# ProtEX-MAX PD8-6001 Explosion-Proof Feet & Inches Meter Instruction Manual

ProtEX™ MAX

**MeterView Pro**
USB Install

FM APPROVED    CSA®    Ex    CE

## Process

- 0-20 mA, 4-20 mA, 0-5 V, 1-5 V, and ±10 V Inputs
- Feet & Inches Display Ideal for Level Applications
- Isolated 24 VDC @ 25 mA Transmitter Power Supply
- Multi-Pump Alternation Control
- Display a Single Input in Two Different Scales (e.g. Height & Volume)
- Signal Input Conditioning for Oddly Shaped and Round Horizontal Tanks
- 32-Point, Square Root, or Exponential Linearization
- Modern, Sleek and Practical Enclosure
- Display Mountable at 0°, 90°, 180°, & 270° Degrees
- Explosion-Proof, IP68, NEMA 4X Enclosure
- SafeTouch® Through-Glass Button Programming
- Flanges for Wall or Pipe Mounting
- Superluminous Sunlight Readable Display
- Free USB Programming Software & Cable
- 4 Relays + Isolated 4-20 mA Output Option

PRECISION DIGITAL

**www.predig.com**

## Disclaimer

The information contained in this document is subject to change without notice. Precision Digital makes no representations or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for a particular purpose.

| ⚠ | ⚡ |
|---|---|
| **CAUTION**: *Read complete instructions prior to installation and operation of the meter.* | **WARNING**: *Risk of electric shock or personal injury.* |

⚡ **Warning!**

- *This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Precision Digital Corporation shall not be held liable for damages resulting from such improper use.*
- *Failure to follow installation guidelines could result in death or serious injury. Make sure only qualified personnel perform the installation.*
- *Never remove the instrument cover in explosive environments when the circuit is live.*
- *Cover must be fully engaged to meet flameproof/explosion-proof requirements.*
- *Information in this manual supersedes all enclosure, compliance, and agency approval information included in additional product manuals included with this product.*

## Limited Warranty

Precision Digital Corporation warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Precision Digital's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit.

## Registered Trademarks

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## Introduction

The ProtEX-MAX PD8-6001 explosion-proof feet & inches meter offers all the functionality of the ProVu PD6001 as a fully FM, CSA, ATEX, and IECEx approved explosion-proof product. Its superluminous LED digits make it easily readable in smoke, dust, fog, and, with the optional SunBright® display, even direct sunlight. It accepts a process current (4-20 mA) or process voltage (0-5V, 1-5V, etc.) signal and displays it on a dual-line, 6-digit SunBright® sunlight readable display. t is ideal for level applications requiring an easy-to-understand display, as it shows feet, inches, and fractions of an inch.

The meter includes a 24 VDC power supply to drive the transmitter and can be equipped with up to four internal relays and a 4-20 mA output. The PD8-6001 can be programmed and operated without opening the housing by using the built-in SafeTouch® through-glass buttons or the RS485 serial communication port with free Modbus® protocol.

The analog input can be scaled to display the process in two different scales. The main display can indicate level in feet and inches with printed feet and inches designations, and the second display could be used to indicate some other scale, such as the volume in gallons or liters.

The basic model includes an isolated 24 VDC transmitter power supply that can be used to power the input transmitter or other devices. An additional isolated 24 VDC power supply is included with the 4-20 mA output option. A digital input is standard.

A fully loaded PD6001 meter has the following: four SPDT relays, 4-20 mA output, and two 24 VDC power supplies. The 4-20 mA isolated output, Modbus RTU serial communications, and digital I/O make the PD8-6001 an excellent addition to any hazardous area level monitoring or control system.

# Ordering Information

## SunBright Display Models

| 85-265 VAC Model | 12-24 VDC Model | Options Installed |
|---|---|---|
| PD8-6001-6H0 | PD8-6001-7H0 | No options |
| PD8-6001-6H7 | PD8-6001-7H7 | 4 relays & 4-20 mA output |
| *Model number for replacement option card. | | |

⚠️ **WARNING** - Cancer and Reproductive Harm - www.P65Warnings.ca.gov

## Accessories

| Model | Description |
|---|---|
| PDA1232 | RS-232 serial adapter |
| PDA1485 | RS-485 serial adapter |
| PDA7485-I | RS-232 to RS-422/485 isolated converter |
| PDA8232-N | USB to RS-232 non-isolated converter |
| PDA8485-I | USB to RS-422/485 isolated converter |
| PDX6901 | Suppressor (snubber): 0.01 µF/470 Ω, 250 VAC |

# Specifications

*Except where noted all specifications apply to operation at +25°C.*

## General

| | |
|---|---|
| **Display** | Line 1: 0.60" (15 mm) high, red LEDs separated by feet and inches designations<br>Line 2: 0.46" (12 mm) high, red LEDs 6 digits each (-99999 to 999999), with lead zero blanking |
| **Display Intensity** | Eight user selectable intensity levels |
| **Display Update Rate** | 5/second (200 ms) |
| **Overrange** | Display flashes 999999 |
| **Underrange** | Display flashes -99999 |
| **Display Assignment** | Display lines 1 & 2 may be assigned to PV1, PV2, PCT, max/min, max & min, set points, units (line 2 only), or Modbus input. |
| **Programming Methods** | Four front panel buttons, digital inputs, PC and MeterView Pro software, or Modbus registers. |
| **Noise Filter** | Programmable from 2 to 199 (0 will disable filter) |
| **Filter Bypass** | Programmable from 0.1 to 99.9% of calibrated span |
| **Recalibration** | All ranges are calibrated at the factory. Recalibration is recommended at least every 12 months. |
| **Max/Min Display** | Max/min readings reached by the process are stored until reset by the user or until power to the meter is turned off. |

| | |
|---|---|
| **Password** | Three programmable passwords restrict modification of programmed settings.<br>Pass 1: Allows use of function keys and digital inputs<br>Pass 2: Allows use of function keys, digital inputs and editing set/reset points<br>Pass 3: Restricts all programming, function keys, and digital inputs. |
| **Power Options** | 85-265 VAC 50/60 Hz, 90-265 VDC, 20 W max or 12-24 VDC ± 10%, 15 W max Powered over USB for configuration only. |
| **Isolated Transmitter Power Supply** | Terminals P+ & P-: 24 VDC ± 10%. selectable for 24, 10, or 5 VDC output supply (internal jumper J4). All models transmitter supply rated @ 25mA max. |
| **Non-Volatile Memory** | All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost. |
| **Fuse** | Required external fuse: UL Recognized, 5 A max, slow blow; up to 6 meters may share one 5 A fuse |
| **Normal Mode Rejection** | Greater than 60 dB at 50/60 Hz |
| **Isolation** | 4 kV input/output-to-power line 500 V input-to-output or output-to-P+ supply |
| **Overvoltage Category** | Installation Overvoltage Category II: Local level with smaller transient overvoltages than Installation Overvoltage Category III. |
| **Environmental** | T6 Class operating temperature range Ta = -40 to 60°C<br>T5 Class operating temperature range Ta = -40 to 65°C |

| | |
|---|---|
| **Max Power Dissipation** | Maximum power dissipation limited to 15.1 W. |
| **Connections** | Screw terminals accept 12 to 22 AWG wire |
| **Enclosure** | Explosion-proof die cast aluminum with glass window, corrosion resistant epoxy coating, color: blue.<br>NEMA 4X, 7, & 9, IP68.<br>Default conduit connections: Four ¾" NPT threaded conduit openings and two ¾" NPT metal conduit plugs with 12 mm hex key fitting installed. Additional conduit opening configurations may be available; verify quantity and sizes on specific device labeling during installation. |
| **Mounting** | Four slotted flanges for wall mounting or NPS 1½" to 2½" or DN 40 to 65 mm pipe mounting. See Mounting Dimensions on page **59**. |
| **Tightening Torque** | Screw terminal connectors: 5 lb-in (0.56 Nm) |
| **Overall Dimensions** | 6.42" x 7.97" x 8.47" (W x H x D) (163 mm x 202 mm x 215 mm) |
| **Approximate Shipping Weight** | 16.0 lbs (7.26 kg) |
| **Warranty** | 3 years parts & labor |

## Process Input

| | |
|---|---|
| **Inputs** | Field selectable:<br>0-20, 4-20 mA, ±10 V (0-5, 1-5, 0-10 V), Modbus PV (Slave) |
| **Accuracy** | ±0.03% of calibrated span ±1 count, square root & programmable exponent accuracy<br>range: 10-100% of calibrated span |
| **Temperature Drift** | 0.005% of calibrated span/°C max from 0 to 65°C ambient,<br>0.01% of calibrated span/°C max from -40 to 0°C ambient |
| **Signal Input Conditioning** | Linear or round horizontal tank volume calculation |
| **Multi-Point Linearization** | 2 to 32 points for PV or PV1<br>2 to 8 points for PV2 (Dual-scale Level feature) |
| **Round H Tank** | Diameter & Length: 999.999 inch or cm calculates volume in gallons or liters respectively. |
| **Low-Flow Cutoff** | $0^{FT}0^{IN}(^0/_{16}$ or $^0/_8) - 99^{FT}11^{IN}(^{15}/_{16}$ or $^7/_8)$<br>$(0^{FT}0^{IN}(^0/_{16}$ or $^0/_8)$ disables cutoff function) |
| **Decimal Point** | Up to five decimal places or none (PV2 only):<br>*d.ddddd*, *d.dddd*, *d.ddd*, *d.dd*, *d.d*, or *dddddd* |
| **Calibration Range** | Input        Minimum Span<br>Range        Input 1 & Input 2<br>4-20 mA     0.15 mA<br>±10 V        0.01 V<br>An error message will appear if the input 1 and input 2 signals are too close together. |

| | |
|---|---|
| **Input Impedance** | Voltage ranges: greater than 500 kΩ<br>Current ranges: 50 - 100 Ω (depending on resettable fuse impedance) |
| **Input Overload** | Current input protected by resettable fuse, 30 VDC max.<br>Fuse resets automatically after fault is removed. |
| **F4 Digital Input Contacts** | 3.3 VDC on contact. Connect normally open contacts across F4 to COM. |
| **F4 Digital Input Logic Levels** | Logic High: 3 to 5 VDC<br>Logic Low: 0 to 1.25 VDC |
| **HART Transparency** | Analog input will not interfere with existing HART communications on the wired 4-20 mA signal |

## Relays

| | |
|---|---|
| **Rating** | 4 SPDT (Form C) internal and/or 4 SPST (Form A) external; rated 3 A @ 30 VDC and 125/250 VAC resistive load; 1/14 HP (≈ 50 W) @ 125/250 VAC for inductive loads |
| **Noise Suppression** | Noise suppression is recommended for each relay contact switching inductive loads; see page 18 for details. |
| **Deadband** | 0-100% of span, user programmable |
| **High Or Low Alarm** | User may program any alarm for high or low trip point.<br>Unused alarm LEDs and relays may be disabled (turn off). |
| **Relay Operation** | Automatic (non-latching) and/or manual reset<br>Latching (requires manual acknowledge) with/without clear<br>Pump alternation control (2 to 4 relays)<br>Sampling (based on time)<br>Off (disable unused relays and enable Interlock feature)<br>Manual on/off control mode |
| **Time Delay** | 0 to 999.9 seconds, on & off relay time delays<br>Programmable and independent for each relay |
| **Fail-Safe Operation** | Programmable and independent for each relay.<br>*Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.* |
| **Auto Initialization** | When power is applied to the meter, relays will reflect the state of the input to the meter. |

| Relay Reset | User selectable via front panel buttons or digital inputs |
|---|---|
| | 1. Automatic reset only (non-latching), when the input passes the reset point. |
| | 2. Automatic + manual reset at any time (non-latching) |
| | 3. Manual reset only, at any time (latching) |
| | 4. Manual reset only after alarm condition has cleared (latching) |
| | *Note: Front panel button or digital input may be assigned to acknowledge relays programmed for manual reset.* |

## Isolated 4-20 mA Transmitter Output

| Output Source | Process variable (PV), max, min, set points 1-8, Modbus input, or manual control mode |
|---|---|
| Scaling Range | 1.000 to 23.000 mA for any display range |
| Calibration | Factory calibrated: 4.000 to 20.000 = 4-20 mA output |
| Analog Out Programming | 23.000 mA maximum for all parameters: Overrange, underrange, max, min, and break |
| Accuracy | ± 0.1% of span ± 0.004 mA |
| Temperature Drift | 0.4 µA/°C max from 0 to 65°C ambient, 0.8 µA/°C max from -40 to 0°C ambient *Note: Analog output drift is separate from input drift.* |
| Isolated Transmitter Power Supply | Terminals I+ & R: 24 VDC ± 10%. May be used to power the 4-20 mA output or other devices. Refer to Figure 16 on page 19. All models @ 25mA max. |
| External Loop Power Supply | 35 VDC maximum |

| Output Loop Resistance | Power supply | Minimum | Maximum |
|---|---|---|---|
| | 24 VDC | 10 Ω | 700 Ω |
| | 35 VDC (external) | 100 Ω | 1200 Ω |

## Serial Communications

| Compatibility | EIA-485 |
|---|---|
| Connectors | Removable screw terminal connector |
| Max Distance | 3,937' (1,200 m) max |
| Status Indication | Separate LEDs for Power (P), Transmit (TX), and Receive (RX) |
| Slave Id | 1 – 247 (Meter address) |

| Baud Rate | 300 – 19,200 bps |
|---|---|
| Transmit Time Delay | Programmable between 0 and 199 ms |
| Data | 8 bit (1 start bit, 1 or 2 stop bits) |
| Parity | Even, Odd, or None with 1 or 2 stop bits |
| Byte-To-Byte Timeout | 0.01 – 2.54 second |
| Turn Around Delay | Less than 2 ms (fixed) |

*Note: Refer to the PROVU® Modbus Register Tables located at www.predig.com for details.*

## Digital Inputs & Outputs

| Channels | 4 digital inputs & 4 digital outputs |
|---|---|
| Digital Input Logic High | 3 to 5 VDC |
| Digital Input Logic Low | 0 to 1.25 VDC |
| Digital Output Logic High | 3.1 to 3.3 VDC |
| Digital Output Logic Low | 0 to 0.4 VDC |
| Source Current | 10 mA maximum output current |
| Sink Current | 1.5 mA minimum input current |
| +5 V Terminal | To be used as pull-up for digital inputs only. Connect normally open pushbuttons across +5 V & DI 1-4. ⚡ **WARNING** *DO NOT use +5 V terminal (pin 1) to power external devices.* |
| Function Assignment | The on-board digital inputs (1-4) are designed to mimic the behavior of the front panel buttons (Menu, F1, F2, & F3). If you wish to change their behavior, re-assign F1-F3 to the desired function, then change the corresponding digital input to match. |

## MeterView Pro

| System Requirements | Microsoft® Windows® XP/Vista/7/8/10 |
|---|---|
| Communications | USB 2.0 (Standard USB A to Micro USB B) |
| Configuration | Configure device settings one at a time |

## Product Ratings and Approvals;

| | |
|---|---|
| **FM** | Enclosure: Type 4X; IP66<br>Class I, Division 1, Groups B, C, D<br>Class II, Division 1, Groups E, F, G<br>Class III, Division 1, T5/T6<br>Class I, Zone 1, AEx d, IIC Gb T5/T6<br> Zone 21, AEx tb IIIC T90°C; Ta -40°C to +65°C<br>T6 Ta = -40°C to +60°C; T5 Ta = -40°C to +65°C<br>Certificate Number: 3047283 |
| **CSA** | Class I, Division 1, Groups B, C, D<br>Class II, Division 1, Groups E, F, G<br>Class III, Division 1<br>Class I Zone 1 Ex d IIC<br>Zone 21 Ex tb IIIC T90°C<br>-40°C < Tamb. < +60° C; Temperature Code T6<br>-40°C < Tamb. < +65° C; Temperature Code T5<br>Enclosure Type 4X & IP66<br>Certificate Number: 2531731 |
| **ATEX** | ⟨Ex⟩ II 2 G D<br>Ex d IIC T* Gb<br>Ex tb IIIC T90°C Db IP68<br>Ta = -40°C to +*°C<br>*T6 = -40°C to +60°C<br>*T5 = -40°C to +65°C<br>Certificate number: Sira 12ATEX1182 |
| **IECEx** | Ex d IIC T* Gb<br>Ex tb IIIC T90°C Db IP68<br>Ta = -40°C to +*°C<br>*T6 = -40°C to +60°C<br>*T5 = -40°C to +65°C<br>Certificate Number: IECEx SIR 12.0073 |

***Special Conditions for Safe Use:***
Use suitably certified and dimensioned cable entry device and/or plug. The equipment shall be installed such that the supply cable is protected from mechanical damage. The cable shall not be subjected to tension or torque. If the cable is to be terminated within an explosive atmosphere, then appropriate protection of the free end of the cable shall be provided. Cable must be suitable for 90°C.

***Year of Construction***
This information is contained within the serial number with the first four digits representing the year and month in the YYMM format.

***For European Community:*** The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC, and the product certificate Sira 12ATEX1182.

# Compliance Information

## Safety

| | |
|---|---|
| **UL & c-UL Listed** | USA & Canada<br>UL 508 Industrial Control Equipment |
| **UL File Number** | E160849 |
| **Front Panel** | UL Type 4X, NEMA 4X, IP65; panel gasket provided |
| **Low Voltage Directive** | EN 61010-1:2010<br>Safety requirements for measurement, control, and laboratory use |

## Electromagnetic Compatibility

| | |
|---|---|
| **Emissions** | EN 55022:2010<br>Class A ITE emissions requirements |
| Radiated Emissions | Class A |
| AC Mains Conducted Emissions | Class A |
| **Immunity** | EN 61326-1:2013<br>Measurement, control, and laboratory equipment<br>EN 61000-6-2:2005<br>EMC heavy industrial generic immunity standard |
| RFI - Amplitude Modulated | 80 -1000 MHz 10 V/m 80% AM (1 kHz)<br>1.4 - 2.0 GHz 3 V/m 80% AM (1 kHz)<br>2.0 - 2.7 GHz 1 V/m 80% AM (1 kHz) |
| Electrical Fast Transients | ±2kV AC mains, ±1kV other |
| Electrostatic Discharge | ±4kV contact, ±8kV air |
| RFI - Conducted | 10V, 0.15-80 MHz, 1kHz 80% AM |
| AC Surge | ±2kV Common, ±1kV Differential |
| Surge | 1KV (CM) |
| Power-Frequency Magnetic Field | 30 A/m 70%V for 0.5 period |
| Voltage Dips | 40%V for 5 & 50 periods<br>70%V for 25 periods |
| Voltage Interruptions | <5%V for 250 periods |

*Note:*

*Testing was conducted on PD6000 meters installed through the covers of grounded metal enclosures with cable shields grounded at the point of entry representing installations designed to optimize EMC performance.*

*Declaration of Conformity available at www.predig.com*

## Safety Information

⚡

**WARNINGS**

- Read complete instructions prior to installation and operation of the instrument.
- Installation and service should be performed only by trained service personnel. Service requiring replacement of internal sub-components must be performed at the factory.
- Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure or within 2" (50mm) for Zone installations.
- Verify that the operating atmosphere of the instrument is consistent with the appropriate hazardous locations certifications.
- If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead
- Read all product labels completely and follow all instructions and requirements listed on the labels for installation or service.

## Installation

*Install in accordance with applicable local and national regulations (e.g. NEC).*

**For Installation in USA:** The ProtEX-MAX must be installed in accordance with the National Electrical Code (NEC) NFPA 70.

**For Installation in Canada:** The ProtEX-MAX must be installed in accordance with the Canadian Electrical Code CSA 22.1. All power supplies below 36 V and input circuits must be derived from a CSA Approved Class 2 source.

**For European Community:** The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC and the product certificate Sira 12ATEX1182.

⚡ **WARNING** Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure or within 2" (50mm) for Zone installations.

