

# PD684 & PD689

## LOOP-POWERED RATE/TOTALIZERS



Loop Leader™  
Series

- 2 V drop (5.7 V with backlight)
- 5 Digit LCD, 0.6" (15.2 mm) High
- 3 Digit Automatic Total Overflow
- Rate in Second, Minute, Hour, or Day
- Open Collector Pulse or Alarm Output
- Custom Engineering Units
- 20 Segment Bargraph Display
- Type 4X, NEMA 4X, IP65 Front
- Maximum & Minimum Display
- Linear, Square Root, or Programmable Exponent
- Non-Volatile Memory – No Battery Needed

Loop-  
Powered  
Backlight  
Standard!

**PRECISION DIGITAL CORPORATION**  
19 Strathmore Road • Natick MA 01760 USA  
Tel (800) 343-1001 • Fax (508) 655-8990

**PRECISION  
DIGITAL**

[www.predig.com](http://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.

## **Registered Trademarks**

NORYL<sup>®</sup> and LEXAN<sup>®</sup> are a registered trademarks of General Electric Company. All other trademarks mentioned in this document are the property of their respective owners.

© 2006 Precision Digital Corporation. All rights reserved.

**Visit our Web Site**  
**<http://www.predig.com>**

## INTRODUCTION

The PD689 is an intrinsically safe and non-incendive loop-powered rate/totalizer approved for hazardous area locations. The PD684 is a general-purpose loop-powered rate/totalizer for safe area applications. The four front panel buttons make the setup and programming an easy task. Five digits, bargraph, engineering units, scientific notation, rate & total indication, and trend arrows provide a clear and attractive presentation of the process.

The square root and programmable exponent functions allow for conditioning of signals from non-linear transmitters without adding external components to the system and the convenience of scaling without a calibrated signal source make the PD684 & PD689 the ideal choice for flow rate & total display applications.

## ORDERING INFORMATION

Model	Description
PD683-0K0	Loop-Powered Panel Meter for Safe Area
PD684-0K1	Loop-Powered Rate/Totalizer for Safe Area
PD688-0K0	FM & CSA Approved Loop-Powered Panel Meter
PD689-0K1	FM & CSA Approved Loop-Powered Rate/Totalizer

## Enclosures and Accessories

Model	# of Meters	Description	Mounting
PDA2407	1	Plastic NEMA 4X Enclosure	Inside Cover
PDA2410	3	Plastic NEMA 4X Enclosure	Inside Cover
PDA2411	2	Plastic NEMA 4X Enclosure	Inside Cover
PDA2601	1	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2602	2	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2603	3	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2604	4	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2605	5	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2606	6	Stainless Steel NEMA 4X Enclosure	Through Door
PDA2701	1	Steel NEMA 4 Enclosure	Through Door
PDA2702	2	Steel NEMA 4 Enclosure	Through Door
PDA2703	3	Steel NEMA 4 Enclosure	Through Door
PDA2704	4	Steel NEMA 4 Enclosure	Through Door
PDA2705	5	Steel NEMA 4 Enclosure	Through Door
PDA2706	6	Steel NEMA 4 Enclosure	Through Door
PDA2801	1	Plastic NEMA 4X Enclosure	Through Cover

## Table of Contents

<b>INTRODUCTION</b>	<b>3</b>
<b>ORDERING INFORMATION</b>	<b>3</b>
<b>SPECIFICATIONS</b>	<b>6</b>
General	6
Input	7
Open Collector Output	8
<b>PD689 COMPLIANCE INFORMATION</b>	<b>9</b>
Ratings and Approvals	9
<b>SAFETY INFORMATION</b>	<b>9</b>
<b>INSTALLATION</b>	<b>10</b>
Unpacking	10
Panel Mounting	10
<b>PD684 Connections</b>	<b>11</b>
4-20 mA Input Connections	12
Open Collector Output Connections	13
<b>SETUP AND PROGRAMMING</b>	<b>14</b>
<b>Front Panel Buttons &amp; Status Indicators</b>	<b>15</b>
<b>Main Menu Display Functions &amp; Messages</b>	<b>16</b>
<b>Main Menu</b>	<b>18</b>
<b>Setting Numeric Values</b>	<b>18</b>
<b>Setting Up the Meter (SEtUP)</b>	<b>19</b>
Setting the Decimal Point (dECPt)	20
Setting the Units Display (un itS)	21
Setting the Time Base (t bRSÉ)	22
Setting the Total Conversion Factor (t o t LF)	22
Manual or Automatic Total Reset Function (t r SÉ)	23
Display Rate or Total Mode (dSPLY)	24
Programming the Meter (Pr oG)	25
Scaling the Meter (SCALÉ)	26
Calibrating the Meter (CAL)	27
Recalibrating the Internal Calibration Reference (iCAL)	27
Setting Up the Bargraph (BARGPH)	28
<b>Setting Up the Password (PR55)</b>	<b>29</b>
Locking the Meter	29
Unlocking the Meter	30

<b>Advanced Features Menu</b> -----	<b>31</b>
Advanced Features Menu & Display Messages-----	32
Noise Filter ( <i>FLtEr</i> )-----	33
Noise Filter Bypass ( <i>bYPR5</i> )-----	33
Contrast ( <i>CoNtR</i> )-----	33
Alarm & Pulse Output ( <i>oUt</i> )-----	34
Math Functions ( <i>LnERr</i> , <i>SqURr</i> , <i>PRoGUE</i> , <i>LUtOF</i> )-----	36
Internal Calibration ( <i>iCAL</i> )-----	37
Information Menu ( <i>INFA</i> )-----	38
<b>OPERATION</b> -----	<b>38</b>
<b>Front Panel Buttons Operation</b> -----	<b>38</b>
<b>Rate or Total Display Readings</b> -----	<b>39</b>
<b>Maximum &amp; Minimum Readings (<i>MAX</i> &amp; <i>MIN</i>)</b> -----	<b>40</b>
<b>MOUNTING DIMENSIONS</b> -----	<b>41</b>
<b>Reset Meter to Factory Defaults</b> -----	<b>42</b>
Factory Defaults & User Settings-----	43
<b>TROUBLESHOOTING</b> -----	<b>44</b>
<b>Troubleshooting Tips</b> -----	<b>44</b>
<b>OTHER PRECISION DIGITAL PRODUCTS</b> -----	<b>45</b>
<b>QUICK USER INTERFACE REFERENCE GUIDE</b> -----	<b>46</b>

## Table of Figures

Figure 1. Panel Cutout and Mounting.....	10
Figure 2. PD684 & PD689 Rear View.....	11
Figure 3. PD684 Input Connections with Backlight.....	12
Figure 4. PD684 Input Connections without Backlight.....	12
Figure 5. PD684 Connection to Device with Internal Pull-Up.....	13
Figure 6. PD684 Connection to External Relay.....	13
Figure 7. Meter Dimensions – Side View.....	41
Figure 8. Case Dimensions – Top View.....	41

