment used, only one additional scaling point must be programmed.

The following chart shows the Scaling Points, the corresponding Parameter mnemonics, and the Factory Default Settings for each point.

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>SCALING POINT</th>
<th>DISPLAY PARAMETER</th>
<th>INPUT PARAMETER</th>
<th>INPUT DEFAULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>r dSP 0</td>
<td>000000</td>
<td>r IMP 0</td>
<td>000000</td>
</tr>
<tr>
<td>1</td>
<td>r dSP 1</td>
<td>001000</td>
<td>r IMP 1</td>
<td>010000</td>
</tr>
<tr>
<td>2</td>
<td>r dSP 2</td>
<td>002000</td>
<td>r IMP 2</td>
<td>020000</td>
</tr>
<tr>
<td>3</td>
<td>r dSP 3</td>
<td>003000</td>
<td>r IMP 3</td>
<td>030000</td>
</tr>
<tr>
<td>4</td>
<td>r dSP 4</td>
<td>004000</td>
<td>r IMP 4</td>
<td>040000</td>
</tr>
<tr>
<td>5</td>
<td>r dSP 5</td>
<td>005000</td>
<td>r IMP 5</td>
<td>050000</td>
</tr>
<tr>
<td>6</td>
<td>r dSP 6</td>
<td>006000</td>
<td>r IMP 6</td>
<td>060000</td>
</tr>
<tr>
<td>7</td>
<td>r dSP 7</td>
<td>007000</td>
<td>r IMP 7</td>
<td>070000</td>
</tr>
<tr>
<td>8</td>
<td>r dSP 8</td>
<td>008000</td>
<td>r IMP 8</td>
<td>080000</td>
</tr>
<tr>
<td>9</td>
<td>r dSP 9</td>
<td>009000</td>
<td>r IMP 9</td>
<td>090000</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 S 65: 0. (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 (r dSP 0 & 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 S 65: 0.

**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

![Input Value](image)

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 (\(r_{DSP}\)) 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 \(\pm 0.1\%\) of the previous entered value.) Press PAR to enter the displayed frequency as the Rate Input value. To prevent the displayed value from being entered, press DSP. This will take the meter out of Programming Mode and the previous Rate Input value will remain.

**RATE DISPLAY ROUND**

![Round](image)

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**

![Locue](image)

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

**MAXIMUM CAPTURE DELAY TIME**

![Max](image)

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**

![Min](image)

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 “\(\text{RQLD}\)”. 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 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 (\(r_{DSP}\)) 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 ((r_{DSP}))</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 Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of \(\#\) of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
4. Both values must be greater than 0.0.

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

**INPUT FREQUENCY CALCULATION**

The meter determines the input frequency by summing the number of falling edges received during a sample period of time. The sample period begins on the first falling edge. At this falling edge, the meter starts accumulating time towards Low Update and High Update values. Also, the meter starts accumulating the number of falling edges. When the time reaches the Low Update Time value, the meter looks for one more falling edge to end the sample period. If a falling edge occurs (before the High Update Time value is reached), the Rate display will update to the new value and the next sample period will start on the same edge. If the High Update Time value is reached (without receiving a falling edge after reaching Low Update Time), then the sample period will end but the Rate display will be forced to zero. The High Update Time value must be greater than the Low Update Time value. Both values must be greater than 0.0. The input frequency calculated during the sample period, is then shown as a Rate value determined by either scaling method.
### Module 5 - Counter C Input Parameters

#### Parameter Menu

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAR</td>
<td>Parameter</td>
</tr>
<tr>
<td>C CNT</td>
<td>Counter C Operating Mode</td>
</tr>
<tr>
<td>C RES</td>
<td>Counter C Reset Action</td>
</tr>
<tr>
<td>C DEC</td>
<td>Counter C Decimal Position</td>
</tr>
<tr>
<td>C SCF</td>
<td>Counter C Scale Factor</td>
</tr>
<tr>
<td>C SCALE</td>
<td>Counter C Scale Multiplier</td>
</tr>
<tr>
<td>C CNTLD</td>
<td>Counter C Count Load Value</td>
</tr>
<tr>
<td>C P-UP</td>
<td>Counter C Reset at Power-up</td>
</tr>
</tbody>
</table>

#### Counter C Operating Mode *

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
<td>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.</td>
</tr>
<tr>
<td>Sub Ab</td>
<td>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.)</td>
</tr>
<tr>
<td>Add Ab</td>
<td>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.)</td>
</tr>
</tbody>
</table>

**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 Reset Action

- **Zero**: Counter C is reset to zero.
- **C NTLD**: Counter C is reset to the count load value.

When Counter C is reset, it returns to zero or Counter C count load value. This reset action affects all Counter C resets, except the Setpoint Counter Auto Reset Action in Module 6.

#### Counter C Decimal Position

This selects the decimal point position for Counter C and any setpoint value assigned to Counter C. The selection will also affect Counter C scale factor calculations.

#### Counter C Scale Factor

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

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 Numeric transmissions modes of operation, the input signal is scaled directly. For EE and 4VC 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 only the scale factor affecting the display. (Details on scaling calculations are explained at the end of Module 1 section.)

#### Counter C Count Load Value

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

#### Counter C Reset Power-up *

- **Yes**: Counter C may be programmed to reset at each meter power-up.
- **No**: Counter C may be programmed to reset at each meter power-up.

---

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.

---

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.

---

Select the operating mode for Counter C.

- **NONE**: 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.

---

**See Serial Communications for details.**

---

**Counter C Reset Power-up**

- **Yes**: Counter C may be programmed to reset at each meter power-up.
- **No**: 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></td>
<td></td>
<td>OUT</td>
<td>bOUND</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>Sb-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>Sre-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 NO. Select the next setpoint to be programmed and continue the sequence for each setpoint. Pressing PAR at SPSEL NO will exit Module 6.

### SETPOINT ANNUNCIATORS

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.
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 \( t_{SP} = \text{HI} \)) or less than or equal to (for \( t_{SP} = \text{LO} \)) the setpoint value. The setpoint output will deactivate when the count value is less than (for \( t_{SP} = \text{HI} \)) or greater than (for \( t_{SP} = \text{LO} \)) the setpoint value.

**Out**
With Timed Out action, the setpoint output activates when the count value equals the setpoint value and deactivates after the Time Out value. This action is not associated with Boundary types.

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 \( t_{SP} = \text{HI} \)) or less than or equal to (for \( t_{SP} = \text{LO} \)) the setpoint value, the output will reactivate.

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

**Out**
With Timed Out action, the setpoint output cycles when the rate value is greater than or equal to (for \( t_{SP} = \text{HI} \)) or less than or equal to (for \( t_{SP} = \text{LO} \)) the setpoint value. The Setpoint Time Out (\( t_{OUT} \)) and Setpoint On Delay (\( t_{ON} \)) values determine the cycling times.

### PAXC & I: SETPOINT ASSIGNMENT

**RSN-n**
Select the display that the setpoint is to be assigned. (See Module 2 for Exchange Parameter Lists explanation.)

### SETPOINT VALUE

-99999 to 999999

Enter the desired setpoint value. Setpoint values can also be entered in the Quick Programming Mode when the setpoint is configured as RSN in Module 3.

### SETPOINT TRACKING *

- \( t_{SP} = \text{HI} \)
- \( t_{SP} = \text{LO} \)

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

- \( t_{SP} = \text{HI} \)
- \( t_{SP} = \text{LO} \)

\( t_{SP} = \text{HI} \) activates the output when the assigned display value (\( t_{SP} \)) equals or exceeds the setpoint value. \( t_{SP} = \text{LO} \) activates the setpoint when the assigned display value is less than or equal to the setpoint.

### SETPOINT STANDBY OPERATION *

- **YES**
- **NO**

Selecting **YES** will disable low acting setpoints at a power up until the displayed 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 *

- **0** to 9999

The hysteresis value is added to (for \( t_{SP} = \text{HI} \)) or subtracted from (for \( t_{SP} = \text{LO} \)) 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 *

- **0.00** to 999999 seconds

This is the amount of time the Rate display must be off before the setpoint’s output deactivates.

### PAXI & R: SETPOINT ON DELAY *

- **0.00** to 999999 seconds

This is the amount of time the Rate display must meet the setpoint activation requirements (below setpoint for high acting and above setpoint for low acting) before the setpoint’s output activates.

### PAXI & I: COUNTER AUTO RESET *

- **NO**
- **2EhDAS**
- **CdAS**
- **2EhORE**
- **ClDAS**
- **2EhORE**
- **ClDAS**

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

- **SELECTION**
- **ACTION**
  - **NO**
    - No auto reset.
  - **2EhDAS**
    - Reset to zero at the start of output activation.
  - **CdAS**
    - Reset to count load value at the start of output activation.
  - **2EhORE**
    - Reset to zero at the end of output activation. (\( t_{OUT} \) action only).
  - **ClDAS**
    - Reset to count load value at the end of output activation. (\( t_{OUT} \) action only).

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

Select **YES**, so the setpoint output will deactivate (reset) when SPn+1 deactivates and then times out (deactivates). This function may only be used if the SPn+1 is programmed for Setpoint Action of **U**. (Example SP1 deactivates when SP2 activates and then times out.) The last setpoint will wrap around to the first.

* 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.)
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. For details on the operation of the Fieldbus cards, refer to the bulletin shipped with each card.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>FACTORY</th>
<th>MNEMONIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 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>rLte</td>
<td>Rate</td>
<td>NO</td>
<td>RTE</td>
</tr>
<tr>
<td>H ILO</td>
<td>Max. &amp; Min.</td>
<td>NO</td>
<td>MIN MAX</td>
</tr>
<tr>
<td>SCFAC</td>
<td>A B C Scale Factors</td>
<td>NO</td>
<td>SFB SFC</td>
</tr>
<tr>
<td>Cntld</td>
<td>A B C Count Load</td>
<td>NO</td>
<td>LDA LDB LDC</td>
</tr>
<tr>
<td>SPnt</td>
<td>1 2 3 4 Setpoints</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 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 does not begin processing the command string until this character is received.

See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

<table>
<thead>
<tr>
<th>ID</th>
<th>VALUE DESCRIPTION</th>
<th>REGISTER NAME</th>
<th>COMMAND 1</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>

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: N17VM350
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</td>
<td>Address</td>
</tr>
<tr>
<td>2</td>
<td>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 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)³</td>
</tr>
<tr>
<td>22</td>
<td>&lt;CR&gt; (Carriage return)³</td>
</tr>
<tr>
<td>23</td>
<td>&lt;LF&gt; (Line feed)³</td>
</tr>
</tbody>
</table>

³ These characters only appear in the last line of a block print.

The first two characters transmitted (bytes 1 and 2) are the unit address. If the address assigned is 00, two spaces are substituted. A space (byte 3) follows the unit address field. The next three characters (bytes 4 to 6) are the register mnemonic. The numeric data is transmitted next.

The numeric field (bytes 7 to 18) is 12 characters long. When the requested value exceeds eight digits for count values or five digits for rate values, an * (used as an overflow character) replaces the space in byte 7. Byte 8 is always a space. The remaining ten positions of this field (bytes 9 to 18) consist of a minus sign (for negative values), a floating decimal point (if applicable), and eight positions for the requested value. The data within bytes 9 to 18 is right-aligned with leading spaces for any unfilled positions.

The end of the response string is terminated with <CR> (byte 19), and <LF> (byte 20). When a block print is finished, an extra <SP> (byte 21), <CR> (byte 22), and <LF> (byte 23) are used to provide separation between the transmissions.

Abbreviated Transmission

<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)³</td>
</tr>
<tr>
<td>16</td>
<td>&lt;CR&gt; (Carriage return)³</td>
</tr>
<tr>
<td>17</td>
<td>&lt;LF&gt; (Line feed)³</td>
</tr>
</tbody>
</table>

³ 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><SP><CR><LF>
2. Address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF><SP><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).

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 additional characters are discarded until a terminator is received. Counter C processes numeric and literal transmissions differently.

Numeric Transmissions

When a string that does not begin with #, T, V, P or R is received, the meter processes it as a Numeric transmission. In this case, only the recognized numbers and punctuation are displayed. All other characters in the string are discarded. If a negative sign appears anywhere in the string the resulting number will be negative. Only the most significant decimal point is retained. If no numerical characters are received, then the numeric value will be zero. The numeric display can be used for setpoint (boundary action only) and analog output functions. When using this display for setpoint and analog output values, the decimal point position must match the programming entered through the front panel. The numeric value is retained in Counter C memory until another Numeric transmission is received.

Recognized Numbers = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Recognized Punctuation = period, comma, minus

Literal Transmissions

When a string that begins with # is received, the meter processes it as a Literal transmission. In this case, any unrecognized characters will be replaced with a space. A Literal display will replace a Numeric value in the Counter C display. However, it will not remove a previous Numeric value from Counter C memory or prevent the Counter C outputs from functioning with the Numeric value. Literal transmissions are only possible when using RS232 or RS485 cards.

Recognized Characters = a, b, c, d, e, f, g, h, i, j, l, n, o, p, q, r, s, t, u, y, z (in upper or lower case)
Recognized Numbers = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Recognized Punctuation = period, comma, minus, blank
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>
<tr>
<td></td>
<td>Voltage levels at the Receiver</td>
<td></td>
<td></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.

Timing Diagrams

NO REPLY FROM METER

RESPONSE FROM METER

COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. 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 <CR>) is received by the meter. The time duration of t1 is dependent on the number of characters and baud rate of the channel.

\[
t_1 = (10 \text{ times the # of characters}) / \text{ baud rate}
\]

At the start of time interval t2, the computer program prints 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 ‘S’ 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.

\[
t_3 = (10 \text{ times the # of characters}) / \text{ baud rate}
\]

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

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>#</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>

The meter can only receive data or transmit data at any one time (half-duplex operation). At the start of 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 <CR>) is received by the meter. The time duration of t1 is dependent on the number of characters and baud rate of the channel.

\[
t_1 = (10 \text{ times the # of characters}) / \text{ baud rate}
\]

At the start of time interval t2, the computer program prints 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.

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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.

\[
t_3 = (10 \text{ times the # of characters}) / \text{ baud rate}
\]

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

Serial Timing

<table>
<thead>
<tr>
<th>COMMAND</th>
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<tbody>
<tr>
<td>R</td>
<td>Reset</td>
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</tr>
<tr>
<td>#</td>
<td>Literal</td>
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</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>

* 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.

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.
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>
<th>0-20</th>
<th>0 to 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20</td>
<td>4 to 20 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>0 to 10 V</td>
<td></td>
<td></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**

| AS IN | rAtE | b CNt | C CNt | A CNt | LO | HI |

Select the display that the analog output is to follow:

- A CNt = Counter A Value
- rAtE = Rate Value
- b CNt = Counter B Value
- LO = Minimum Value
- C CNt = Counter C Value
- HI = Maximum Value

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.

**ANALOG LOW SCALE VALUE**

-99999 to 999999

**ANALOG HIGH SCALE VALUE**

-99999 to 999999

Enter the display value within the selected Analog Assignment that corresponds to the high limit of the type selected.

The decimal point is determined by the decimal point setting of the assigned counter or rate. The scale value can not be set to read values with more than 6 digits. Reverse acting output is possible by reversing the scaling values.

**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 rE5Et and then returns to Code 50. Press DSP key to return to the Display Mode. This will overwrite all user settings with the factory settings.

Pressing the PAR and DSP keys at the same time on power-up will load the factory settings and display ErR14. This allows operation in the event of a memory failure or corrupted data. Immediately press RST key and reprogram the meter. If the meter is powered down again before pressing the RST key, the existing dynamic data will not be overwritten.
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.

**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. Code is displayed. Use the arrow keys to select SF5 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.

<table>
<thead>
<tr>
<th>SELECTION</th>
<th>EXTERNAL METER</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0A</td>
<td>0.00</td>
<td>Adjust if necessary, press PAR</td>
</tr>
<tr>
<td>4.0A</td>
<td>4.00</td>
<td>Adjust if necessary, press PAR</td>
</tr>
<tr>
<td>20.0A</td>
<td>20.00</td>
<td>Adjust if necessary, press PAR</td>
</tr>
<tr>
<td>0.0u</td>
<td>0.00</td>
<td>Adjust if necessary, press PAR</td>
</tr>
<tr>
<td>10.0u</td>
<td>10.00</td>
<td>Adjust if necessary, press PAR</td>
</tr>
</tbody>
</table>

**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></td>
<td>ENTER: Security code requested</td>
</tr>
<tr>
<td>CERTAIN DISPLAYS ARE LOCKED OUT</td>
<td>CHECK: Module 3 programming</td>
</tr>
<tr>
<td>INCORRECT DISPLAY VALUE or NOT COUNTING</td>
<td>CHECK: Input wiring, DIP switch setting, input programming, scale factor calculation, input signal level, user input jumper, lower input signal frequency</td>
</tr>
<tr>
<td>USER INPUT NOT WORKING CORRECTLY</td>
<td>CHECK: User input wiring, user input jumper, user input being used for signal, Module 2</td>
</tr>
<tr>
<td>OUTPUT DOES NOT WORK</td>
<td>CHECK: Corresponding plug-in card installation, output configuration, output wiring</td>
</tr>
<tr>
<td>JITTERY DISPLAY</td>
<td>CHECK: Wiring is per EMC installation guidelines, input signal frequency, signal quality, scaling, update time, DIP switch setting</td>
</tr>
<tr>
<td>&quot;r 000&quot; &quot; Rate</td>
<td>CHECK: Lower input signal frequency, reduce rate scaling</td>
</tr>
<tr>
<td>MODULES or PARAMETERS NOT ACCESSIBLE</td>
<td>CHECK: Corresponding plug-in card installation, related controlling parameter selected</td>
</tr>
<tr>
<td>ERROR CODE (Err 1-4)</td>
<td>PRESS: Reset key (if unable to clear contact factory.)</td>
</tr>
<tr>
<td>SERIAL COMMUNICATIONS</td>
<td>CHECK: Wiring, connections, meter and host settings</td>
</tr>
</tbody>
</table>

Shaded areas are model dependent.
### 1 - INP Counter A & B Input Parameters - PAXC & I only

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>R CNb</td>
<td>COUNTER A OPERATING MODE</td>
<td>cnk</td>
<td></td>
</tr>
<tr>
<td>R reESEl</td>
<td>COUNTER A RESET ACTION</td>
<td>2E-0</td>
<td></td>
</tr>
<tr>
<td>R edEcp</td>
<td>COUNTER A DECIMAL POSITION</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>R AsCFAc</td>
<td>COUNTER A SCALE FACTOR (A)</td>
<td>100000</td>
<td></td>
</tr>
<tr>
<td>R AsCFAc</td>
<td>COUNTER A SCALE FACTOR (B)</td>
<td>100000</td>
<td></td>
</tr>
<tr>
<td>R AsCFAc</td>
<td>COUNTER A SCALE MULTIPLIER</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>R AcCnLd</td>
<td>COUNTER A COUNT LOAD VALUE (A)</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>R AcCnLd</td>
<td>COUNTER A COUNT LOAD VALUE (B)*</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>R p-Up</td>
<td>COUNTER A RESET POWER-UP</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>R p-Up</td>
<td>PRESCALER OUTPUT ENABLE</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>R p-Up</td>
<td>PRESCALER SCALE VALUE</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>b CNb</td>
<td>COUNTER B OPERATING MODE</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>b reESEl</td>
<td>COUNTER B RESET ACTION</td>
<td>2E-0</td>
<td></td>
</tr>
<tr>
<td>b edEcp</td>
<td>COUNTER B DECIMAL POSITION</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>b AsCFAc</td>
<td>COUNTER B SCALE FACTOR (A)</td>
<td>100000</td>
<td></td>
</tr>
<tr>
<td>b AsCFAc</td>
<td>COUNTER B SCALE FACTOR (B)*</td>
<td>100000</td>
<td></td>
</tr>
<tr>
<td>b AsCFAc</td>
<td>COUNTER B SCALE MULTIPLIER</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>b AcCnLd</td>
<td>COUNTER B COUNT LOAD VALUE (A)</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>b AcCnLd</td>
<td>COUNTER B COUNT LOAD VALUE (B)*</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>b p-Up</td>
<td>COUNTER B RESET POWER-UP</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

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

Shaded areas are model dependent.