Wiring connectors are accessed by opening the enclosure. To access electrical connectors, remove the 2 captive screws and then remove the electronics module. Connectors are on the rear of the electronics module.
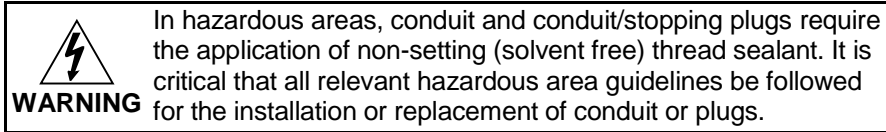
## Unpacking

Remove the instrument from packing box. Inspect the packaging and contents for damage. Report damages, if any, to the carrier.

If any part is missing or the instrument malfunctions, please contact your supplier or the factory for assistance.
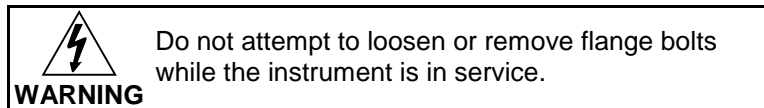
## Pre-Installed Conduit/Stopping Plug

The PD8-6000 is supplied with two pre-installed conduit plugs for installations that do not require the use of all conduit entries. The conduit/stopping plugs include an internal 12mm hexagonal socket recess for removal. The pre-installed plugs and their installation are included in the hazardous area approvals for the PD8 Series enclosure.

| ⚠ **WARNING** | In hazardous areas, conduit and conduit/stopping plugs require the application of non-setting (solvent free) thread sealant. It is critical that all relevant hazardous area guidelines be followed for the installation or replacement of conduit or plugs. |
|---|---|

## Mounting

The ProtEX-MAX has four slotted mounting flanges that should be used for pipe mounting or wall mounting. Refer to *Mounting Dimensions*, page 59 for details.

| ⚠ **WARNING** | Do not attempt to loosen or remove flange bolts while the instrument is in service. |
|---|---|

## Cover Jam Screw

The cover jam screw should be properly installed once the instrument has been wired and tested in a safe environment. The cover jam screw is intended to prevent the removal of the instrument cover in a flameproof environment without the use of tools. Using a M2 hex wrench, turn the screw clockwise until the screw contacts the aluminum enclosure. Turn the screw an additional 1/4 to 1/2 turn to secure the cover. Caution: Excess torque may damage the threads and/or wrench.

## Transmitter Supply Voltage Selection (P+, P-)

All meters, including models equipped with the 12-24 VDC power option, are shipped from the factory configured to provide 24 VDC power for the transmitter or sensor.

If the transmitter requires 5 or 10 VDC excitation, the internal jumper J4 must be configured accordingly.

To access the voltage selection jumper:

1. Remove all the wiring connectors.
2. Unscrew the back cover.
3. Slide out the back cover by about 1 inch.
4. Configure the J4 jumper, located behind the input signal connector, for the desired excitation voltage as shown.
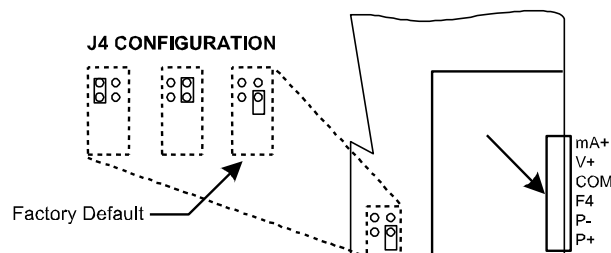


**Figure 1. Transmitter Supply Voltage Selection**

## Connections

| | |
|---|---|
| ⚠️ **WARNINGS** | • **Static electricity can damage sensitive components.**<br>• **Observe safe handling precautions for static-sensitive components.**<br>• **Use proper grounding procedures/codes.**<br>• **If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead or terminal.**<br>• **Follow all fusing and wiring precautions requirements for the instrument integrated to the PD8 Series model number being connected.** |

To access the connectors, remove the enclosure cover and unscrew the two captive screws that fasten the electronics module. Signal connections are made to de-pluggable connectors on the back of the electronics module.

Some connectors may be provided already connected. These connections are required for proper operation of the ProtEX-MAX, and should not be removed unless instructed to by this manual.

Wires marked as being used for testing purposes should be removed.

Grounding connections are made to the two ground screws provided on the base – one internal and one external.

After all connections have been completed and verified, apply power to the unit.

### Required & Factory Wired Connection

The ProtEX-MAX comes with a pre-wired connection. This connection is detailed below, and must be maintained in order for the instrument to function properly.

| | |
|---|---|
| ⚠️ WARNING | Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety. |
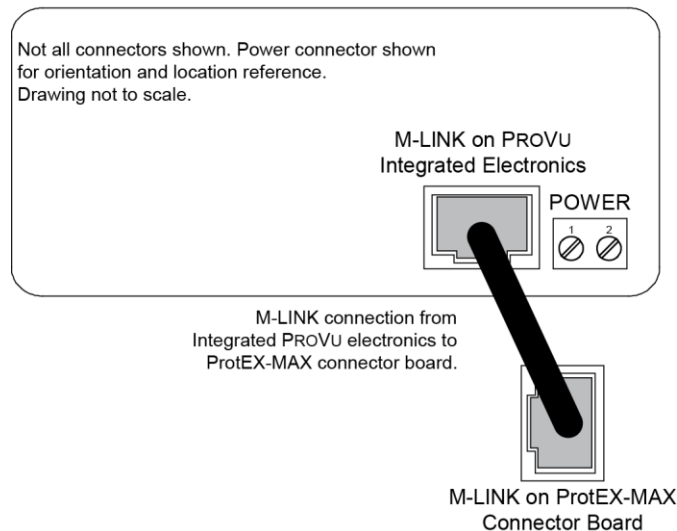


**Figure 2: Integrated ProVu Required Connections**

## Connectors Labeling

The connectors' label, affixed to the meter, shows the location of all connectors available with requested configuration.

⚠️ **Warning!** ***Do not disconnect the RJ45 M-LINK connector cable. Otherwise the instrument will not function properly.***
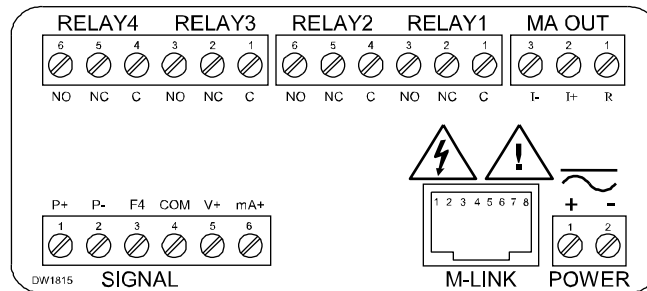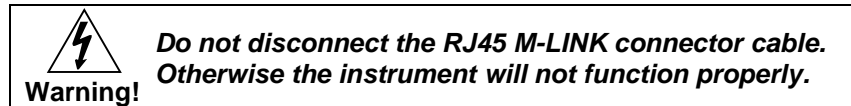


**Figure 3. Connector Labeling for Fully Loaded PD6001**

## Power Connections

Power connections are made to a two-terminal connector labeled POWER on Figure 3 on page 13. The meter will operate regardless of DC polarity connection. The + and - symbols are only a suggested wiring convention.
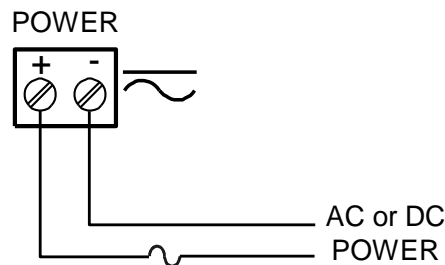


**Figure 4. Power Connections**

## Signal Connections

Signal connections are made to a six-terminal connector labeled
SIGNAL on Figure 3. The COM (common) terminal is the return for the 4-20 mA and the ±10 V input
signals.

## Current and Voltage Connections

The following figures show examples of current and voltage connections.

There are no switches or jumpers to set up for current and voltage inputs. Setup and programming is
performed through the front panel buttons.
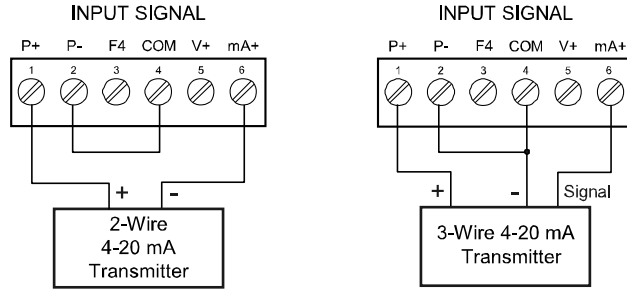


**Figure 5. Transmitters Powered by Internal Supply**
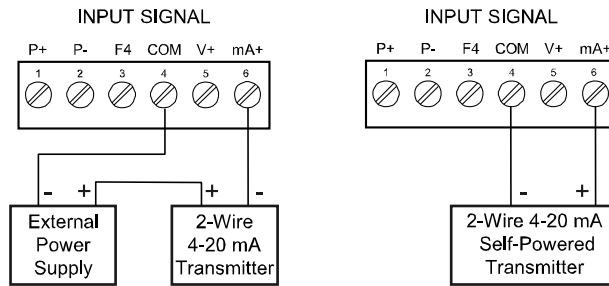


**Figure 6. Transmitter Powered by Ext. Supply or Self-Powered**

The current input is protected against current overload by a resettable fuse. The display may or may not
show a fault condition depending on the nature of the overload.

The fuse limits the current to a safe level when it detects a fault condition, and automatically resets itself
when the fault condition is removed.
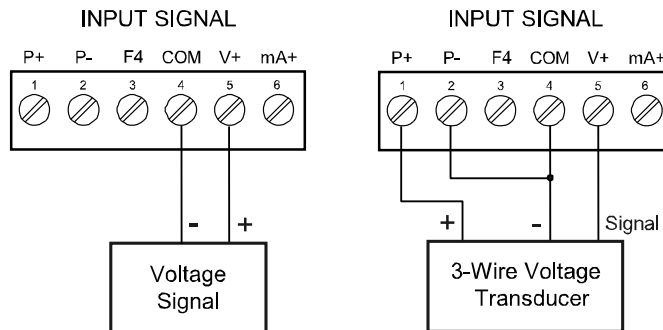


**Figure 7. Voltage Input Connections**

The meter is capable of accepting any voltage from -10 VDC to +10 VDC.

### Serial Communications Connections

The ProtEX-MAX has a 5 position terminal block for connecting RS-485 serial devices.

Figure 8 details the wiring connections from the ProtEX-MAX to an RS-485 serial converter (such as the PDA7485 or PDA8485) for a four-wire network.

| ProtEX-MAX to RS-485 Serial Converter Connections ||
|---|---|
| RS-485 Serial Converter | ProtEX-MAX RS-485 Connections |
| $\frac{\perp}{=}$ | $\frac{\perp}{=}$ |
| $\overline{DO}$ | $\overline{DI}$ |
| DO | DI |
| $\overline{DI}$ | $\overline{DO}$ |
| DI | DO |

**Figure 8: ProtEX-MAX Connections to a Serial Converter**

The ProtEX-MAX has three diagnostic LEDs: a Power (P) LED to show when the module is powered properly, a Transmit Data (TX) LED to show when the module is being transmitted to by the PC side, and a Receive Data (RX) LED to show when the module is sending data to a receiving device.

The following diagrams detail how to connect the RS-485 serial communications from the ProtEX-MAX to a RS-485/RS-232 serial converter (PDA7485) in four wire and two wire configurations.

### Three Wire Connections

In order to wire the 5 pins for use as a 3-wire half-duplex RS-485 connection, it is necessary to create a jumper connection between DI – DO and DI- – DO- as shown below.
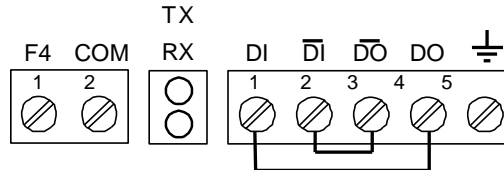
**Figure 9. Three-Wire RS485 Connection**

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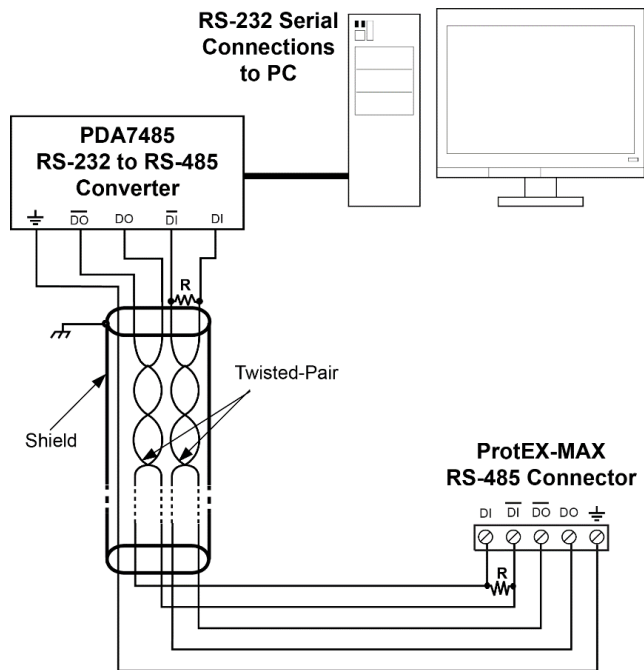
**Figure 10: RS-485 Wiring**

**Notes:**

1. Termination resistors are optional and values depend on the cable length and characteristic impedance. Consult the cable manufacturer for recommendations.
2. Refer to RS-232 to RS-485 Converter documentation for further details.
3. Use shielded cable, twisted-pairs plus ground. Connect ground shield only at one location.

| ⚠ **WARNING** | Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety. |
|---|---|

**Figure 11: RS-485 Two-Wire Multi-Drop Wiring**

**Notes:**
1. Termination resistors are optional and values depend on the cable length and characteristic impedance. Consult the cable manufacturer for recommendations.
2. Refer to RS-232 to RS-485 Converter documentation for further details.
3. Use shielded cable, twisted-pair plus ground. Connect ground shield only at one location.

| ⚡ WARNING | Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety. |
|---|---|

When using more than one instrument in a multi-drop or multi-point mode, each meter must be provided with its own unique address. See Modbus RTU Serial Communications on page 47.

## Using PROVU Serial Adapters

| ⚠ NOTICE | PROVU expansion modules and serial adapters are not included in the hazardous area approvals of the ProtEX-MAX. The PDA1232 may be used only while the ProtEX-MAX is in a safe area, and will disable some features while installed. |
|---|---|

PROVU expansion modules and serial adapters are not recommended for use with the ProtEX-MAX. It is recommended that any serial protocol conversion required on the RS-485 communications connection be performed using a PDA7485 RS-232 to RS-485 or PDA8485 USB to RS-485 serial converter located in a safe area.

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## Relay Connections

Relay connections are made to two six-terminal connectors labeled RELAY1 – RELAY4 on Figure 3. Each relay's C terminal is common only to the normally open (NO) and normally closed (NC) contacts of the corresponding relay. The relays' C terminals should not be confused with the COM (common) terminal of the INPUT SIGNAL connector.
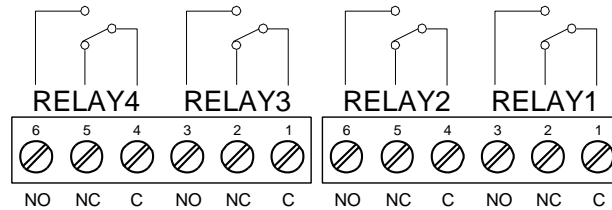


**Figure 12. Relay Connections**

## Switching Inductive Loads

The use of suppressors (snubbers) is strongly recommended when switching inductive loads to prevent disrupting the microprocessor's operation. The suppressors also prolong the life of the relay contacts. Suppression can be obtained with resistor-capacitor (RC) networks assembled by the user or purchased as complete assemblies. Refer to the following circuits for RC network assembly and installation:
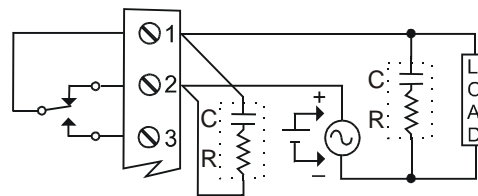


**Figure 13. AC and DC Loads Protection**

Choose R and C as follows:

R: 0.5 to 1 Ω for each volt across the contacts

C: 0.5 to 1 µF for each amp through closed contacts

*Notes:*

1. *Use capacitors rated for 250 VAC.*

2. *RC networks may affect load release time of solenoid loads. Check to confirm proper operation.*

3. *Install the RC network at the meter's relay screw terminals. An RC network may also be installed across the load. Experiment for best results.*
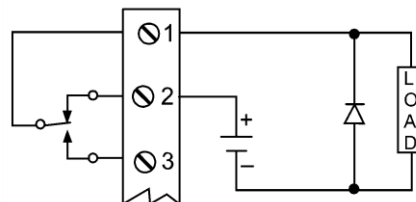


Use a diode with a reverse breakdown voltage two to three times the circuit voltage and forward current at least as large as the load current.

**Figure 14. Low Voltage DC Loads Protection**

### RC Networks Available from Precision Digital

RC networks are available from Precision Digital and should be applied to each relay contact switching an inductive load. Part number: PDX6901.

*Note: Relays are de-rated to 1/14th HP (50 watts) with an inductive load.*

## F4 Digital Input Connections

A digital input, F4, is standard on the meter. This digital input is connected with a normally open contact across F4 and COM, or with an active low signal applied to F4.
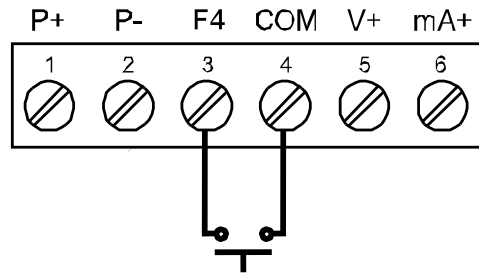


**Figure 15. F4 Digital Input Connections**

## 4-20 mA Output Connections

Connections for the 4-20 mA transmitter output are made to the connector terminals labeled MA OUT. The 4-20 mA output may be powered internally or from an external power supply.
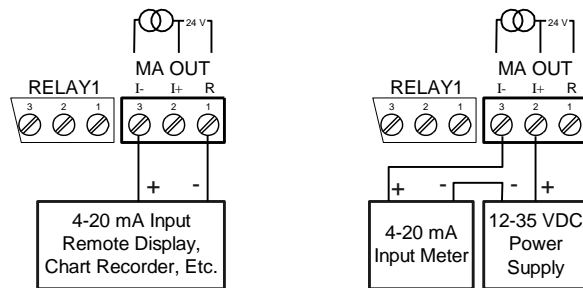


**Figure 16. 4-20 mA Output Connections**

## Analog Output Transmitter Power Supply

The internal 24 VDC power supply powering the analog output may be used to power other devices, if the analog output is not used. The I+ terminal is the +24 V and the R terminal is the return.