## **SPECIFICATIONS**

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

### **General**

<b>DISPLAY</b>	Five digits (-99999 to 99999)	0.60" (15.2 mm) high, 7-segment, automatic lead zero blanking.
	Four characters (Engineering Units)	0.25" (6.4 mm) high, 14 segment.
	Bargraph	20-segment, 0% to 100% indication.
	Trend arrows	Up and down trend indication.
	Backlight	Orange (intensity varies with signal)
<b>DISPLAY UPDATE RATE</b>	2.5/second	
<b>OVERRANGE</b>	Display flashes	<b>99999</b>
<b>UNDERRANGE</b>	Display flashes	<b>-99999</b>
<b>PROGRAMMING METHOD</b>	Four front panel buttons	
<b>NOISE FILTER</b>	Programmable from 1 to 199	
<b>RECALIBRATION</b>	Recalibration is recommended at least every 12 months.	
<b>MAX/MIN DISPLAY</b>	Max/min readings reached by the process are stored until reset by the user or until power to the meter is turned off.	
<b>PASSWORD</b>	Programmable password restricts modification of programmed settings.	
<b>NON-VOLATILE MEMORY</b>	All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost.	
<b>NORMAL MODE REJECTION</b>	64 dB at 50/60 Hz	
<b>ENVIRONMENTAL</b>	Operating temperature range: -20 to 65°C (-40°C allowed)* Storage temperature range: -40 to 65°C Relative humidity: 0 to 90% non-condensing *Below -20°C, the LCD becomes less readable.	
<b>CONNECTIONS</b>	Removable screw terminals accept 12 to 22 AWG wire	
<b>ENCLOSURE &amp; MATERIALS</b>	1/8 DIN, high impact plastic, UL 94V-0, color: gray GE Plastics NORYL® N190X Polyphenylene Ether & Polystyrene blend (PPE PS) Resin GE Plastics LEXAN® HP92W Polycarbonate (PC) Film	
<b>MOUNTING</b>	1/8 DIN panel cutout required. Two panel mounting bracket assemblies provided	

## PD684 & PD689 Loop-Powered Rate/Totalizers Instruction Manual

<b>TIGHTENING TORQUE</b>	Screw terminal connectors: 4.5 lb-in (0.5 Nm) Mounting screws: 8.0 lb-in max. (0.9 Nm)
<b>OVERALL DIMENSIONS</b>	4.68" x 2.45" x 3.79" (119 mm x 62 mm x 96 mm) (W x H x D)
<b>WEIGHT</b>	5.7 oz (162 g)
<b>WARRANTY</b>	3 years parts and labor
<b>EXTENDED WARRANTY</b>	1 or 2 years, refer to Price List for details

### Input

<b>ACCURACY</b>	±0.03% of span ±1 count, square root and programmable exponent: 10-100% FS				
<b>FUNCTION</b>	Linear, square root, or programmable exponent				
<b>LOW-FLOW CUTOFF</b>	-99999 to 99999 (-99999 disables cutoff function)				
<b>TEMPERATURE DRIFT</b>	50 PPM/°C from -40 to 65°C ambient				
<b>DECIMAL POINT</b>	Up to four decimal places: <i>d.ddddd, dd.dddd, ddd.ddd, dddd.d, or ddddd</i>				
<b>TOTAL DISPLAY OVERFLOW</b>	Total up to 99,999,999 with total overflow feature. "oF" is displayed to the left of total overflow value (e.g. <i>oF999</i> ).				
<b>TOTALIZER</b>	Calculates total based on rate, time base of second, minute, hour, or day, and field programmable multiplier; stored in non-volatile memory upon power loss.				
<b>TOTALIZER RESET</b>	User selectable via panel button, time delay, or protected				
<b>CALIBRATION RANGE</b>	An <i>Error</i> message will appear if input 1 and input 2 signals are too close together. <table><thead><tr><th><b>Input Range</b></th><th><b>Minimum Span Input 1 &amp; Input 2</b></th></tr></thead><tbody><tr><td>4-20 mA</td><td>0.40 mA</td></tr></tbody></table>	<b>Input Range</b>	<b>Minimum Span Input 1 &amp; Input 2</b>	4-20 mA	0.40 mA
<b>Input Range</b>	<b>Minimum Span Input 1 &amp; Input 2</b>				
4-20 mA	0.40 mA				
<b>VOLTAGE DROP</b>	<table><thead><tr><th><b>Without Backlight</b></th><th><b>With Backlight</b></th></tr></thead><tbody><tr><td>2.0 V maximum</td><td>5.7 V maximum</td></tr></tbody></table>	<b>Without Backlight</b>	<b>With Backlight</b>	2.0 V maximum	5.7 V maximum
<b>Without Backlight</b>	<b>With Backlight</b>				
2.0 V maximum	5.7 V maximum				
<b>EQUIVALENT RESISTANCE</b>	100 Ω @ 20 mA                      285 Ω @ 20 mA				
<b>INPUT OVERLOAD</b>	Over current protection to 2 A max.				

**Open Collector Output**

<b>RATING</b>	Isolated open collector, 30 VDC @ 175 mA max.
<b>ALARM OUTPUT</b>	Assign to rate for high or low alarm trip point. Assign to total for total alarm trip point.
<b>DEADBAND</b>	0-100% FS, user selectable
<b>ACKNOWLEDGE</b>	Front panel ACK button resets output and screen indication.
<b>PULSE OUTPUT K-FACTOR</b>	K-factor programmable from 0.0001 to 99999. One pulse is generated for every total increment selected (e.g. K-factor value of 100 will generate one pulse every time the total is incremented by 100 units).  If the pulse output exceeds the programmed output frequency, pulses are accumulated as pending and are not lost. Pulses will continue to output until the buffer is emptied or the total is reset from the front panel.
<b>PULSE OUTPUT FREQUENCY</b>	Programmable frequency: 2, 4, 8, 16, 32, 64, 128 Hz. Minimum pulse width: 3.9 ms @ 128 Hz Maximum pulse width: 250 ms @ 2 Hz Factory default pulse width: 31 ms @ 16 Hz

## PD689 COMPLIANCE INFORMATION

### Ratings and Approvals

---

<b>FM</b>	Class I, Div 1, 2, Groups ABCD Class II, Div 1, Groups EFG Class II, Div 2, Groups FG Class III, Div 1, 2 Class 1, Zone 0, Group IIC
-----------	--

---

<b>CSA</b>	Class I, Div 1, 2, Groups ABCD Class II, Div 1, Groups EFG Class II, Div 2, Groups FG Class III, Div 1, 2 Class 1, Zone 0, Group IIC
------------	--

---

PD689 installation must be performed in  
accordance with Control Drawing  
**LIM688-2**

## SAFETY INFORMATION



**CAUTION:** Read complete  
instructions prior to installation  
and operation of the meter.

Installation and service should be performed only by trained service personnel. Service requiring replacement of internal components must be performed at the factory.