### 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>USr-2</td>
<td>USER INPUT 2</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>USr-3</td>
<td>USER INPUT 3</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>FUNCTION KEY 1</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>FUNCTION KEY 2</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>r b5</td>
<td>RESET KEY</td>
<td>dSP &amp; f5</td>
<td></td>
</tr>
<tr>
<td>Sc-f1</td>
<td>2nd FUNCTION KEY 1</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Sc-f2</td>
<td>2nd FUNCTION KEY 2</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

Shaded areas are model dependent.

### 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>R 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 AsLE</td>
<td>RATE DISPLAY LOCK-OUT</td>
<td>rEd</td>
<td></td>
</tr>
<tr>
<td>r $E$</td>
<td>MAX DISPLAY LOCK-OUT</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>LO</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>R AcCnLd</td>
<td>COUNT LOAD A ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>b AcCnLd</td>
<td>COUNT LOAD B ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>C AcCnLd</td>
<td>COUNT LOAD C ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>R AsCFAc</td>
<td>SCALE FACTOR A ACCESS</td>
<td>Enb</td>
<td></td>
</tr>
<tr>
<td>b AsCFAc</td>
<td>SCALE FACTOR B ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>R AsCFAc</td>
<td>SCALE FACTOR C ACCESS</td>
<td>LOC</td>
<td></td>
</tr>
<tr>
<td>CoD</td>
<td>SECURITY CODE</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Shaded areas are model dependent.

### 4 - FEE Rate Input Parameters - PAXI & R only

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>PARAMETER</th>
<th>FACTORY SETTING</th>
<th>USER SETTING</th>
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<td>rdSP</td>
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<td>rdSP</td>
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Shaded areas are model dependent.

### 5 - LcC Counter C Input Parameters - PAXC & I only

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<td>COUNTER C SCALE FACTOR (B)*</td>
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<td>C AcCnLd</td>
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<td>COUNTER C COUNT LOAD VALUE (B)*</td>
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<td>C p-Up</td>
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* See Module 2, Exchanging Parameter Lists, for details on programming this value.

Shaded areas are model dependent.
### Analog Output Parameters - PAXI only

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<td>SETPOINT ACTION</td>
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<td>R CNT</td>
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* See Module 2, Exchanging Parameter Lists, for details on programming this value.

Shaded areas are model dependent.

### Serial Communication Parameters - PAXI only

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<td>SrL</td>
<td>PRINT COUNTER C</td>
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<td>SrL</td>
<td>PRINT RATE</td>
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<td>SrL</td>
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<td>PRINT SCALE FACTORS</td>
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<td>PRINT COUNT LOAD VALUES</td>
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### Factory Service Parameters

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

GENERAL DESCRIPTION

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

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

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

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

The capability of the CUB5 can be easily expanded with the addition of option modules. Setpoint capability is field installable with the addition of the single setpoint relay output module or the dual setpoint solid state output module. 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 equipment in the event of a fault to the meter.

READ complete instructions prior to installation and operation of the unit.

CAUTION: Risk of Danger.

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

DIMENSIONS In inches (mm)

COUNTER AND RATE INDICATOR

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

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 electric shock.

Read complete instructions prior to installation and operation of the unit.
GENERAL METER SPECIFICATIONS

1. DISPLAY: 8 digit LCD 0.46" (11.7 mm) high digits
   CUBSB000: Transmissive LCD with selectable red or green LED backlight, viewing angle optimized. Display color change capability with output state when using an output module.
   CUBS5B000: 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. COUNTER DISPLAYS:
   Counter A: 8-digits, enabled in all count modes
     Display Range: 999999999 to 999999999
     Overflow Indication: Display flashes "----".
   Counter B: 7-digits, enabled in Dual Counter Mode or batch counting
     Display Designator: "b" to the left side of the display
     Display Range: 0 to 999999999 (positive count only)
     Overflow Indication: Display flashes "----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/----/---
1.0 INSTALLING THE METER

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

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

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

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

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

2.0 SETTING THE DIP SWITCHES

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

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

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

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

SWITCH 1
LOGIC: Input A trigger levels $V_{IL} = 1.25$ V max.; $V_{IH} = 2.75$ V min.; $V_{MAX} = 28$ VDC
MAG: 200 mV peak input sensitivity; 100 mV hysteresis; maximum input voltage: ±40 V peak (28 Vrms); Must also have SRC switch ON. (Not recommended with counting applications.)

SWITCH 2
SNK: Adds internal 7.8 KΩ pull-up resistor to +9 to 28 VDC, $V_{MAX} = 3.8$ mA.
SRC: Adds internal 3.9 KΩ pull-down resistor, 7.2 mA max. @ 28 VDC max.

SWITCHES 3 and 4
HI Frequency: Removes damping capacitor and allows max. frequency.
LO Frequency: Adds a damping capacitor for switch contact bounce. Limits input frequency to 50 Hz and input pulse widths to 10 msec.
3.0 Installing Plug-In Cards

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

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 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.

3.0 Installing Plug-In Cards

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

4.0 Wiring the Meter

Wiring Overview

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EMC Installation Guidelines

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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. 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.

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 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 # ZCAT305-130A
  - 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.

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.

4.1 Power Wiring

DC Power

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

4.2 User Input Wiring

Sinking Logic

INP COMM
USR
INP B
INP A

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

The user input of the meter is internally pulled up to +9 to +28 V with 10 K resistance. The input is active when it is pulled low (<1.0 V).
4.3 INPUT WIRING

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

### AC Inputs From Tach Generators, Etc.

**Input A**
- Magnetic Pickup
- AC Inputs From Tach Generators, Etc.
- Two Wire Proximity, Current Source

### Current Sinking Output

**Input A**
- Current Sinking Output
- Interfacing With TTL

### Current Sourcing Output

**Input A**
- Current Sourcing Output
- Interfacing With TTL

### Switch or Isolated Transistor; Current Sink

**Input A**
- Switch or Isolated Transistor; Current Sink
- Current Sink Output; Quad/Direction

* Switch position is application dependent.
Shaded areas not recommended for counting applications.

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

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

OPERATING MODE DISPLAY DESIGNATORS

- The left of the display is the rate value.
- Counter A has no designator.

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

6.0 PROGRAMMING THE METER

OVERVIEW

PROGRAMMING MENU

<table>
<thead>
<tr>
<th>PROGRAMMING MODE ENTRY (SEL KEY)</th>
<th>PROGRAMMING MODE EXIT (SEL KEY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended all programming changes be made off line, or before installation. The meter normally operates in the Display Mode. No parameters can be programmed in this mode. The Programming Mode is entered by pressing and holding the SEL key. It is not accessible then it is locked by either a security code, or a hardware lock.</td>
<td>The Programming Mode is exited by pressing the SEL key with Pro NO displayed. This will commit any stored parameter changes to memory and return the meter to the Display Mode. (If power loss occurs before returning to the Display Mode, verify recent parameter changes.)</td>
</tr>
</tbody>
</table>

MODULE ENTRY (SEL & RST KEYS)

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

MODULE MENU (SEL KEY)

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

SELECTION / VALUE ENTRY

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

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

PROGRAMMING TIPS

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

FACTORY SETTINGS

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

ALTERNATING SELECTION DISPLAY

In the explanation of the modules, the following dual display with arrows will appear. This is used to illustrate the display alternating between the parameter on top and the parameter’s factory setting on the bottom. In most cases, selections and values for the parameter will be listed on the right.
6.1 MODULE 1 - INPUT SETUP PARAMETERS (I - INPUT)

PARAMETER MENU

**COUNT MODE**

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cnt ud</td>
<td>Count with Direction</td>
</tr>
<tr>
<td>Rate/Counter</td>
<td></td>
</tr>
<tr>
<td>Dual Counter</td>
<td></td>
</tr>
<tr>
<td>Quadrature x1</td>
<td></td>
</tr>
<tr>
<td>Quadrature x2</td>
<td></td>
</tr>
<tr>
<td>Quadrature x4</td>
<td></td>
</tr>
<tr>
<td>2 Input Add/Add</td>
<td></td>
</tr>
<tr>
<td>2 Input Add/Subtract</td>
<td></td>
</tr>
</tbody>
</table>

INPUT A ACTION

- Counter A
- Counter A Direction
- Rate only
- Counter A Add
- Counter A Add
- Counter A Add
- Counter A Add

INPUT B ACTION

- Counter B
- Counter B Direction
- Counter B
- Counter B
- Counter B
- Counter B

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

**COUNTER A DECIMAL POSITION**

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

**COUNTER A SCALE FACTOR**

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

**COUNTER A COUNT LOAD VALUE**

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

**COUNTER B DECIMAL POSITION**

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

**COUNTER B SCALE FACTOR**

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

**COUNTER B BATCH COUNT ENABLE**

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

**COUNTER A COUNT DIRECTION**

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

**COUNTER A RESET ACTION**

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

**COUNTER RESET AT POWER-UP**

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

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

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

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

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

**WHERE:**

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

**Decimal Point Position:**
- 0 = 1
- 0.0 = 10
- 0.00 = 100
- 0.000 = 1000
- 0.0000 = 10000
- 0.00000 = 100000

**EXAMPLE:**

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

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

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

- Scale Factor = \( \frac{100}{128} \) = 0.7812
- Scale Factor = \( 0.007812 \times 100 \)
- Scale Factor = 0.7812

**USER INPUT FUNCTION**

<table>
<thead>
<tr>
<th>DISPLAY MODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>No Function</td>
</tr>
<tr>
<td>Pro Loc</td>
<td>Program Mode Lock-out (Module 3)</td>
</tr>
<tr>
<td>Inh b-t</td>
<td>Inhibit</td>
</tr>
<tr>
<td>rESet</td>
<td>Maintained Reset</td>
</tr>
<tr>
<td>Stor</td>
<td>Store</td>
</tr>
<tr>
<td>Stor + RSt</td>
<td>Store and Reset</td>
</tr>
<tr>
<td>d-SELECt</td>
<td>Display Select</td>
</tr>
<tr>
<td>d-LEVEL</td>
<td>Display Intensity Level</td>
</tr>
<tr>
<td>d-COLOR</td>
<td>Backlight Color</td>
</tr>
<tr>
<td>Pr nt</td>
<td>Print Request</td>
</tr>
<tr>
<td>Prnt + rSt</td>
<td>Print and Reset</td>
</tr>
<tr>
<td>rESet + 1</td>
<td>Setpoint 1 Reset</td>
</tr>
<tr>
<td>rESet + 2</td>
<td>Setpoint 2 Reset</td>
</tr>
<tr>
<td>rESet + 12</td>
<td>Setpoint 1 and 2 Reset</td>
</tr>
</tbody>
</table>

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

**USER INPUT ASSIGNMENT**

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

---

**6.2 MODULE 2 - RATE SETUP PARAMETERS (2-rALE)**

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

**RATE ENABLE**

- Rate Enable
- Rate Enable
- Rate Enable
- Rate Enable

**RATE DECIMAL POINT**

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

**RATE SCALING DISPLAY VALUE**

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

**RATE SCALING INPUT VALUE**

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

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

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

SCALING FOR RATE INDICATION

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

SCALING CALCULATION

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

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

<table>
<thead>
<tr>
<th>RATE PER</th>
<th>DISPLAY (RATE dsp)</th>
<th>INPUT (RATE 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 Display value is raised or lowered, then Input value must be raised or lowered by the same proportion (i.e. Display value for per hour is entered by a third less (1200) then Input value is a third less of # of pulses per unit). The same is true if the Input value is raised or lowered, then Display value must be raised or lowered by the same proportion.
4. Both values must be greater than 0.0.

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

RATE LOW UPDATE TIME

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

RATE HIGH UPDATE TIME

The High Update Time is the maximum amount of time before the rate display is forced to zero. (For more explanation, refer to Rate Value Calculation.) The High Update Time must be higher than the Low Update Time and higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 2.0, will force the display to zero for speeds below 0.5 Hz or a pulse every 2 seconds.
The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (Pro Loc) in the User Input Function parameter (Module 1).

Two programming modes are available. Full Programming mode allows all parameters to be viewed and modified. Quick Programming mode permits only the setpoint output time-out and counter load values (when applicable) to be modified, but allows direct access to these values without having to enter Full Programming mode.

Programming a Security Code other than 0, requires this code to be entered at the Pro Code prompt in order to access Full Programming mode. Depending on the code value, Quick Programming may be accessible before the Pro Code prompt appears (see chart).

### USER INPUT FUNCTION

<table>
<thead>
<tr>
<th>USER INPUT STATE</th>
<th>SECURITY CODE</th>
<th>MODE WHEN &quot;SEL&quot; KEY IS PRESSED</th>
<th>FULL PROGRAMMING MODE ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro Loc</td>
<td>0</td>
<td>Full Programming</td>
<td>Immediate Access</td>
</tr>
<tr>
<td></td>
<td>1-99</td>
<td>Quick Programming with correct code entry at Pro Code prompt</td>
<td>After Quick Programming with correct code entry at Pro Code prompt</td>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>Pro Code prompt</td>
<td>With correct code entry at Pro Code prompt</td>
</tr>
<tr>
<td></td>
<td>Active</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>
</tr>
<tr>
<td></td>
<td>100-999</td>
<td>Pro Code prompt</td>
<td>With correct code entry at Pro Code prompt</td>
</tr>
<tr>
<td></td>
<td>Not Active</td>
<td>0-999</td>
<td>Full Programming</td>
</tr>
</tbody>
</table>

* Entering Code 222 allows access regardless of security code.

### SOFTWARE VERSION DISPLAY

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

### LOAD FACTORY DEFAULT SETTINGS

The YES selection will return the meter to the factory default settings. The meter will display rESEt and then return to Pro, at which time all settings have been changed.
The Setpoint Output Parameters are only active when an optional Setpoint Output Module is installed in the meter. Some parameters in the menu will not appear depending on the Setpoint Assignment and Setpoint Output Action. The Setpoint Parameter Availability chart below illustrates this.

**SETPOINT SELECT**

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

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

**SETPOINT 2 ENABLE (SP2 Only)**

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

**SETPOINT ASSIGNMENT**

Select the display to which the Setpoint is assigned.

**SETPOINT PARAMETER AVAILABILITY**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESCRIPTION</th>
<th>COUNTER ASSIGNMENT (A or B)</th>
<th>RATE ASSIGNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TIMED OUT</td>
<td>BOUNDARY</td>
</tr>
<tr>
<td>SPn EOL</td>
<td>Setpoint Output Time-out Value</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SPn URL</td>
<td>Setpoint Value</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn URL</td>
<td>Setpoint Output Logic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn L R</td>
<td>Setpoint Annunciator</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn P-UP</td>
<td>Setpoint Output Power-up State</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn LTYE</td>
<td>Setpoint Boundary Type</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn STBY</td>
<td>Standby Operation (Low acting only)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SPn RST</td>
<td>Counter Auto Reset</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SPT OFF2</td>
<td>SP1 Output Off at SP2 (SP1 only)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SPT OFF2</td>
<td>SP2 Output Off at SP1 (SP2 only)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SPn RST</td>
<td>Output Reset with Manual Reset</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SPn CHC</td>
<td>Change Display Color w/ Output State</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* BOUNDARY Setpoint Action not applicable for Counter B Assignment
SETPOINT OUTPUT TIME-OUT

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

SETPOINT VALUE

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

SETPOINT OUTPUT LOGIC

Normal (NOr) turns the output “on” when activated and “off” when deactivated. Reverse (rEV) turns the output “off” when activated and “on” when deactivated.

SETPOINT ANNUNCIATOR

Normal (NOr) displays the setpoint annunciator when the corresponding output is “on”. Reverse (rEV) displays the setpoint annunciator when the output is “off”.

SETPOINT OUTPUT POWER-UP STATE

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

SETPOINT BOUNDARY TYPE

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

SETPOINT STANDBY OPERATION

This parameter only applies to Low Acting Boundary Type setpoints. Select YES to disable a Low Acting Setpoint at power-up, until the assigned display value crosses into the output “off” area. Once in the output “off” area, the Setpoint will then function per the description for Low Acting Boundary Type.
The Serial Communications Parameters are only accessible when an optional RS232 or RS485 serial communications module is installed in the meter.

This section replaces the bulletin shipped with the RS232 and RS485 serial communications plug-in cards. Discard the separate bulletin when using those serial plug-in cards with the CUB5B and CUB5R.

**BAUD RATE**

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

**DATA BIT**

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

**PARITY BIT**

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

**METER ADDRESS**

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

**ABBREVIATED PRINTING**

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

**PRINT OPTIONS**

This parameter selects the meter values transmitted in response to a Print Request. A print request is also referred to as a block print because more than one parameter can be sent to a printer or computer as a block. Selecting YES displays a sublist for choosing the meter parameters to appear in the print block. All active parameters entered as YES in the sublist will be transmitted during a block print. Parameters entered as NO will not be sent.

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

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

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

Command Chart

<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 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 a register ID character and numeric data.</td>
</tr>
<tr>
<td>V</td>
<td>Value Change (write)</td>
<td>Write to register of the meter. Must be followed by a register ID character and numeric data.</td>
</tr>
<tr>
<td>R</td>
<td>Reset</td>
<td>Reset a counter value or setpoint output. Must be followed by a register ID character.</td>
</tr>
<tr>
<td>P</td>
<td>Block Print Request (read)</td>
<td>Initiates a block print output. Registers in the print block are selected in Print Options.</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 all the active selections chosen in the Print Options menu parameter.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Command Response Time section for differences in meter response time when using the * and $ terminating characters.

Receiving Data From The Meter

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

Full Field Transmission

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

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

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

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

Abbreviated Transmission

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

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

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

\[
t_1 = (10 \text{ times the } \# \text{ of characters}) / \text{ baud rate}
\]

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

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

**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 \(\infty\)). 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 CUB5 meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

**Stop Bit**

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

**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 key to enter Programming Mode.
**DESCRIPTION**

The model BMK11 can be used to mount a CUB5 meter or a Micro Line Power Supply (MLPS) in various applications. Need a DIN rail mounted display? Simply add the DIN rail clips to the back of the BMK11, install your meter and snap it on the rail. If your application requires an inexpensive power supply, simply mount an MLPS to the BMK11 and snap it to the rail. For base mount application, just use the appropriate mounting screws to securely fasten the BMK11. Nothing could be easier.

**DIMENSIONS In inches (mm)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMK11</td>
<td>CUB5 or MLPS DIN Rail Base Mount Kit</td>
<td>BMK11000</td>
</tr>
</tbody>
</table>
**MLPS INSTALLATION**

1. Using the two nuts supplied with the BMK11, affix standoffs from MLPS hardware pack as indicated in the diagram at left. Verify indicator is fully seated and latches have engaged. With latches properly engaged the indicator will not pull out of the BMK11.