## Interlock Relay Feature

As the name implies, the interlock relay feature reassigns one, or more, alarm/control relays for use as interlock relay(s). Interlock contact(s) are wired to digital input(s) and trigger the interlock relay. This feature is enabled by configuring the relay, and relative digital input(s) (see page 42). In one example, dry interlock contacts are connected in series to one digital input which will be used to force on (energize) the assigned interlock power relay when all interlock contacts are closed (safe). The interlock relay front panel LED flashes when locked out. The interlock relay would be wired in-series with the load (N/O contact). See below.
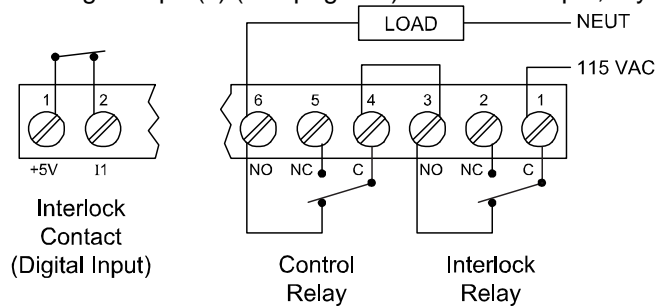


**Figure 17. Interlock Connections**

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## Digital I/O Connections

The ProtEX-MAX has a 10 position terminal block for connecting digital inputs and outputs.
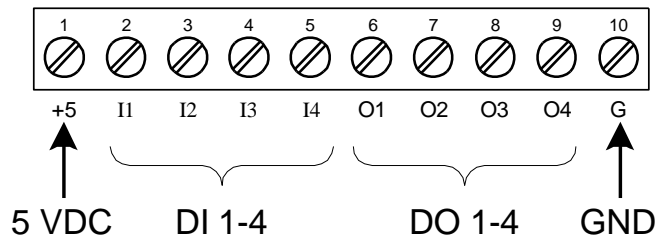


**Figure 18: Digital I/O Connections**

| ! NOTICE | The onboard digital inputs (1-4) are configured at the factory to function identically to the front panel pushbuttons (Menu, F1, F2, & F3) in order to work with the SafeTouch buttons. Changing the programming of the digital inputs will affect the function of the SafeTouch buttons. If you wish to change the behavior of the digital inputs, re-assign F1-F3 to the desired function, then change the corresponding digital input to match. |
|---|---|
| ⚡ WARNING | Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety. |

## External Switch Contacts

The ProtEX-MAX includes 4 digital inputs. These digital inputs are preconfigured at the factory to function as external contacts to duplicate the front button functions of the instrument. The factory configuration uses the following corresponding digital input terminals for external switch contacts.

| Digital Input Connection | Factory Default Function |
|---|---|
| I1 | MENU |
| I2 | RIGHT arrow |
| I3 | UP arrow |
| I4 | ENTER arrow |

See Digital Inputs & Outputs in the Specification on page 7 for details on the digital inputs.

| ! NOTICE | The digital inputs are configured at the factory to function identically to the front panel pushbuttons in order to work with the SafeTouch buttons. Changing the programming of the digital inputs will affect the function of the SafeTouch buttons. |
|---|---|

# Setup and Programming

> The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.

## Overview

There are no jumpers to set for the meter input selection.

Setup and programming may be done through the infrared through-glass SafeTouch buttons, or using the mechanical buttons when uncovered. There is a slide switch located on the connector board. This is used to enable or disable SafeTouch Buttons.

After power and input signal connections have been completed and verified, apply power to the meter.

## SafeTouch® Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area.

These buttons can be disabled for security by selecting DISABLE on the switch labeled NO-CONTACT BUTTONS located on the connector board.

To actuate a button, press one finger to the glass directly over the marked button area. Then retract finger more than three inches from the glass before pressing the next button. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

The SafeTouch Buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the SafeTouch Buttons be disabled (slide switch to LOCK) if there is an infrared interference source in line-of-sight to the display.

The SafeTouch Buttons are configured by default to duplicate the function of the front panel mechanical pushbuttons associated with the integrated meter. The symbols by each SafeTouch button correspond to a mechanical button as shown in the table on the next page.

SafeTouch Button Tips:
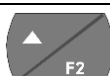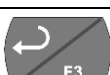
- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the glass window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.

> ⚠ **WARNING** Take caution when cleaning the window glass as it may result in unintentional SafeTouch button events. Only clean the ProtEX-MAX when the system is safely shut down, and inspect the ProtEX-MAX for proper configuration prior to system restart.

## Front Panel Buttons and Status LED Indicators



| Symbol | Description |
|---|---|
| FT    IN<br><br>**-    -** | Feet and inches designation separators |
| MENU | Menu |
| F1 | Right arrow/F1 |
| F2 | Up arrow/F2 |
| F3 | Enter/F3 |
| *Note:*<br><br>*F4-8 are digital inputs.* | |

| LED | Status |
|---|---|
| $\overline{8}$<br>$\overline{16}$ | Fractions of an inch indicator (eighths or sixteenths) |
| 1-8 | Alarm 1-8 indicator |
| 1-8<br>M | Flashing: Relay in manual control mode |
| 1-8 | Flashing: Relay interlock switch open |
| *Note:*<br><br>*LEDs for relays in manual mode flash with the "M" LED every 10 seconds. "M" flashing by itself indicates Aout – manual control is used.* | |

- Press the Menu button to enter or exit the Programming Mode at any time.
- Press the Right arrow button to move to the next digit during digit or decimal point programming.
- Press or hold the Up arrow button to scroll through the menus, decimal point, or to increment the value of a digit.
- Press the Enter button to access a menu or to accept a setting.
- Press and hold the Menu button for three seconds to access the advanced features of the meter.

# MeterView® Pro Software

The meter can also be programmed using the PC-based MeterView Pro software included with the meter. This software can be installed on any Microsoft® Windows® (XP/Vista/7/8/10) computer by connecting the meter's onboard USB. The meter is powered by the USB connection, so there is no need to wire anything prior to programming the meter, though USB is intended only for meter configuration.

## MeterView Pro Installation

1. Connect one end of the provided USB cable to the internal electronics module and the other end to the computer. The computer will automatically install the driver software it needs to talk to the meter. **Only one meter may be connected at a time. Attaching multiple meters will cause a conflict with the meter software.**
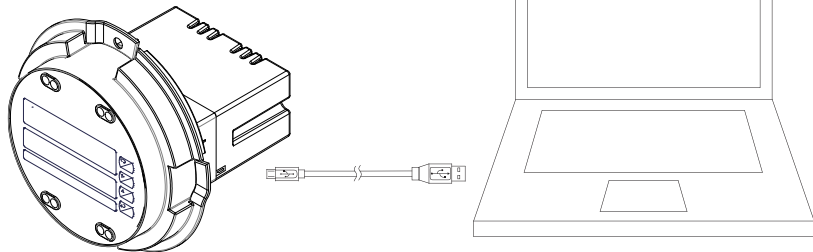
2. Once the driver is installed, an AutoPlay dialog should appear for the drive "MAINSTAL." Click "Open folder to view files." If the computer does not display an AutoPlay dialog for the drive "MAINSTAL," you should open My Computer and double-click on the drive labeled "MAINSTAL."

3. Double-click on the file named "MAStart." The program will open a few windows and install two programs on your computer. Simply follow the onscreen instructions until you see one of the dialogs below. If you receive a "User Account Control" warning, click "Yes."

4. If there is an update available, click the "Update" button to install the new version. Otherwise, click "Configure" to begin programming your meter.
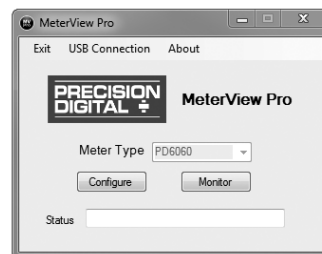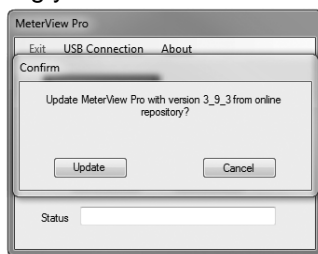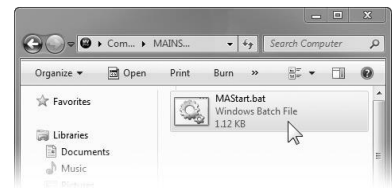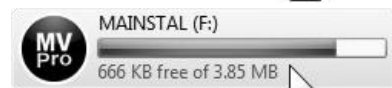
**Note:** If you decide to update your MeterView Pro software, once the installation has completed, you will be asked if you want to update the setup files located on the meter itself. This way, you will always have the most current version on the meter for future installs.

| ⚠ **Warning!** | **Do not unplug the meter while the new installation files are being written to it. The meter will display *uwrite* during the process and you will receive an onscreen notification once the process is complete.** |
|---|---|

Data logging for one meter at a time is available with MeterView Pro software. More advanced data acquisition may be accomplished by using any Modbus RTU compliant software. Additional information regarding configuration and monitoring of the meter using MeterView Pro software is available online. Go to **www.predig.com/meterview-pro**.

## Display Functions & Messages

The meter displays various functions and messages during setup, programming, and operation. The following table shows the main menu functions and messages in the order they appear in the menu.

| Display | Parameter | Action/Setting Description | Display | Parameter | Action/Setting Description |
|---------|-----------|----------------------------|---------|-----------|----------------------------|
| SEtuP | Setup | Enter Setup menu | d HL | Display hi/low | Alternate between high/low value |
| InPut | Input | Enter Input selection menu | m buS | Display Modbus | Display Modbus input register |
| m A | 4-20 mA | Set meter for 4-20 mA input | d PU | Display PV | Select to display PV |
| UoLt | 0-10 VDC | Set meter for ±10 VDC input | L inE 2 | Display line 2 | Press Enter to assign the small display parameter (default: engineering units) |
| d-SCAL | Dual-scale | Press Enter to select dual-scale display for some level applications (Select Yes or No) | d un it | Display unit | Display line 1 display channel units |
| un itS | Units | Select the display units/tags | d PU2 | Display PV2 | Select to display PV2 (dual-scale display) |
| dEc Pt | Decimal point | Set decimal point | d PCt | Display PCT | Select to display percent of PV1 (dual-scale display) |
| PU 2 | PV2 | PV2 decimal point (Level) | d L-u | Display Level Units | Select to display PV1 level in decimal units on display line 2 |
| ProG | Program | Enter the Program menu | | | |
| SCALE | Scale | Enter the Scale menu | d oFF | Display off | Turn off display line 2 |
| SCAL 1 | Scale 1 | Enter the Scale menu for PV1 | d- IntY | Display intensity | Set display intensity level from 1 to 8 |
| SCAL 2 | Scale 2 | Enter the Scale menu for PV2 | rELAY | Relay | Enter the Relay menu |
| CAL | Calibrate | Enter the Calibration menu | rLY 1* | Relay 1* | Relay 1 (*through 4) setup |
| InP 1 | Input 1 | Calibrate input 1 signal or program input 1 value | Act 1 | Action 1 | Set relay 1 action |
| d iS 1 | Display 1 | Program display 1 value | Auto | Automatic | Set relay for automatic reset |
| InP 2 | Input 2 | Calibrate input 2 signal or program input 2 value (up to 32 points) | A-nman | Auto-manual | Set relay for automatic & manual reset any time |
| d iS 2 | Display 2 | Program display 2 value (up to 32 points) | LAtCH | Latching | Set relay for latching operation |
| Error | Error | Error, calibration not successful, check signal or programmed value | Lt-CLr | Latching-cleared | Set relay for latching operation with manual reset only after alarm condition has cleared |
| dSPLAY | Display | Enter the Display menu | ALtErn | Alternate | Set relay for pump alternation control |
| L inE 1 | Display line 1 | Press Enter access Main display format and parameter options (default: PV) | Sanmpl | Sampling | Set relay for sampling operation |
| Form t | Format | Format fractional inches to either eighths (1/8) or sixteenths (1/16) | OFF | Off | Disable relay and front panel status LED (Select Off to enable Interlock feature) |
| PArAm | Parameter | Press Enter to assign the Main display parameter (default: PV) | SEt 1 | Set 1 | Program set point 1 |
| dSEt 1* | Display set 1* | Display relay 1 (*through 8) set point | rSt 1 | Reset 1 | Program reset point 1 |
| | | | FA iLSF | Fail-safe | Enter Fail-safe menu |
| d Hi | Display high | Display high value | FLS 1 | Fail-safe 1 | Set relay 1 fail-safe operation |
| d Lo | Display low | Display low value | on | On | Enable fail-safe operation |
| | | | oFF | Off | Disable fail-safe operation |

| Display | Parameter | Action/Setting Description |
|---------|-----------|---------------------------|
| FLS 2 | *Fail-safe 2* | Set relays 2-4 fail-safe operation |
| dELAY | *Delay* | Enter relay *Time Delay* menu |
| dLY 1 | *Delay 1* | Enter relay 1 time delay setup |
| On 1 | *On 1* | Set relay 1 On time delay |
| OFF 1 | *Off 1* | Set relay 1 Off time delay |
| dLY 2 | *Delay 2* | Enter relays 2-4 time delay setup |
| brEAH | *Loop break* | Set relay condition if loop break detected |
| brEAH 1* | *Loop break 1\** | Set relay 1 (\*through 4) condition if loop break detected |
| iGnorE | *Ignore* | Ignore loop break condition (Processed as a low signal condition) |
| On | *On* | Relay goes to alarm condition when loop break is detected |
| OFF | *Off* | Relay goes to non-alarm condition when loop break is detected |
| Rout | *Analog output* | Enter the *Analog output* scaling menu |
| d iS 1 | *Display 1* | Program display 1 value |
| Out 1 | *Output 1* | Program output 1 value (e.g. 4.000 mA) |

| Display | Parameter | Action/Setting Description |
|---------|-----------|---------------------------|
| d iS 2 | *Display 2* | Program display 2 value |
| Out 2 | *Output 2* | Program output 2 value (e.g. 20.000 mA) |
| rESEt | *Reset* | Press Enter to access the *Reset* menu |
| rSt H i | *Reset high* | Press Enter to reset max display |
| rSt Lo | *Reset low* | Press Enter to reset min display |
| rSt HL | *Reset high & low* | Press Enter to reset max & min displays |
| ContrL | *Control* | Enter *Control* menu |
| Auto | *Automatic* | Press Enter to set meter for automatic operation |
| m An | *Manual* | Press Enter to manually control relays or analog output operation |
| PASS | *Password* | Enter the *Password* menu |
| PASS 1 | *Password 1* | Set or enter Password 1 |
| PASS 2 | *Password 2* | Set or enter Password 2 |
| PASS 3 | *Password 3* | Set or enter Password 3 |
| unLoc | *Unlocked* | Program password to lock meter |
| Locd | *Locked* | Enter password to unlock meter |
| 999999 -99999 | *Flashing* | Over/under range condition |

## Main Menu

The main menu consists of the most commonly used functions: *Setup*, *Reset, Control,* and *Password*.

- Press Menu button to enter Programming Mode then press the Up arrow button to scroll main menu.
- Press Menu, at any time, to exit and return to Run Mode. Changes made to settings prior to pressing Enter are not saved.
- Changes to the settings are saved to memory only after pressing Enter/F3.
- The display moves to the next menu every time a setting is accepted by pressing Enter/F3.
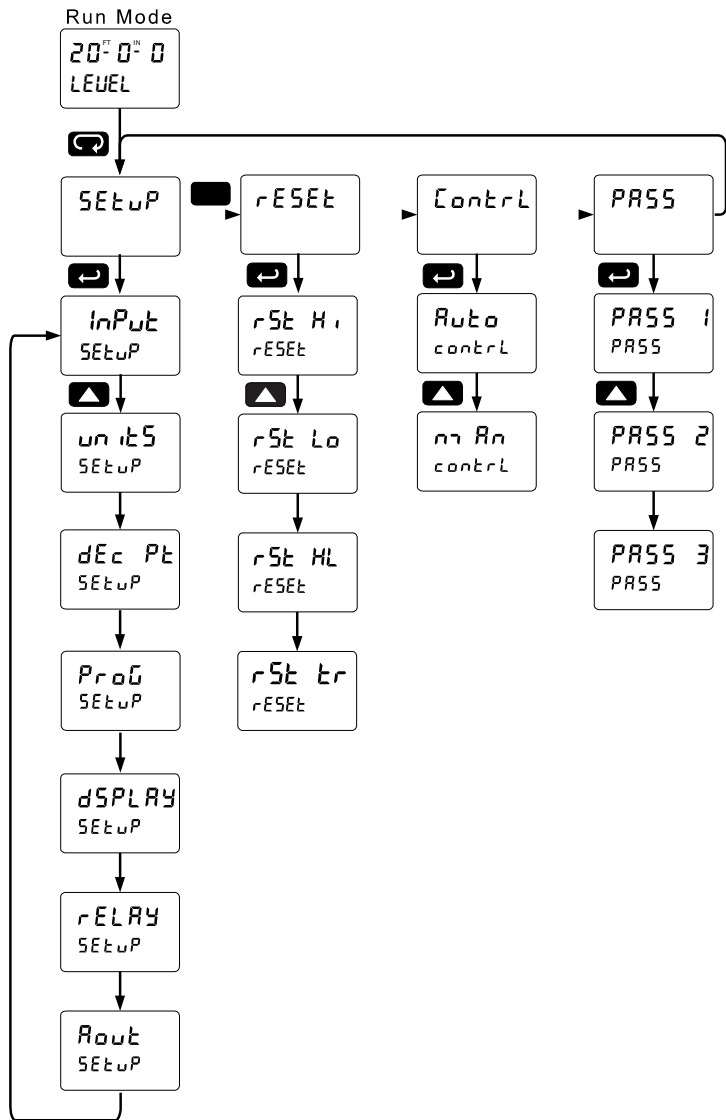


## Setting Numeric Values

The numeric values on PV1 (main display) are set using the Right and Up arrow buttons. Press Right arrow to select next digit and Up arrow to increment digit value.

The digit being changed is displayed brighter than the rest. The leading zero in any of the unit designations is omitted. Because of this, if the leading zero of any unit designation is the currently selected unit, none of the digits will be brighter than any other. Pressing the Up arrow will increment the value to 1.

The range of numeric values for each unit designation is from 0-99 for feet, 0-11 for inches and either 0-7 or 0-15 for fractional inches depending on whether you are in eighths ($1/8$) or sixteenths ($1/16$) mode. Press and hold up arrow to auto-increment the display value.

Press the Enter button, at any time, to accept a setting or Menu button to exit without saving changes.
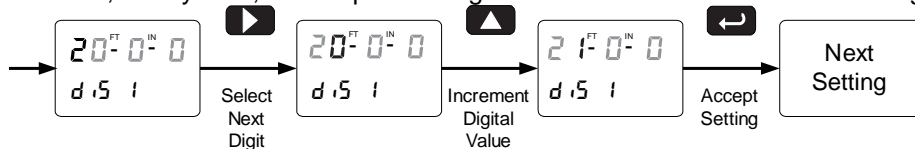
# Setting Up the Meter (SEtuP)

The *Setup* menu is used to select:

1. Input signal the meter will accept
2. Dual-scale feature for some level applications
3. Select the display units/tags
4. Decimal point position
5. Programming Menu
6. Display parameter and intensity
7. Relay operation
8. 4-20 mA analog output scaling

Press the Enter button to access any menu or press Up arrow button to scroll through choices. Press the Menu button to exit at any time.



**Note:**
Use the d-SCAL selection to activate the dual-scale level feature - PV1 & PV2 (see introduction on page 6). Set d-SCAL to no if both displays are to be used for anything other than PV1 & PV2.

**Note:**
Decimal Point menu only appears when dual scale is active. Decimal point selection is only available for PV2 on the secondary (little) display.

**Note:**
Scal 1 & Scal 2 are displayed instead of Scale if d-SCAL is selected under the Setup Input menu. They correspond to the PV1 & PV2 scales.

## Setting the Input Signal ( InPut )

Enter the *Input* menu to set up the meter to display current (m A) or voltage (UoLt) inputs.

The current input is capable of accepting any signal from 0 to 20 mA. Select current input to accept 0-20 mA or 4-20 mA signals.

The voltage input is capable of accepting any signal from -10 to +10 VDC. Select voltage input to accept 0-5, 1-5, 0-10, or ±10 VDC signals.

After selecting *mA* or *Volt* input, *d-SCAL* is displayed; press Enter to select "*Yes*" or "*No*". Selecting "*Yes*" enables the dual-scale feature, which allows for the Scale (SCALE) and Units (units) menus to be used to scale the same input in two different scales for PV1 & PV2.
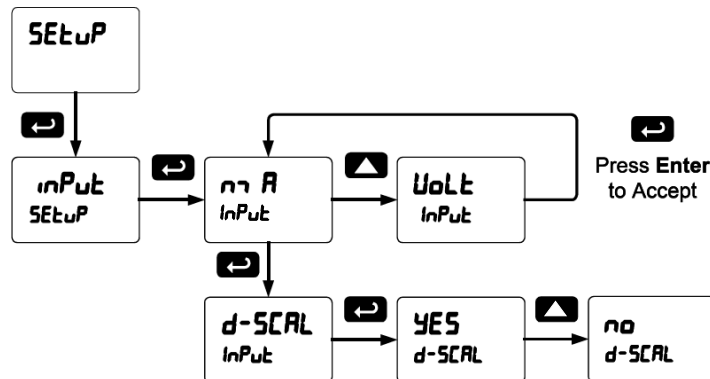


Set d-SCAL to NO if both displays are to be used for anything other than PV1 & PV2.