## INSTALLATION

There is no need to remove the meter from its case to complete the installation, wiring, and setup of the meter.

### Unpacking

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

If any part is missing or the meter malfunctions, please contact your supplier or the factory for assistance.

### Panel Mounting

- Prepare a standard 1/8 DIN panel cutout – 3.622" x 1.772" (92 mm x 45 mm). Refer to *Mounting Dimensions*, page 41 for more details.
- Clearance: allow at least 4" (102 mm) behind the panel for wiring.
- Panel thickness: 0.04" - 0.25" (1.0 mm - 6.4 mm).  
Minimum steel/stainless steel panel thickness to maintain watertight rating: 0.06" (1.5 mm).

**Note: A steel or stainless steel panel rather than plastic is recommended in cases where a watertight or dust-tight seal is required between the meter and the panel.**

- Remove the two mounting brackets provided with the meter (back-off the two screws so that there is ¼" (6.4 mm) or less through the bracket. Slide the bracket toward the front of the case and remove).
- Insert meter into the panel cutout.
- Install mounting brackets and tighten the screws against the panel. To achieve a proper seal, tighten the mounting bracket screws evenly until meter is snug to the panel along its short side. **DO NOT OVER TIGHTEN**, as the rear of the panel may be damaged.

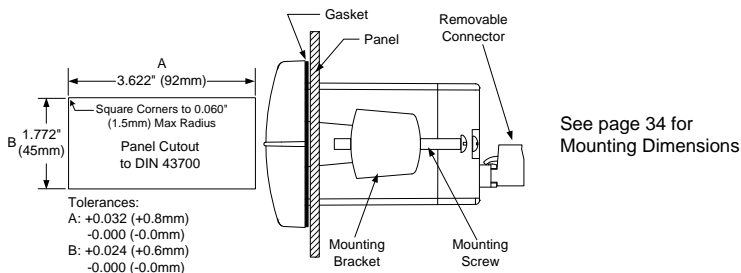


Figure 1. Panel Cutout and Mounting

## PD684 Connections

Signal connections are made to a four-terminal and a two-terminal removable connector. This section is only intended for the PD684.

***PD689 installation must be performed in accordance with Control Drawing LIM688-2 in order to meet agency approval ratings.***

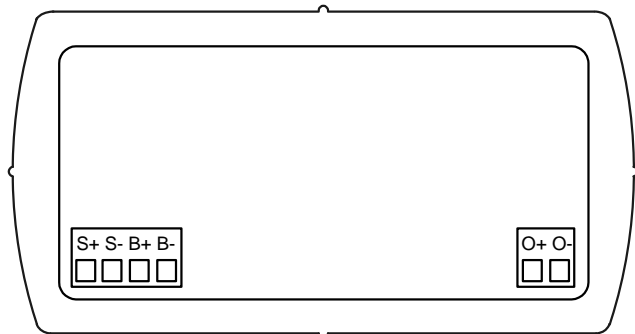
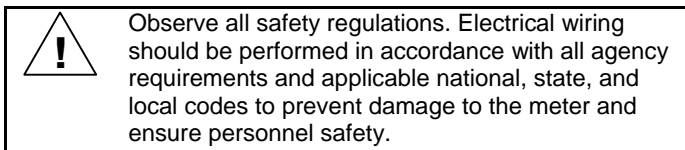


Figure 2. PD684 & PD689 Rear View

## 4-20 mA Input Connections

Input connections are made to a four-terminal connector labeled S+|S-|B+|B-. The loop-powered backlight is an optional configuration and requires a total maximum voltage drop of 5.7 V. The backlight is recommended for dim lighting conditions and is enabled when wired as shown in Figure 3. It may be bypassed if installed in bright lighting conditions to reduce the maximum voltage drop to 2.0 V as shown in Figure 4.

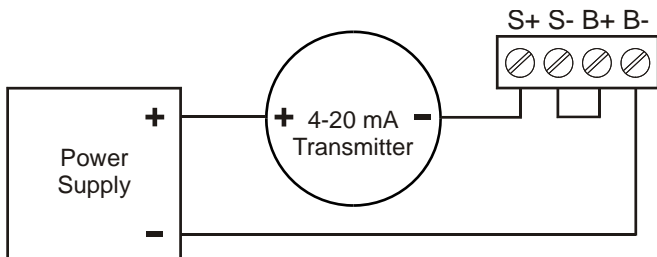


Figure 3. PD684 Input Connections with Backlight

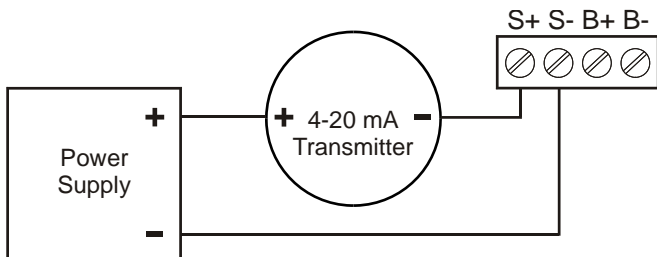


Figure 4. PD684 Input Connections without Backlight

## Open Collector Output Connections

Output connections are made to a two-terminal connector labeled O+|O-. Connect to an input device such as alarm indicator or pulse counter as shown in Figure 5, or drive a relay as shown in Figure 6.

**To avoid damaging the PD684's amplifying components, use care not to wire incorrectly or exceed output ratings. A diode, such as 1N4000 series, will provide protection from relay transients.**

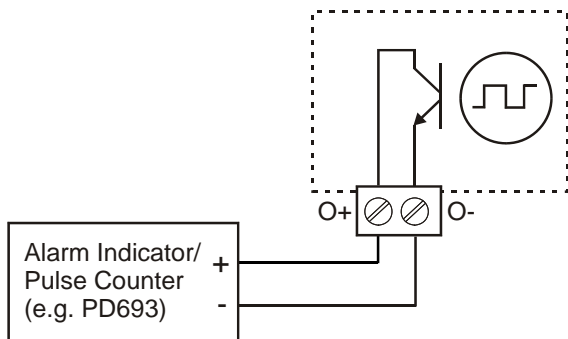


Figure 5. PD684 Connection to Device with Internal Pull-Up

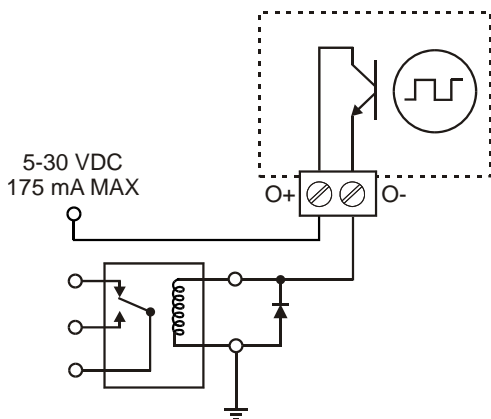


Figure 6. PD684 Connection to External Relay

## SETUP AND PROGRAMMING

- There is **no need to recalibrate** the meter for milliamps when first received from the factory.
- The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.