2. Wire the indicator.

3. For DIN RAIL mounting, insert the two plastic feet as shown in the diagram at right. Angle the assembly so that the top groove of both rail feet are located over the top lip of the rail. Rotate the assembly towards the rail until it snaps into place.

4. To remove the assembly from the rail, place a screwdriver behind one of the rail feet and draw the rail foot away from the rail disengaging it from the rail. Apply the same procedure to the second rail foot and remove the complete assembly from the rail.

5. For Base Mount, use the holes indicated in the diagram at left, and screw or bolt the assembly to the desired mounting surface. User is responsible for selecting the appropriate screw or bolt to provide mounting to the desired surface. Base mount holes in the BMK11 are designed for #8 hardware.

6. To remove the indicator from the BMK11, slide a small screwdriver between the MLPS and the latch wall. Draw the latch away from the MLPS until disengaged. Repeat procedure on the other side. Once the latches are released, remove the indicator from the BMK11.

---

**CUB5 INSTALLATION**

1. Remove the panel latch (mounting clip) from the indicator. Insert the indicator into the BMK11 per diagram at right. Verify indicator is fully seated and latches have engaged. With latches properly engaged the indicator will not pull out of the BMK11.

2. Wire the indicator.

3. For DIN RAIL mounting, insert the two plastic feet as shown in the diagram at right. Angle the assembly so that the top groove of both rail feet are located over the top lip of the rail. Rotate the assembly towards the rail until it snaps into place.

4. To remove the assembly from the rail, place a screwdriver behind one of the rail feet and draw the rail foot away from the rail disengaging it from the rail. Apply the same procedure to the second rail foot and remove the complete assembly from the rail.

5. For Base Mount, use the holes indicated in the diagram at left, and screw or bolt the assembly to the desired mounting surface. User is responsible for selecting the appropriate screw or bolt to provide mounting to the desired surface. Base mount holes in the BMK11 are designed for #8 hardware.

6. To remove the indicator from the BMK11, slide a small screwdriver into the slot provided in the latch. Draw the latch away from the indicator until disengaged. Repeat the procedure on the other side. Once the latches are released, remove the indicator from the BMK11.

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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.
GEMINI 1000/2000 - 6-DIGIT PRESETTABLE COUNTERS OR RATE INDICATORS
GEMINI 1000 - SINGLE LEVEL & GEMINI 2000 - DUAL LEVEL w/OPTIONAL 20 mA CURRENT LOOP

DESCRIPTION

The Gemini 1000 and 2000 offer the features and performance of a single/dual level preset counter or a programmable sample time rate indicator in one economically priced package. The reliability of solid-state MOS technology coupled with the flexibility of user programmable functions makes these units ideally suited to handle practically any preset control application.

As a counter, the Gemini 1000/2000 offers a choice of six (6) programmable counting modes to cover Bi-directional, Anti-Coincidence and Quadrature applications. The input circuitry is switch selectable to accept signals from a wide variety of sources. In addition, the unit may be programmed to register counts on both edges of the input signal thus providing frequency doubling capability. The choice of several reset cycle modes along with the compatibility of count and control inputs to other RLC products, provides added versatility for both stand-alone and systems counter needs.

As a rate indicator, the Gemini 1000/2000 features crystal-controlled accuracy along with a variety of data sampling times to allow the needed resolution for precision applications. The combination of 5-digit scale factor and decade scale multipliers provide a wide range of scaling correction for direct readout in terms of units being measured.

The construction of the Gemini 1000/2000 features a zinc die-cast bezel offering maximum durability with a high quality appearance. The sealed front panel meets NEMA 4/IP65 specifications, for wash-down and/or dust when properly installed. Electrical connections are made via pluggable terminal strips at the rear of the unit. Clamp-type pressure plate terminals accept stripped #14 AWG wire without lugs.

SPECIFICATIONS

1. DISPLAY: 6-digit 0.56" (14.2 mm) High LED display.
2. POWER REQUIREMENTS:
   AC Power: Switch selectable 115/230 VAC (±10%), 50/60 Hz, 20 VA
   DC Power: 11 to 14 VDC @ 0.7 A max.
3. SENSOR POWER: +12 VDC (±25%) @ 100 mA max.
4. MEMORY: Non-volatile E2PROM memory retains all programming information and count value when power is removed or interrupted.
5. INPUTS A & B: Switch selectable to accept count pulses from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, and all standard RLC sensors.
   Current Sourcing - Unit provides 3.9 KΩ pull-down load for sensors with current sourcing outputs. Max. input voltage = 28 VDC @ 7 mA.
   Current Sinking - Unit provides 7.8 KΩ pull-up load for sensors with current sinking outputs. Max. sensor current = 1.6 mA.
   Debounce - Damping capacitor provided for switch contact debounce. Limits count speed to 100 Hz max. with 50% duty cycle.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 6.8" (173 mm) W.
PROGRAMMABLE FUNCTIONS

UNIT PERSONALITY
- Functions as a Counter and Rate Indicator.

RESET(S)
- Range 0 to ±999999

SCALE FACTORS
- 5-digit input scaling, Range 0.0000 to ±5.9999.

SCALE MULTIPLIER
- Multiplies the contents of the 9-digit internal counter by a factor of 1, 0.1, 0.01, or 0.001 to view the desired number of significant digits on the 6-digit display.

COUNTING MODES
- Count with Inhibit
- Count with Up/Down Control
- 2-Input Anti-Coincidence Add
- 2-Input Anti-Coincidence Add/Subtract

Enclosure class A

QUICK START


7. Performed during a process without losing counts.

SELF-TEST
- Performs a complete check on the display and output circuitry along with a functional check on the CPU. Self-test is non-destructive and may be performed during a process without losing counts.

FREQUENCY DOUBLING
- Registers counts on both edges of input signal.

DECIMAL POINT & LEADING ZERO BLANKING
- Decimal point programmable to desired location. Leading zero blanking, when selected, begins with second digit to the left of the decimal point.

RIGHT-HAND DUMMY ZEROS
- Up to three non-functional zeros may be placed on the least significant end of the display.

OUTPUT TERMINATION MODES
- Terminate at “other” Output Start (Gemini 2000 only)
- Terminate at “other” Output End (Gemini 2000 only)
- Terminate at Manual Reset
- Terminate at Manual Reset End
- Terminate after Time Delay
- Boundary
- For positive preset value: Output terminates when Display is less than Preset.
- For negative preset value: Output terminates when Display is greater than Preset (i.e. more positive).

Note: In any of the above modes, the unit may be programmed for “Reverse Phase” operation which complements the logic state of the output.

OUTPUT TIME DELAY
- Programmable from 0.01 to 599.99 seconds. Accurate to ±(0.01% + 10 msec.).

SAMPLE TIME MULTIPLIER
- Multiplies the basic one-second data sampling time by 1, 2, 5, 10, 20, or 50. Accurate to ±0.01%.

FRONT PANEL LOCKOUT MODES
- When the “Program Disable” control input is activated, the ability to change front panel programmed functions will be prevented as per the following modes:
  - Complete Front Panel Disable
  - Preset(s) Enabled Only
  - Scale Factor Enabled
  - Both Preset(s) and Scale Factor Enabled

Note: Reset may be enabled or disabled in any of the above modes.

SPECIFICATIONS (Cont’d)

Lo Bias - Input trigger levels \( V_{IL} = 1.5 \text{ V max.}, V_{IH} = 3.75 \text{ V} \).
Hi Bias - Input trigger levels \( V_{IL} = 5.5 \text{ V max.}, V_{IH} = 7.5 \text{ V} \).

Note: Bias levels given are ±10% @ 12 VDC. They vary proportionally with sensor supply voltage.

MAGNETIC PICKUP INPUT:
- Sensitivity - 150 mV peak nominal
- Hysteresis - 100 mV nominal
- Input Impedance - 26.5 kΩ @ 60 Hz nominal
- Maximum Input Voltage - ±50 V peak

MAXIMUM COUNT RATES:
- Uni- or Bi-Directional Modes: 9 KHz; 8 KHz (X2)
- 2-Input Anti-Coincidence Modes: 5 KHz; 4 KHz (X2)
- Quadrature Modes: 5 KHz; 4 KHz (X2 or X4)
- Rate Indicator: 10 KHz; 8 KHz (X2)

CONTROL INPUTS:
- Reset - Active Low (\( V_{IL} = 1.5 \text{ V max.} \)) internally pulled up to +12 VDC (\( I_{SNK} = 3 \text{ mA} \)), response time = 10 msec (typical).
- Program Disable - Active Low (\( V_{IL} = 1.5 \text{ V max.} \)), internally pulled up to +5 VDC (\( I_{SNK} = 1 \text{ mA} \)).
- Print Request - (GEM2 only) Active Low (\( V_{IL} = 1.5 \text{ V max.} \)) internally pulled up to +5 VDC (\( I_{SNK} = 1 \text{ mA} \)).

SERIAL COMMUNICATIONS (Optional, Gemini 2000 only):
- Type - Bi-directional 20 mA current loop, 20 mA source provided. (Powers up to seven units in a loop with internal current source.)
- Baud Rate - Programmable 300 to 2400.
- Maximum Address - 16 units (0 to 15). (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.)

HARDWARE SPECIFICATIONS:
- SO - Output Transistor Rating: \( V_{MAX} = 30 \text{ VDC}, V_{SAT} = 1 \text{ V max.} @ 20 \text{ mA.} \) (Can address 16 units in a loop)
- SI - Input Diode Rating: \( V_{D} = 1.25 \text{ V TYP.}, 1.5 \text{ V max} \).

Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop.

10. OUTPUT(S):
- Solid-State - Current sinking NPN Open Collector Transistor(s). \( I_{SNK} = 100 \text{ mA max.}, V_{OH} = 30 \text{ VDC max.} \) (Internal Zener Diode Protected), \( V_{OL} = 1 \text{ VDC max } @ 100 \text{ mA} \).
- Relay(s) - Mounted on a field-replaceable P.C. board. Form C contacts rated 5 amps @ 120/240 VAC, 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.

RELAY LIFE EXPECTANCY - 100,000 cycles at max. rating. (As load level decreases, life expectancy increases.)

Programmable Timed Outputs(s) - The timed output(s) can be set from 0.01 to 599.99 seconds, ±(0.01% + 10 msec.).

11. CERTIFICATIONS AND COMPLIANCE:
- 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
  - Electromagnetic RF fields: EN 61000-4-3 Level 3: 8 Kv air
  - Fast transients (burst): EN 61000-4-4 Level 4: 2 Kv I/O
  - RF conducted interference: EN 61000-4-6 Level 3: 10 V/m
  - Power frequency magnetic fields: EN 61000-4-8 Level 4: 30 A/m
  - Emissions to EN 50081-2
    - RF interference: EN 55011 Enclosure class A
    - Power mains class A
Notes:
1. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.
2. When the unit is DC powered, a power line filter (RLC# LFIL0000 or equivalent) was installed, so as not to impair the function of the unit. Refer to the EMC Installation Guidelines section of the manual for additional information.

12. ENVIRONMENTAL CONDITIONS:
- Operating Temperature: 0 to 50°C
- Storage Temperature: -40 to 80°C
- Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0 to 50°C.
- Altitude: Up to 2000 meters

13. CONSTRUCTION:
- Metal die-cast bezel, plastic case. This unit is rated for NEMA 4/IP65 indoor use. Installation Category II, Pollution Degree 2

14. WEIGHT: 2.1 lbs. (0.9 kg)

PROGRAMMING
The Gemini 1000/2000 input circuit set-up is programmed using DIP switches on the rear of the unit. All other functions are programmed through the front panel pushbuttons.

To program or interrogate a function, the user first enters a two-digit function code. The unit will then display that function code along with a single-digit representing the present mode of operation. Programming changes are made by changing the single-digit mode identifier.

EXAMPLE: The function code representing the “Unit Personality” is 41. The mode identifiers for this function are:

Counter (1) and Rate Indicator (2).

To interrogate the Unit Personality, Press “41”:
Unit displays function code along with mode identifier (Rate Indicator).

TYPICAL COUNTER APPLICATIONS

“IN PROCESS” MONITORING SYSTEM
Some applications require continuous monitoring of items “in-process”. In this example, a material processing system is equipped with an in-feed photo-electric scanner to count raw parts going into the system, and an out-feed scanner to count finished parts leaving the machine. The number of parts between the in-feed and out-feed is displayed by the GEMINI 1000 operating in the Anti-Coincidence Add/Subtract mode. In this mode, counts applied to INPUT A are added while counts applied to INPUT B are subtracted.

Before start-up, the system is completely empty of parts and the counter is reset to zero. When the operation begins, raw parts move through the in-feed scanner field of view with each part generating an “up” count. After processing, finished parts appearing at the out-feed scanner generate “down” counts so the counter continuously displays the number of “in-process” parts.

The GEMINI 1000 preset value is set to the maximum system capacity and the output is used to control power to the system drive. Therefore, if a jam-up occurs within the system and the maximum capacity is reached, the counter output will shut down the system drive until the problem can be corrected.

Conversely, the counter could be used in the Reset-to-Preset mode which delivers an output at zero. If the supply of raw parts is interrupted, the system will eventually empty and the counter will reach zero. At this point, the counter output will shut down the system drive until the supply of raw parts is replenished.

“CUT-TO-LENGTH” WITH FLAW DETECTION
In this application, sheets of material are to be cut to length as per customer order with any flaws being corrected by the vendor. Sales are both domestic and foreign and require lengths to be measured in either yards or meters.

A rotary pulse generator (RPG) with a 10 pulse/revolution (PPR) quadrature output is coupled to a length sensor conversion bracket with a 4/10 yard wheel. The GEMINI 1000 is set up in the Quadrature x4 mode which effectively increases the RPG output to 40 PPR. With the 4/10 yard wheel, the information rate becomes 100 pulses/yard and allows the material to be cut to the nearest 1/100 yard. The counter display is programmed for two decimal places to provide a readout in 1/100 yard increments.

The Preset value on the GEMINI 1000 is set to the desired length of material and the output is used to control power to the cutting knife. The counter is programmed to automatically reset to zero at the preset value which allows the process to run continuously without losing counts. If a flaw is detected, a contact in the flaw detector is used to shut down power to the system drive allowing the material to be “backed-up” to the point at which the flaw occurred. As the material is rewound, the counter will count “down” to maintain a readout of the total length of material “in-process”. For metric orders, the scale factor on the GEMINI 1000 is set to 0.9144 which provides the conversion from yards to meters (1 yard = 0.9144 meters). Otherwise, all equipment and settings remain as above.
This application depicts a GEMINI 2000 controlling a coil winding machine. A length sensor provides output units in feet. Output 1 is used as the slow-down for the drive motor and Output 2 is used for the cut off knife control. A printer is used to record the length of each coil that is wound. Preset 1 is set to the slow down length and Preset 2 is set to the desired length of the coil.

In this application, a GEMINI 1000 is used to indicate the speed of a printing press operation in feet/minute, while limiting the maximum speed to a desirable level.

A magnetic pickup is used to sense a gear coupled to a feed roll on the system drive. The scale factor on the GEMINI 1000 is set to provide a direct readout in feet/minute with a one-second sample time.

The maximum allowable speed of the operation is entered as the preset value on the rate indicator. The output termination is programmed for the “boundary” mode in which the output remains “OFF” as long as the speed of the operation stays below the preset level. If the operational speed equals or exceeds the maximum allowable limit, the output will turn “ON” and remain “ON” until the speed is reduced below the preset value.

The output of the GEMINI 1000 is tied to the speed control circuitry of the system drive and triggers the necessary speed reduction if the maximum allowable rate is exceeded. The jumper between the “Program Disable” and “Common” terminals is used to prevent any accidental or unauthorized programming changes. Connecting the jumper after the unit set-up is complete will allow full interrogation of front panel functions, although any function alteration will be inhibited.

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>OPTIONS</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEM1</td>
<td>Gemini 1000</td>
<td>No W/relay board</td>
<td>115/230 VAC</td>
</tr>
<tr>
<td>GEM2</td>
<td>Gemini 2000</td>
<td>No W/relay board</td>
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</tr>
<tr>
<td></td>
<td>Gemini 1000 Relay</td>
<td>W/relay board</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gemini 2000 Relay</td>
<td>W/relay board</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.

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 Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
GEMINI 1000 PROGRAMMING CHART

FEATURE & MODE SELECTION (See Programming Procedure)

DETAILED MODE MENUS

INPUTS A & B RESPONSE MODES
(1) A = CNT. UP, B = INH.  (2) A = CNT. IN, B = U/D
(3) A = CNT. UP, B = CNT. DN.  (4) A = CNT. UP, B = CNT. UP
(5) QUADRATURE X1  (6) QUADRATURE X4

INPUT PULSE EDGES REGISTERING COUNTS*
(1) NEG. GOING EDGES ONLY  (2) BOTH + & - EDGES
(1 count/pulse)  (doubling)
* Not accessible with Quadrature X4 Counter Input Response Mode.

SCALE MULTIPLIER
(1) x1  (2) x0.1  (3) x0.01  (4) x0.001

DECIMAL POINT & LEADING ZERO BLANKING
(1) 0 (NO D. P.)  (-1) 0 0 0 0 0 0 0 0 (NO L.Z.B.)
(2) 0,0  (-2) 0 0 0 0 0 0 0 0
(3) 0,0,0  (-3) 0 0 0 0 0 0 0 0
(4) 0,0,0,0  (-4) 0 0 0 0 0 0 0 0
(5) 0,0,0,0,0  (-5) 0 0 0 0 0 0 0 0
(6) 0,0,0,0,0,0  (-6) 0 0 0 0 0 0 0 0

COUNTER RESET MODES

NOTE 1

OUTPUT TERMINATION MODES
(3) TERM. AT START OF MAN. RST.  (5) TERM. AFTER TIME DELAY
(4) TERM. AT END OF MAN. RST.  (6) BOUNDARY MODE
* BOUNDARY MODE: Output goes "OFF" when count < preset and "ON"
when count ≥ preset as value goes up and down through preset.
NOTE: Output normally "OFF"; turns "ON" @ preset. To reverse output action,
enter (-) before mode 1, D.

RIGHT HAND DUMMY ZEROS
(1) = 0  (2) = 00  (3) = 000  (4) = NONE

SAMPLE TIME (Rate Only)
(1) 1 sec  (2) 2 sec  (3) 5 sec  (4) 10 sec  (5) 20 sec  (6) 50 sec

"OPERATOR ACCESSIBLE FUNCTIONS" MODES (Programming Daidal)
With the "PGM. DIS." terminal on the rear pulled low to common, all programming functions are disabled, except for those listed below which remain enabled.
(-1) NONE (Completely Disabled)  (1) RESET (Enabled)
(-2) PRESET (Enabled)  (2) RESET & PRESET (Enabled)
(-3) S. F. (Scale Factor) (Enabled)  (3) S. F. & RESET (Enabled)
(-4) S. F. & PRESET (Enabled)  (4) S. F. PRESET & RESET (Enabled)
NOTE: Locked out modes can be interrogated but not changed.

NOTES:
(1) Manual reset used only in special applications. For normal rate use, function code 51 may be ignored, and switch S8 on rear should be set on "DISABLE" to deactivate reset button.
(2) Rate applications normally use only (5) or (6).
GEMINI 1000 PROGRAMMING

SOME NOTES & HINTS ON PROGRAMMING THE GEMINI 1000

1. Be systematic about programming! Plan out the exact features & functions you need for your application. Write out the code entries you need from start to finish, and then enter the codes completely. Don't start in the middle of the program codes & make arbitrary entries to "see what it will do." This is a sure way to create confusing results. Finally, after you are done, record your program & file it where you can find it later if you want to make changes. You can use this card to write in your codes in the program ladder on the reverse side, together with any fixed data entries, for convenient future reference.