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## Setting the Input Units or Custom Tags (un it5)

Enter the input unit or custom tag that will be displayed if d un it is selected as the display line 2 parameter. See the flow chart on page 32 to access the display menu to show the unit or tag on line 2. The engineering units or custom legends can be set using the following 7-segment character set:

| Display | Character |
|---------|-----------|
| 0 | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 7 |
| 8 | 8 |
| 9 | 9 |
| A | A |
| b | b |

| | |
|---|---|
| C | C |
| c | c |
| d | d |
| E | E |
| F | F |
| G | G |
| g | g |
| H | H |
| h | h |
| I | I |
| i | i |
| J | J |
| K | K |

| | |
|---|---|
| L | L |
| m | m |
| n | n |
| O | O |
| o | o |
| P | P |
| q | q |
| r | r |
| S | S |
| t | t |
| u | u |
| V | V |

| u w | w |
|-----|---|
| X | X |
| Y | Y |
| Z | Z |
| - | - |
| / | / |
| ] | ] |
| [ | [ |
| = | = |
| ! | Degree(<) |
| | Space |

*Notes:*

*Degree symbol represented by (<) if programming with MeterView® Pro.*

*The letters "m" and "w" use two 7-segment LEDs each; when selected the characters to the right are shifted one position.*

*Press and hold up arrow to auto-scroll the characters in the display.*

### Setting the Decimal Point (dEc Pt)

The decimal point on PV2 (display line 2) may be set only if the dual-scale level feature is selected. It may be set with up to five decimal places or with no decimal point at all.

Pressing the Right arrow moves the decimal point one place to the right until no decimal point is displayed, and then it moves to the leftmost position. Pressing the Up arrow moves the decimal point one place to the left.
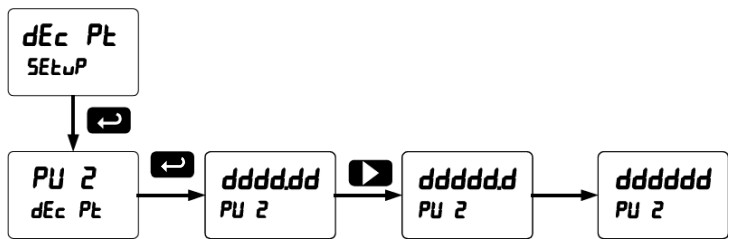
## Programming the Meter (𝖯𝗋𝗈𝖦)

It is **very important** to read the following information, before proceeding to program the meter:

- The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.
- Use the *Scale* menu to scale the process input (e.g. 4-20 mA). A calibrated signal source is not needed to scale the meter.
- Use the *Calibrate* menu to apply a signal from a calibrator.
- The PD6001 is a single input meter with dual-scale capability.

The *Program* menu contains the *Scale* and the *Calibrate* menus.

*Note: The **Scale** and **Calibrate** functions are exclusive of each other. The meter uses the last function programmed. Only one of these methods can be employed at a time. The Scale and Calibrate functions can use up to 32 points (default is 2). The number of points should be set in the Advanced menu under the Multi-Point Linearization (L 𝗂𝗇𝖤𝖠𝗋) menu selection prior to scaling and calibration of the meter, see page 49 for details.*

If the dual-scale level feature is selected in the *Setup* menu, the *Scale 1* and *Scale 2* menus are enabled for PV1 & PV2 respectively.

The process input may be calibrated or scaled to any display value within the range of the meter.

### Program Menu for Single Scale Process
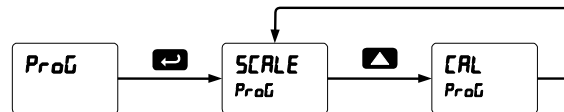


### Program Menu for Dual-Scale Level Applications
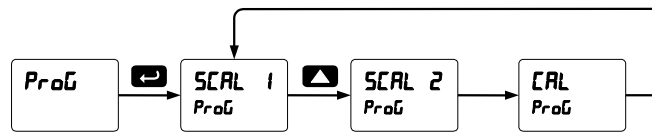


Additional parameters, not needed for most applications, are programmed in the *Advanced Features* menu; see *Advanced Features Menu*, page 45.

### Multi-Point Calibration & Scaling

The meter is set up at the factory for 2-point linear calibration. The number of points for multi-point calibration/scaling is set up in the *Advanced Features* menu. Up to 32 linearization points may be selected for PV1 and up to 8 linearization points may be selected for PV2. See page 49 for details.

## Scaling the Meter (SCALE)

The process input (4-20 mA, ±10 VDC) can be scaled to display the process variable in engineering units. A signal source is not needed to scale the meter; simply program the inputs and corresponding display values.



For instructions on how to program numeric values see *Setting Numeric Values*, page 26.
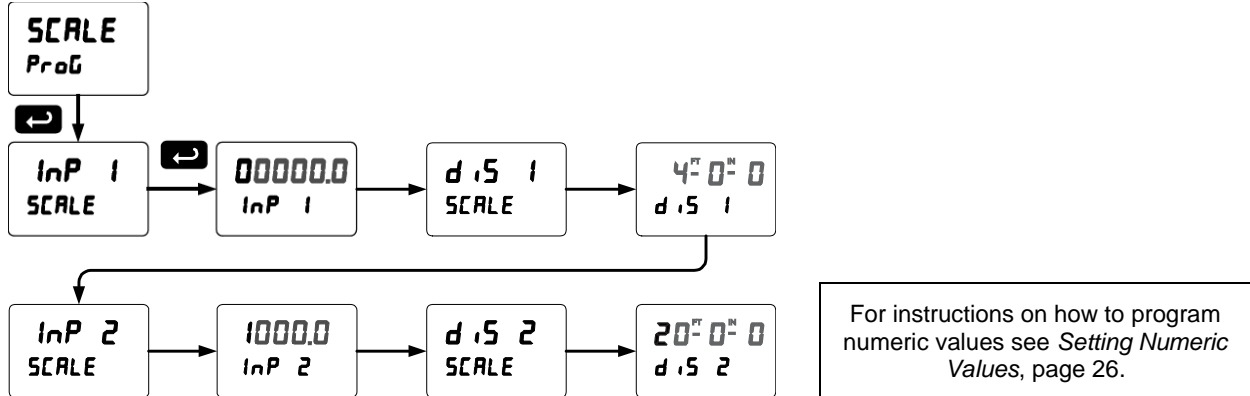
## Dual-Scale for Level Application

The analog input can be displayed in two different scales, by enabling the dual-scale feature (d-SCAL) in the *Setup-Input* menu, see page 27.

To enable the dual-scale feature for some level applications you must select d-SCAL in the Input selection menu.

### Scaling the Input for PV1 (SCAL 1)
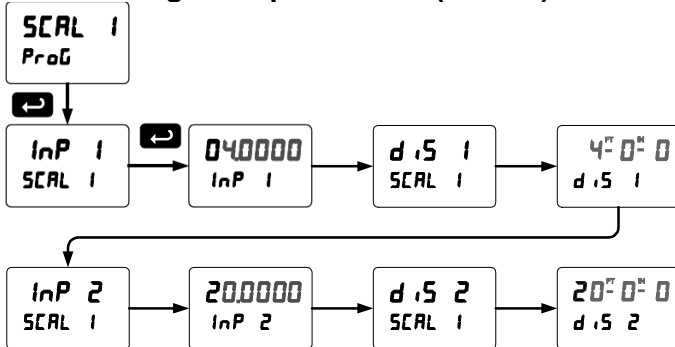


### Scaling the Input for PV2 (SCAL 2)
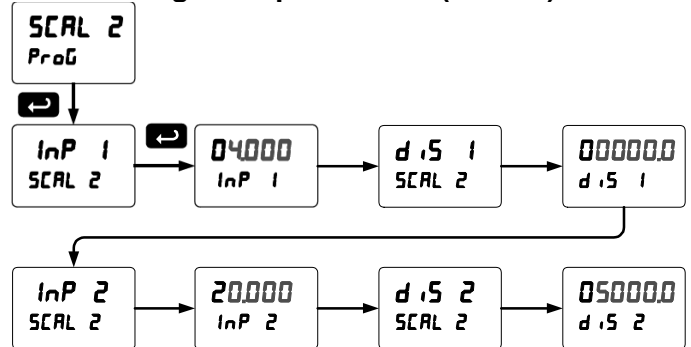


## Error Message (Error)

An error message indicates that the calibration or scaling process was not successful.

After the error message is displayed, the meter reverts to the input prior to the failure during calibration or scaling and to input 1 during internal calibration, allowing the appropriate input signal to be applied or programmed.

The error message might be caused by any of the following conditions:

1. Input signal is not connected to the proper terminals or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.
4. Input 1 signal inadvertently applied to calibrate input 2.

## Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

| Input Range | Input 1 & Input 2 Span |
|-------------|------------------------|
| 4-20 mA | 0.15 mA |
| ±10 VDC | 0.01 VDC |

## Calibrating the Meter with External Source (CRL)

> *Note: To scale the meter without a signal source refer to* Scaling the Meter (5CRLE), *page 30.*

The meter can be calibrated to display the process variable in engineering units by applying the appropriate input signal and following the calibration procedure.

The use of a calibrated signal source is strongly recommended to calibrate the meter.
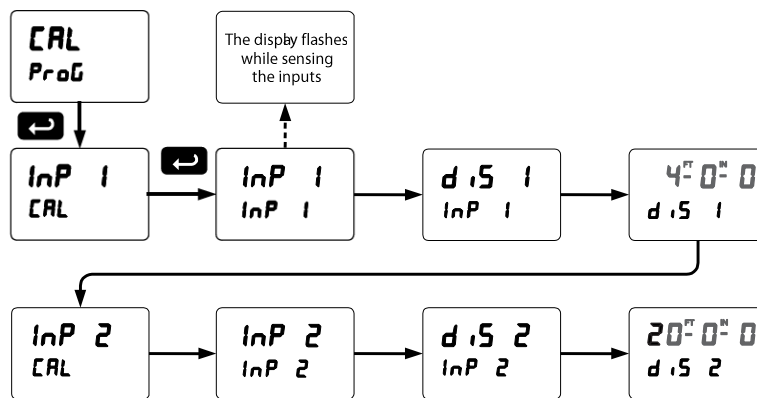


> *Warm up the meter for at least 15 minutes before performing calibration to ensure specified accuracy.*

## Setting the Display Parameter & Intensity (dSPLAY)

Display line 1 can be programmed to display:

1. Process value
2. Relay set points
3. Max & min values
4. Modbus input

Display line 2 can be programmed to display:

1. Unit or tag
2. Process value 2 (PV2)
3. Percent of PV1 (PCT)
4. Relay set points
5. Level value in feet with unit or tag
6. Max & min values
7. Engineering units or custom legends
8. Modbus input
9. Off (no display)

**Display Intensity:** The meter has eight display intensity levels to give the best performance under various lighting conditions. Select intensity 8 for outdoor applications. The default intensity setting is 8.
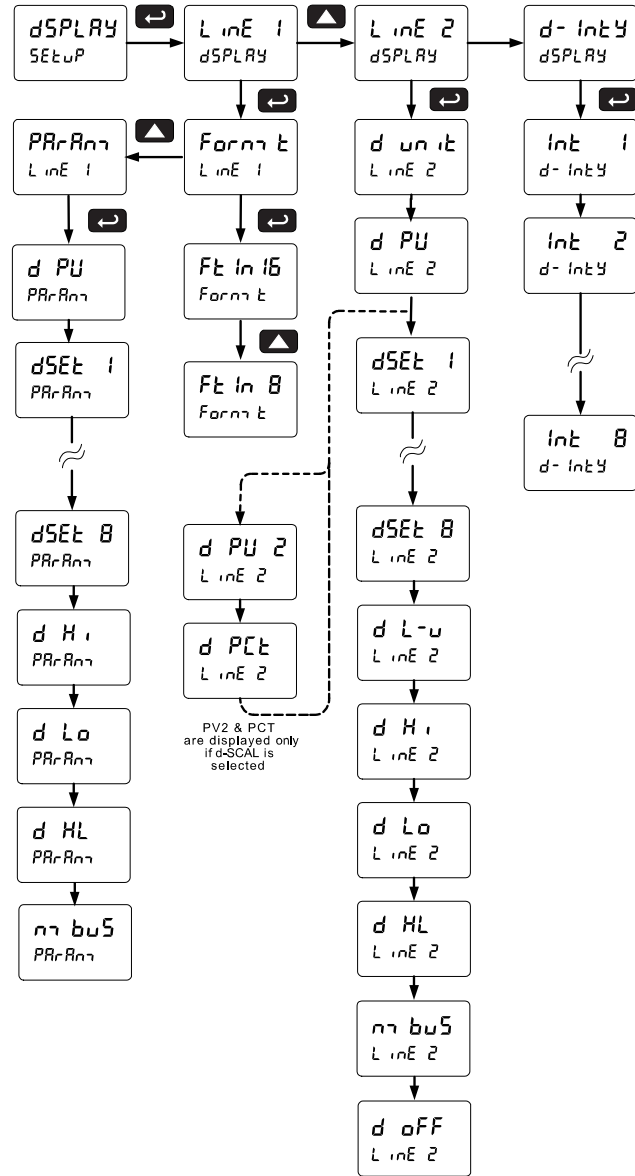


After setting up the input and display, press the Menu button to exit programming and skip the rest of the setup menu. Press the Menu button again and the Up arrow to reach the *Program* menu and complete the scaling or calibration of the meter.

## Setting the Relay Operation (rELAY)

This menu is used to set up the operation of the relays.

> ⚠ **Caution!** *During setup, the relays do not follow the input and they will remain in the state found prior to entering the Relay menu.*

1. Relay action
   a. Automatic reset only (non-latching)
   b. Automatic + manual reset at any time (non-latching)
   c. Latching (manual reset only)
   d. Latching with Clear (manual reset only after alarm condition has cleared)
   e. Pump alternation control (automatic reset only)
   f. Sampling (the relay is activated for a user-specified time)
   g. Off (relay state controlled by Interlock feature)
2. Set point
3. Reset point
4. Fail-safe operation
   a. On (enabled)
   b. Off (disabled)
5. Time delay
   a. On delay (0-999.9 seconds)
   b. Off delay (0-999.9 seconds)
6. Relay action for loss (break) of 4-20 mA input (ignore, on, off)
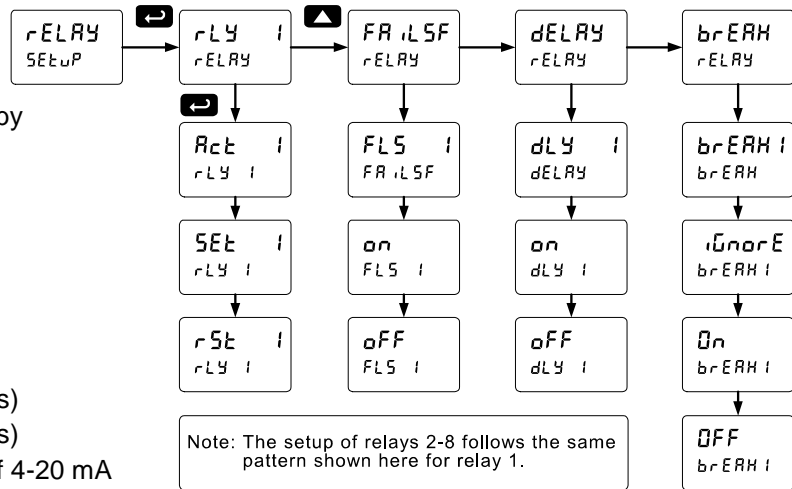


Note: The setup of relays 2-8 follows the same pattern shown here for relay 1.

### Setting the Relay Action

Operation of the relays is programmed in the *Action* menu. The relays may be set up for any of the following modes of operation:

1. Automatic reset (non-latching)
2. Automatic + manual reset at any time (non-latching)
3. Latching (manual reset only, at any time)
4. Latching with Clear (manual reset only after alarm condition has cleared)
5. Pump alternation control (automatic reset only)
6. Sampling (the relay is activated for a user-specified time)
7. Off (relay state controlled by Interlock feature)
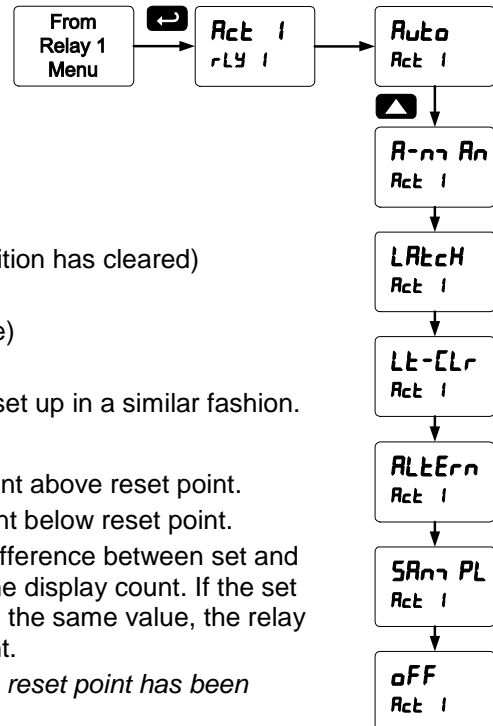
The following graphic shows relay 1 action setup; relay 2-4 are set up in a similar fashion.



### Programming Set and Reset Points
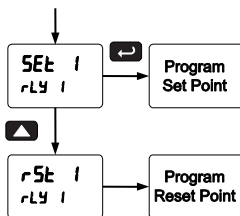


High alarm indication: program set point above reset point.

Low alarm indication: program set point below reset point.

The deadband is determined by the difference between set and reset points. Minimum deadband is one display count. If the set and reset points are programmed with the same value, the relay will reset one count below the set point.

*Note: Changes are not saved until the reset point has been accepted.*

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### Setting Fail-Safe Operation

In fail-safe mode of operation, the relay coil is energized when the process variable is within safe limits and the relay coil is de-energized when the alarm condition exists. The fail-safe operation is set independently for each relay. Select **on** to enable or select **oFF** to disable fail-safe operation.

### Programming Time Delay

The *On* and *Off* time delays may be programmed for each relay between 0 and 999.9 seconds. The relays will transfer only after the condition has been maintained for the corresponding time delay.

The *On* time delay is associated with the set point.

The *Off* time delay is associated with the reset point.

### Relay Action for Loss of 4-20 mA Input (Loop Break)

The loop break feature is associated with the 4-20 mA input. Each relay may be programmed to go to one of the following conditions when the meter detects the loss of the input signal (i.e. < 0.005 mA):

1. Turn *On* (Go to alarm condition)
2. Turn *Off* (Go to non-alarm condition)
3. Ignore (Processed as a low signal condition)

*Note: This is not a true loop break condition; if the signal drops below 0.005 mA, it is interpreted as a "loop break" condition.*

## Relay and Alarm Operation Diagrams

The following graphs illustrate the operation of the relays, status LEDs, and ACK button.