### Overview





There are no jumpers involved in the setup process of the meter. Setup and programming is done through the front panel buttons.

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

For  
**Quick User Interface Reference Guide**  
go to page 46

## Front Panel Buttons & Status Indicators



Button Symbol	Description
	Menu
	Right arrow/Reset
	Up arrow/Max
	Enter/Ack

Symbol	Status
0%	Bargraph minimum
100%	Bargraph maximum
▲	Increasing trend
▼	Decreasing trend

- 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 or decimal position during programming.
- Press the **Up** arrow button to scroll through the menus, decimal point, or to increment the value of a digit.
- Press the **Enter/Ack** button to access a menu or to accept a setting.
- Press and hold the **Menu** button for five seconds to access the *Advanced* features of the meter.

## Main Menu 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.

<b>Display</b>	<b>Parameter</b>	<b>Action/Setting</b>
SEtUP	Setup	Enter Setup menu
dEC.Pt	Decimal point	Enter Decimal Point menu
rRtE	Rate	Set Rate decimal point
tOtAL	Total	Set Total decimal point
un tS	Units	Enter the Units menu
rRtE	Rate	Set Rate units
tOtAL	Total	Set Total units
tBAsE	Time Base	Enter the Time Base menu
SEc	Second	Units per second
nr n	Minute	Units per minute
Hour	Hour	Units per hour
dAY	Day	Units per day
tOt.CF	Conversion Factor	Enter the Conversion Factor menu
t rSt	Total Reset	Enter the Total Reset menu
AutO	Automatic	Automatic Total Reset
tDLy	Time Delay	Automatic Reset Time Delay
nr Rn	Manual	Manual Total Reset
EnRbL	Enable	Enable Manual reset
dSRbL	Disable	Disable Manual reset
dSPLY	Display	Enter the Display menu
r-t	Rate-Total	Display Rate or Total
rRtE	Rate	Display Rate only
tOtAL	Total	Display Total only
tOGGLE	Toggle	Toggle between Rate & Total every 10 sec

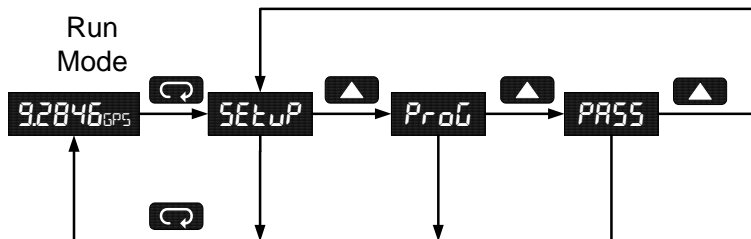
**PD684 & PD689 Loop-Powered Rate/Totalizers Instruction Manual**

<b>Display</b>	<b>Parameter</b>	<b>Action/Setting</b>
<i>PrOg</i>	<i>Program</i>	Enter the <i>Program</i> menu
<i>SCALE</i>	<i>Scale</i>	Enter the <i>Scale</i> menu
<i>CAL</i>	<i>Calibrate</i>	Enter the <i>Calibrate</i> menu
<i>inPt 1</i>	<i>Input 1</i>	Calibrate input 1 signal or program input 1 value
<i>dSP1 1</i>	<i>Display 1</i>	Program display 1 value
<i>inPt 2</i>	<i>Input 2</i>	Calibrate input 2 signal or program input 2 value
<i>dSP1 2</i>	<i>Display 2</i>	Program display 2 value
<i>Error</i>	<i>Error</i>	Error, calibration not successful, check signal
<i>GrAPh</i>	<i>Graph</i>	Enter the <i>Graph</i> menu
<i>PASS</i>	<i>Password</i>	Enter the <i>Password</i> menu
<i>unLoc</i>	<i>Unlocked</i>	Program password to lock meter
<i>Locd</i>	<i>Locked</i>	Enter password to unlock meter
<i>99999</i> <i>-99999</i>	<i>Flashing display</i>	Overrange condition Underrange condition
<i>oF</i>	<i>Overflow</i>	Total <i>Overflow</i> condition

## Main Menu

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

- Press **Menu** button to enter Programming Mode then press **Up** arrow button to scroll main menu.

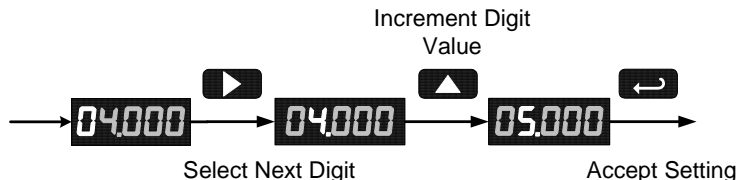


- Press **Menu**, at any time, to exit and return to Run Mode. Changes made to settings prior to pressing **Enter/Ack** are not saved.
- Changes to the settings are saved to memory only after pressing **Enter/Ack**.
- The display moves to the next menu every time a setting is accepted by pressing **Enter/Ack**.

## Setting Numeric Values

The numeric values are set using the **Right** and **Up** arrow buttons. Press **Right** arrow to select next digit and **Up** arrow to increment digit. The digit being changed blinks.

Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



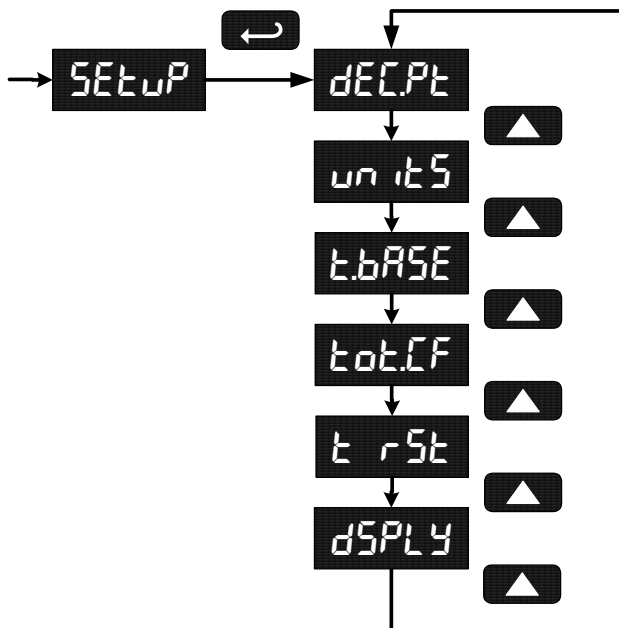
The decimal point is set using the **Right** or **Up** arrow button in the *Setup-decimal point* menu.