2. Watch out for conflicting modes! The programs in the GEMINI 1000 have been written to prevent illegal code entry. However, to provide optimum flexibility, some reliance must be placed on the programmer to avoid conflicting codes. For example, when set-up as a counter with any of the automatic reset modes (51, 3, 4, 5, 6), the entry of a manual output termination code (52 or 52) results in a situation where the counter will cycle but the output simply latches on & stays on until a manual reset occurs.

3. The GEMINI 1000 can be interrogated at any time to see what modes & data entries have been made. Such interrogation can be made during a counting cycle or a sample time run without interrupting the normal counting process. In the lockout mode, all functions can also be interrogated, but those functions locked out cannot be changed. Making changes in program modes or data during a run is not recommended since mid-cycle changes can result in unanticipated outputs for that particular cycle.

PROGRAMMING PROCEDURE FOR FUNCTION & MODE SELECTION *
(Applies To Programming Chart)

To enter a programmable function or mode, enter the function selector code desired and then select the particular mode identifier required.

For example, to set up a decimal point to display a reading in 1/100ths with leading zero blanking, function selector code #46 must be entered. (See codes on reverse side.)

Press button #4, then button #6. The display will temporarily interrupt its normal readout (without interfering with the normal operation of the unit) and will display the entered code on the L.H. side.

46 (DISPLAY READOUT)

Next enter the mode identifier (button #3) that defines the decimal point location & LZB condition. This code is displayed on the right.

46 3 (DISPLAY READOUT)

Now enter this new selection by pressing the “E” button.

PROGRAMMING PROCEDURE FOR DATA ENTRY
(Applies To Both Counter 41 Mode & Rate Indicator 41 Mode)

In data entry, the front panel pushbuttons are identified by two different sets of references and will cause two different reactions in the course of making a data entry.

In the first phase of a data entry cycle, the particular data entry mode is called up by pushing the buttons identified by their panel markings. (i.e. Buttons “5”, “3”, “P”, or “S.”). Once the data entry mode has been entered, the existing data appears on the display and the buttons below the display reference themselves to the digits directly above each button. The data can then be changed a digit at a time by depressing the button directly below the digit to be changed. After the new data value is obtained, the “E” button is depressed to enter the new value.

53

OUTPUT TIME DELAY SETTING*

Entering Code “53” will call up the time delay setting in seconds & hundredths. The T.D. can now be set to the new value by incrementing each digit with the button underneath that digit. Press the “E” button to enter the new T.D. value. (Max. T.D. = 599.99 sec.)

S.F. SCALE FACTOR

One stroke of the “S.F.” (3) button calls up the existing scale factor. (The scale factor is the multiplier used to convert the actual count pulses coming into the unit & stored in the counter into the direct readout display). The value can now be changed by incrementing each digit with the button below it. Depressing the “E” key enters the new S.F. S.F. can be set at any value from -.9999 to +.9999.

P PRESET

One stroke of the “P” (1) button calls up the preset value which can then be changed by incrementing each digit with the button below it. Depressing the “E” button to enter the new Preset.

* Program before connecting “PGM. DIS.” to “COMMON”.

SELF TEST ROUTINE 6, +/–

Depressing “6” & then “+/–” starts the self test routine by lighting all decimal points, then all 9’s, all 8’s, all 7’s etc., down to all zeros. Then it displays alternate 1’s & 2’s, etc., until alternate 8’s & 9’s are displayed. At this time, the output can be manually activated for testing by pressing the “P” button. (Output test is disabled when “PGM. DIS.” terminal is pulled to “COMMON”). Pressing the “E/CNT” button will exit the Test Mode at any time, or automatic exit will occur six (6) seconds after the Test Mode is completed. Test Mode can be run at any time and will not interfere with the normal operation of the Gemini 1000 during a run.
GEMINI 2000 PROGRAMMING CHART

FEATURE & MODE SELECTION (See Programming Procedure)

DETAILED MODE MENUS

INPUTS A & B RESPONSE MODES
(1) A = CNT. UP, B = INH.
(2) A = CNT. IN, B = U/D
(3) A = CNT. UP, B = CNT. DN.
(4) A = CNT. UP, B = CNT. UP
(5) QUADRATURE X1
(6) QUADRATURE X4

INPUT PULSE EDGES REGISTERING COUNTS*
(1) NEG. GOING EDGES ONLY
(2) BOTH + & - EDGES
(doubling)
* Not accessible with Quadrature X4 Counter Input Response Mode.

SCALE MULTIPLIER

1 x (2) x 0.1 (3) x 0.01 (4) x 0.001

DECIMAL POINT & LEADING ZERO BLANKING

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>0 (NO D.P.)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

COUNTER RESET MODES

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) MAN. **MAINT. RST. --- 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) MAN. **MAINT. RST. --- PRESET 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) AUTO RESET --- 0 @ END OF OUTPUT 2 T.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) AUTO RESET --- PRESET 2 @ COUNT = PRESET 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) AUTO RESET --- PRESET 2 @ COUNT = 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE 1
* Counter maintained in reset as long as reset is activated.
** Counter momentarily resets and runs at reset initiation.
*** Manual reset via front panel button overrides auto reset modes.

OUTPUT 1 TERMINATION MODES

| (1) TERM. AT OUTPUT 2 START * |
| (2) TERM. AT OUTPUT 2 END |
| (3) TERM. AT START OF MAN. |

NOTE 1
* COUNTER MODES ONLY: These modes are locked out when rate or [54, 6] is programmed.
** Output 1 activates when count \geq\ preset 1 (Counter)

NOTE 2
*** BOUNDARY MODE: Output 1 goes "OFF" when count \less\ preset 1 and "ON" when count \geq\ preset 1 as the value goes up and down through preset 1. This mode is locked out when [54, 1, 2] is programmed.

NOTE: Output 1 normally "OFF", turns "ON" at preset 1. To reverse output action, enter (\-) before mode I.D.

OUTPUT 2 TERMINATION MODES

| (1) TERM. AT OUTPUT 1 START * |
| (2) TERM. AT OUTPUT 1 END |
| (3) TERM. AT START OF MAN. |

NOTE 1
* COUNTER MODES ONLY: These modes are locked out when rate or [52, 6] is programmed.
** Output 2 activates when count \geq\ preset 2 (Counter)

NOTE 2
*** BOUNDARY MODE: Output 2 goes "OFF" when count \less\ preset 2 and "ON" when count \geq\ preset 2 as the value goes up and down through preset 2. This mode is locked out when [52, 1, 2] is programmed.

NOTE: Output 2 normally "OFF", turns "ON" at preset 2. To reverse output action, enter (\-) before mode I.D.

RIGHT HAND DUMMY ZEROS

| (1) = 0 |
| (2) = 00 |
| (3) = 000 |
| (4) = NONE |

SAMPLE TIME (Rate Only)

| (1) 1 sec |
| (2) 2 sec |
| (3) 5 sec |
| (4) 10 sec |
| (5) 20 sec |
| (6) 50 sec |

"OPERATOR ACCESSIBLE FUNCTIONS" MODES (Programming & Disabling)

NOTE: With the "PGM. DIS:" terminal on the rear pulled low to common, all programming functions are disabled, except for those listed below which remain enabled.

| (1) NONE (Completely Disabled) |
| (2) PRESETS (Enabled) |
| (3) S.F. (Scale Factor) (Enabled) |
| (4) S.F. & PRESETS (Enabled) |

NOTE: Locked out modes can be interrogated but not changed.

DATA ENTRY

(1) Manual reset used only in special applications. For normal rate use, function code 51 may be ignored, and switch S6 on rear should be set on "DISABLE" to deactivate reset button.
(2) Rate applications normally use only (5) or (6).
GEMINI 2000 PROGRAMMING

SOME NOTES & HINTS ON PROGRAMMING THE GEMINI 2000

1. Be systematic about programming! Plan out the exact features & functions you need for your application. Write out the code entries you need from start to finish, and then enter the codes completely. Don’t start in the middle of the program codes & make arbitrary entries to “see what it will do.” This is a sure way to create confusing results. Finally, after you are done, record your program & file it where you can find it later if you want to make changes. You can use this card to write in your codes in the program ladder on the reverse side, together with any fixed data entries, for convenient future reference.

2. Watch out for conflicting modes! The programs in the GEMINI 2000 have been written to prevent illegal code entry. However, to provide optimum flexibility, some reliance must be placed on the programmer to avoid conflicting codes. For example, when set-up as a counter with any of the automatic reset modes (5 3, 4, 5 or 6), the entry of a manual output termination code (52 3) or (52 4) results in a situation where the counter will cycle but the output simply latches on & stays on until a manual reset occurs.

3. The GEMINI 2000 can be interrogated at any time to see what modes & data entries have been made. Such interrogation can be made during a counting cycle or a sample time run without interrupting the normal counting process. In the lockout mode, all functions can also be interrogated, but those functions locked out cannot be changed. Making changes in program modes or data during a run is not recommended since mid-cycle changes can result in unanticipated outputs for that particular cycle.

PROGRAMMING PROCEDURE FOR FUNCTION & MODE SELECTION *
(Appplies To Programming Chart)

To enter a programmable function or mode, enter the function selector code desired and then select the particular mode identifier required.

For example, to set up a decimal point to display a reading in 0.1/00ths with leading zero blanking, function selector code #46 must be entered. (See codes on reverse side.)

Press button #4, then button #6. The display will temporarily interrupt its normal readout (without interfering with the normal operation of the unit) and will display the entered code on the L.H. side.

46  (DISPLAY READOUT)

Next, enter the mode identifier (button #3) that defines the decimal point location & L/ZB condition. This code is displayed on the right.

3  (DISPLAY READOUT)

Now enter this new selection by pressing the “E” button.

PROGRAMMING PROCEDURE FOR DATA ENTRY
(Appplies To Both Counter 41 1 Mode & Rate Indicator 41 2 Mode)

In data entry, the front panel pushbuttons are identified by two different sets of references and will cause two different reactions in the course of making a data entry.

In the first phase of a data entry cycle, the particular data entry mode is called up by pushing the buttons identified by their panel markings. (i.e. Buttons “5”, “3”, “P”, or “S.F.”). Once the data entry mode has been entered, the existing data appears on the display and the buttons below the display reference themselves to the digits directly above each button. The data can then be changed a digit at a time by depressing the button directly below the digits to be changed. After the new data value is obtained, the “E” button is depressed to enter the new value.

53  55

OUTPUT TIME DELAY SETTING*

Entering Code “53” or “55” will call up the output 1 or output 2 time delay setting in seconds & hundredths. The T.D. can now be set to the new value by incrementing each digit with the button underneath that digit. Press the “E” button to enter the new T.D. value. (Max. T.D. = 599.99 sec.)

S.F.  SCALE FACTOR

One stroke of the “S.F.” (3) button calls up the existing scale factor. (The scale factor is the multiplier used to convert the actual count pulse coming into the unit & stored in the counter into the direct readout display). The value can now be changed by incrementing each digit with the button below it. Depressing the “E” key enters the new S.F. S.F. can be set at any value from -5.9999 to +5.9999.

P(1)  P(2)

PRESETS

One stroke of the “P” (1) or “P” (2) button calls up the preset value which can then be changed by incrementing each digit with the button below it. Depress the “E” button to enter the new Preset.

* Program before connecting “PGM. DIS.” to “COMMON”.

SELF TEST ROUTINE 6. +/-

Depressing “6” & then “+/−” starts the self test routine by lighting all decimal points, then all 9’s, all 8’s, all 7’s etc., down to all zeros. Then it displays alternate 1’s & 2’s, etc., until alternate 8’s & 9’s are displayed. At this time, the outputs can be manually activated for testing by pressing the “P”(1) or “P”(2) button. (Output test is disable when “PGM. DIS.” terminal is pulled to “COMMON”). An automatic exit will occur six (6) seconds after the Test Mode is completed. Test Mode can be run at any time and will not interfere with the normal operation of the Gemini 2000 during a run.
**GEMINI 4100/4200 - 6-DIGIT PRESETTABLE COUNTER/RATE OR DUAL COUNTER INDICATORS**

**GEMINI 4100 - SINGLE LEVEL & GEMINI 4200 - DUAL LEVEL**

- Accepts count rates to 10 KHz
- Bi-directional counting, up/down control
- Quadrature sensing (Up to 4 times resolution)
- Solid-state current sink output(s)
- Output(s) assignable to either channel
- CSA certified (File #LR67285) [115/230 VAC versions]
- Optional 20 mA current loop for serial data communication
- Relay output(s) (field replaceable)
- Programmable timed output(s) (0.01 to 599.99 sec.)
- Ability to lock out front panel functions
- Sealed front panel construction (NEMA 4/IP65)
- Non-volatile memory (E2PROM)
- Programmability of decimal point location & leading zero blanking

**DESCRIPTION**

The Gemini 4100 and 4200 offer the features of a single (4100) or dual (4200) level, dual function Counter and Rate instrument or Dual Counter instrument in one economically priced package. The Gemini 4000 Series is ideally suited for applications where rate and count indication or control of a process is desired or where batching and totalizing is needed.

The reliability of solid-state MOS technology coupled with the flexibility of user programmability makes these units suited to handle practically any preset control application.

There are two signal inputs to which the count or count control signals for both channels are applied. The Gemini can operate under any one of six input response modes: Count with Inhibit, Count with Up/Dn Control, Anti-Coincidence Add/Subtract, Separate Input mode, or Quadrature modes. As a Counter/Rate instrument, the rate indicator will utilize the same count signal input as the counter except when in “Separate Input” mode, where the rate channel will use one input and the counter channel the other. As a dual counter instrument, both counters will utilize the signal inputs in the same manner. In other words, in all modes except the “Separate Input” mode, a count pulse applied to the input will affect both counters in the same manner.

The choice of several reset cycle modes along with the compatibility of count and control inputs to other RLC products, provides added versatility for both stand-alone and system counter needs.

The Rate Indicator portion uses a time interval method (1/tau) to calculate the rate value. This method enables high resolution at all input rates. The unit counts input pulses and after a programmable minimum update time has occurred, it waits until the next count edge occurs, then takes the elapsed time and number of edges and calculates the rate value.

At slower rates, averaging can be accomplished by programming the “Rate Minimum Update Time” (0.5 sec. to 16 sec.) for the desired response. The minimum input frequency is 0.03 counts/sec. or one pulse every 32 seconds. Extensive scaling capabilities allow practically any desired reading at very slow input rates.

The output(s) can be assigned to either the Rate or Count channel, or one output to each. When programmed as a Dual Counter, both outputs can be assigned to Counter B or Output 1 to Counter A and Output 2 to Counter B.

The 20 mA Current Loop Communications Option provides the capability of two-way serial communications between the Gemini and a variety of equipment, such as a printer, remote terminal, programmable controller, or host computer. The baud rate can be set to 300, 600, 1200, or 2400 baud. The format for transmitted and received data is 1 start bit, 7 data bits, 1 parity bit (odd) and 1 stop bit. When utilizing an external power supply (30 VDC max), up to sixteen units can be installed in the loop, each with an individual address. When utilizing the Gemini’s 20 mA current source, up to seven units can be installed in a loop. The Preset and Scale Factor can be changed by sending the proper command codes and numerical data to the unit. Other functions, such as setting the various counters, can also be performed. Various “Print Options” can be selected to automatically interrogate the Count Values, Presets, and Scale Factor by activating the “Print Request” terminal or by sending a “Transmit Per Print Option” (P) command.

The construction of the Gemini 4000 Series features a metal die-cast bezel offering maximum durability with a high quality appearance. The sealed front panel meets NEMA 4/IP65 specifications for wash-down and/or dust when properly installed. Electrical connections are made via plug-in terminal strips. Clamp-type pressure plate terminals accept stripped #14 AWG wire without lugs.

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**DIMENSIONS In inches (mm)**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>6.20 (157)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>4.48 (113)</td>
</tr>
<tr>
<td>Panel Cut-Out</td>
<td>5.90 (149)</td>
</tr>
</tbody>
</table>

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 6.8" (173 mm) W.
**SPECIFICATIONS**

1. **DISPLAY:** 6-Digit 0.56" (14.2 mm) High LED display

2. **POWER REQUIREMENTS:**
   - **AC Versions:**
     - AC Power: Switch selectable 115/230 VAC, (±10%), 50/60 Hz, 20 VA.
     - DC Power: 11 to 14 VDC @ 0.7 amp max.
   - **DC Versions:**
     - DC Power: +24 VDC (±10%) @ 0.7 amp max.

3. **SENSOR POWER:** +12 VDC (±25%) @ 100 mA.
   - **Note:** The sensor supply voltage varies ±25% due to line and internal load variations. All RLC sensors will accommodate this variation.

4. **MEMORY:** Non-volatile EPROM memory retains all programming information and count values (except Counter Load Values) when power is removed or interrupted.
   - **Power Cycles:** 100,000 min.

5. **INPUTS 1 AND 2:** Switch selectable to accept count pulses from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, and all standard RLC sensors.
   - **Current Source:** Unit provides 3.9 KΩ pull-down resistor for sensors with current sourcing outputs. Max. input voltage = 28 VDC @ 7 mA.
   - **Current Sinking:** Unit provides 7.8 KΩ pull-up resistor for sensors with current sinking outputs. Max. sensor current = 1.6 mA.
   - **Debounce:** Damping capacitor provides for switch contact debounce. Limits count speed to 100 Hz max. with 50% duty cycle.
   - **Lo Bias:** Input trigger levels Vll = 1.5 V, Vlh = 3.75 V.
   - **Hi Bias:** Input trigger levels Vll = 5.5 V, Vlh = 7.5 V.
   - **Note:** Bias levels given are ±10% @ 12 VDC. These levels vary proportionally with sensor supply voltage at "DC OUT" terminal.

6. **MAGNETIC PICKUP INPUT:**
   - **Sensitivity:** 150 mV peak (typical @ 12 VDC)
   - **Hysteresis:** 100 mV
   - **Input Impedance:** 26.5 KΩ @ 60 Hz
   - **Maximum Input Voltage:** ±50 V peak
   - **RATE ACCURACY AND REPEATABILITY:** 0.012%
   - **RATE MINIMUM INPUT FREQUENCY:** 0.03 Hz
   - **Note:** At frequencies below 0.03 Hz (1 pulse every 32 sec.) the rate display will go to zero.

9. **MAXIMUM COUNT RATES:**

<table>
<thead>
<tr>
<th>MODE</th>
<th>X1</th>
<th>X2</th>
<th>X4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uni or Bi-directional</td>
<td>10KHz</td>
<td>5KHz</td>
<td></td>
</tr>
<tr>
<td>Anti-Coincidence Add/Subtract</td>
<td>4KHz</td>
<td>2.5KHz</td>
<td></td>
</tr>
<tr>
<td>Separate Input</td>
<td>8KHz</td>
<td>4KHz</td>
<td></td>
</tr>
<tr>
<td>Quadrature</td>
<td>5KHz</td>
<td>4.5KHz</td>
<td>2.5KHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODE</th>
<th>X1</th>
<th>X2</th>
<th>X4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uni or Bi-directional</td>
<td>9KHz</td>
<td>4.5KHz</td>
<td></td>
</tr>
<tr>
<td>Anti-Coincidence Add/Subtract</td>
<td>5KHz</td>
<td>2.5KHz</td>
<td></td>
</tr>
<tr>
<td>Separate Input</td>
<td>7.5KHz</td>
<td>3.5KHz</td>
<td></td>
</tr>
<tr>
<td>Quadrature</td>
<td>4.5KHz</td>
<td>4KHz</td>
<td>2.5KHz</td>
</tr>
</tbody>
</table>

10. **CONTROL INPUTS:**
   - **Reset:** Active low (Vll = 1.5 V max.) internally pulled up to +12 VDC (ISNK = 3 mA), activation and de-activation response time = 10 msec.
   - **Program Disable:** Active low (Vll = 1.5 V max.) internally pulled up to +5 VDC (ISNK = 1 mA).
   - **Print Request:** Active low (Vll = 1.5 V max.) internally pulled up to +5 VDC (ISNK = 1 mA).