High Alarm Operation (Set > Reset)

Low Alarm Operation (Set < Reset)
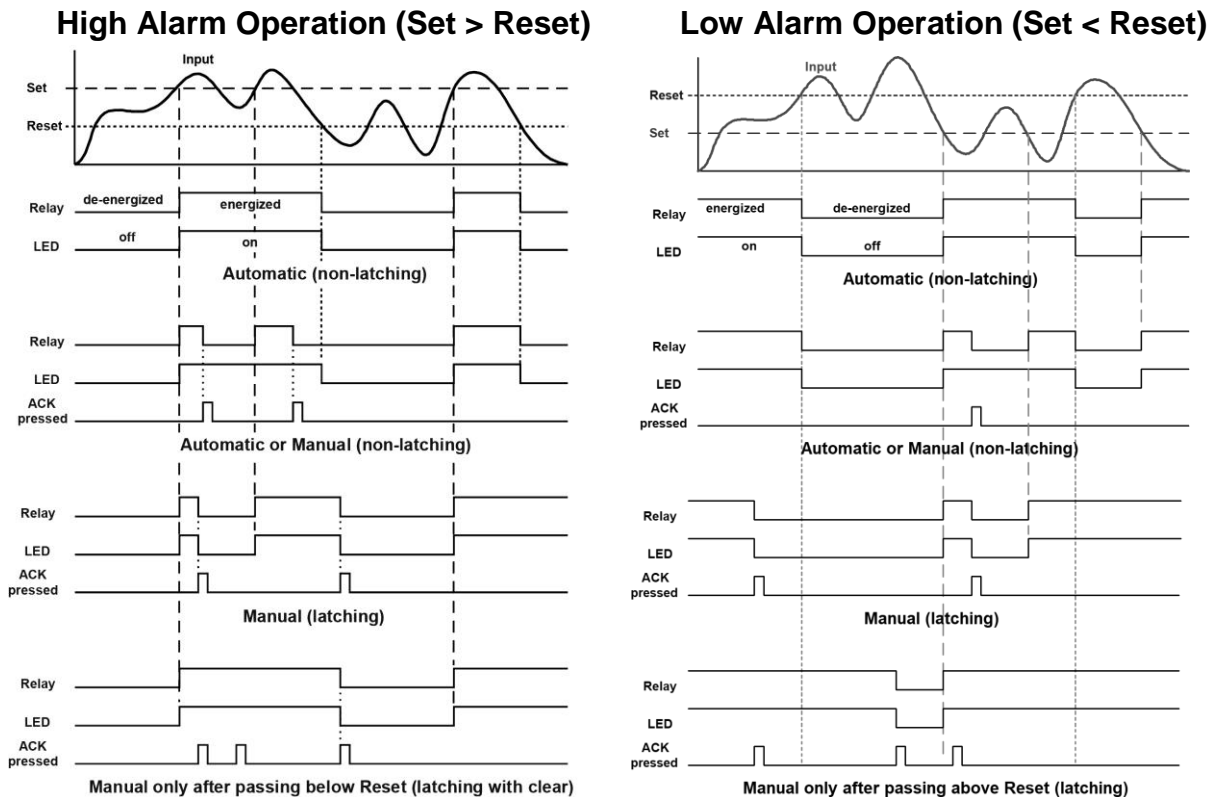
For Manual reset mode, ACK can be pressed anytime to turn "off" relay. To detect a new alarm condition, the signal must go below the set point, and then go above it.

For Manual reset mode, ACK can be pressed anytime to turn "off" relay. For relay to turn back "on", signal must go above set point and then go below it.

## High Alarm with Fail-Safe Operation (Set > Reset)
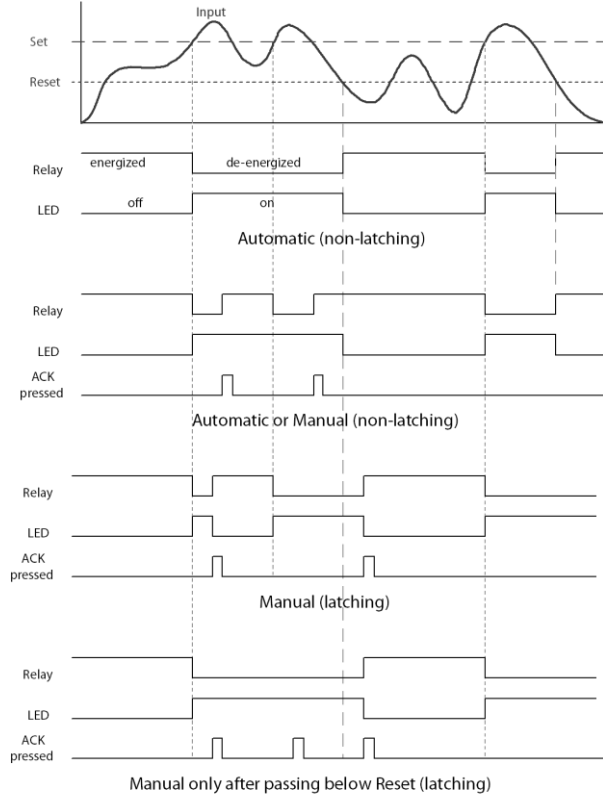


## Low Alarm with Fail-Safe Operation (Set < Reset)



*Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.*

*Note: Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.*

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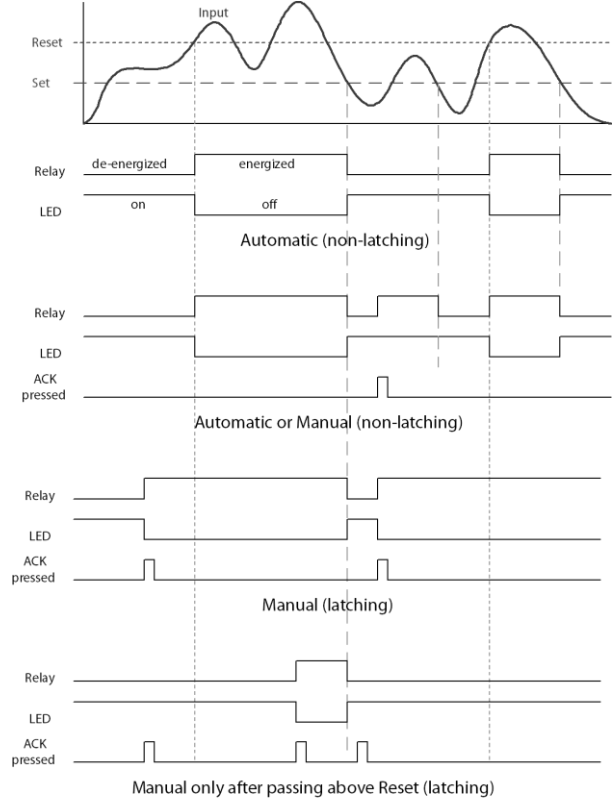
## Pump Alternation Control Operation



LEDs indicate the relay status
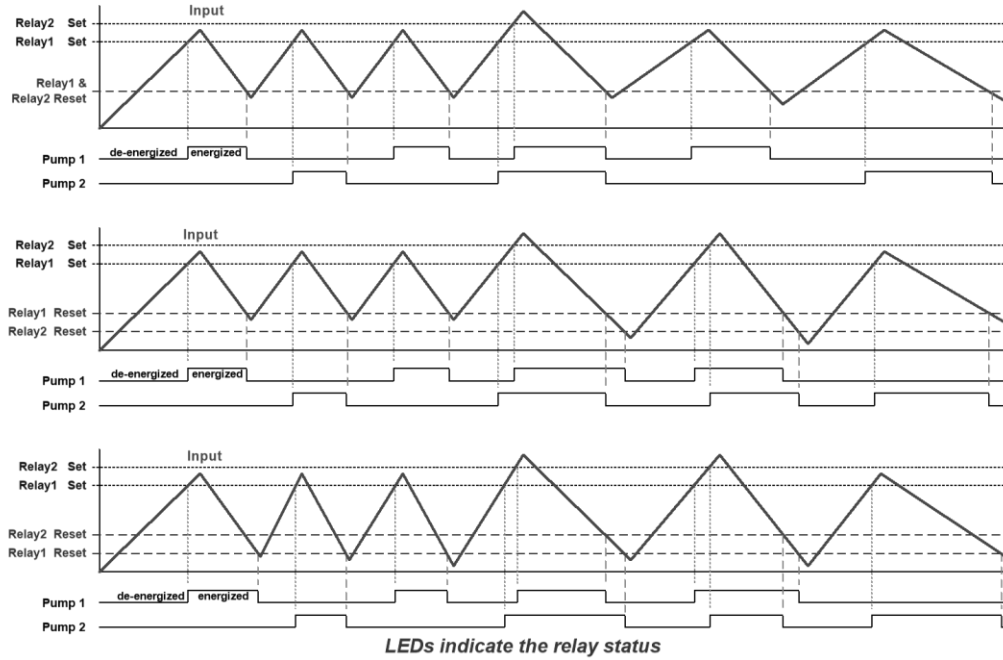
## Relay Sampling Operation
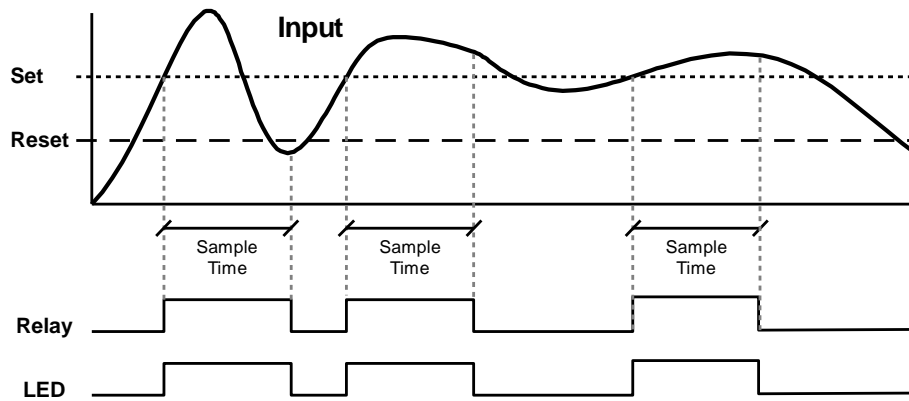


When the signal crosses the set point, the relay trips and the sample time starts. After the sample time has elapsed, the relay resets. The cycle repeats every time the set point is crossed, going up for high alarms and going down for low alarms.

The sample time can be programmed between 0.1 and 5999.9 seconds.

### Signal Loss or Loop Break Relay Operation

The following graph shows the loop break relay operation for a high alarm relay.
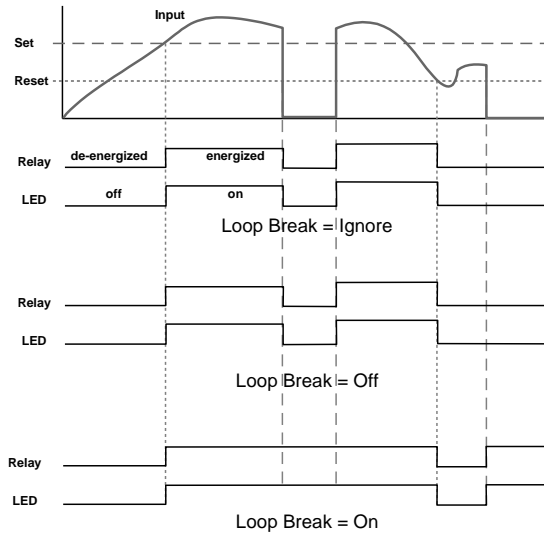


When the meter detects a break in the 4-20 mA loop, the relay will go to one of the following selected actions:

1. Turn *On* (Go to alarm condition)
2. Turn *Off* (Go to non-alarm condition)
3. Ignore (Processed as a low signal condition)

### Time Delay Operation

The following graphs show the operation of the time delay function.



**On Time Delay**
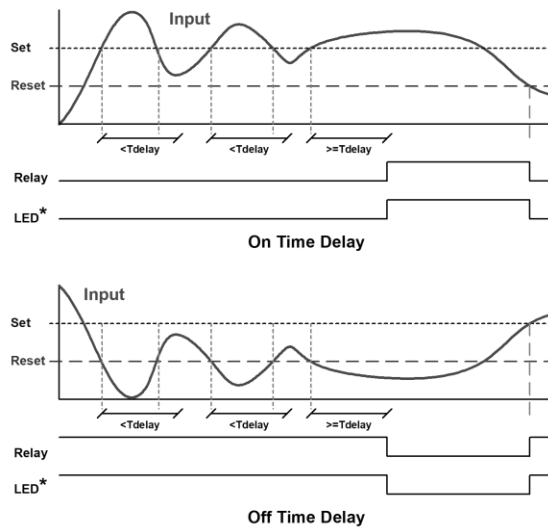


**Off Time Delay**

When the signal crosses the set point, the *On* time delay timer starts and the relay trips when the time delay has elapsed. If the signal drops below the set point (high alarm) before the time delay has elapsed, the *On* time delay timer resets and the relay does not change state. The same principle applies to the *Off* time delay.

*Note: If "Automatic or Manual (A-no An)" reset mode is selected, the LED follows the reset point and not the relay state when the relay is acknowledged.*

# Relay Operation Details

## Overview

The relay capabilities of the meter expand its usefulness beyond simple indication to provide users with alarm and control functions. These capabilities include front panel alarm status LEDs as well as either 2 or 4 optional internal relays. Typical applications include high or low level alarms, control applications such as simple on/off pump control, and pump alternation control for up to 4 pumps. There are four basic ways the relays can be used:

1. High or Low Alarms with Latching or Non-Latching Relays
2. Simple On/Off Control with 100% Adjustable Deadband
3. Sampling (Based on Time)
4. Pump Alternation Control for up to 4 Pumps

## Relays Auto Initialization

When power is applied to the meter, the front panel LEDs and alarm relays will reflect the state of the input to the meter. The following table indicates how the alarm LEDs and relays will react on power-up based on the set and reset points:

| Alarm # | HI or LO Alarm | Set Point | Reset Point | Power-Up Reading | Relay & LED |
|---------|----------------|-----------|-------------|------------------|-------------|
| 1 | HI | $10^{FT}0^{IN\ 0}/_{16}$ | $5^{FT}0^{IN\ 0}/_{16}$ | $4^{FT}11^{IN\ 15}/_{16}$ | Off |
| 2 | LO | $7^{FT}0^{IN\ 0}/_{16}$ | $9^{FT}0^{IN\ 0}/_{16}$ | $4^{FT}11^{IN\ 15}/_{16}$ | On |
| 3 | LO | $2^{FT}6^{IN\ 0}/_{16}$ | $4^{FT}0^{IN\ 0}/_{16}$ | $4^{FT}11^{IN\ 15}/_{16}$ | Off |
| 4 | HI | $4^{FT}6^{IN\ 0}/_{16}$ | $2^{FT}0^{IN\ 0}/_{16}$ | $4^{FT}11^{IN\ 15}/_{16}$ | On |

## Fail-Safe Operation

The following table indicates how the relays behave based on the fail-safe selection for each relay:

*Note: NO = Normally Open, NC = Normally Closed. This refers to the condition of the relay contacts when the power to the meter is off.*

| Fail-Safe Selection | Non-Alarm State | | Alarm State | | Power Failure |
|---------------------|-----------------|--------|-------------|--------|---------------|
| | NO | NC | NO | NC | |
| Off | Open | Closed | Closed | Open | Relays go to non-alarm state |
| On | Closed | Open | Open | Closed | Relays go to alarm state |

## Front Panel LEDs

The LEDs on the front panel provide status indication for the following:

| LED | Status | | LED | Status |
|-----|--------|---|-----|--------|
| 1 | Alarm 1 | | 5 | Alarm 5 |
| 2 | Alarm 2 | | 6 | Alarm 6 |
| 3 | Alarm 3 | | 7 | Alarm 7 |
| 4 | Alarm 4 | | 8 | Alarm 8 |

The meter is supplied with four alarm points that include front panel LEDs to indicate alarm conditions. This standard feature is particularly useful for alarm applications that require visual-only indication. The LEDs are controlled by the set and reset points programmed by the user. When the display reaches a set point for a high or low alarm, the corresponding alarm LED will turn on. When the display returns to the reset point the LED will go off. The front panel LEDs respond differently for latching and non-latching relays.

For non-latching relays, the LED is always off during normal condition and always on during alarm condition, regardless of the state of the relay (e.g. Relay acknowledged after alarm condition).

For latching relays, the alarm LEDs reflect the status of the relays, regardless of the alarm condition. The following tables illustrate how the alarm LEDs function in relation to the relays and the acknowledge button (Default: F3 key assigned to ACK):

## Latching and Non-Latching Relay Operation

The relays can be set up for latching (manual reset) or non-latching (automatic reset) operation.
The On and Off terminology does not refer to the status of the relay's coil, which depends on the fail-safe mode selected.

**Relay terminology for following tables**

| Terminology | Relay Condition |
|---|---|
| On | Alarm (Tripped) |
| Off | Normal (Reset) |
| Ack | Acknowledged |

> ⚡ **Warning!** *In latching relay mode, latched relays will reset (unlatch) when power is cycled.*

### Non-Latching Relay (Auto)

In this application, the meter is set up for automatic reset (non-latching relay). Acknowledging the alarm while it is still present has no effect on either the LED or the relay. When the alarm finally goes away, the relay automatically resets and the LED also goes off.

**Automatic reset only**

| Condition | LED | Relay |
|---|---|---|
| Normal | Off | Off |
| Alarm | On | On |
| Ack (No effect) | On | On |
| Normal | Off | Off |

### Non-Latching Relay (A-n⌐ An)

In this application, the meter is set up for automatic and manual reset at any time (non-latching relay). The LED and the relay automatically reset when the meter returns to the normal condition.
The next time an alarm occurs, the operator acknowledges the alarm manually while the alarm condition still exists. This causes the relay to reset, but the LED stays on until the meter returns to the normal condition.

**Automatic + manual reset at any time**

| Condition | LED | Relay |
|---|---|---|
| Normal | Off | Off |
| Alarm | On | On |
| Normal | Off | Off |
| Next Alarm | On | On |
| Ack | On | Off |
| Normal | Off | Off |

### Latching Relay (LAtcH)

In this application, the meter is set up for manual reset at any time. Acknowledging the alarm even if the alarm condition is still present resets the relay and turns off the LED.

**Manual reset any time**

| Condition | LED | Relay |
|---|---|---|
| Normal | Off | Off |
| Alarm | On | On |
| Ack | Off | Off |

### Latching Relay (Lt-CLr)

In this application, the meter is set up for manual reset only after the signal passes the reset point (alarm condition has cleared). Acknowledging the alarm while it is still present has no effect on either the LED or the relay. When the alarm is acknowledged after it returns to the normal state, the LED and the relay go off. Notice that the LED remains on, even after the meter returns to the normal condition. This is because, for latching relays, the alarm LED reflects the status of the relay, regardless of the alarm condition.

**Manual reset only after alarm condition has cleared**

| Condition | LED | Relay |
|---|---|---|
| Normal | Off | Off |
| Alarm | On | On |
| Ack (No effect) | On | On |
| Normal | On | On |
| Ack | Off | Off |

### Acknowledging Relays

There are two ways to acknowledge relays programmed for manual reset:

1. Via the programmable front panel function keys F1-F3 (Default: F3 assigned to ACK).
2. Remotely via a normally open pushbutton wired across one of the digital inputs and the +5 V terminals on the digital I/O modules, or using the F4 digital input, which is triggered with a contact closure to COM, or with an active low signal (see page 19).

When the ACK button or the assigned digital input is closed, all relays programmed for manual reset are acknowledged.
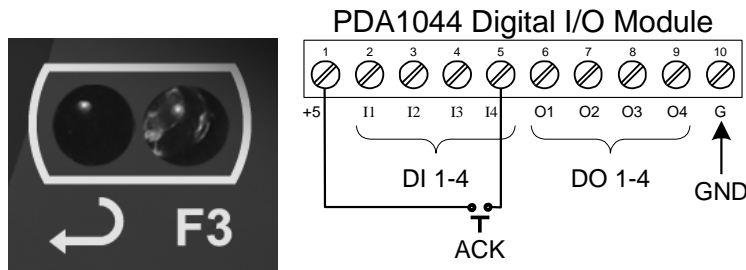


**Figure 19. Acknowledge Relays w/Function Key or Digital Input**

### Pump Alternation Control Applications (ALtErn)

For pump control applications where two or more similar pumps are used to control the level of a tank or a well, it is desirable to have all the pumps operate alternately. This prevents excessive wear and overheating of one pump over the lack of use of the other pumps.

Up to 4 relays can be set up to alternate every time an on/off pump cycle is completed. The set points and reset points can be programmed, so that the first pump on is the first pump off.