## Setting Up the Meter (SEtUP)

The *Setup* menu is used to select:

1. Rate and total decimal point position
2. Rate and total engineering units display
3. Time base
4. Total conversion factor
5. Manual or automatic total reset function
6. Rate or total display mode

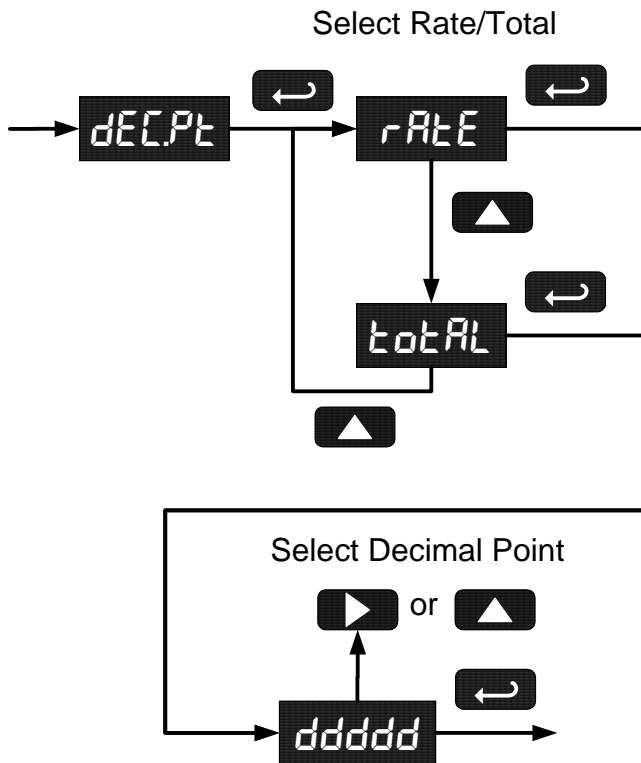
Press the **Enter/Ack** button to access any menu or press **Up** arrow button to scroll through choices. Press the **Menu** button to exit at any time.



### Setting the Decimal Point (*dEc.Pt*)

Decimal point may be set with up to four decimal places or with no decimal point at all. Rate decimal and total decimal are programmed individually.

Pressing the **Right** or **Up** arrow moves the decimal point one place to the right until no decimal point is displayed, then it moves to the left most position.



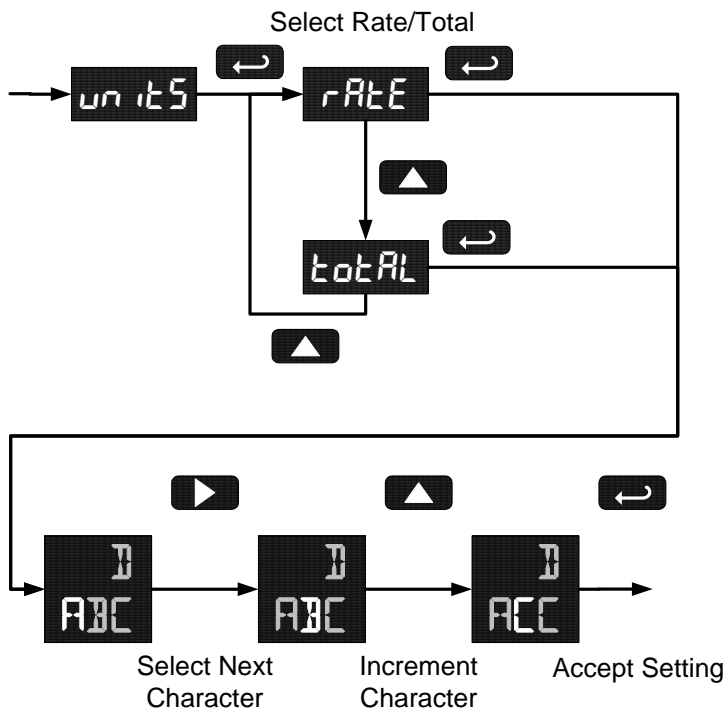
### Setting the Units Display (units)

The meter can be set to display a combination of three alphanumeric characters for engineering units (e.g. G/S, LPM) or for identification (e.g. TR3, L7). There is also a fourth alphanumeric character located above this row, which supports a degrees symbol and "x10" symbol (e.g. °C, °F, x103, x106, x109). Rate and total units are programmed individually allowing for combinations (e.g. GPM and GAL, LPS and LTRx103).

Press **Right** arrow to select next unit and **Up** arrow to increment unit.

The unit being changed blinks.

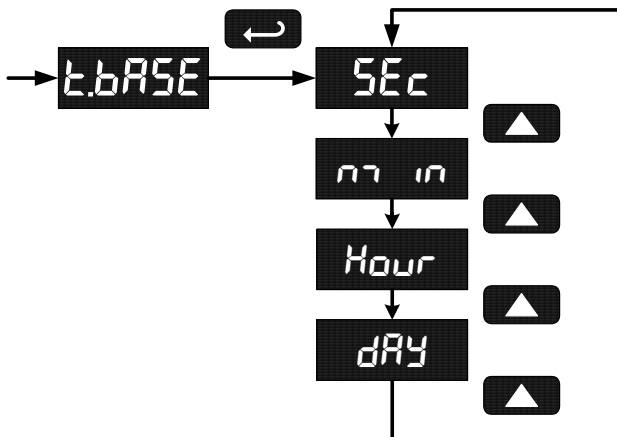
Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



### Setting the Time Base (tBASE)

The meter calculates total based on rate and a time base of units per second, minute, hour, or day.

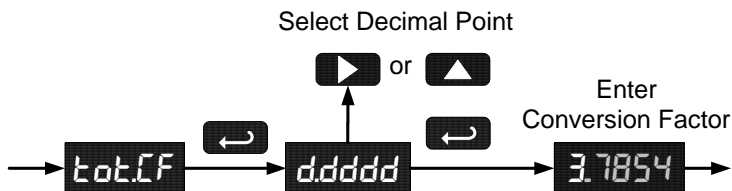
Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



### Setting the Total Conversion Factor (tot.CF)

Total Conversion Factor is used to convert to a different unit of total display. For example, to display rate in gallons and total in liters, enter a conversion factor of 3.7854. When rate and total units are the same, the Conversion Factor should be 1.0000.

Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



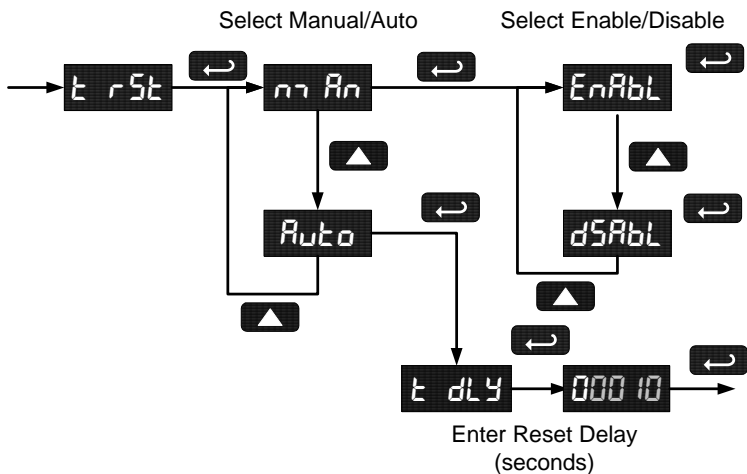
## Manual or Automatic Total Reset Function (t rSt)

The meter may be programmed to reset the total either manually using the **Reset** button or automatically. Manual reset button may be disabled to avoid inadvertent total reset.

The automatic reset is based on the set point programmed in the *Advanced* menu: `aut` → `RLrn` → `tStRL`. Once the set point is reached, the meter waits for a programmed amount of time (`t dLY`) and then resets the total to zero.

- To enable total reset by **Reset** button, choose `nr Rn` → `EnRbL`.
- To disable total reset by **Reset** button, choose `nr Rn` → `dSRbL`.
- To reset total upon total alarm set point, choose `RuLa`, enter a time delay (`t dLY`), and proceed to Alarm Output (`alm`) programming, page 35.

Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.

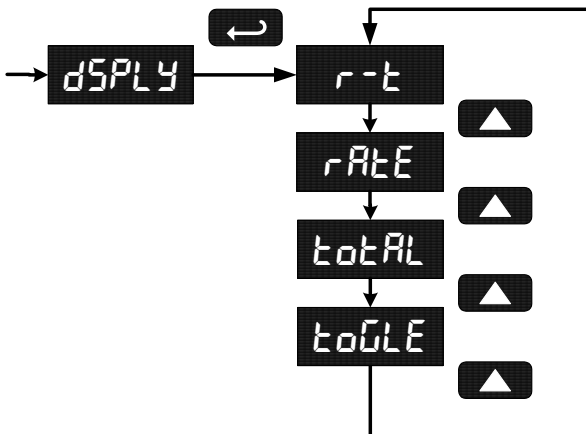


## Display Rate or Total Mode (dSPLY)

The meter may be programmed to switch between rate and total with **Enter/Ack** button press, display rate only, display total only, or to automatically toggle between rate and total display every 10 seconds.

- To enable rate or total display toggle by **Enter/Ack** button, choose *r-t*.
- To display rate only (disable button toggle), choose *rAtE*.
- To display total only (disable button toggle), choose *tOtAL*.
- To automatically toggle between rate and total display every 10 seconds, choose *tOGLE*. Pressing **Enter/Ack** button will also toggle the display.

Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



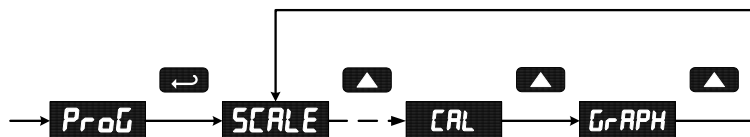
## Programming the Meter (*Prog*)

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

- There is **no need to recalibrate** the meter for milliamps when first received from the factory.
- The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.
- Use the *Scale* menu to enter scale parameters without applying a live signal.
- Alternatively, use the *Calibrate* menu to apply a signal from a calibrator or a 4-20 mA transmitter to calibrate the meter.

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

Inputs may be calibrated or scaled to any display within the range of the meter.



Additional parameters, not needed for most applications, are programmed with the *Advanced features* menu, see Advanced Features Menu, page 31.

### 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 input 1, allowing the appropriate input signals to be applied.

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

1. Minimum input span requirements not maintained.
2. Input 1 signal inadvertently applied to calibrate input 2.

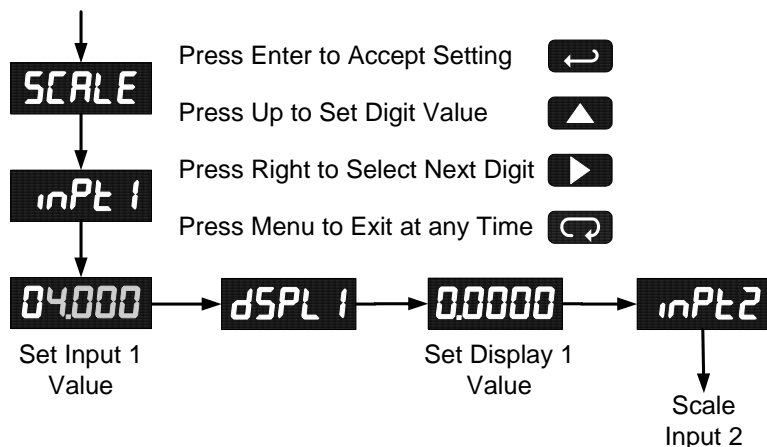
### Minimum Input Span

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. The minimum span is 0.40 mA.

## Scaling the Meter (SCALE)

The 4-20 mA input can be scaled to display the process in engineering units.

A signal source is not needed to scale the meter; simply program the inputs and corresponding display values.



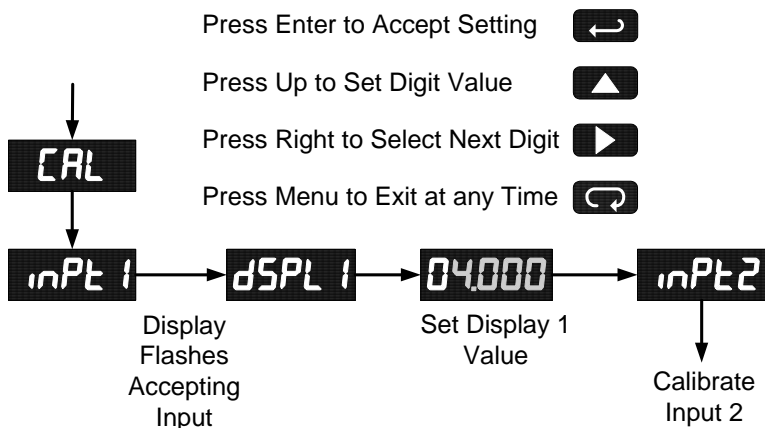
For instructions on how to program numeric values see *Setting Numeric Values*, page 18.