11. **SERIAL COMMUNICATIONS (Optional):**
   - **Type:** Bi-directional 20 mA current loop, 20 mA source provided. (Powers up to 7 units in a loop with internal current source.)
   - **Baud Rate:** Programmable 300 to 2400
   - **Maximum Address:** 16 units. (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 V, VCE = 1 V. VOH = 30 VDC max. (Internal Zener Diode Protection).
     - **Relays:** Mounted on a field-replaceable PC board. Form C contacts rated at 5 amps @ 120/240 VAC, 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load). The operate time is 5 msecs nominal and the release time is 3 msecs nominal.

12. **OUTPUT(S):**
   - **Solid-State:** Current sinking NPN Open Collector Transistor(s), ISNK = 100 mA max. @ VCE = 1 V. VOH = 30 VDC max. (Internal Zener Diode Protection).
   - **Relays:** Mounted on a field-replaceable PC board. Form C contacts rated at 5 amps @ 120/240 VAC, 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load). The operate time is 5 msecs nominal and the release time is 3 msecs nominal.

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
       - 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
       - RF conducted interference EN 61000-4-6 Level 3; 10 V/m
       - Power frequency magnetic fields EN 61000-4-8 Level 4; 30 A/m
     - Emissions to EN 50081-2
       - RF interference EN 55011 Enclosure class A
       - Power mains class A

   **Notes:**
   - 1. Metal bezel of unit connected with ground from rear bezel screw to metal mounting panel.
   - 2. When the unit is DC powered, a power line filter (RLC# LFIL0000 or equivalent) was installed, so as not to impair the function of the unit. Refer to the EMC Compliance Installation section of the manual for additional information.

14. **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

15. **CONSTRUCTION:**
   - Metal die-cast bezel, plastic case. This unit is rated for NEMA 4/IP65 indoor use. Installation Category II, Pollution Degree 2

16. **WEIGHT:** 2.1 lbs. (0.9 kg)
PROGRAMMABLE FUNCTIONS

UNIT PERSONALITY
Functions as a Counter and Rate Indicator or as two counters.

PRESET(S)
Range 0 to ±999999

SCALE FACTORS
Separate 5-digit input scaling for each channel. Range ±0.0001 to 5.9999.

SCALE MULTIPLIER
Multiplies the actual count or rate input by 1, 0.1, 0.01, or 0.001 (counter) or 1000, 100, 10, 1, 0.1, 0.01 (rate), to view the desired number of significant digits on the 6-digit display.

INPUTS 1 & 2 RESPONSE MODES
- Count (1) with Inhibit (2)
- Count (1) with Up/Down Control (2)
- 2-Input Anti-Coincidence Add (1)/Subtract (2)
- Separate Inputs
- Quadrature
- Quadrature X4

NUMBER OF COUNT EDGES
Register counts on one or both edges of input signal (counter only).

RESET ACTION
Reset-to-Zero; Output activates when count equals the preset value. Counter returns to zero when reset.
Reset-to-Preset; Output activates when count equals zero. Counter returns to preset when reset.

RESET MODES
- Manual Reset
- Automatic Reset at Preset or Zero
- Automatic Reset after Timed Output

Manual reset via front panel pushbutton or remote “RST.” terminal can be programmed to act on one or both count channels with either momentary or maintained action. A separate “RST. A” terminal is available to provide independent reset of each channel. Front panel pushbutton reset may be disabled by a switch at the rear of the unit.

COUNTER LOAD
Allows counter value(s) to be changed via the front panel.

RATE RIGHT-HAND DUMMY ZEROS
Up to three non-functional zeros may be placed on the least significant end of the display.

PROGRAMMING
The Gemini 4000 Series input circuit set-up is programmed using DIP switches on the rear of the unit. All other functions are programmed through the front panel pushbuttons.

To program or interrogate a function, the user first enters a two-digit function code. The unit will then display that function code along with a single-digit mode identifier.

EXAMPLE: The function code representing the “Inputs 1 & 2 Response Modes” is 43. The mode identifiers for this function are:
1. Count with Inhibit
2. Count with Up/Down Control
3. 2-Input Anti-Coincidence Add/Subtract
4. Separate Inputs
5. Quadrature
6. Quadrature X4

To interrogate the counting modes,
Press “4”, then “3”:
Unit displays the function code along with mode identifier 1 (Count with Inhibit)

To change the counting mode to “Count with Up/Dn control”, Press “2”:

To enter and save the new mode, Press “E”:
Unit enters new mode and returns display to the present selected display value.

The most commonly used functions, Preset(s) and Scale Factors, are initialized through single front panel pushbuttons rather than a two-digit function code. Pressing the “P” or “SF” pushbuttons will immediately display the current Preset or Scale Factor value for the selected display. To change any digit, the user presses the pushbutton directly below that particular digit, which is then scrolled until the desired value is obtained. Each digit is changed, if necessary, in the same manner until the complete Preset or Scale Factor value is registered on the display. Pressing the “E” pushbutton completes the entry sequence.

To interrogate the Preset value, Press “P”:
Unit displays current Preset value.

To change the Preset value:
Any digit may be changed by pressing the pushbutton directly below it. Release the pushbutton when the digit reaches the desired value.

Press “E”:
Unit enters new Preset value and returns display to the present selected display value.

The Gemini 4000 Series can display either of two selected display values as indicated by LEDs along the left side of the display.

To display a different count value:
Press the “DISP” pushbutton repeatedly until the indicator corresponding to the desired value turns on.
TYPICAL DUAL COUNTER APPLICATION

A manufacturer of molded plastic parts wants to track the percentage of usable parts versus parts produced to determine if a defect has developed in the mold or some other malfunction is occurring which requires corrective action.

From the molding press, parts pass through an inspection station and exit on one of two conveyors depending on whether the part is accepted or rejected. A Gemini 4100 programmed as a dual counter is used in the separate inputs mode. Count Channel B tabulates the number of acceptable parts via a photo sensor mounted on the conveyor. Likewise, count Channel A tabulates the number of rejected parts from a second photo sensor. A system computer constantly monitors the two count values through the Gemini Serial Communications Loop and performs the percentage calculation required.

Since the application requires two presets (upper and lower limits) the Gemini 4200 programmed as a Counter/Rate indicator is used. An LMPC can be used to sense a bolt head located on the auger shaft. Both outputs of the Gemini 4200 are assigned to the Rate channel. First the scaling required for the counter will be calculated. At 30 RPM the pulse rate per minute is the same since a single bolthead is being sensed once each revolution. Since it takes one hour at 30 RPM to use 1.8 tons of coal, the number of pulses accumulated in that hour will be 1800 (30 PPM x 60 min/hr = 1800). The Scale Factor needed is 0.01 (SF = desired reading/# of pulses = 18/1800= 0.01). Since the same information rate and desired reading applies to the rate indication, the same Scale Factor value will be used. It is then only necessary to program the Rate Conversion Factor for Rate per Hour. Both Presets are programmed for boundary operation and the Relay outputs are connected to overspeed and underspeed indicator lights.

TYPICAL COUNTER/RATE APPLICATION

COAL FEED RATE & USAGE INDICATION

An industrial plant has an in-house coal fired boiler which provides heating and powers an electric generator used for secondary power. An auger feeds the coal into the boiler furnace. The actual pressure of the boiler is controlled by the feed rate of the auger. An indication is required when the feed rate falls below or exceeds the desired RPM levels. The plant manager also wants an indication of the amount of coal that is used. The normal desired auger revolution rate is between 30 and 40 RPM. A shaft rotation speed of 30 RPM is equal to a feed rate of 1.8 tons of coal per hour. Rate and usage indication is to be in 10ths of tons per hour.

Since the application requires two presets (upper and lower limits) the Gemini 4200 programmed as a Counter/Rate indicator is used. An LMPC can be used to sense a bolt head located on the auger shaft. Both outputs of the Gemini 4200 are assigned to the Rate channel. First the scaling required for the counter will be calculated. At 30 RPM the pulse rate per minute is the same since a single bolthead is being sensed once each revolution. Since it takes one hour at 30 RPM to use 1.8 tons of coal, the number of pulses accumulated in that hour will be 1800 (30 PPM x 60 min/hr = 1800). The Scale Factor needed is 0.01 (SF = desired reading/# of pulses = 18/1800= 0.01). Since the same information rate and desired reading applies to the rate indication, the same Scale Factor value will be used. It is then only necessary to program the Rate Conversion Factor for Rate per Hour. Both Presets are programmed for boundary operation and the Relay outputs are connected to overspeed and underspeed indicator lights.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>w/20 mA CURRENT LOOP</th>
<th>PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEM41</td>
<td>GEMINI 4100</td>
<td>No</td>
<td>24 VDC - GEM41030 GEM41060</td>
</tr>
<tr>
<td>GEM42</td>
<td>GEMINI 4200</td>
<td>Yes</td>
<td>115/230 VAC - GEM41130 GEM41160</td>
</tr>
<tr>
<td></td>
<td>Gemini 4100 Relay Board</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gemini 4200 Relay Board</td>
<td>N/A</td>
<td>RLYBD001</td>
</tr>
</tbody>
</table>

For more information on Pricing, Enclosures, & Panel Mount Kits, refer to the RLC Catalog or contact your local RLC distributor.
**GEMINI 4100 COUNTER/RATE PROGRAMMING CHART**

**FEATURE & MODE SELECTION (See Programming Procedure)**

### DETAILED MODE MENUS

<table>
<thead>
<tr>
<th>Mode</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Enter star mode.</td>
</tr>
<tr>
<td>42</td>
<td>(1) RST RATE OUTPUT</td>
</tr>
<tr>
<td>43</td>
<td>(2) RST COUNTER</td>
</tr>
<tr>
<td>44</td>
<td>(3) RST RATE OUTPUT &amp; COUNTER</td>
</tr>
</tbody>
</table>

#### INPUTS 1 & 2 RESPONSE MODES

- (1) CNT. & RATE, 2 = INT. (CNT.) |
- (2) CNT. & RATE, 2 = UP/DN |
- (3) CNT. UP & RATE, 2 = CNT. ON |
- (4) CNT. RATE, 2 = CNT. |
- (5) QUADRATURE X1 (1 = RATE) |
- (6) QUADRATURE X4 (1 = RATE) |

**INPUT PULSE EDGES REGISTERING COUNTS (Counter B)**

- (1) NEG. GOING EDGES ONLY |
- (2) BOTH + & - EDGES |
- (1 count/pulse) |
- (2 counts/pulse) |

*Not accessible with Quadrature X4 Input Response Mode.*

#### COUNTER SCALE MULTIPLIER

<table>
<thead>
<tr>
<th>Multiplier</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x1</td>
<td>1</td>
</tr>
<tr>
<td>2 x0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>3 x0.01</td>
<td>0.005</td>
</tr>
<tr>
<td>4 x0.001</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

#### COUNTER DECIMAL POINT & LEADING ZERO BLANKING

| (1)      | 00000000 (NO L.Z.B.) |
| (2)      | 00000000             |
| (3)      | 00000000             |
| (4)      | 00000000             |
| (5)      | 00000000             |
| (6)      | 00000000             |

#### OUTPUT ASSIGNMENT

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 OUT</td>
<td>Output to counter</td>
</tr>
<tr>
<td>3 OUT</td>
<td>Output to rate</td>
</tr>
</tbody>
</table>

#### OUTPUT TERMINATION MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>AT RESET START</th>
<th>AT RESET END</th>
<th>AFTER TIMED OUTPUT</th>
<th>BOUNDARY MODE</th>
<th>OUTPUT NORMALLY OFF</th>
<th>OUTPUT NORMALLY ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5</td>
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<tr>
<td>4</td>
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<tr>
<td>6</td>
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</tr>
</tbody>
</table>

*BOUNDARY MODE: Output goes “OFF” when count or rate < Preset and goes “ON” when count or rate is ≥ Preset as the value goes up and down through the Preset.

#### TIMED OUTPUT VALUE

Timed Output Value range: 0.01 to 599.99 Sec

#### COUNTER RESET MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Reset to Zero</th>
<th>Reset to Preset</th>
<th>Auto Rst After Timed Out</th>
<th>Auto Rst At Timed Out</th>
<th>Maintained Manual Rst</th>
<th>Momentary Manual Rst</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<td>3</td>
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<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Automatically selected when [51] [3] or [52] [6] is programmed.

#### RATE RIGHT HAND DUMMY ZEROS

| Mode | 0 | 0.000%
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### RATE CONVERSION FACTOR

<table>
<thead>
<tr>
<th>Mode</th>
<th>Rate/Sec (x1)</th>
<th>Rate/Minute (x60)</th>
<th>Rate/Hr (x3600)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05 Sec</td>
<td>2.033 Min</td>
<td>10.0 Hr</td>
</tr>
<tr>
<td>2</td>
<td>1 Sec</td>
<td>60 Min</td>
<td>3600 Hr</td>
</tr>
<tr>
<td>3</td>
<td>8 Sec</td>
<td>480 Min</td>
<td>28800 Hr</td>
</tr>
</tbody>
</table>

*Maximum update time varies with each minimum update time.

#### RATE MINIMUM UPDATE TIME

<table>
<thead>
<tr>
<th>Mode</th>
<th>Rate/Sec (x1)</th>
<th>Rate/Minute (x60)</th>
<th>Rate/Hr (x3600)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.05 Sec</td>
<td>2.033 Min</td>
<td>10.0 Hr</td>
</tr>
<tr>
<td>2</td>
<td>1 Sec</td>
<td>60 Min</td>
<td>3600 Hr</td>
</tr>
<tr>
<td>3</td>
<td>8 Sec</td>
<td>480 Min</td>
<td>28800 Hr</td>
</tr>
</tbody>
</table>

#### RATE SCALE MULTIPLIER

<table>
<thead>
<tr>
<th>Mode</th>
<th>x1000</th>
<th>x100</th>
<th>x1</th>
<th>x0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
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<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### RATE DECIMAL POINT & LEADING ZERO BLANKING

| (1)      | 00000000 (NO L.Z.B.) |
| (2)      | 00000000             |
| (3)      | 00000000             |
| (4)      | 00000000             |
| (5)      | 00000000             |
| (6)      | 00000000             |

#### OPERATOR ACCESSIBLE FUNCTIONS** MODES

With “PGM DIS.” terminal to “COMM”

<table>
<thead>
<tr>
<th>Mode</th>
<th>Preset Value</th>
<th>Scale Factors</th>
<th>Counter Load Value</th>
<th>Reset Button &amp; Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<tr>
<td>6</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Entering a [41 - 1], at any time will load factory settings for all modes.
**Gemini 4100 Dual Counter Programming Chart**

**Feature & Mode Selection (See Programming Procedure)**

### Detailed Mode Menus

- **Reset Button & Terminal Actuation Modes**
  - (1) RST Counter A
  - (2) RST Counter B
  - (3) RST Counter A & B

- **Inputs 1 & 2 Response Modes**
  - (1) 1 = CNT. (A & B), 2 = INH.
  - (2) 1 = CNT. (A & B), 2 = UP/DN
  - (3) 1 = CNT. UP (A & B), 2 = CNT. DN (A & B)
  - (4) 1 = CNT. A, 2 = CNT. B
  - (5) Quadrature X1 (A & B)
  - (6) Quadrature X4 (A & B)

- **Input Pulse Edges Registering Counts (Counter A & B)**
  - (1) Neg. Going Edges Only
  - (2) Both + & - Edges
  - (1 count/pulse)
  - (2 counts/pulse)

- **Counter B Scale Multiplier**

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>x0.1</th>
<th>x0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(3)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(4)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(6)</td>
<td>0</td>
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</tbody>
</table>

*Not accessible with Quadrature X4 Input Response Mode.*

### COUNTER B DECIMAL POINT & LEADING ZERO BLANKING

<table>
<thead>
<tr>
<th>MODE</th>
<th>AT RESET START</th>
<th>AT RESET END</th>
<th>AFTER TIMED OUTPUT</th>
<th>BOUNDARY MODE</th>
<th>OUTPUT NORMALLY &quot;OFF&quot;</th>
<th>OUTPUT NORMALLY &quot;ON&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3)</td>
<td>*</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>*</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*BOUNDARY MODE: Output goes "OFF" when count or rate < Preset and goes "ON" when count or rate is ≥ Preset as the value goes up and down through the Preset.

### Timed Output Value

Timed output value range: 0.01 to 599.99 Sec

### Counter B Reset Modes

- **Manual Reset to Zero**
- **Maintained Reset**

### Counter A Reset Modes

- (1) Manual Reset to Zero
- (2) Maintained Reset

### Counter A Scale Multiplier

<table>
<thead>
<tr>
<th>(1)</th>
<th>x1</th>
<th>x0.1</th>
<th>x0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(3)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(4)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(6)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Operator Accessible Functions**

(With "PGM DIS." terminal to "COM")

<table>
<thead>
<tr>
<th>MODE</th>
<th>PRESET VALUE</th>
<th>SCALE FACTORS</th>
<th>COUNTER LOAD VALUE</th>
<th>RESET BUTTON &amp; TERMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Entering a [41-2] at any time will load factory settings for all modes.
GEMINI 4100 PROGRAMMING

SOME NOTES & HINTS ON PROGRAMMING THE GEMINI 4100

1. Be systematic about programming! Plan out the exact features & functions you need for your application. Write out the code entries you need from start to finish, and then enter the codes completely. Don’t start in the middle of the program codes & make arbitrary entries to “see what it will do.” This is a sure way to create confusing results. Finally, after you are done, record your program & file it where you can find it later if you want to make changes. You can use this card to write in your codes in the program ladder on the reverse side, together with any fixed data entries, for convenient future reference.

2. Watch out for conflicting modes! The programs in the GEMINI 4100 have been written to prevent illegal code entry.

However, to provide optimum flexibility, some reliance must be placed on the programmer to avoid conflicting codes.

3. The GEMINI 4100 can be interrogated at any time to see what modes & data entries have been made. Such interrogation can be made during a counting cycle or a sample time run without interrupting the normal counting process. In the lookout mode, all functions can also be interrogated, but those functions locked out cannot be changed. Making changes in program modes or data during a run is not recommended since mid-cycle changes can result in unanticipated outputs for that particular cycle.

PROGRAMMING PROCEDURE FOR FUNCTION & MODE SELECTION ☆
(Applies To Programming Chart)

To enter a programmable function or mode, enter the function selector code desired and then select the particular mode identifier required.

For example, to set up a decimal point to display a reading in 1/100ths with leading zero blanking, function selector code #46 must be entered. (See codes on reverse side.)

Press button #4, then button #6. The display will temporarily interrupt its normal readout (without interfering with the normal operation of the unit).

It will then display the entered code on the L.H. side.

[46 ] (DISPLAY READOUT)

Next, enter the mode identifier (button #3) that defines the decimal point location & LZB condition. This code is displayed on the right.

[46 3] (DISPLAY READOUT)

Now, enter this new selection by pressing the “E” button.