#### Application #1: Pump Alternation Using Relays 1 & 2

1. Relays 1 and 2 are set up for pump alternation.
2. Relays 3 and 4 are set up for low and high alarm indication.

| Set and Reset Point Programming | | | |
|---|---|---|---|
| **Relay** | **Set Point** | **Reset Point** | **Function** |
| 1 | $30^{FT}0^{IN}$ $0/_{16}$ | $10^{FT}0^{IN}$ $0/_{16}$ | Controls pump #1 |
| 2 | $35^{FT}0^{IN}$ $0/_{16}$ | $5^{FT}0^{IN}$ $0/_{16}$ | Controls pump #2 |
| 3 | $4^{FT}0^{IN}$ $0/_{16}$ | $9^{FT}0^{IN}$ $0/_{16}$ | Controls low alarm |
| 4 | $40^{FT}0^{IN}$ $0/_{16}$ | $29^{FT}0^{IN}$ $0/_{16}$ | Controls high alarm |

#### Pump Alternation Operation

1. Pump #1 turns on when level reaches $30^{FT}$, when level drops below $10^{FT}$, pump #1 turns off.
2. The next time level reaches $30^{FT}$, pump #2 turns on, when level drops below $10^{FT}$, pump #2 turns off.
3. If the level doesn't reach $35^{FT}$, pump #1 and pump #2 will be operating alternately.
4. If pump #1 cannot keep the level below $35^{FT}$, pump #2 will turn on at $35^{FT}$, then as the level drops to $10^{FT}$, pump #1 turns off, pump #2 is still running and shuts off below $5^{FT}$.
5. Notice that with the set and reset points of pump #2 outside the range of pump #1, the first pump on is the first pump to go off. This is true for up to 4 alternating pumps, if setup accordingly.
6. Relay #3 will go into alarm if the level drops below $4^{FT}$ and relay #4 will go into alarm if the level exceeds $40^{FT}$.

### Application #2: Pump Alternation Using Relays 3 & 4

1. Relays 1 and 2 are set up for low and high alarm indication.
2. Relays 3 and 4 are set up for pump alternation.

**Set and Reset Point Programming**

| Relay | Set Point | Reset Point | Function |
|-------|-----------|-------------|----------|
| 1 | $4^{FT}10^{IN}$ $0/16$ | $7^{FT}6^{IN}$ $0/16$ | Controls low alarm |
| 2 | $45^{FT}0^{IN}$ $0/16$ | $42^{FT}0^{IN}$ $0/16$ | Controls high alarm |
| 3 | $40^{FT}0^{IN}$ $0/16$ | $9^{FT}0^{IN}$ $0/16$ | Controls backup pump |
| 4 | $30^{FT}0^{IN}$ $0/16$ | $10^{FT}0^{IN}$ $0/16$ | Controls main pump |

The following graphics provide a visual representation of a typical pump alternation application with high and low alarm monitoring:

1. Relay #4 turns the main pump on at $30^{FT}$ and turns it off at $10^{FT}$.
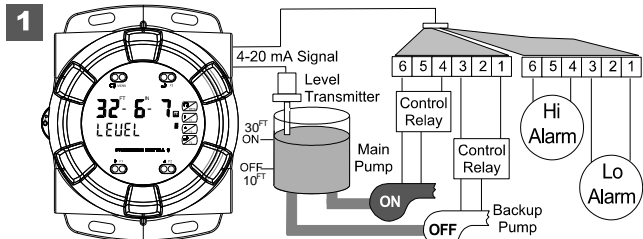


2. With the Pump Alternation feature activated, the next time the level reaches $30^{FT}$, relay #3 transfers and starts the backup pump.
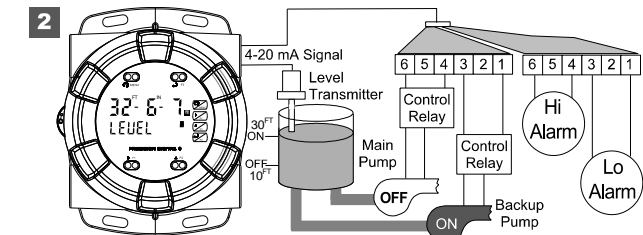


3. If the backup pump is not able to keep up, and the level reaches $40^{FT}$, relay #4 transfers and starts the main pump as well.
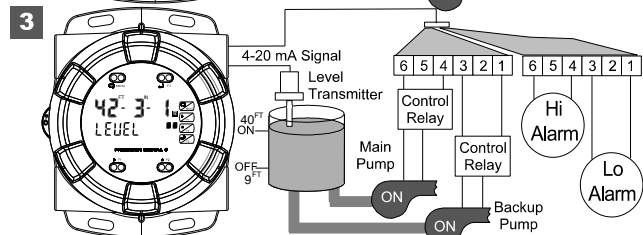


4. Relay #2 trips the High Level Alarm at $45^{FT}$ and resets at $42^{FT}$.
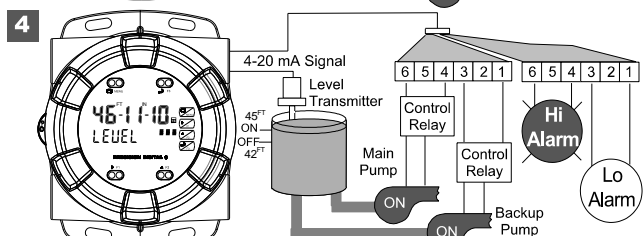


5. Relay #1 trips the Low Level Alarm at $4^{FT}10^{IN}$ and resets at $7^{FT}6^{IN}$.



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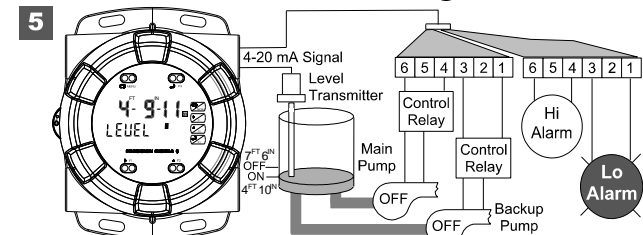
### Setting Up the Interlock Relay (Force On) Feature

Relays 1-4 can be set up as interlock relays. To set up the relays for the interlock feature:

1. Access the *Setup – Relay – Action* menu and set the action to off.
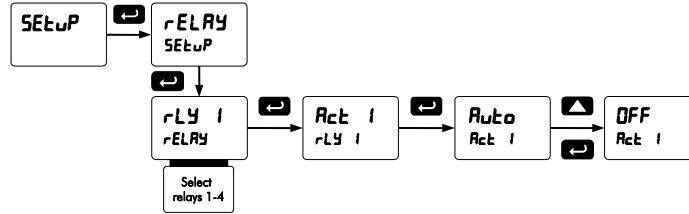


2. In the Advanced features – *User* menu program any of the digital inputs to *Force On* any of the internal relays (1-4).
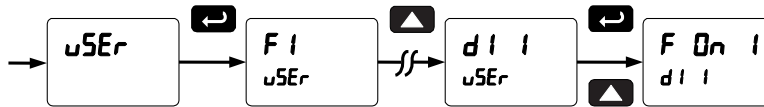


3. Connect a switch or dry contact between the +5V terminal and the corresponding digital input (dI-1 to dI-4) terminal.
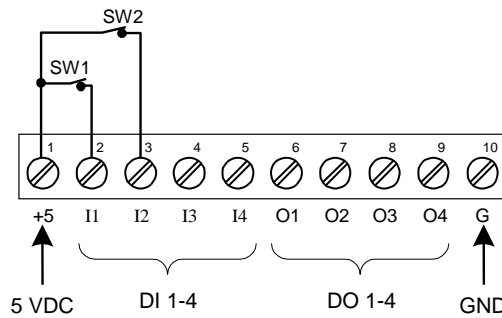


### Interlock Relay Operation Example

Relays 1 & 2 are configured to energize (their front panel LEDs are off) when SW1 & SW2 switches (above) are closed. If the contacts to these digital inputs are opened, the corresponding front panel LEDs flash indicating this condition. The processes being controlled by the interlock relay will stop, and will re-start only after the interlock relay is re-activated by the digital inputs (switches).

*Note: If multiple digital inputs are assigned to the same relay, then the corresponding logic is (AND) – i.e. both switches must be closed to trip the relay.*

# Scaling the 4-20 mA Analog Output (Aout)

The 4-20 mA analog output can be scaled to provide a 4-20 mA signal for any display range selected.

No equipment is needed to scale the analog output; simply program the display values to the corresponding mA output signal.

The *Analog Output* menu is used to program the 4-20 mA output based on display values.
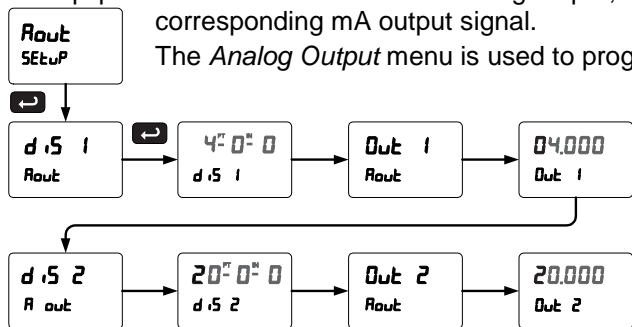


For instructions on how to program numeric values see *Setting Numeric Values*, page 26.

## Reset Menu (`rESEt`)

The *Reset* menu is used to reset the maximum or minimum reading (peak or valley) reached by the process; both may be reset at the same time by selecting "reset high & low" (`rSt HL`).

## Control Menu (`Contrl`)

The *Control* menu is used to control the 4-20 mA analog output and the relays manually, ignoring the input. Each relay and analog output can be programmed independently for manual control. Selecting automatic control sets all relays and analog output for automatic operation.



Once Manual mode is initiated on any relay or analog output, an LED labeled "M" is turned on. Every few seconds, all LEDs representing outputs that are in Manual mode, as well as the "M" LED flash. This process will continue as long as any output is in manual mode.
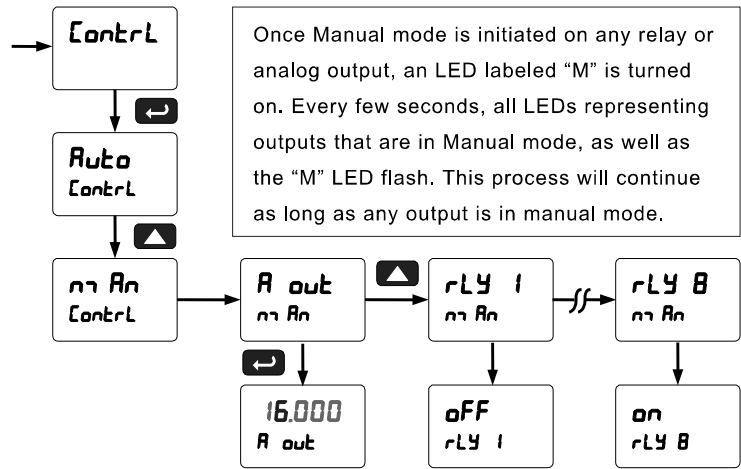
## Setting Up the Password (`PASS`)

The *Password* menu is used for programming three levels of security to prevent unauthorized changes to the programmed parameter settings.

Pass 1: Allows use of function keys and digital inputs
Pass 2: Allows use of function keys, digital inputs and editing set/reset points
Pass 3: Restricts all programming, function keys, and digital inputs.

### Protecting or Locking the Meter

Enter the *Password* menu and program a six-digit password.
For instructions on how to program numeric values see *Setting Numeric Values*, page 26.
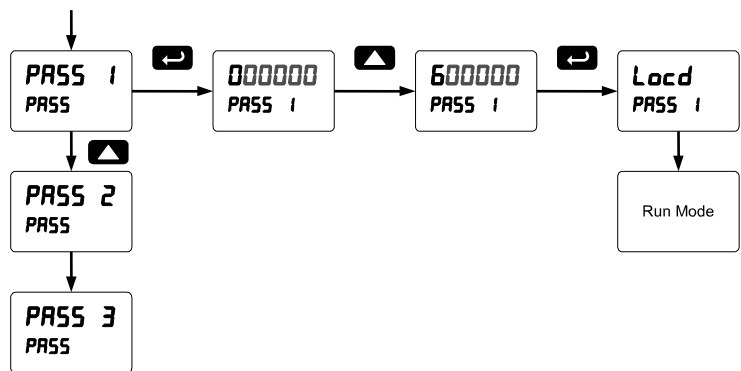
### Making Changes to a Password Protected Meter

If the meter is password protected, the meter will display the message *Locd* (*Locked*) when the Menu button is pressed. Press the Enter button while the message is being displayed and enter the correct password to gain access to the menu. After exiting the programming mode, the meter returns to its password protected condition.

### Disabling Password Protection

To disable the password protection, access the *Password* menu and enter the correct password twice, as shown below. The meter is now unprotected until a new password is entered.
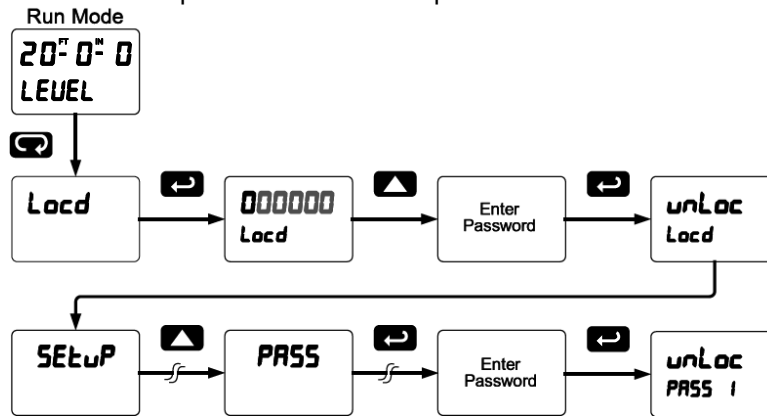


If the correct six-digit password is entered, the meter displays the message *unLoc* (*unlocked*) and the protection is disabled until a new password is programmed.

If the password entered is incorrect, the meter displays the message *Locd* (Locked) for about two seconds, and then it returns to Run Mode. To try again, press Enter while the *Locked* message is displayed.

> **Did you forget the password?**
> The password may be disabled by entering a master password once. If you are authorized to make changes, enter the master password 508655 to unlock the meter.

## Advanced Features Menu

To simplify the setup process, functions not needed for most applications are located in the *Advanced Features* menu.

Press and hold the Menu button for three seconds to access the advanced features of the meter.
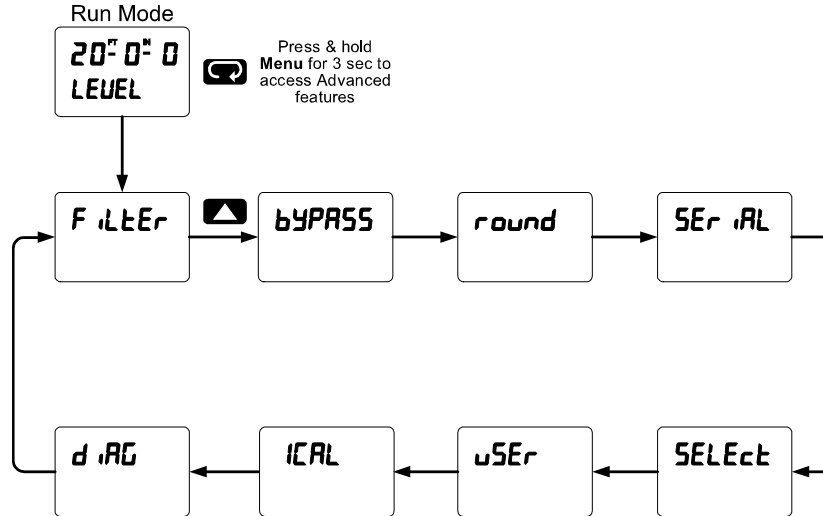


### Advanced Features Menu & Display Messages

The following table shows the functions and messages of the *Advanced Features* menu in the order they appear in the menu.

| Display | Parameter | Action/Setting |
|---|---|---|
| F iLtEr | *Filter* | Set noise filter value |
| bYPASS | *Bypass* | Set filter bypass value |
| round | *Round* | Set the rounding value for display variables |
| SEr iAL | *Serial* | Set serial communication parameters |
| SLAU Id | *Slave ID* | Set slave ID or meter address |
| bAud | *Baud rate* | Select baud rate |
| tr dLY | *Transmit delay* | Set transmit delay for serial communication |
| PAr itY | *Parity* | Select parity Even, Odd, or None with 1 or 2 stop bits |
| t-bYt | *Time byte* | Set byte-to-byte timeout |
| SELEct | *Select* | Enter the Select menu (function, cutoff, out) |
| Functn | *Signal input conditioning* | Select linear, square root, programmable exponent, or round horizontal tank function |
| PU 1 | *PV1* | Select PV1 number of linearization points |
| L inEAr | *Linear* | Set meter for linear function and select number of linearization points |
| no PtS | *Number of points* | Set PV1 for 2 to 32-point linearization Set PV2 for 2 to 8-point linearization |

| Display | Parameter | Action/Setting |
|---|---|---|
| PU 2 | *PV2* | Select PV2 number of linearization points |
| rht | *Round horizontal tank* | Set meter for round horizontal tank volume calculation |
| Inch | *Dimension* | Calculate volume in gallons |
| cnז | *Dimension* | Calculate volume in liters |
| d iAnז r | *Diameter* | Enter the tank's diameter in inches |
| LEnGth | *Length* | Enter the tank's length in inches |
| CutoFF | *Cutoff* | Program Low Flow Cutoff Value for PV 1 |
| RoutPr | *Analog Output Program* | Enter *Analog Output Programmable* parameters menu |
| SourcE | *Source* | Select source for the 4-20 mA output |
| O-rAnG | *Overrange* | Program mA output for display overrange |
| u-rAnG | *Underrange* | Program mA output for display underrange |
| brEAH | *Break* | Set input break condition operation |
| nז AH | *Maximum* | Program maximum mA output allowed |
| nז in | *Minimum* | Program minimum mA output allowed |

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| Display | Parameter | Action/Setting |
|---------|-----------|----------------|
| CAL ib | Calibrate | Calibrate 4-20 mA output (internal reference source used for scaling the output) |
| 4 mA | 4 mA output | Enter mA output value read by milliamp meter with at least 0.001 mA resolution |
| 20 mA | 20 mA output | Enter mA output value read by milliamp meter with at least 0.001 mA resolution |
| uSEr | User I/O | Assign function keys and digital I/O |
| F 1* | F1 function key | *Assign F1-F4 function key |
| AcH | Acknowledge | Acknowledge relays |
| rESEt | Reset | Enter Reset menu |
| rSt Hi | Reset Max | Reset Maximum |
| rSt Lo | Reset Min | Reset Minimum |
| rSt HL | Reset Max-Min | Reset Maximum & Minimum |
| rELAY | Relay | Relay menu |
| SEt 1* | Set Points 1-8 | Set Points 1-8 |
| rLY d | Relay Disable | Relay Disable (all relays) |
| rLY E | Relay Enable | Relay Enable (all relays) |
| O HoLd | Output Hold | Output Hold (all relays) |
| d HoLd | Display Hold | Display Hold (while held low) |
| Ln1 Hi | Line 1 High | Max on line 1 |
| Ln1 Lo | Line 1 Low | Min on line 1 |
| Ln1 HL | Line 1 High/Low | Max/min line 1 |

| Display | Parameter | Action/Setting |
|---------|-----------|----------------|
| Ln2 Hi | Line 2 High | Max on line 2 |
| Ln2 Lo | Line 2 Low | Min on line 2 |
| Ln2 HL | Line 2 High/Low | Max/min line 2 |
| F On 1* | Force On Relay 1 | *Force relay 1-4 on |
| ContrL | Control | Control Menu |
| d iSAbL | Disable | Disable |
| dI 1 | Digital input 1 | Assign digital input 1 – 4 |
| dO 1 | Digital output 1 | Assign digital output 1 – 4 |
| ICAL | Internal source calibration | Enter internal source calibration (used for scaling the meter without a signal source) |
| C CAL | Current calibration | Calibrate 4-20 mA current input (internal reference source used for scaling the input) |
| C Lo | Current low | Calibrate low current input (e.g. 4 mA) |
| C Hi | Current high | Calibrate high current input (e.g. 20 mA) |
| U CAL | Voltage calibration | Calibrate voltage input |
| U Lo | Voltage low | Calibrate low voltage input (e.g. 0 V) |
| U Hi | Voltage high | Calibrate high voltage input (e.g. 10 V) |
| d iAG | Diagnostics | Display parameter settings |
| LEd t | LED test | Test all LEDs |
| InFo | Information | Display software and S/N information |
| ErASE | Erase | Erase MeterView Pro software stored in meter's memory |

### Noise Filter (F ILEEr)

The noise filter is available for unusually noisy signals that cause an unstable process variable display. The noise filter averages the input signal over a certain period. The filter level determines the length of time over which the signal is averaged. The filter level can be set between 2 and 199. The higher the filter level, the longer the averaging time and so the longer it takes the display to settle to its final value. Setting the filter level to zero disables the filter function.