## Calibrating the Meter (CAL)

To scale the meter without a signal source refer to *Scaling the Meter (sCalE)*, page 26.

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

The use of a calibrated signal source is strongly recommended.



## Recalibrating the Internal Calibration Reference (iCAL)

The *Internal Calibration (iCAL)* menu, located in the *Advanced* features menu, is used to recalibrate the internal calibration reference. Recalibration is recommended at least every twelve months.

Refer to *Internal Calibration (ICal)*, page 37 for instructions.

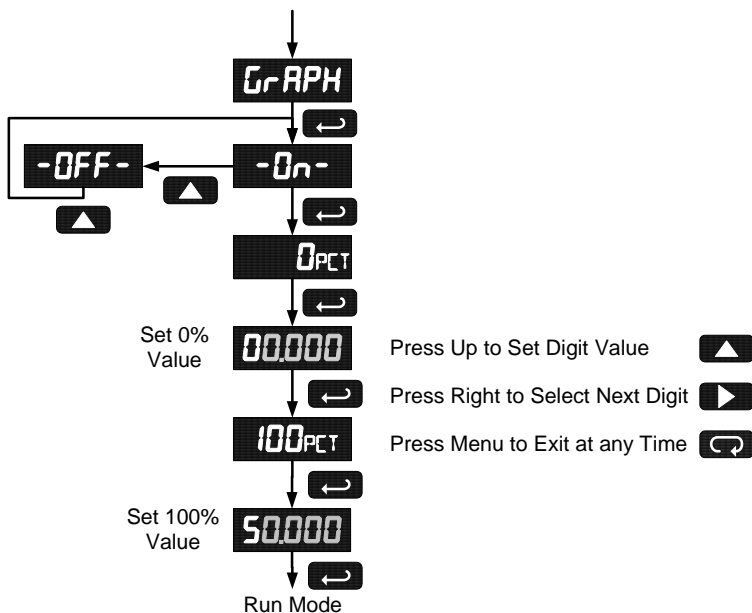
## Setting Up the Bargraph (GRAPH)

The meter can be set to display a bargraph proportional to the percentage process reading within a user-defined span.

The span is determined by values entered for 0% and 100%.

If the 0% and 100% values are the same as the values that were entered for display 1 and display 2, respectively, from the scale or calibrate steps, then it is not necessary to modify them.

The bargraph may be disabled by selecting *OFF* from the bargraph menu.



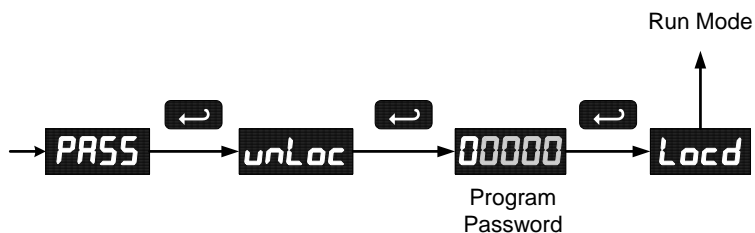
## Setting Up the Password (PR55)

The *Password* menu is used to program a five-digit password to prevent unauthorized changes to the programmed parameter settings.

### Locking the Meter

Enter the *Password* menu and program a five-digit password.

For instructions on how to program numeric values see *Setting Numeric Values*, page 18.

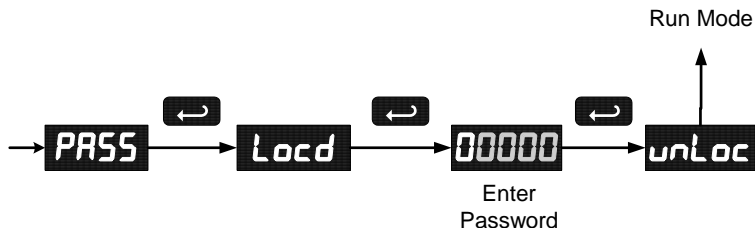


Record the password for future reference. If appropriate, it may be recorded in the space provided.

Model:	
Serial Number:	
Password:	_ _ _ _ _

## Unlocking the Meter

If the meter is password protected, the correct password must be entered in order to make changes to the parameter settings.



Entering the correct five-digit number sets the password to 00000, disabling the protection. The meter remains unlocked until a new password is programmed or the former password is re-programmed using the *Password* menu.

Changes to the programmed parameter settings are allowed only with the password set to 00000.

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

### Forgot the Password?

The password may be disabled by the following procedure:

1. Note rate reading prior to pressing the Menu button. Ignore decimal point and sign.
2. Access the *Password* menu, add 2 to the noted reading and enter that number as the password (e.g. display reading = -1.23, password = 00125).