PROGRAMMING PROCEDURE FOR DATA ENTRY

In data entry, the front panel pushbuttons are identified by two different sets of references and will cause different reactions in the course of making a data entry.

In the first phase of a data entry cycle, the particular data entry mode is called up by pushing the buttons identified by their panel markings. (i.e. Buttons “5”, “3”, “P”, & “SF”). Once the data entry mode has been entered, the existing data appears on the display and the buttons below the display reference themselves to the digits directly above each button. The data can then be changed a digit at a time by depressing the button directly below the digits to be changed.

After the new data value is obtained, the “E” button is depressed to enter the new value.

Press the “E” button to enter the new Timed Output value. (Max. Timed Output value = 599.99 sec.)

[S.F. ] SCALE FACTOR
One stroke of the “S.F.” (3) button calls up the existing Scale Factor for the currently displayed count or rate value. (The Scale Factor is the multiplier used to convert the actual count or rate to the direct readout display). The value can be changed by incrementing each digit with the button below it. Pressing the “E” key enters the new S.F. The S.F. can be set at any value from +/-0.0001 to +/-5.9999. (Positive only for Rate Scale Factor A.)

[P ] PRESET
One stroke of the “P” button calls up the preset value, which can then be changed by incrementing each digit with the button below it. Press the “E” button to enter the new Preset.

☆ Program before connecting “PGM. DIS.” to “COMMON”.

SELF TEST ROUTINE 6, +/-

Depressing “6” & then “+-” starts the self test routine by lighting all decimal points, then all 9’s, all 8’s, all 7’s etc., until alternate 8’s & 9’s are displayed. At this time, the output can be manually activated for testing by pressing the “P” button. (The Output test is disabled when “PGM. DIS.” terminal is pulled to “COMMON.”) An automatic exit will occur six (6) seconds after the Test Mode is completed. Test Mode can be run at any time and will not interfere with the normal operation of the Gemini 4100.
# GEMINI 4200 COUNTER/RATE PROGRAMMING CHART

## FEATURE & MODE SELECTION (See Programming Procedure)

### DETAILED MODE MENUS

#### RESET BUTTON & TERMINAL ACTUATION MODES

1. RST RATE OUTPUT
2. RST COUNTER
3. RST RATE OUTPUT & COUNTER

#### INPUTS 1 & 2 RESPONSE MODES

1. CNT. & RATE, 1 = CNT. & RATE, 2 = INH. (CNT.)
2. CNT. & RATE, 2 = UP/DWN
3. CNT. & RATE, 2 = CNT. DNL.
4. CNT. & RATE, 2 = CNT.
5. QUADRATURE X1 (1 = RATE)
6. QUADRATURE X4 (1 = RATE)

#### INPUT PULSE EDGES REGISTERING COUNTS (Counter B)*

1. NEG. GOING EDGES ONLY
2. BOTH + & - EDGES

- 1 count/pulse
- 2 counts/pulse

* Not accessible with Quadrature X4 Input Response Mode.

#### COUNTER SCALE MULTIPLIER

- x1
- x0.01
- x0.001

#### COUNTER DECIMAL POINT & LEADING ZERO BLANKING

- (1) 0
- (2) 0.0
- (3) 0.00
- (4) 0.000
- (5) 0.0000
- (6) 0.00000

#### OUTPUT ASSIGNMENT :

- (1) OUT 1 → RATE, OUT 2 → CNTR
- (2) OUT 1 & 2 → CNTR
- (3) OUT 1 & 2 → RATE

* A (1) preceding the mode identifier enables Preset 1 to track Preset 2.

### OUTPUT 1 TERMINATION MODES

<table>
<thead>
<tr>
<th>MODE</th>
<th>AT OUTPUT 2 START</th>
<th>AT OUTPUT 2 END</th>
<th>AT RESET START</th>
<th>AT RESET END</th>
<th>AFTER TIMED OUTPUT 1</th>
<th>BOUNDARY MODE</th>
<th>OUTPUT 1 NORMALLY &quot;OFF&quot;</th>
<th>OUTPUT 1 NORMALLY &quot;ON&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>† (1)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (2)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (3)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (4)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (5)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (6)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† These modes are available only when [51, 2] is programmed.

‡ Output 1 activates when Count or Rate ≥ Preset 1 [51.2], Output 1 activates when Rate ≤ Preset 1 [51.3].

* BOUNDARY MODE: Output goes "OFF" when Count or Rate < Preset and goes "ON" when Count or Rate is ≥ Preset as the value goes up and down through the Preset.

### TIMED OUTPUT 1 VALUE

Timed Output Value range: 0.01 to 599.99 Sec

### OUTPUT 2 TERMINATION MODES

<table>
<thead>
<tr>
<th>MODE</th>
<th>AT OUTPUT 1 START</th>
<th>AT OUTPUT 1 END</th>
<th>AT RESET START</th>
<th>AT RESET END</th>
<th>AFTER TIMED OUTPUT 2</th>
<th>BOUNDARY MODE</th>
<th>OUTPUT 2 NORMALLY &quot;OFF&quot;</th>
<th>OUTPUT 2 NORMALLY &quot;ON&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>† (1)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (2)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (3)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (4)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (5)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (6)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† These modes are available only when [51, 2] is programmed.

‡ Output 2 activates when Count or Rate ≥ Preset 2.

* BOUNDARY MODE: Output goes "OFF" when Count or Rate < Preset and goes "ON" when Count or Rate is ≥ Preset as the value goes up and down through the Preset. Automatically selects [56, 1] if [51, 1] or 2 is programmed.

### TIMED OUTPUT 2 VALUE

Timed Output Value range: 0.01 to 599.99 Sec

### COUNTER RESET MODES

<table>
<thead>
<tr>
<th>MODE</th>
<th>RESET TO ZERO</th>
<th>RESET TO PRESET 2</th>
<th>AUTO RST AFTER TIMED OUT 2</th>
<th>AUTO RST AT TIMED OUT 2</th>
<th>MAINTAINED MANUAL RST</th>
<th>MOMENTARY MANUAL RST</th>
</tr>
</thead>
<tbody>
<tr>
<td>† (1)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (2)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (3)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (4)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (5)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>† (6)</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Automatically selected when [54, 6] or [51, 3] is programmed.
<table>
<thead>
<tr>
<th>MODE</th>
<th>PRESET VALUE</th>
<th>SCALE FACTORS</th>
<th>COUNTER LOAD VALUE</th>
<th>RESET BUTTON &amp; TERMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Entering a [41 -1], at any time will load factory settings for all modes.
# GEMINI 4200 DUAL COUNTER PROGRAMMING CHART

## FEATURE & MODE SELECTION (See Programming Procedure)

### DETAILED MODE MENUS

#### RESET BUTTON & TERMINAL ACTUATION MODES

RST COUNTER A  
RST COUNTER B  
RST COUNTER A & B

#### INPUTS 1 & 2 RESPONSE MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 = CNT. (A &amp; B), 2 = INH.</td>
</tr>
<tr>
<td>2</td>
<td>1 = CNT. (A &amp; B), 2 = UP/DN</td>
</tr>
<tr>
<td>3</td>
<td>1 = CNT. UP (A &amp; B), 2 = CNT. DN (A &amp; B)</td>
</tr>
<tr>
<td>4</td>
<td>1 = CNT. A, 2 = CNT. B</td>
</tr>
<tr>
<td>5</td>
<td>QUADRATURE X1 (A &amp; B)</td>
</tr>
<tr>
<td>6</td>
<td>QUADRATURE X4 (A &amp; B)</td>
</tr>
</tbody>
</table>

#### INPUT PULSE EDGES REGISTERING COUNTS (Counter A & B)*

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NEG. GOING EDGES ONLY</td>
</tr>
<tr>
<td>2</td>
<td>BOTH + &amp; - EDGES</td>
</tr>
<tr>
<td></td>
<td>(1 count/pulse)</td>
</tr>
<tr>
<td></td>
<td>(2 counts/pulse)</td>
</tr>
</tbody>
</table>

* Not accessible with Quadrature X4 Input Response Mode.

### COUNTER B SCALE MULTIPLIER

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>x1</td>
</tr>
<tr>
<td>2</td>
<td>x0.1</td>
</tr>
<tr>
<td>3</td>
<td>x0.01</td>
</tr>
<tr>
<td>4</td>
<td>x0.001</td>
</tr>
</tbody>
</table>

### COUNTER B DECIMAL POINT & LEADING ZERO BLANKING

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

### OUTPUT ASSIGNMENT *

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUT. 1→CNTAX A, OUT. 2→CNTAX B</td>
</tr>
<tr>
<td>2</td>
<td>OUT. 1 &amp; 2→CNTAX B</td>
</tr>
</tbody>
</table>

* A (.) preceding the mode identifier enables Preset 1 to track Preset 2.

### OUTPUT 1 TERMINATION MODES

#### Mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>OFF</td>
</tr>
</tbody>
</table>

### OUTPUT 2 TERMINATION MODES

#### Mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>OFF</td>
</tr>
</tbody>
</table>

### TIMED OUTPUT 1 VALUE

Timed Output Value range: 0.01 to 599.99 Sec

### TIMED OUTPUT 2 VALUE

Timed Output Value range: 0.01 to 599.99 Sec

### COUNTER B RESET MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AUTO RST AFTER TIMED OUT.</td>
</tr>
<tr>
<td>2</td>
<td>MAINTAINED MANUAL RST</td>
</tr>
<tr>
<td>3</td>
<td>MOMENTARY MANUAL RST</td>
</tr>
</tbody>
</table>

* Automatically selected when [54, 6] is programmed.

---

* These modes are available only when [51, 2] is programmed.

* BOUNDARY MODE: Output goes “OFF” when Count < Preset and goes “ON” when Count ≥ Preset as the value goes up and down through the Preset. Automatically selects [51, 1].
# COUNTER A RESET MODES

<table>
<thead>
<tr>
<th>MODE</th>
<th>RESET TO ZERO</th>
<th>RESET TO PRESET 1</th>
<th>AUTO RST AFTER TIMED OUT.</th>
<th>AUTO RST AT TIMED OUT.</th>
<th>MAINTAINED MANUAL RST</th>
<th>MOMENTARY MANUAL RST</th>
</tr>
</thead>
<tbody>
<tr>
<td>* (1)</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- (1)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
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<td>(3)</td>
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<td>(4)</td>
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<td>(5)</td>
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<tr>
<td>(6)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Automatically selected when [51-2] or [52-6] is programmed.

---

# COUNTER A SCALE MULTIPLIER

(1) \(\times 1\)  
(2) \(\times 0.1\)  
(3) \(\times 0.01\)  
(4) \(\times 0.001\)

- **COUNTER A DECIMAL POINT & LEADING ZERO BLANKING**
  
<table>
<thead>
<tr>
<th>MODE</th>
<th>PRESET VALUE</th>
<th>SCALE FACTORS</th>
<th>COUNTER LOAD VALUE</th>
<th>RESET BUTTON &amp; TERMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td>(2)</td>
<td>0.0</td>
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<td></td>
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<td>(3)</td>
<td>0.00</td>
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<tr>
<td>(4)</td>
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<tr>
<td>(5)</td>
<td>0.0000</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>0.00000</td>
<td></td>
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</tr>
</tbody>
</table>

- **OPERATOR ACCESSIBLE FUNCTIONS**

  (With "PGM. DIS." terminal to "COMM")

<table>
<thead>
<tr>
<th>MODE</th>
<th>PRESET VALUE</th>
<th>SCALE FACTORS</th>
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<th>RESET BUTTON &amp; TERMINAL</th>
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<tbody>
<tr>
<td>(1)</td>
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<tr>
<td>(6)</td>
<td></td>
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</tr>
</tbody>
</table>

☆ Entering a [41-1], at any time will load factory settings for all modes.
GEMINI 4200 PROGRAMMING

SOME NOTES & HINTS ON PROGRAMMING THE GEMINI 4200

1. Be systematic about programming! Plan out the exact features & functions you need for your application. Write out the code entries you need from start to finish, and then enter the codes completely. Don’t start in the middle of the program codes & make arbitrary entries to “see what it will do.” This is a sure way to create confusing results. Finally, after you are done, record your program & file it where you can find it later if you want to make changes. You can use this card to write in your codes in the program ladder on the reverse side, together with any fixed data entries, for convenient future reference.

2. Watch out for conflicting modes! The programs in the GEMINI 4200 have been written to prevent illegal code entry. However, to provide optimum flexibility, some reliance must be placed on the programmer to avoid conflicting codes.

3. The GEMINI 4200 can be interrogated at any time to see what modes & data entries have been made. Such interrogation can be made during a counting cycle without interrupting the normal counting process. In the lockout mode, all functions can also be interrogated, but those functions locked out cannot be changed. Making changes in program modes or data during a run is not recommended since mid-cycle changes can result in unanticipated outputs for that particular cycle.

PROGRAMMING PROCEDURE FOR FUNCTION & MODE SELECTION ☆

(Appplies To Programming Chart)

To enter a programmable function or mode, enter the function selector code desired and then select the particular mode identifier required.

For example, to set up a decimal point to display a reading in 1/100ths with leading zero blanking, function selector code #46 must be entered. (See codes on reverse side.)

Press button #4, then button #6. The display will temporarily interrupt its normal readout (without interfering with the normal operation of the unit).

It will then display the entered code on the L.H. side.

[46 ] (DISPLAY READOUT)

Next, enter the mode identifier (button #3) that defines the decimal point location & LZB condition. This code is displayed on the right.

[46 3] (DISPLAY READOUT)

Now, enter this new selection by pressing the “E” button.

PROGRAMMING PROCEDURE FOR DATA ENTRY

In data entry, the front panel pushbuttons are identified by two different sets of references and will cause two different reactions in the course of making a data entry.

In the first phase of a data entry cycle, the particular data entry mode is called up by pushing the buttons identified by their panel markings. (i.e. Buttons “5”, “3”, “P”, or “SF”). Once the data entry mode has been entered, the existing data appears on the display and the buttons below the display reference themselves to the digits directly above each button. The data can then be changed a digit at a time by depressing the button directly below the digits to be changed.

After the new data value is obtained, the “E” button is depressed to enter the new value.

[53,55 ] TIMED OUTPUT VALUES ☆

Entering Code “53” or “55” will call up the Timed Output 1 or 2 value in seconds & hundredths. The value can be set to the new value by incrementing each digit with the button underneath that digit.

Press the “E” button to enter the new Timed Output value. (Max. Timed Output value = 599.99 sec.)

[S.F. ] SCALE FACTORS

One stroke of the “SF” (3) button calls up the existing Scale Factor for the currently displayed count or rate value. (The Scale Factor is the multiplier used to convert the actual count or rate to the direct readout display). The value can be changed by incrementing each digit with the button below it. Pressing the “E” key enters the new S.F. The S.F. can be set at any value from +/- 0.0001 to +/- 5,9999. (Positive only for Rate Scale Factor A.)

[P(1),P(2) ] PRESETS

One stroke of the “P(1)” or “P(2)” button calls up the preset 1 or 2 value, which can then be changed by incrementing each digit with the button below it. Press the “E” button to enter the new Preset.

☆ Program before connecting “PGM. DIS.” to “COMMON”.

SELF TEST ROUTINE 6, +/-

Depressing “6” & then “+/-” starts the self test routine by lighting all decimal points, then all 9’s, all 8’s, all 7’s etc., until alternate 8’s & 9’s are displayed. At this time, the output can be manually activated for testing by pressing the “P(1)” or “P(2)” button. (The Output test is disable when “PGM. DIS.” terminal is pulled to “COMMON”.) An automatic exit will occur six (6) seconds after the Test Mode is completed. Test Mode can be run at any time and will not interfere with the normal operation of the Gemini 4200.
DESCRIPTION

The Legend Plus Series consists of two models that are multi-input count and rate indicators. The LGPB features process, batch, and total counting, as well as a time interval rate indicator. The four available presets can be assigned to the process counter or the rate indicator. Outputs three and four can also be assigned to the batch or total indicator. The Legend Plus foot-inch counter provides Process and Total count read-outs in feet and inches. A decimal point is used to separate the foot and inch units. All Process and Total presets are also displayed in feet and inches. The LGPM features six presets, which can be assigned to either the rate or count display.

The Legend Plus has advanced features which allow the units to be more closely coupled to the application. The units feature a 2 line by 8 character alpha-numeric display, allowing the value mnemonics and programming menus to be easily read. The units are available in single or dual color display models. The four scroll-through indication displays can be programmed to show various parameters and automatically scroll, if desired. On dual color models, each indication display can be programmed for either color. The mnemonics corresponding to the main display values (RATE, PROCESS, BATCH, TOTAL) can be individually programmed and modified as desired. For example, the RATE mnemonic can be reprogrammed to display the word SPEED, so that when the rate mnemonic is to be displayed, the mnemonic SPEED is displayed instead.

Two custom display lines are available which enable the user to specify the number of digits of a value to be displayed on the line, along with any alpha-numeric prefix or suffix. This capability allows displays such as: ‘1000 RPM’, ‘99999 Ft’, ‘PRC 9999’, etc.

The Legend Plus also features messaging capabilities that can inform the user of output actions or other events that occur in a system. Up to ten messages can be programmed. Messages can be requested by an output status change, user input(s), or through serial communications. The messages can be programmed to blink, scroll, time out, and to alternately flash between message and indication display.

On dual color models, the message can be programmed to be displayed in either color.

DIMENSIONS **“In inches (mm)”**

<table>
<thead>
<tr>
<th>RATe</th>
<th>RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1567</td>
<td></td>
</tr>
</tbody>
</table>

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 3.0” (76.2)H x 4.0” (101.6)W.
DESCRIPTION (Cont’d)

This capability is very useful in drawing the operator’s attention to particular messages.

The program disable DIP switch, the code value, and an external user input selected for Program Disable can be utilized to provide multi-level protection against unwanted changes to data values and unit configuration.

The Legend Plus features enhanced serial communications. The serial port can be configured for connection to RS-485 or RS-232 devices. It can be used for data retrieval and for programming various data values.

All Optional Legend Plus Programming Software for IBM® compatible PC’s is available to program all the Legend configuration parameters, such as messages, count modes, etc. The software allows unit configurations to be created, uploaded, downloaded and saved to a file for rapid programming of the Legend unit.

The six programmable User Inputs can be configured to provide a variety of functions. Four user inputs are located on the upper rear terminal block and the other two inputs are front panel function keys. The User Inputs can be created, uploaded, downloaded and saved to a file for rapid programming of the Legend unit.

The units offer a choice of seven programmable counting modes for use in applications requiring Bi-directional, Anti-coin, and Quadrature counting. The count inhibit function can be utilized with all of these input response modes by programming User Input 4 for the Inhibit Count function. The input circuitry is switch selectable to accept signals from a variety of sources. In the Anti-coin mode both inputs are monitored simultaneously, so that no counts are missed, and the final count can be chosen as the sum or difference of the two inputs.

Rate, Process and Total displays have separate scaling and decimal point placement, for readouts in different units. The Counter Load feature enables the operator to modify the count value. This is useful when flawed material has been counted and it is necessary to adjust the count value accordingly.

The rate operates in the time interval method (1/tau) to calculate the rate value. This method insures high resolution at all input rates. Averaging can be accomplished by programming the Minimum and Maximum Update Time for the desired response. Extensive scaling capabilities allow practically any reading at very slow input rates.

The construction of the Legend Plus unit is a lightweight, high impact plastic case with a clear viewing window. The sealed front panel with silicone rubber keypad meets NEMA4X/IP65 specifications for wash-down and/or dusty environments, 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.