### Noise Filter Bypass (bYPASS)

The noise filter bypass changes the behavior of the meter so that small variations in the signal are filtered out but large abrupt changes in the input signal are displayed immediately. The bypass value determines the minimum amount of signal change to be displayed immediately. All signal changes smaller than the bypass value are filtered or averaged by the meter. The noise filter bypass may be set between 0.1 and 99.9% of full scale.

### Rounding Feature (round)

The rounding feature is used to give the user a steadier display with fluctuating signals. Rounding is used in addition to the filter function. Rounding is only applicable if line 2 is setup to display level unit tags (d L-u). Rounding will round line 2 to the nearest decimal value according the rounding selected. The main display's level reading will be adjusted to match the rounded decimal value. See examples below:

| Rounding Selection | Actual Value | Secondary Display Value | Main Display Value | Actual Value | Secondary Display Value | Main Display Value |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 12.093 | 12.093 | 12$^{FT}$1$^{IN}$ $^{2}/_{16}$ | 12.953 | 12.953 | 12$^{FT}$11$^{IN}$ $^{7}/_{16}$ |
| 5 | 12.093 | 12.095 | 12$^{FT}$1$^{IN}$ $^{2}/_{16}$ | 12.953 | 12.955 | 12$^{FT}$11$^{IN}$ $^{7}/_{16}$ |
| 10 | 12.093 | 12.090 | 12$^{FT}$1$^{IN}$ $^{1}/_{16}$ | 12.953 | 12.950 | 12$^{FT}$11$^{IN}$ $^{6}/_{16}$ |
| 50 | 12.093 | 12.100 | 12$^{FT}$1$^{IN}$ $^{3}/_{16}$ | 12.953 | 12.950 | 12$^{FT}$11$^{IN}$ $^{6}/_{16}$ |

### Modbus RTU Serial Communications (SEr IAL)

The meter is equipped with serial communications capability as a standard feature using Modbus RTU Serial Communication Protocol.

The meter may be connected to a PC for initial configuration via the onboard micro USB connection. For ongoing digital communications with a computer or other data terminal equipment, an RS-232, or RS-485 option is required; see *Ordering Information* on page 5 for details.

| ⚠ **Warning!** | ***Do not connect any equipment other than Precision Digital's expansion modules, cables, or meters to the RJ45 M-LINK connector. Otherwise damage will occur to the equipment and the meter.*** |
| --- | --- |

*Note: More detailed instructions are provided with each optional serial communications adapter.*
*Note: Refer to the ProVu® Modbus Register Tables located at www.predig.com for details.*
*Note: Changes made to the Serial menu are initialized after the menu key is pressed or after navigating through the remainder of the serial parameters (i.e. pass the t-byte parameter).*
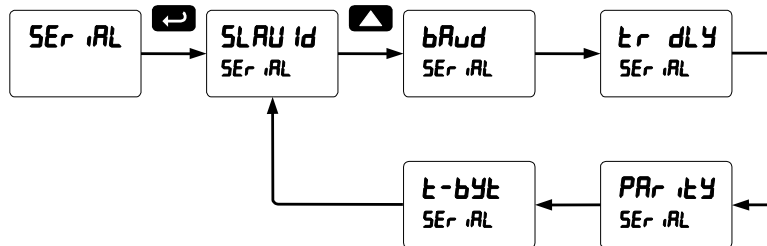


When using more than one meter in a multi-drop mode, each meter must be provided with its own unique address. The meter address (Slave ID) may be programmed between 1 and 247. The transmit delay may be set between 0 and 199 ms. The parity can be set to even, odd, or none with 1 or 2 stop bits.

### Serial Communications Overview

RS-232 and RS-485 are standard interfaces approved by the Electronic Industries Alliance (EIA) for connecting serial devices. In EIA terms, the device (e.g. meter) that connects to the interface is called a Data Communications Equipment (DCE) and the device to which it connects (e.g. the computer) is called a Data Terminal Equipment (DTE).

RS-485 can support multi-point connections per line because it uses lower-impedance drivers and receivers.

Line drivers and receivers are used to exchange data between two or more points (nodes) on a serial communications network. Reliable data communications can be difficult in the presence of induced noise, ground level differences, and other hazards associated with installation of a network. When communicating at high data rates, or over long distances in real world environments, RS-232 is often inadequate. The differential data transmission of RS-485 offers superior performance in most applications. Differential signals can help nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

A multi-point network consists of multiple drivers and receivers connected on a single bus, where any point (node) can transmit and/or receive data. RS-485 allows multiple drivers and receivers on the same two-wire or four-wire system. The RS-485 standard specifies up to 32 drivers and 32 receivers on a single bus, but with the introduction of "automatic" repeaters and high-impedance drivers/receivers, this number can be extended to hundreds of points (nodes) on a network.

The cabling used for an RS-485 serial communications network should always be a high quality cable such as Belden 8162 or Alpha 6203C. A two-wire system requires two twisted pairs, and a four-wire system requires three twisted pairs (the extra twisted pair is needed for the signal ground).

Figure 20 illustrates how to connect a general four-wire network (a four-wire network actually contains 5 wires).
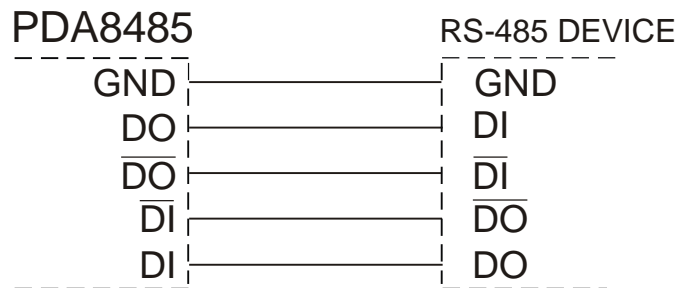


**Figure 20: General Four-Wire Network Connection**

Figure 21 illustrates how to connect a general two-wire network (a two-wire network actually contains 3 wires). Note that the PDA7485 and PDA8485 have DIP switches that allow for two-wire connections without the need to externally wire the DO to the DI and the /DO to the /DI (see the converter section for complete details).
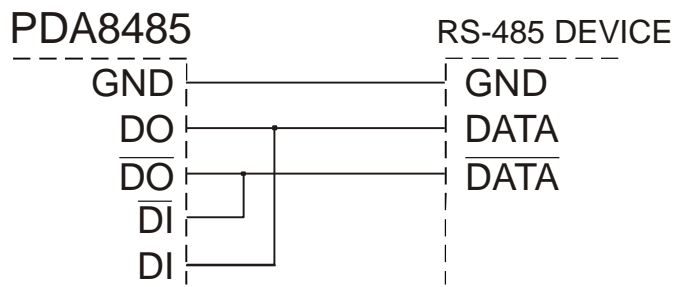


**Figure 21: General Two-Wire Network Connection**

## Select Menu (SELEct)

The *Select* menu is used to select the signal input conditioner applied
to the input (linear or round horizontal tank), low-flow cutoff, and analog output programming. The multi-point linearization is part of the linear function selection.
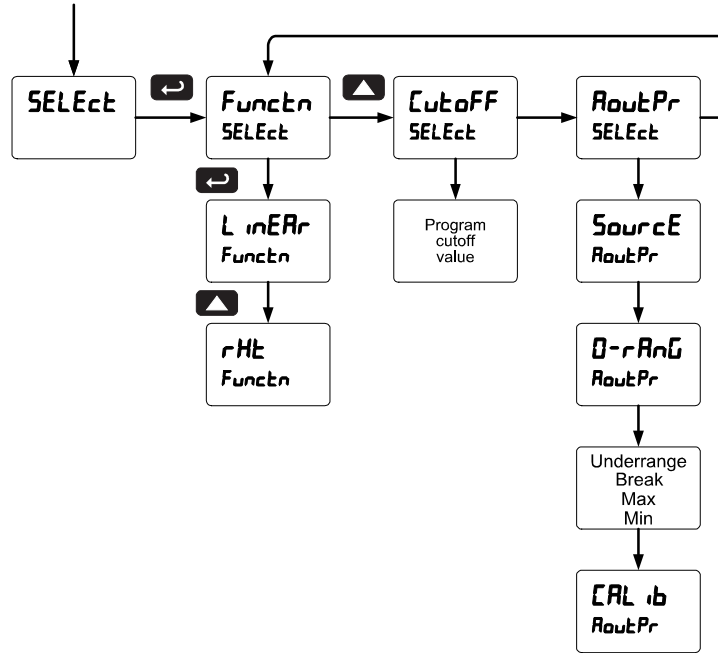


### Signal Input Conditioning (Functn)

The *Function* menu is used to select the signal input conditioner
applied to the input: linear or round horizontal tank volume calculation. Multi-point linearization is part of the linear function selection.

Meters are set up at the factory for linear function with 2-point linearization. The linear function provides a display that is linear with respect to the input signal.

### Multi-Point Linearization (L inEAr)

Meters are set up at the factory for linear function with 2-point linearization. Up to 32 linearization points can be selected for PV1 under the linear function. The multi-point linearization can be used to linearize the display for non-linear signals such as those from level transmitters used to measure volume in odd-shaped tanks or to convert level to flow using weirs and flumes with complex exponent.

If the dual-scale level feature has been selected, the menus for PV1 & PV2 are enabled. PV2 can be programmed with up to 8 linearization points.



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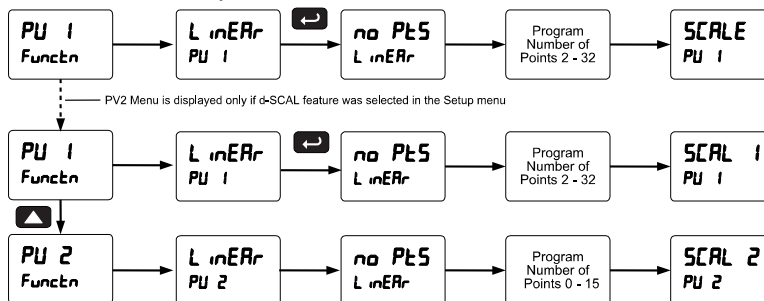
### Round Horizontal Tank Linearization (rHt)

This function automatically calculates the volume in a round horizontal tank with flat ends. This option is only available on PV2 since PV1 is the designated level indicator.

Set the display for the desired decimal point and engineering units before entering the round horizontal tank function. Select units, inches or cm for the tank dimensions. Enter the diameter and the length in inches and the results are calculated automatically in US gallons.

The meter can be scaled to display the volume in any engineering unit.
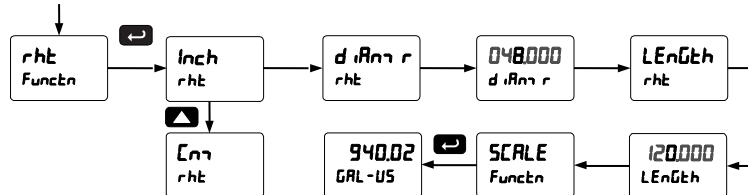


*Note: After Scale is displayed continue pressing the Enter button until the meter completes the scaling of the input and display values.*

**Changing the Volume from Gallons to Liters**

In the above graphic, entering the 48" for the diameter and 120" for the length of the round horizontal tank, the meter automatically calculates that the volume of the tank is 940.02 gallons.

1.  Convert gallons to liters

    1 US gallon = 3.7854 L

    940.02 gal = 3558.4 L

2.  Go to the *Setup* menu and change the decimal point to 1 decimal.

3.  Go to the *Program – Scale* menu and press Enter until *d iS 2* is shown on the main display.

4.  Press Enter and change the display 2 value to 3558.4.

5.  The meter is now displaying the volume in liters.

*Note: The display can be scaled to display the volume in any engineering units.*

### Low-Flow Cutoff (CutoFF)

The low-flow cutoff feature allows the meter to be programmed so that the often-unsteady outputs from level transmitters, or levels that read close to zero but do not reach zero due to setup constraints, may display zero on the meter. The display will read zero when the display would be below the programmed cutoff level value.

The cutoff value may be programmed from 0 to 999999. The meter will display zero below the cutoff value. Programming the cutoff value to zero disables the cutoff feature.

### Analog Output Programming (RoutPr)

The *Analog Output Programming* menu is used to program the behavior of the 4-20 mA output. The following parameters and functions are programmed in this menu:

1. Source: Source for generating the 4-20 mA output (e.g. PV)
2. Overrange: Analog output value with display in overrange condition
3. Underrange: Analog output value with display in underrange condition
4. Break: Analog output value when loop break is detected
5. Max: Maximum analog output value allowed regardless of input
6. Min: Minimum analog output value allowed regardless of input
7. Calibrate: Calibrate the internal 4-20 mA source reference used to scale the 4-20 mA output

#### Analog Output Source

The source for generating the 4-20 mA output may be assigned to the process variable, maximum or minimum value reached by the process, one of the set points, or the Modbus PV input.
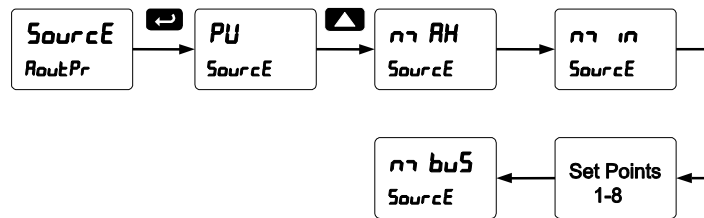


#### Analog Output Calibration

To perform the analog output calibration, it is recommended to use a milliamp meter with a resolution of at least 0.1 µA to measure the output current. The values saved internally during this procedure are used for scaling the 4-20 mA output in the *Setup* menu.

### Programmable Function Keys User Menu (uSEr)

The *User* menu allows the user to assign the front panel function keys F1, F2, and F3, the digital input F4 (a digital input located on the signal input connector), and up to eight additional digital inputs to access most of the menus or to activate certain functions immediately (e.g. reset max & min, hold relay states, etc.). This allows the meter to be greatly customized for use in specialized applications.

Up to eight digital outputs can be assigned to a number of actions and functions executed by the meter (i.e. alarms, relay acknowledgement, reset max, min, or max & min, tare, and reset tare). The digital outputs can be used to trigger external alarms or lights to indicate these specific events.
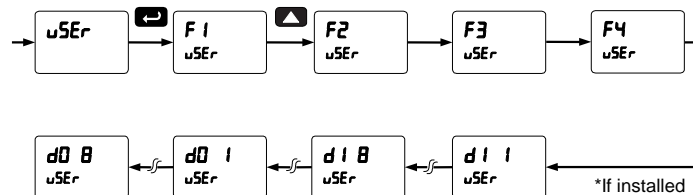
### Function Keys & Digital I/O Available Settings

Refer to the following table for descriptions of each available function key or digital I/O setting.

| Display | Description |
|---------|-------------|
| r5t Hi | Reset the stored maximum display value |
| r5t Lo | Reset the stored minimum display value |
| r5t HL | Reset the stored maximum & minimum display values |
| tArE | Capture tare and zero the display |
| r5t tr | Reset captured tare and resume normal operation |
| rELAY | Directly access the relay menu |
| 5Et 1* | Directly access the set point menu for relay 1 (*through 8) |
| rLY d | Disable all relays until a button assigned to *enable relays* (rLY E) is pressed |
| rLY E | Enable all relays to function as they have been programmed |
| 0 HoLd | Hold current relay states as they are until a button assigned to *enable relays* (rLY E) is pressed |
| d HoLd | Hold the current display value momentarily while the function key or digital input is active. The process value will continue to be calculated in the background. |
| Ln1 Hi | Display maximum display value on line 1 |
| Ln1 Lo | Display minimum display value on line 1 |
| Ln1 HL | Display maximum & minimum display values on line 1 |

| Display | Description |
|---------|-------------|
| Ln2 Hi | Display maximum display value on line 2 |
| Ln2 Lo | Display minimum display value on line 2 |
| Ln2 HL | Display maximum & minimum display values on line 2 |
| F On 1* | Force relay 1 (*through 4) into the on state. This function is used in conjunction with the digital inputs to achieve interlock functionality. See page 42 for details about interlock relays. |
| Contrl | Directly access the control menu |
| d i5AbL | Disable the selected function key or digital I/O |
| AcH | Acknowledge all active relays that are in a manual operation mode such as auto-manual or latching |
| rE5Et | Directly access the reset menu |
| nnEnu | Mimic the menu button functionality (digital inputs only) |
| r iGHt | Mimic the right arrow/F1 button functionality (digital inputs only) |
| uP | Mimic the up arrow/F2 button functionality (digital inputs only) |
| EntEr | Mimic the enter/F3 button functionality (digital inputs only) |
| ALnn 1* | Provide indication when alarm 1 (*through 8) has been triggered (digital outputs only) |

### Internal Source Calibration ( ICAL )

> The meter is factory calibrated prior to shipment to read in milliamps and volts depending on the input selection. The calibration equipment is traceable to NIST standards.

The use of calibrated signal sources is necessary to calibrate the internal source of the meter. The meter's internal source is what allows the user to scale the meter without applying a signal.

Check calibration of the meter at least every 12 months. Each input must be recalibrated separately.

> *Notes:*
> 1. *If meter is in operation and it is intended to accept only one input type (e.g. 4-20 mA), recalibration of other input is not necessary.*
> 2. *Allow the meter to warm up for at least 15 minutes before performing the internal source calibration procedure.*

The *Internal calibration* menu is part of the *Advanced Features* menu.

1. Press and hold the Menu button for three seconds to access the advanced features of the meter.
2. Press the Up arrow button to scroll to the *Internal calibration* menu ( ICAL ) and press Enter.
3. The meter displays either current calibration (C CAL) or voltage calibration (U CAL), according to the input setup. Press Enter to start the calibration process.

   **Example of *Internal Calibration* for current input:**
4. The meter displays *low* input current message (C Lo). Apply the low input signal and press Enter. The display flashes for a moment while the meter is accepting the low input signal.
5. After the display stops flashing, a number is displayed with the leftmost digit brighter than the rest. The bright digit is the active digit that can be changed by pressing the Up arrow button. Press the Right arrow button to move to the next digit.
6. Set the display value to correspond to the input signal being calibrated, typically 4.000 mA.
7. The display moves to the *high* input calibration (C Hi). Apply the high input signal and press Enter.
8. Set the display for the high input calibration, in the same way as it was set for the low input calibration, typically 20.000 mA.



The display flashes while sensing the inputs
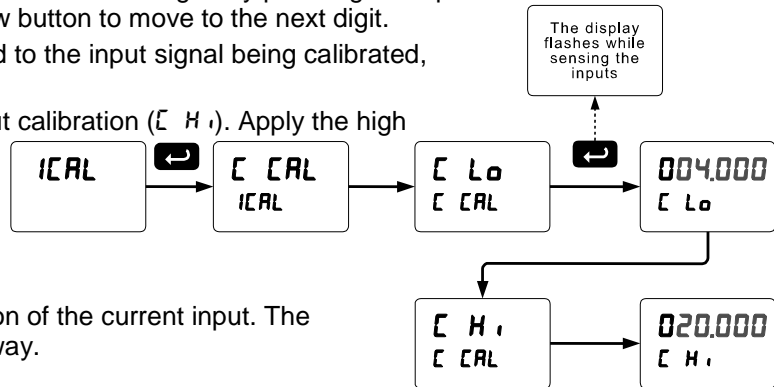
The graphic above shows the calibration of the current input. The voltage input is calibrated in a similar way.

> **Tips:**
> - Low and high input signals can be any valid values within the range of the meter.
> - Observe minimum input span requirements between input 1 and input 2.
> - Low input should be less than high input signal.

### Error Message (Error)

An error message indicates that the calibration or scaling process was not successful.

The error message might be caused by any of the following conditions:

1. Input signal is not connected to the proper terminals, or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.

### Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

| Input Range | Input 1 & Input 2 Span |
|---|---|
| 4-20 mA | 0.15 mA |
| ±10 VDC | 0.01 VDC |

# Meter Operation

The meter is capable of accepting current (0-20 mA, 4-20 mA) and voltage signals (0-5 V, 1-5 V, 0-10 V, $\pm$ 10 V) and displaying these signals in engineering units from -9$^{FT}$11$^{IN}$($^{15}/_{16}$ or $^{7}/_{8}$) - 99$^{FT}$11$^{IN}$($^{15}/_{16}$ or $^{7}/_{8}$) on display line 1 and units from -99999 to 999999 on display line 2 (*e.g.* a 4-20 mA signal could be displayed as 0$^{FT}$0$^{IN}$ $^{0}/_{16}$ to 25$^{FT}$0$^{IN}$ $^{0}/_{16}$ on display line 1 and -50.000 to 50.000 on display line 2).