MODEL - LGPB

The process counter is used to monitor the count within the batch. Presets 1 through 4 can be assigned to the process counter or the rate indicator. Presets 3 and 4 can also be assigned to either the batch counter or totalizer.

Presets 1 and 2 can activate relay outputs 1 and 2 respectively. Presets 3 and 4 can activate the NPN open collector outputs O3-SNK and O4-SNK respectively.

Mode: unordered batch. The batch preset count is limited only by the hardware specifications. All 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.

MODEL - LGPM

The Multi Preset unit has 6 presets which can control NPN open collector outputs 01-SNK to 06-SNK respectively. Presets 1 through 6 can be assigned to either the rate or count displays.

SPECIFICATIONS

1. DISPLAY: 2x8, 0.3" (7 mm) high characters, negative image transmissive LCD, with Single (green or red) or Dual Color (green and red) LED backlighting.

2. POWER:
   AC Operation: 115/230 VAC ±10%, 50/60 Hz, 10 VA, switch selectable.
   DC Operation: +12 VDC ±20% @ 250 mA max.

3. MEMORY: Non-volatile memory retains all programming information. Count and Preset values are written to non-volatile memory when power is interrupted. All other configuration parameters are written to memory when programming mode is exited. If power is removed while in the programming menu’s parameters are stored to previously saved settings.

Data Retention: 10 yr. min.

Message/Mnemonic Memory:
792 (LGPB) / 804 (LGPM) bytes available (with factory settings loaded).

4. SENSOR POWER: +12 VDC ±20% @ 100 mA.

5. INPUTS A and B: DIP Switch selectable to accept count pulses from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups and all standard RLC sensors.

LOGIC: Input trigger levels VIL = 1.5 VMIN, VIH = 3.75 VMIN.
Current sinking: Internal 7.8 KΩ pull-up to +12 VDC, Imin = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA @ 28 VDC.
Debounce: Damping capacitor provided for switch contact bounce.

Limits count speed to 50 Hz and input pulse widths to 10 msec min.

MAGNETIC PICKUP:
Sensitivity: 200 mV peak.
Hysteresis: 100 mV.
Input impedance: 3.9 KΩ @ 60 Hz.
Maximum input voltage: +50 Vp
Note: For magnetic pickup input, the sink/source DIP switch must be in the SRC position.

6. RATE ACCURACY: ±0.01%.

7. RATE MINIMUM INPUT FREQUENCY: 0.01 Hz.

8. MAXIMUM COUNT RATE IN KHz:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>COUNT + DIR</th>
<th>QUAD</th>
<th>ADD/ADD</th>
<th>ADD/SUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGPB (Batch)</td>
<td>X1</td>
<td>X2</td>
<td>X1</td>
<td>X2</td>
</tr>
<tr>
<td>LGPM (Six Preset)</td>
<td>X1</td>
<td>6</td>
<td>X2</td>
<td>6</td>
</tr>
<tr>
<td>LGPB (Foot-Inch)</td>
<td>X1</td>
<td>7</td>
<td>X2</td>
<td>7</td>
</tr>
</tbody>
</table>

Note:
1. Maximum count rates given are for Process counter set for Auto reset with the auto cycle preset set to an equivalent of 100 count pulses or greater.
With auto cycle presets less than 100 counts the maximum count rates may be lower. The actual Preset value for 100 count pulses, with Count SF=0.5000 and Count Scale Multiplier=1X1, would be 50.
2. Maximum count rate given for X2 & X4 count modes are given for 50% duty cycle signals and Quad signals with 90° phase shift.

9. MAXIMUM COUNTER CAPACITY:
Process or Count:
9 digits internal (non-scaled), 6 digits displayable (scaled)
Batch Count:
6 digits
Total Count:
11 digits internal (non-scaled), 8 digits displayable (scaled)

10. CONTROL INPUTS:

Programmable user inputs (4):

USR INP 1 to 3: Internal 10 KΩ pull-up to +5 VDC, VIL = 1.5 VMAX, VIH = 3.5 VMIN, response time = 30 msec typical, 100 msec max. (count rate dependent).

USR INP 4/INH: Internal 10 KΩ pull-up to +5 VDC, VIL = 1.5 VMAX, VIH = 3.0 VMIN, response time = 30 msec typical, 100 msec max. (count rate dependent).

INHIBIT Response time = 50 µsec max.

User Inputs Programmed for Binary Message Request: Debounce = 100 msec. (Binary message request inputs must be stable for 100 msec before a message is requested).

11. SERIAL COMMUNICATIONS:
Type: Jumper selectable RS-485 or RS-232.
Can connect up to 32 units when using RS-485 interface.
Baud Rate: Programmable from 1200 to 9600.
Maximum Addresses: Programmable from 00 to 99. (Actual number on a line is limited by hardware specifications)
Transmit Delay: Programmable for 0.002 or 0.100 second.
Data Format: 10 Bit Frame; 1 start bit, 7 or 8 data bits, 1 or no parity bit, and 1 stop bit. Parity is programmable for ODD (7 data bits), EVEN (7 data bits), or NO Parity (8 data bits).

12. OUTPUT(S):

Solid-State: Current sinking NPN open collector transistor.
VCC = 1.1 Vsat @ 100 mA max. VCC = 30 VDC max.
(Internal Zener Diode Protection).

Relay(s): Mounted on field-replaceable P.C. board. Form C contacts rated at 5 amps @ 120 VAC/240 VAC or 28 VDC (resistive load), 1/8 H.P. @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.
12. OUTPUT(S): (Cont’d)
Programmable Timed Output(s): Programmable time ranges from 0.01 to 99.99 seconds, ±0.05% - 11 msec max.
Output Time Required To Request Message: 50 msec.
13. ENVIRONMENTAL CONDITIONS:
Operating Temperature: 0 to 50°C
Storage Temperature: -40 to 70°C
Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
Altitude: Up to 2000 meters
14. CERTIFICATIONS AND COMPLIANCES:
UL Recognized Component, File #E137808
Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
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 61000-4-4 - Electrical fast transient/burst (EFT)
EN 61000-4-8 - Power frequency magnetic field
Notes:
1. Unit required a line filter (Corcom #1VB3) when DC powered. Test: EN 61000-4-4 EFT and ENV 50141 RF Conducted Immunity.
2. Ground shield or ferrite suppression core (TDK #ZCAT3035-1330A) at device end (opposite end from unit) on serial communication cable eliminates serial transmission garble.
15. CONSTRUCTION:
High impact plastic case with clear viewing window.
The front panel meets NEMA4X/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. (Panel gasket, mounting clips, nut fasteners and screws included with unit.)
16. WEIGHT: 1.5 lbs. (0.68 Kg)

PROGRAMMING
The Legend Plus Series provides an easy to use, menu driven programming interface. The English prompts, the front panel keypad, and the flashing display aid the operator during programming. In the normal operating mode, the main display loop allows the user to scroll through the four programmable indication displays using the direction keys. From the main loop, presets and scale factors can be accessed directly. All other parameters are accessed through the programming loop, which can be set to require an access code number to enter the loop. In the programming loop, parameters can be viewed or changed and the operator can exit anywhere in the loop. The drawing at left shows the main display loop and part of the programming loop of a Legend Plus unit. Also shown above are four different views of the indication displays.

PROGRAMMABLE FUNCTIONS
PRESET(S)
Ranges from -99999 to 999999
Counter Load ranges from -99999 to 999999
SCALE FACTORS (RATE, COUNT & TOTAL)
Ranges from 0.0001 to 5.9999. The internal count value is multiplied by the count scale factor and the count scale multiplier to provide the process count display value. The total count is scaled by the count scale factor and the count scale multiplier, and is additionally scaled by the total scale factor. The number of negative edges is multiplied by the rate scale factor, the rate scale multiplier, and the rate conversion factor to calculate the rate value.
COUNT SCALE MULTIPLIER
Multiplies the contents of the 9-digit internal counter or the 11-digit internal totalizer by a factor of 1, 0.1, 0.01 or 0.001 to view the desired number of significant digits on the 6-digit Counter display or the 8-digit Totalizer display.
DECIMAL POINT
Separate decimal point location for Count, Rate, and Total displays.
\[
\begin{align*}
0 & \\
0.0 & \\
0.00 & \\
0.000 & \\
0.0000 & \\
\end{align*}
\]
RATE SCALE MULTIPLIERS
Multiplies the contents of the actual internal rate, pulses per second (PPS), by a factor of 0.01, 0.1, 1, 10, 100, or 1000 to view the desired number of significant digits on the 6-digit Rate display. The desired time units for the rate can be programmed as per Second (x1), per Minute (x60), or per Hour (x3600).
UPDATE TIME
The Rate Minimum and Maximum Update Times range from 0.1 to 99.9 seconds. This provides averaging capability for non-consistent pulse spacing.
Note: The maximum update time must be larger than the minimum update time.
COUNTING MODES
Count with Direction
Count with Direction (X2)
Quadrature
Quadrature (X2)
Quadrature (X4)
2-Input Anti-coincidence Add/Subtract
2-Input Anti-coincidence Add/Add
A separate Inhibit input is available for all count modes.
RESET MODES
Manual Reset
Automatic Reset at Preset
Reset at Beginning Of Output 1
Reset at End Of Timed Output 1
Reset at Beginning Of Output 2
Reset at End Of Timed Output 2
Reset at Beginning Of Output 1 or Output 2
Reset at End Of Timed Output 1 or Output 2

MODEL LGPB ONLY
Reset at Beginning Of Output 3
Reset at End Of Timed Output 3
Reset at Beginning Of Output 4
Reset at End Of Timed Output 4
Reset at Beginning Of Output 3 or Output 4
Reset at End Of Timed Output 3 or Output 4

RESET ACTION
Reset to Zero: Count display value returns to zero when reset. Output activates, if programmed, when the count equals the preset value.
Reset to Preset: Count display value returns to preset value when reset. Output assigned to the specified preset activates, if programmed, when the count equals zero.
Reset to Counter Load: Count display value returns to counter load value when reset. Output activates, if programmed, when the count equals the preset value.

USER INPUTS
There are four external user inputs and two front panel Function keys that are programmable. When activated, each user input can be programmed to perform one of the following functions:
Maintained Reset or Momentary Reset:
- Can reset Rate, Peak, Valley, Process*, Batch*, Total*, or Count* display values and/or any output associated with that display.
- * On Models with these available display options.
Reset Output(s):
- Places the output(s) in their inactive state. (Momentary action)
Set Output(s):
- Places the output(s) in their active state. (Momentary action)

View Display 1-4:
- Causes the selected indication display (1, 2, 3, or 4) to be displayed and held from anywhere in the main display loop. The current display value is frozen (not updated) while the display is held.

Change Display:
- Causes the indication display to toggle to the next indication display.

Request Message:
- Requests a specific programmed message to activate.
Clear Message:
- Causes the displayed message to be canceled. (Maintained action)
Skip Preset:
- Keeps the output from activating and automatic reset from occurring, if programmed, when the count value equals the preset value.

Output(s) Power Up or Power Down State:
- The Output’s state can be set to be Off (Inactive) @ power up.
- OR
- The Output’s state can be set to be On (Active) @ power up.
- Note: Power down state for Latched Mode Only.

Reset Output when Count is Reset:
- This feature can be enabled or disabled.

Request Message:
- Each output can be programmed to request a specific message when the output conditions are satisfied.

INDICATION DISPLAYS
Each of the four indication displays is programmed individually. Each line of each indication display can be programmed to show a value mnemonic, a numeric value, the output status, a preset value, the counter load value, or any output associated with that display.

SPEED.

OUTPUT(S)
Output Assignment:
- The LGPB can have outputs 1 through 4 assigned to the process or the rate. Outputs 3 and 4 can also be assigned to the batch or total.
- The LGPM can have outputs 1 through 6 assigned to either count or rate.

Phase:
- Each output can have its active logic state set for positive phase (normally on) or negative phase (normally off).
PROGRAMMABLE FUNCTIONS (Cont'd)

MESSAGES (Cont'd)
Message Type:
1 line block - message scrolls in block fashion on the top line of the display, bottom line contains programmed indication display.
2 line block - message scrolls in block fashion on both lines of the display
1 line scroll - message scrolls right to left on the top line of the display, bottom line contains programmed indication display
2 line scroll - Top line scrolls right to left, bottom line is blanked

Maintained/Momentary Request:
A Maintained Request setting enables messages to be restored or redisplayed when the display is available if the input/output action requesting the message is still active.
A Momentary Message setting will allow only one request per message requesting input/output action. Lower priority messages will be canceled by higher priority messages.

Blinking Message:
Enables the message to blink when displayed. Only available with 1 or 2 line block messages.

Multiplex:
Setting this parameter to yes will cause the unit to display the message for 2 seconds, then display the programmed display for 2 seconds. Only available with 1 or 2 line block messages.

Message Cancellation:
The displayed message is canceled when:
A message of equal or higher priority is requested.
Message times out (Timed) and input/output action is deactivated.
User input or output is deactivated (Til End).
User input programmed for clear message is activated.

Message Time:
Ranges from 1 to 599 Seconds.

Message Color: (Dual Color Option only)
Green or Red

MODEL LGPB APPLICATION

A local canning plant wishes to improve the display and control capabilities of its nine process lines. There is a requirement to add message interaction for the operators during process operation. The following application facts and requirements have been specified by the plant engineer.

1. The cans are sensed by a photo-electric device specially suited for can manufacturing. The device produces one pulse per can.
2. The can count for the process of boxing the cans is the first requirement. The can count is never changed, there are always 24 cans to each box. An output is required at 20 cans to slow the line temporarily until the second output is turned on. The second output changes the gate direction to begin the next grouping of 24. The second output has a time delay output of 2 seconds. After the time delay, both outputs are reset and ready for the next process cycle.
3. A count of the number of batches is required for each 8-hour shift. This count is recorded and reset by the manufacturing computer.
4. A total count of cans produced per 24-hour period is required. This count is also transmitted to the manufacturing computer, and reset as required via the communication link.
5. A display of cans per minute is required with minimum and maximum speed limits. Output 3 activates below 100 counts per minute and Output 4 activates above 500 counts per minute.
6. The four desired displays are process, batch, total, and rate. These are to be scrolled via the front panel.
7. The customer also wants the following messages displayed when the listed events occur:
   Output 3 - Line #4 Slow
   Output 4 - Overspd STOP! (Wants this display to stand out and have top priority)
   Proximity 1 - Check Label Glue
   Proximity 2 - Check Top Supply
   Proximity 3 - System Fault! Stop Line #4! (Wants this display to stand out and have top priority)
8. Once the unit is set up, the only front panel access should be for a reset of the process count and viewing of the displays.

The following page is a chart of the necessary programming for the Legend Plus unit.

COMMUNICATION PORT
Jumper selectable for RS-485 or RS-232
Baud Rate - 1200 to 9600
Parity - Odd (7 data bits), Even (7 data bits), or No parity (8 data bits)
Unit Address - 00 to 99
Transmit Delay - 0.002 or 0.100 seconds

PRINT OPTIONS
The programmable print options specify which values are transmitted when a print request is issued. The available options are; Rate, Peak, Valley, Count*, Process*, Batch*, Total*, Scale Factors, Preset(s), Counter Load values, and Message 0.

* On Models with these available display options.

The unit can be programmed to transmit or NOT to transmit mnemonics (unit address & value identifiers). The mnemonic transmitted is the first three characters of the programmed display mnemonic. For total, only the first character is transmitted. A transmit and reset count capability allows the selected count values to automatically reset after the value is printed (transmitted).

OPERATOR ACCESS TO FRONT PANEL
There are several program disable modes that can be used to limit the operator from programming the parameter values via the front panel keypad. The Program Disable DIP switch can be used alone or in conjunction with a User Input, programmed for the program disable function and a programmable code value, to provide the desired level of security.
## ORDERING INFORMATION

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGBP</td>
<td>Four Preset Batch Legend Plus w/Grn Backlighting</td>
<td>LGBP0000</td>
</tr>
<tr>
<td></td>
<td>Four Preset Batch Legend Plus w/Red Backlighting</td>
<td>LGBP0100</td>
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<td>Four Preset Batch Legend Plus w/Dual Color Backlighting</td>
<td>LGBP0200</td>
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<tr>
<td>LGPM</td>
<td>Multi-Preset (6) Legend Plus w/Grn Backlighting</td>
<td>LGPM0001</td>
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<td>Multi-Preset (6) Legend Plus w/Red Backlighting</td>
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<td>Multi-Preset (6) Legend Plus w/Dual Color Backlighting</td>
<td>LGPM0201</td>
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<td>LGPBF</td>
<td>Four Preset Foot-Inch Counter w/Red Backlighting</td>
<td>LGBP100</td>
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<td>SFLGP</td>
<td>Legend Plus Programming Software, 3 1/2&quot;, 1.44 M Disk</td>
<td>SFLGP</td>
</tr>
<tr>
<td></td>
<td>Dual Relay Board (Model LGBP's only)</td>
<td>RLYLG002</td>
</tr>
</tbody>
</table>
LEGEND SERIES

MODEL LGS - Single Preset Counter/Rate Indicator
MODEL LGD - Dual Preset Counter/Rate Indicator
MODEL LGB - Four Preset Batch/Counter/Rate Indicator
MODEL LGM - Six Preset Counter/Rate Indicator

DESCRIPTION

The Legend Series consist of four different models that are multi-function count and rate indicators. There can be up to six presets and six programmable outputs depending upon the unit. The count and rate displays have separate programmable decimal point settings. The unit also has rate peak and valley displays that show the highest and lowest rate readings since they were reset (peak and valley readings are not retained when power is removed). There are five Programmable User Inputs, three external remote inputs and two front panel function keys, which allow the user to select from a variety of functions. The two line by eight character alphanumeric display with English menus, allows for easy viewing and simple programming of the units. The four scroll through indication displays can be programmed to show other parameters and if desired, automatically scroll at one of the two programmable rates. A program disable DIP switch used with an external User Input can be utilized to protect the settings and guarantee that no unwanted changes occur during operation.

The standard RS-485 serial communication feature provides the capability of two-way communication between the Legend unit and other compatible equipment such as a printer, a programmable controller, or a host computer. The Baud Rate is programmable and ranges from 1200 to 9600. The unit address number can be programmed from 00-99. Up to thirty-two units can be installed on a single pair of wires, each with an individual address. The Count value(s), Preset(s), Rate, Peak, Valley, etc can all be interrogated or changed. The output(s), counters(s), rate and peak readings can be reset, by sending the proper command codes via serial communications or by activating a programmable user input. When a user input, selected for the print request function, is activated, the values specified in the Program Print Options module can be transmitted to a printer.

Optional Programming Software (SFLGP) for IBM® compatible PC’s is available to program all of the Legend configuration parameters such as User Inputs, count modes, etc. The software allows unit configurations to be created, uploaded, downloaded, and saved to a file for rapid programming of the Legend.

The Legend offers a choice of seven programmable counting modes for use in applications requiring Bi-directional, Anti-coincidence, and Quadrature counting. A separate external inhibit terminal can be used in conjunction with any of the count modes. The input circuitry is switch selectable to accept signals from a variety of input sources. A unit may be programmed to register counts on both edges of the input signal providing frequency doubling capability.