The dual-line display can be customized by the user to operate in such a way as to satisfy a specific application. Typically, the main display is used for the process variable; while the second display is used for engineering units, custom legend, or set point indication.

The analog input can be scaled to display the process in two different scales; for example: with *d-SCAL* enabled, the main display could indicate level in feet and inches and the second display could indicate the volume in gallons.

Additionally, the meter can be set up to display the analog input in feet and inches on the main display and the Modbus input on the second display. The relays and analog output can be programmed to operate from the Modbus PV input.

## Front Panel Buttons Operation

| Button Symbol | Description |
|---|---|
| | Press to enter or exit Programming Mode, view settings, or exit max/min readings |
| | Press to reset max/min readings or other parameter/function assigned through the *User* menu |
| | Press to display max/min readings or other parameter/function assigned through the *User* menu |
| | Press to acknowledge relays or other parameters/function assigned through the *User* menu |

## SafeTouch® Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area.

These buttons can be disabled for security by selecting DISABLE on the switch labeled NO-CONTACT BUTTONS located on the connector board.

To actuate a button, press one finger to the glass directly over the marked button area. Then retract finger more than three inches from the glass before pressing the next button. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

The SafeTouch Buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the SafeTouch Buttons be disabled (slide switch to LOCK) if there is an infrared interference source in line-of-sight to the display.

The SafeTouch Buttons are configured by default to duplicate the function of the front panel mechanical pushbuttons associated with the integrated meter. The symbols by each SafeTouch button correspond to a mechanical button as shown in the above table.

SafeTouch Button Tips:

- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the glass window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.

| | |
|---|---|
| **⚠ WARNING** | Take caution when cleaning the window glass as it may result in unintentional SafeTouch button events. Only clean the ProtEX-MAX when the system is safely shut down, and inspect the ProtEX-MAX for proper configuration prior to system restart. |

## F4 Operation

A digital input, F4, is standard on the meter. This digital input is programmed identically to function keys F1, F2, and F3. The input is triggered with a contact closure to COM, or with an active low signal. During operation, F4 operates according to the way it has been programmed in the *Advanced Features – User* menu.

## Maximum/Minimum Readings

The max & min readings (peak & valley) reached by the process can be displayed either continuously or momentary:

1. Display briefly by assigning to the F1-F3 function keys or to the digital inputs in the *User* menu.
2. Display continuously by assigning either display to max/min through the *Display* menu.

Any of the F1-F3 function keys (buttons) and the digital inputs can be programmed to reset the max & min readings. The meters are set at the factory to display the max reading by pressing the Up arrow/F2 button and to use the Right arrow/F1 button to access the *Reset* menu.

**To display max reading using function key with factory defaults:**

1. Press Up arrow/F2 button to display maximum reading since the last reset/power-up.
2. To reset max/min press Right arrow/F1 button to access the Reset menu. The max & min displays are reset to actual values.
3. Press Menu to exit max/min display reading.

**To display max/min readings continuously:**

Assign either display to Max (d Hi), Min (d Lo), or toggle between Max and Min (d HL) every 10 seconds.
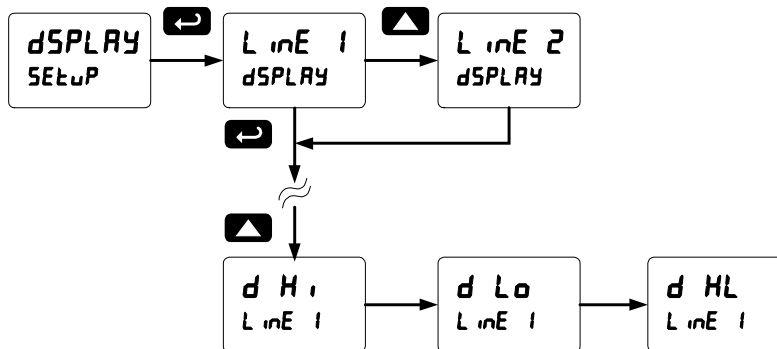
# Troubleshooting

Due to the many features and functions of the meter, it's possible that the setup of the meter does not agree with what an operator expects to see. If the meter is not working as expected, refer to the *Diagnostics* menu and consult the recommendations described below.

## Diagnostics Menu (d ɪAG)

The *Diagnostics* menu is located in the *Advanced Features* menu, to access *Diagnostics* menu see *Advanced Features Menu*, page 45.

This menu allows the user to test the functionality of all the meter LEDs, check the meter's software and version information, and erase the MeterView Pro software installation files from the meter. Press the Enter button to view the settings and the Menu button to exit at any time.

For a description of the diagnostic messages, *see Advanced Features Menu &* Display Messages, page 45.

### Determining Software Version

To determine the software version of a meter:

1. Go to the *Diagnostics* menu (d ɪAG) and press Enter button.
2. Press Up arrow button and scroll to Information menu ( InFo).
3. Press Enter to access the software number (SFt) and version (UEr) information. Write down the information as it is displayed. Continue pressing Enter until all the information is displayed.
4. The meter returns to Run Mode after displaying all the settings.

## Reset Meter to Factory Defaults

When the parameters have been changed in a way that is difficult to determine what's happening, it might be better to start the setup process from the factory defaults.

**Instructions to load factory defaults:**

1. Enter the *Advanced Features* menu. See *Advanced Features Menu*, page 45.
2. Press Up arrow to go to *Diagnostics* menu
3. Press and hold Right arrow for three seconds, press
   Enter when display flashes rESEt.
   Note: If Enter is not pressed within three seconds, the display returns to the *Diagnostics* menu.
4. The meter goes through an initialization sequence (similar as on power-up), and loads the factory default settings.

Run Mode
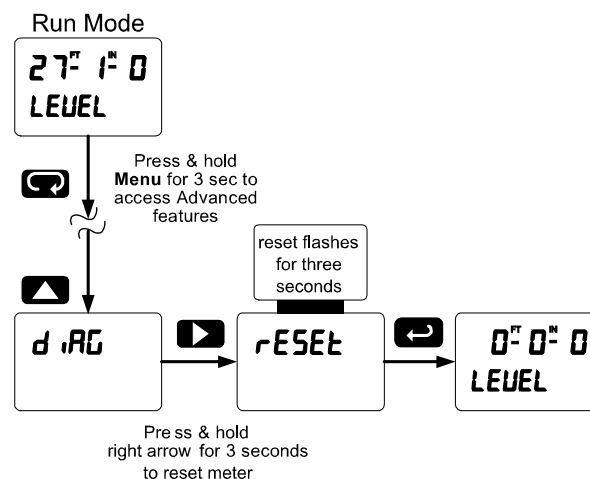


*Note: The dual-scale selection for some level applications (d-SCAL) is not reset to the single scale factory default. This can be changed using the Setup – Input menu.*

## Factory Defaults & User Settings

The following table shows the factory setting for most of the programmable parameters on the meter.

| Parameter | Display | Default Setting | Parameter | Display | Default Setting |
|---|---|---|---|---|---|
| Input type | InPut | 4-20 mA | Off delay relay 3 | OFF 3 | 0.0 sec |
| Dual-scale feature | d-SCAL | No (Single scale) | On delay relay 4 | On 4 | 0.0 sec |
| Filter | FiLtEr | 70 | Off delay relay 4 | OFF 4 | 0.0 sec |
| Bypass | bYPASS | 0.2 | Loop break relay 1 | iGnorE | Ignore |
| Function | Functn | Linear | Loop break relay 2 | iGnorE | Ignore |
| Number of points | no PtS | 2 | Loop break relay 3 | iGnorE | Ignore |
| Programming | ProG | Scale | Loop break relay 4 | iGnorE | Ignore |
| Input 1 | InP 1 | 4.000 mA | Display 1 analog out | diS 1 | $4^{FT}0^{IN}\,0/16$ |
| Display 1 | diS 1 | $4^{FT}0^{IN}\,0/16$ | Output 1 value | Out 1 | 4.000 mA |
| Input 2 | InP 2 | 20.000 mA | Display 2 analog out | diS 2 | $20^{FT}0^{IN}\,0/16$ |
| Display 2 | diS 2 | $20^{FT}0^{IN}\,0/16$ | Output 2 value | Out 2 | 20.000 mA |
| Decimal point | ddddd | 3 places | Source analog output | SourcE | Process Variable |
| Cutoff value | CutoFF | 0.000 (disabled) | Overrange output | O-rAnG | 21.000 mA |
| Display assignment | dSPLAY | | Underrange output | u-rAnG | 3.000 mA |
| Display line 1 (Main) | LinE 1 | PV: Process variable | Loop break output | brEAH | 1.000 mA |
| Display line 2 | LinE 2 | Eng unit default= level | Maximum output | n̄ AH | 23.000 mA |
| Display intensity | d-IntY | 8 | Minimum output | n̄ in | 1.000 mA |
| Relay 1 action | Act 1 | Automatic | Slave ID (Address) | SLAU Id | 247 |
| Relay 1 set point | SEt 1 | $1^{FT}0^{IN}\,0/16$ | Baud rate | bAud | 9600 |
| Relay 1 reset point | rSt 1 | $0^{FT}6^{IN}\,0/16$ | Transmit delay | tr dLY | 50 ms |
| Relay 2 action | Act 2 | Automatic | Parity | PAritY | Even |
| Relay 2 set point | SEt 2 | $2^{FT}0^{IN}\,0/16$ | Byte-to-byte timeout | t-bYt | 010 (0.1 sec) |
| Relay 2 reset point | rSt 2 | $1^{FT}6^{IN}\,0/16$ | F1 function key | F1 | Reset max & min |
| Relay 3 action | Act 3 | Automatic | F2 function key | F2 | Line 1: Max (Hi) |
| Relay 3 set point | SEt 3 | $3^{FT}0^{IN}\,0/16$ | F3 function key | F3 | Acknowledge relays |
| Relay 3 reset point | rSt 3 | $2^{FT}6^{IN}\,0/16$ | F4 function | F4 | Acknowledge relays |
| Relay 4 action | Act 4 | Automatic | Digital input 1 | di 1 | Menu |
| Relay 4 set point | SEt 4 | $4^{FT}0^{IN}\,0/16$ | Digital input 2 | di 2 | Right arrow |
| Relay 4 reset point | rSt 4 | $3^{FT}6^{IN}\,0/16$ | Digital input 3 | di 3 | Up arrow |
| Fail-safe relay 1 | FLS 1 | Off | Digital input 4 | di 4 | Enter |
| Fail-safe relay 2 | FLS 2 | Off | Digital output 1 | dO 1 | Alarm 1 |
| Fail-safe relay 3 | FLS 3 | Off | Digital output 2 | dO 2 | Alarm 2 |
| Fail-safe relay 4 | FLS 4 | Off | Digital output 3 | dO 3 | Alarm 3 |
| On delay relay 1 | On 1 | 0.0 sec | Digital output 4 | dO 4 | Alarm 4 |
| Off delay relay 1 | OFF 1 | 0.0 sec | Password 1 | PASS 1 | 000000 (unlocked) |
| On delay relay 2 | On 2 | 0.0 sec | Password 2 | PASS 2 | 000000 (unlocked) |
| Off delay relay 2 | OFF 2 | 0.0 sec | Password 3 | PASS 3 | 000000 (unlocked) |
| On delay relay 3 | On 3 | 0.0 sec | | | |

## Troubleshooting Tips

| Symptom | Check/Action |
|---|---|
| SafeTouch buttons do not respond | If mechanical button was pushed. The SafeTouch buttons will be re-enabled automatically **60 seconds** after the last button push. |
| | If slide switch on connector board is in DISABLE position, switch to ENABLE. |
| | Strong direct sunlight may interfere with SafeTouch button operation. It is recommended to operate the buttons by standing so as to block direct sunlight. |
| Serial Communications Power LED Indicator is off | 1. Check modular cable connection<br>2. Check power to the device |
| If only the TX (or DATA IN) data status LED is flashing when serial communications attempted | 1. Check serial cable<br>2. Check protocol selected on device<br>3. Check instrument address & baud rate<br>**4.** Check program address & baud rate |
| If both data status LEDs (TX and RX) are off when trying to communicate | Remove all unnecessary cables and instruments from the bus. Try getting the system to work with only one device (to ease troubleshooting) and then expand the system one device at a time. |
| Communications slow | Increase the baud rate |
| Random communication errors | 1. Increase the TX delay time<br>2. Decrease the baud rate |
| Power LED is off | 1. Check modular cable connection<br>2. Check power to instrument |
| No display at all | Check power at power connector |
| Not able to change setup or programming, *Locd* is displayed | Meter is password-protected, enter correct six-digit password to unlock |
| Meter displays error message during calibration (*Error*) | 1. Check signal connections<br>2. Check input selected in *Setup* menu<br>3. Check minimum input span requirements |
| Meter displays<br>1. *999999*<br>2. *-99999* | 1. Check input selected in *Setup* menu<br>2. Check corresponding signal at Signal connector |
| Display is unstable | 1. Check input signal stability and value<br>2. Check display scaling vs. input signal<br>3. Check filter and bypass values (increase) |
| Display response is too slow | Check filter and bypass values |
| Display reading is not accurate | 1. Check signal input conditioner selected: Linear, square root, etc.<br>2. Check scaling or calibration |
| Display does not respond to input changes, reading a fixed number | Check display assignment, it might be displaying max, min, or set point. |
| Display alternates between<br>1. *Hi* and a number<br>2. *Lo* and a number | Press Menu to exit max/min display readings. |
| Relay operation is reversed | 1. Check fail-safe in *Setup* menu<br>2. Check wiring of relay contacts |
| Relay and status LED do not respond to signal | 1. Check relay action in *Setup* menu<br>2. Check set and reset points |
| Flashing relay status LEDs | Relays in manual control mode or relay interlock switches opened. |
| If the display locks up or the meter does not respond at all | Cycle the power to reboot the microprocessor. |
| Other symptoms not described above | Call Technical Support for assistance. |

*Note: Certain sequences of events can cause unexpected results. To solve these issues, it is best to start fresh from factory defaults and map changes ahead of time, rather than at random.*

# Service

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**WARNINGS**

- Installation and service should be performed only by trained service personnel. Service requiring replacement of internal sub-components must be performed at the factory.
- Disconnect from supply before opening enclosure. Keep cover tight while circuits are alive. Conduit seals must be installed within 18" (450mm) of the enclosure.
- Verify that the operating atmosphere of the instrument is consistent with the appropriate hazardous locations certifications.
- If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead
- Read all product labels completely and follow all instructions and requirements listed on the labels for installation or service.

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If the enclosure is sound and undamaged, then only the internal electronics housing will need to be returned to the factory for service. Contact the factory for RMA number and return instructions.

# Mounting Dimensions
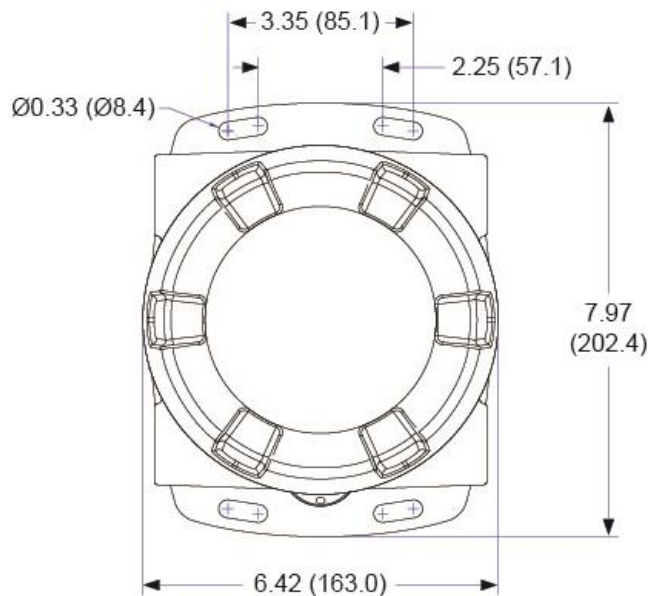
All units: inches (mm)
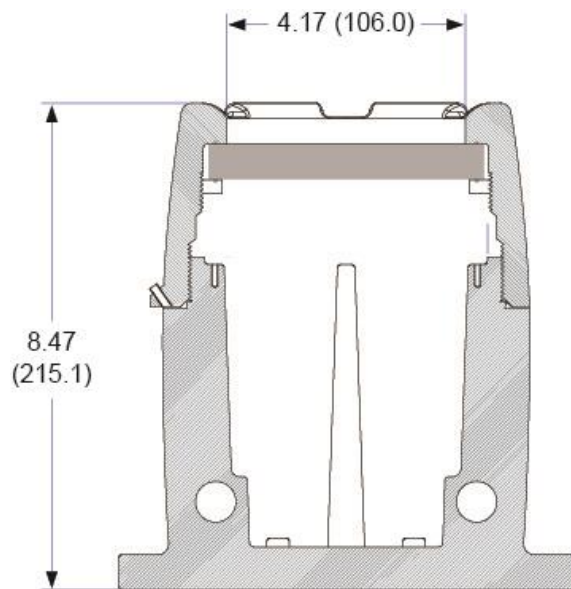


**Figure 22: Enclosure Dimensions – Front View**



**Figure 23: Enclosure Dimensions – Side Cross Section View**

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**PRECISION DIGITAL ÷**

# EU Declaration of Conformity

Issued in accordance with ISO/IEC 17050-1:2004 and ATEX Directive 2014/34/EU.

We,

**Precision Digital Corporation**
**233 South Street**
**Hopkinton, MA 01748 USA**

as the manufacturer, declare under our sole responsibility that the product(s),

**Model PD8 ProtEX-MAX Series**

to which this declaration relates, is in conformity with the European Union Directives shown below:

| | |
|---|---|
| **2014/35/EU** | **Low Voltage Directive** |
| **2014/34/EU** | **ATEX Directive** |
| **2014/30/EU** | **EMC Directive** |
| **2011/65/EU** | **RoHS Directive** |

This conformity is based on compliance with the application of harmonized or applicable technical standards and, when applicable or required, a European Union notified body certification.

**Standards:**

| | | | |
|---|---|---|---|
| EN 55022:2007 | EN 61000-6-2:2005 | EN 60079-0:2009 | EN 61000-6-4:2007 |
| EN 60079-1:2007 | EN 61010-1:2001 | EN 60079-31:2008 | EN 61326:2006 |

The standards EN 55022:2007, EN 60079-0:2009, EN 60079-1:2007, EN 60079-31:2008, EN 61000-6-4:2007, EN 61010-1:2001, and EN 61326:2006 are no longer harmonized. The requirements of these standards have been checked against the harmonized standard EN 55022:2010, EN 60079-0:2012+A11:2013, EN 60079-1:2014, EN 60079-31:2014, EN 61000-6-4:2007+A1:2011, EN 61010-1:2010, and EN 61326:2013 and there were no major technical changes affecting the latest technical knowledge for the products listed above.

**EC Type Examination Certificate:**     Sira 12ATEX1182

**Product Markings:**     $\langle Ex \rangle$ II 2 G D
Ex d IIC T* Gb
Ex tb IIIC T90°C Db IP68
Tamb = -40°C to +*°C (*T5 = 65°C, *T6 = 60°C)

**ATEX Notified Body for EC Type Examination Certificate:**     Sira Certification Service, NB 0518
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US, UK

**ATEX Quality Assurance Notification No.:**     SIRA 10 ATEX M462

**ATEX Notified Body for Quality Assurance:**     Sira Certification Service, NB 0518
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US, UK

Signed for and on behalf of Precision Digital Corporation:

Name:          Jeffrey Peters
Company:     Precision Digital Corporation
Title:            President
Date:           02/12/2018                                    Document No: DoC PD8 {021218}

# How to Contact Precision Digital

- For Technical Support please

  Call: (800) 610-5239 or (508) 655-7300

  Fax: (508) 655-8990

  Email: support@predig.com

- For Sales Support or to place an order please contact your local distributor or

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