- 2X8 TRANSMISSIVE LCD, NEGATIVE IMAGE, WITH L.E.D. BACKLIGHTING
- FOUR USER PROGRAMMABLE INDICATION DISPLAYS
- OPTIONAL PROGRAMMING SOFTWARE
- ENGLISH PROGRAMMING MENUS
- RATE, PEAK & VALLEY INDICATION
- ABILITY TO LOCKOUT OPERATOR ACCESS TO PROGRAMMING PARAMETERS
- ACCEPTS COUNT RATES UP TO 23 KHz (for Model LGS)
- BI-DIRECTIONAL COUNTING, UP/DOWN CONTROL
- QUADRATURE SENSING (Up to 4 times resolution)
- COUNT INHIBIT PIN AVAILABLE FOR ALL COUNT MODES
- SEPARATE INPUT SCALING FOR RATE & COUNT
- PROGRAMMABLE CONTROL INPUTS
- INPUTS ARE SWITCH SELECTABLE FOR MAGNETIC PICKUPS
- RELAY OUTPUT(S) (Field Replaceable)
- OUTPUT(S) ASSIGNABLE TO COUNT OR RATE
- SOLID STATE CURRENT SINKING OUTPUT(S)
- 115/230VAC SWITCH SELECTABLE
- RS-485 SERIAL COMMUNICATIONS
- NONVOLATILE MEMORY
- NEMA4X/IP65 SEALED FRONT PANEL BEZEL

DIMENSIONS “In inches (mm)”

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 3.0” (76.2)H x 4.0” (101.6)W.
DESCRIPTION (Cont'd)

A Legend unit will indicate an overflow condition when the capacity of a Count display (Process, Batch, or Total) is exceeded, by flashing the word “OVERFLOW” in the appropriate display.

All count values and program setting are retained when unit power is removed in nonvolatile memory.

The choice of several reset cycle modes along with the compatibility of count and control inputs to other RLC products, provides added versatility for stand-alone and system counter needs.

The rate input uses the time interval method (1/tau) to calculate the rate value. This method insures high resolution at all input rates. The unit counts input pulses and after the programmable minimum update time elapses and the next count edge occurs, the unit will take the number of edges that occurred during the elapsed time to calculate the rate value. The minimum update time can be as low as 0.1 second per update, enabling quick response to rate changes. At slower rates, averaging can be accomplished by programming the Minimum and Maximum Update Time for the desired response. Extensive scaling capabilities allow practically any reading at very slow input rates.

The construction of the Legend series is a light weight high impact plastic case with a clear viewing window. The sealed front panel with the silicone rubber keypad meets NEMA4X/IP65 specifications for wash-down and/or dusty environments, 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.

MODELS - LGS & LGD

The single preset unit has one NPN open collector output and the dual preset unit has two outputs which are activated from presets 1 and 2 respectively. Each output can be assigned to either Rate or Count display. An optional relay board can be installed that operates in parallel with the solid state output(s).

MODEL - LGB

The process counter is used to monitor the progress of the count within the batch. Presets 1 and 2 are assigned to the Process Counter and activate relay outputs 1 and 2 respectively.

Presets 3 and 4 can be assigned to either the Batch Counter, Totalizer, or Rate indicator. Presets 3 and 4 activate the NPN open collector outputs O3-SNK and O4-SNK respectively.

MODEL - LGM

The Multi Preset unit has six Presets (1-6) which control NPN open collector outputs 01-SNK to 06-SNK respectively. Preset one through four are assigned to the count display. Presets 5 and 6 can be assigned to either the Rate or Count display.

<table>
<thead>
<tr>
<th>AVAILABLE INDICATION DISPLAYS AND PRESETS FOR EACH MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LGS</strong></td>
</tr>
<tr>
<td><strong>RATE</strong></td>
</tr>
<tr>
<td><strong>PEAK</strong></td>
</tr>
<tr>
<td><strong>VALLEY</strong></td>
</tr>
<tr>
<td><strong>COUNT</strong></td>
</tr>
<tr>
<td><strong>(1 Preset)</strong></td>
</tr>
</tbody>
</table>

SPECIFICATIONS

1. **DISPLAY**: 2x8, 0.3” (7 mm) high characters, negative image transmissive LCD, with yellow/green or red LED backlighting.

2. **POWER**
   - AC Operation: 115/230 VAC ±10%, 50/60 Hz, 10 VA, switch selectable.
   - DC Operation: +12 VDC ±20% @ 250 mA.

3. **MEMORY**: Non-volatile memory retains all programming information. Count and Preset values are written to non-volatile memory when power is interrupted. All other programming parameters are written to memory when memory is programmed. When power is removed while in the programming menus, the parameters are restored to previously saved settings.

4. **DATA RETENTION**: 10 years minimum

5. **SENSOR POWER**: +12 VDC ±25% @ 100 mA.

6. **INPUTS A and B**: DIP Switch selectable to accept count pulses from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, and all standard RLC sensors.

   **LOGIC**: Input trigger levels
   - VIL = 1.5 VMAX, VIH = 3.75 VMIN.
   - Current sinking: Internal 7.8 KΩ pull up internally to +12 VDC, IMAX = 1.6 mA.

   **Current sourcing**: Internal 3.9 KΩ pull-down, 7.3 mA @ 28 VDCMAX.

   **Debounce**: Damping capacitor provided for switch contact bounce. Limits count speed to 50 Hz and input pulse widths to 10 msec min.

   **MAGNETIC PICKUP**: Sensitivity: 200 mV/peak. Hysteresis: 100 mV.

   **Input impedance**: 3.9 KΩ @ 60 Hz.

   **Maximum input voltage**: ±50 Vp

   Note: For magnetic pickup input, the sink/source DIP switch must be in the SRC position.

6. **RATE ACCURACY**: ±0.01%

7. **RATE MINIMUM INPUT FREQUENCY**: 0.01 Hz.

8. **MAXIMUM COUNT RATE IN KHz**:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CNT + DIR</th>
<th>QUAD</th>
<th>ADD/ADD</th>
<th>ADD/SUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGS (Single Preset)</td>
<td>23</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>LGD (Dual Preset)</td>
<td>20</td>
<td>10</td>
<td>9.5</td>
<td>7</td>
</tr>
<tr>
<td>LGD (Batch)</td>
<td>17</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>LGM (Six Preset)</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

Notes:
1. Maximum count rates given are for Process counter set for Auto reset with the auto cycle preset set to an equivalent of 100 count pulses or greater. With auto cycle presets less than 100 count pulses, with Count SF = 0.5000 and Count Scale Multiplier = X1, would be 50.

2. Maximum count rate given for X2 & X4 count modes are given for 50% duty cycle signals and Quad signals with 90° phase shift.

   *Inputs A & B count rates summed.

9. **CONTROL INPUTS**

   Programmable user inputs (3): Internal 10 KΩ pull-up to +5 VDC, VIL = 1.0 VMAX, VIH = 4.0 VMIN, response time = 10 msec.

   **Inhibit**: Internal 10 KΩ pull-up to +5 VDC, VIL = 1.0 VMAX, VIH = 4.0 VMIN.

10. **SERIAL COMMUNICATIONS**

   **Type**: RS-485 Multi-point Balanced Interface (2 Wire).

   **(Can connect up to 32 units on a single pair of wires)**

   **Baud Rate**: Programmable from 1200 to 9600.

   **Maximum Addresses**: Programmable from 00 to 99.

   **(Actual number on a single pair of wires is limited by serial hardware specifications)**

   **Transmit Delay**: Programmable for 0.002 or 0.100 second.

   **Data Format**: 10 Bit Frame; 1 start bit, 7 data bits, 1 parity bit, and 1 stop bit. Parity is programmable for either ODD, EVEN, or No Parity.

11. **OUTPUTS**

   **Solid-State**: Current sinking NPN open collector transistor. VCE = 1 VSAT @ 100 mA max, VIL = 30 VDC max.

   **(Internal Zener Diode Protection)**

   **Relay(s)**: Mounted on field-replaceable P.C. board. Form C contacts rated at 5 amps @ 120 VAC/240 VAC or 28 VDC. VIL = 0.5 amps @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.

   **Programmable Timed Output**: Programmable time ranges from 0.01 to 99.99 seconds, ±0.05% - 11 msec max.

12. **ENVIRONMENTAL CONDITIONS**

   **Operating Temperature**: 0 to 50°C

   **Storage Temperature**: -40 to 70°C

   **Operating and Storage Humidity**: 85% max. (non-condensing) from 0°C to 50°C.

   **Altitude**: Up to 2000 meters

13. **CERTIFICATIONS AND COMPLIANCE**

   **UL Recognized Component, File #E137808**

   **Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.**

   **EMC EMISSIONS**

   **Meets EN 50081-2: Industrial Environment.**

   **CISPR 11 Radiated and conducted emissions**

   **EMC IMMUNITY**

   **Meets EN 50082-2: Industrial Environment.**

   **ENV 50140 - Radio-frequency radiated electromagnetic field**

   **ENV 50141 - Radio-frequency conducted electromagnetic field**

   **ENV 61000-4-2 - Electrostatic discharge (ESD)**

   **ENV 61000-4-3 - Radiated electromagnetic field**

   **ENV 61000-4-4 - Electrical fast transient/burst (EFT)**

   **ENV 61000-4-8 - Power frequency magnetic field**

   **Notes:**

   1. **RF Conducted and EFT Immunity DC Power Lines**

   **Unit required a line filter (RLC # LFIL0000) when DC powered.**

   2. **RF Conducted Immunity I/O lines**

   **Ground the shield or use one ferrite suppression core (TDK #ZCAT3035-G3a).**

   **Limitations**: Ground the shield or use one ferrite suppression core (TDK #ZCAT3035-G3a) to provide the shield immunity to the unit.
14. **CONSTRUCTION:** High impact plastic case with clear viewing window. The front panel meets NEMA4X/IP65 requirements for indoor use when installed properly. Installation Category II, Pollution Degree 2. Panel gasket and mounting clips included.

15. **WEIGHT:** 1.5 lbs. (0.68 Kg)

### PROGRAMMING

The Legend Series provides an easy to use, menu driven programming interface. The English prompts, the front panel keypad, and the flashing display aids the operator during programming. In the normal run mode, the main display loop allows the user to scroll through the four programmable indication displays, using the direction keys. From the main loop, presets and scale factors can be accessed directly for changing parameters. All other parameters are accessed through the programming loop. In the programming loop, parameters can be viewed or changed and the operator can exit anywhere in the loop. Shown to the side is part of the main display loop and part of the programming loop of a Dual Preset Legend (LGD) unit. Also shown are four different views of the indication displays.

### PROGRAMMABLE FUNCTIONS

#### PRESET(S)
Ranges from -99999 to 999999
Counter Load ranges from -99999 to 999999

#### SCALE FACTORS (RATE & COUNT)
Range from 0.0001 to 5.9999

#### COUNT SCALE MULTIPLIER
Multiplies the contents of the 9-digit internal counter or the 11-digit internal totalizer by a factor of 1, 0.1, 0.01 or 0.001 to view the desired number of significant digits on the 6-digit Counter display or the 8-digit Totalizer display.

#### DECIMAL POINT
Separate decimal point location for Count and Rate displays.  
- 0
- 0.0
- 0.00
- 0.000
- 0.0000

#### RATE SCALE MULTIPLIERS
Multiplies the contents of the actual internal rate, pulses per second (PPS), by a factor of 0.01, 0.1, 1, 10, 100, or 1000 to view the desired number of significant digits on the 6-digit Rate display. The desired time units that the rate is to be displayed, can also be programmed as per Second (s/1), per Minute (s/60), or per Hour (s/3600).

#### UPDATE TIME
The Rate Minimum/Maximum Update Times range from 0.1 to 99.9 seconds which provides averaging capability for non-consistent pulse spacing.

### COUNTING MODES

- **Count with Direction**
- **Count with Direction (X2)**
- **Quadrature**
- **Quadrature (X2)**
- **Quadrature (X4)**
- **2-Input Anti-coincidence Add/Add**
- **2-Input Anti-coincidence Add/Subtract**

A separate Inhibit input, is available for all count modes.

### RESET MODES

- **Manual Reset**
- **Automatic Reset at Preset**
- **Reset at Beginning Of Output 1**
- **Reset at End Of Timed Output 1**
- **Reset at Beginning Of Output 2**
- **Reset at End Of Timed Output 2**
- **Reset at Beginning Of Output 1 or Output 2**
- **Reset at End Of Timed Output 1 or Output 2**

### MODEL LGB ONLY

- **Reset at Beginning Of Output 3**
- **Reset at End Of Timed Output 3**
- **Reset at Beginning Of Output 4**
- **Reset at End Of Timed Output 4**
- **Reset at Beginning Of Output 3 or Output 4**
- **Reset at End Of Timed Output 3 or Output 4**
PROGRAMMABLE FUNCTIONS (Cont’d)

RESET ACTION
Reset to Zero: Output activates when the count equals the preset value. Count display value returns to zero when reset.
Reset to Preset: Output activates when the count equals zero. Count display value returns to preset value when reset.
Reset to Counter Load: Output activates when count equals the preset value. Count display value returns to counter load value when reset.

USER INPUTS
There are three external user inputs and two front panel Function keys that are programmable. When activated each User Input can be programmed to perform one of the following functions:

Maintained Reset or Momentary Reset:
Can reset Rate, Peak, Valley, Process*, Batch*, Total*, or Count* display values and/or any output associated with that display.

Reset Output(s):
Places the output(s) in their inactive state. (Momentary action)

Set Output(s):
Places the output(s) in their active state. (Momentary action)

View Display 1-4:
Will cause the selected indication display (1, 2, 3, or 4) to be displayed and held from anywhere in the main display loop.

Change Display:
Will cause the indication display to toggle to the next indication display.

Counter Load:
Loads the counter load value into the count display.

Print Request:
Transmits the values specified in the Program Print Options module over the serial port.

Skip Preset 1, Skip Preset 3 (LGB Only):
Keeps the output from activating and automatic reset from occurring, if programmed, when the count value equals the preset value.

Program Disable:
Operates in conjunction with the program disable DIP switch, to provide a variety of program disable modes.

OUTPUT(S)
Output Assignment:
The LG5 can have its Output assigned to the Count or the Rate.
The LGD can have Outputs 1 & 2 assigned to the Count or the Rate.
The LGB has Outputs 1 & 2 assigned to the Process. Outputs 3 and 4 can be assigned to the Batch, Total, or Rate.
The LGM can have Outputs 5 and 6 assigned to either Count or Rate and Outputs 1-4 are assigned to the Counter.

Output Activation Mode:
Latched
Boundary
Timed - 0.01 to 99.99 seconds

Output Reset Mode:
Outputs 1 & 2 Only:
End Output 1 @ Output 2 Start
End Output 1 @ Timed Output 2 End
End Output 2 @ Output 1 Start
End Output 2 @ Timed Output 1 End

Output(s) Power Up or Power Down State:
The Output’s state can be set to be Off (Inactive) @ power up.
OR
The Output’s state can be saved @ power down and restored at power-up.
Note: Power down state for Latched Mode Only.

Reset Output when Count is Reset:
This feature can be enabled or disabled.

Phase:
Each Output can have its logic state set for Positive (ON) Phase or Negative (OFF) Phase.

INDICATION DISPLAYS
There are four configurable indication displays are programmed individually. Each line of each indication display can be programmed to show one of the following Mnemonics; COUNT*, PROCESS*, BATCH*, TOTAL*, PEAK, VALLEY, OR RATE, and a Numeric value, Output status, Preset value, or the Counter Load value. A single or dual character Mnemonic is displayed to the left of the appropriate Numeric value if the other line is not programmed to display the full mnemonic. Also the indication displays can be set to scroll automatically at a 2.5 or 5 second rate, if desired.

COMMUNICATION PORT
Baud Rate - 1200 to 9600
Parity - Odd, Even, or No parity
Unit Address - 00 to 99
Transmit Delay - 0.002 or 0.100 seconds

PRINT OPTIONS
The programmable print options specify which values will be transmitted when a print request is issued. The available options are; Rate, Peak, Valley, Count*, Totalizer*, Process*, Batch*, Scale Factors, Preset(s), and Counter Load values.

The unit can be programmed to transmit or NOT transmit mnemonics (unit address & value identifiers).

OPERATOR ACCESS TO FRONT PANEL
There are several program disable modes that can be used to limit the operator from programming the parameter values via the front panel keypad. The Program Disable DIP switch can be used alone or in conjunction with a User Input, programmed for the program disable function, to provide the desired level of security.
MODEL LGB APPLICATION

An order requires that sheets of material be cut in two different lengths. The operator would like to change the settings for the second length to be cut with no down time. A Legend series LGB (Four Preset Batch Counter/Rate Indicator) is used to satisfy the requirement.

A Length Sensor (LSQ) with a 100 pulse per revolution (PPR) quadrature output is coupled with an LSAHC hinge clamp assembly and a one foot circumference wheel. The LEGEND series LGB is set to the Quadrature X1 mode. With a one foot wheel, the information becomes 100 pulses/foot and allows the material to be cut to the nearest 1/100 of a foot. The counter display is programmed for two decimal places to provide a readout in 1/100 of a foot increments.

Preset value $P_1$ (Process count) is programmed for the first length to be cut for the order and Preset value $P_2$ (Process count) for the second length.

The outputs are used to control power to the cutting knife and the counter is programmed to reset when Preset 1 or Preset 2 is reached.

Preset value $P_3$ (Batch count) is programmed to activate User Input 1 (skip P1) when the total number of pieces is reached for the first order. Preset value $P_4$ (Batch count) is programmed to stop the process after the second order is complete. The totalizer will keep track of the total amount of feet used.
**LGM APPLICATION**

A process performs five different procedures to a piece of raw stock at five different locations. The Legend series LGM with six presets and six solid state outputs is used for this application.

The raw stock comes in ten foot sections and requires five various operations to be performed at 9.00”, 23.00”, 72.00”, 83.00”, & 111.00”. A rotary pulse generator (RPGB) with a 600 pulse per revolution (PPR) quadrature output is coupled to a 1 foot circumference wheel. A quadrature sensor is specified because the stock must be reversed after stations #1 and #4. This allows the Legend to keep track of true position.

The Legend is set to the quadrature X2 mode which increases the pulses to 1200 PPR. This gives a measurement resolution of 1/100 of an inch. The five Presets are programmed with the proper values and the solid state outputs control pilot relays that control the actuators. As the material passes each station, a signal is sent to the proper equipment and the process is performed. Also, the outputs are programmed so that if a power outage occurs they will save the state that they were in at power down.

The sixth output is assigned to rate so that if the rate drops below a predetermined value the output will activate a warning indicator.

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**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>DESCRIPTION</th>
<th>OPTION w/ RELAY BOARD</th>
<th>PART NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGS</td>
<td>Single Preset Legend w/Yel-Grn Backlighting No</td>
<td>LGS00001</td>
<td></td>
</tr>
<tr>
<td>LGS</td>
<td>Single Preset Legend w/Yel-Grn Backlighting Yes</td>
<td>LGS00000</td>
<td></td>
</tr>
<tr>
<td>LGS</td>
<td>Single Preset Legend w/Red Backlighting No</td>
<td>LGS00101</td>
<td></td>
</tr>
<tr>
<td>LGS</td>
<td>Single Preset Legend w/Red Backlighting Yes</td>
<td>LGS00100</td>
<td></td>
</tr>
<tr>
<td>LGD</td>
<td>Dual Preset Legend w/Yel-Grn Backlighting No</td>
<td>LGD00001</td>
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<td>Four Preset Batch Legend w/Yel-Grn Backlighting Yes</td>
<td>LG50000</td>
<td></td>
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<td>LGM</td>
<td>Multi Preset (6) Legend w/Yel-Grn Backlighting N/A</td>
<td>LGM00001</td>
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<td>LGM</td>
<td>Multi Preset (6) Legend w/Red Backlighting N/A</td>
<td>LGM00101</td>
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<td>SPLGP</td>
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