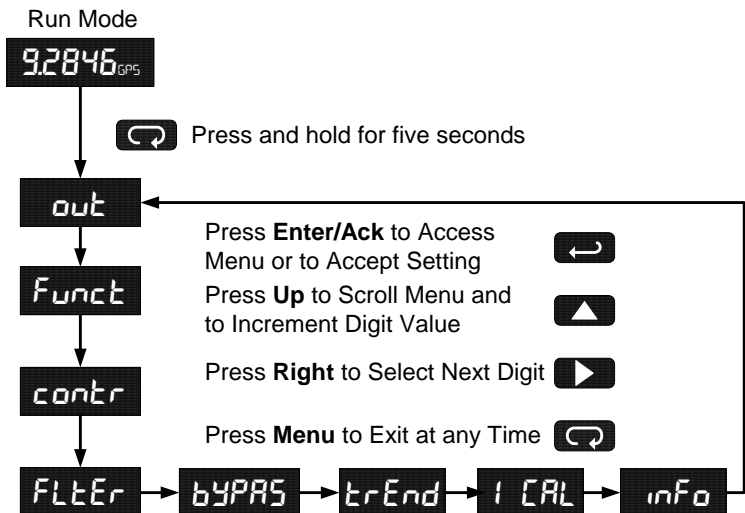
**OR**

3. If rate display is not available, enter 01179.

## 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 five **seconds** to access the Advanced features of the meter.



## Advanced Features Menu & Display Messages

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

<b>Display</b>	<b>Parameter</b>	<b>Action/Setting</b>
<b>OUT</b>	<i>Output</i>	Enter output menu
<b>OFF</b>	<i>Off</i>	Disable output
<b>ALARM</b>	<i>Alarm Output</i>	Enter alarm output menu
<b>RATE</b>	<i>Rate Alarm</i>	Assign alarm output to rate
<b>TOTAL</b>	<i>Total</i>	Assign alarm output to total
<b>SET</b>	<i>Set Point</i>	Program set point
<b>RESET</b>	<i>Reset Point</i>	Program reset point
<b>PULSE</b>	<i>Pulse Output</i>	Program pulse output K-factor
<b>FREQ</b>	<i>Frequency</i>	Program pulse output frequency
<b>FUNC</b>	<i>Function</i>	Enter function menu
<b>LINEAR</b>	<i>Linear</i>	Set linear scaling
<b>SQUR</b>	<i>Square Root</i>	Set square root extraction
<b>PROG</b>	<i>Programmable Exponent</i>	Set programmable exponent
<b>CUTOFF</b>	<i>Low-Flow Cutoff</i>	Set low-flow cutoff
<b>CONTR</b>	<i>Contrast</i>	Enter contrast adjustment menu
<b>FILTER</b>	<i>Filter</i>	Set noise filter value
<b>BYPAS</b>	<i>Bypass</i>	Set filter bypass value
<b>TREND</b>	<i>Trend Arrows</i>	Enable or disable trend arrows
<b>-ON-</b>	<i>On</i>	Enable trend arrow display
<b>-OFF-</b>	<i>Off</i>	Disable trend arrow display
<b>ICAL</b>	<i>Internal Calibration</i>	Enter internal reference calibration
<b>INFO</b>	<i>Meter Information</i>	Show software number and version, or reset to factory defaults
<b>RESET</b>	<i>Reset Defaults</i>	Restore factory default parameter settings

For instructions on how to program numeric values see *Setting Numeric Values*, page 18.

### Noise Filter (*FLtEr*)

Most applications do not require changing this parameter. It is intended to help attain a steady display with an unsteady (noisy) input signal.

The field selectable noise filter averages any minor or quick changes in the input signal and displays the reading with greater stability.

Increasing the filter value will help stabilize the display, however this will reduce the display response to changes on the input signal.

The filter level may be set anywhere from 1 to 199.

### Noise Filter Bypass (*bYPAS*)

The meter can be programmed to filter small input changes, but allow larger input changes to be displayed immediately, by setting the bypass value accordingly.

If the input signal goes beyond the bypass value, it will be displayed immediately with no averaging done on it.

The noise filter bypass value may be set anywhere from 0.2 to 99.9. It corresponds to percentage of full scale.

Increasing the bypass value may slow down the display response to changes on the input signal.

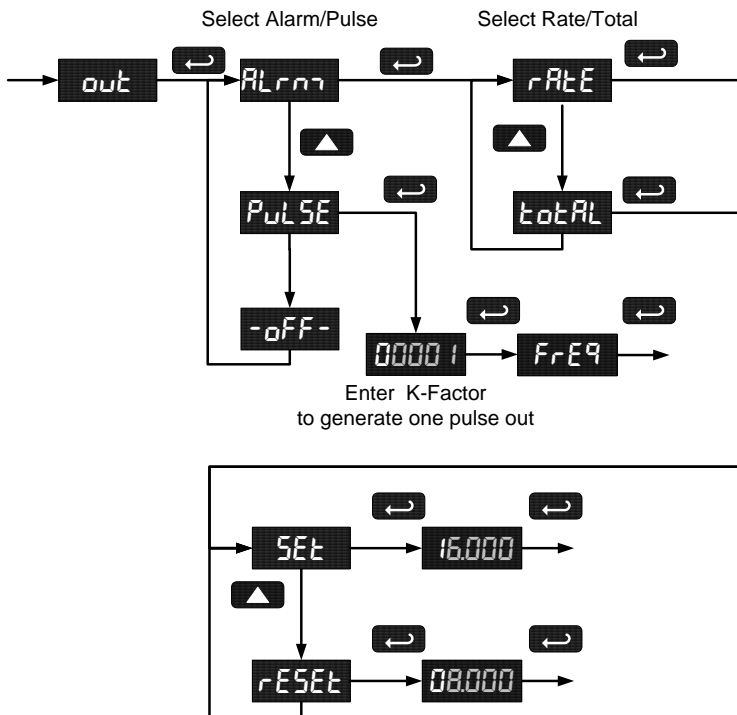
### Contrast (*contR*)

LCD contrast is adjustable through the front panel buttons. Select *contR* and increase level using **Up Arrow/Max** button. Settings 1 through 9 will be displayed on the screen as *11111* to *99999*. Settings 1 through 4 are usually best when viewing from below the angle perpendicular to the display. Settings 5 through 9 are usually best when viewing straight on (meter is at eye level) or when viewing from above.

## Alarm & Pulse Output (out)

The PD684 & PD689 are equipped with an NPN open collector output that may be set up for high or low rate alarm trip point, total alarm trip point, or pulse output based on K-factor. The pulse output frequency may be programmed for 2, 4, 8, 16, 32, 64, or 128 Hz.

The output may be disabled by selecting `-OFF-`. The alarm status will show on the display even if the output is not wired.



### Alarm Output (ALARM)

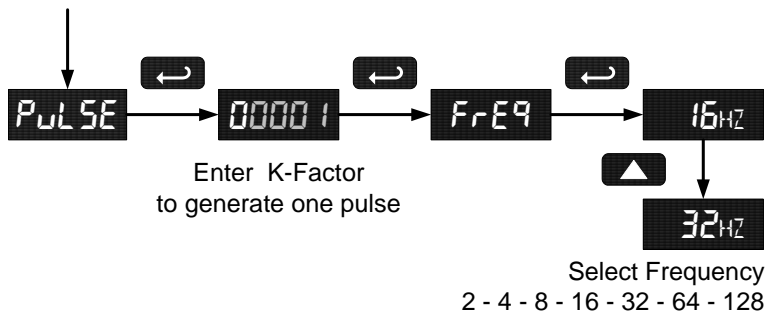
- **Rate high alarm trip point:** program set point above reset point.
- **Rate low alarm trip point:** program set point below reset point.
- Rate alarm deadband is determined by the difference between set and reset points. Minimum deadband is one display count. If set and reset points are programmed the same, output will reset one count below set point.
- **Total alarm trip point:** program total set point. Alarm reset is triggered by total reset (There is no reset parameter entered for total). If automatic total reset is enabled, this setting will be the trigger point for the timer. *It is not necessary to have the output wired for automatic reset function to work.*

To acknowledge rate or total alarm, press and hold **Enter/Ack** button for two seconds.

### Pulse Output K-Factor (PULSE)

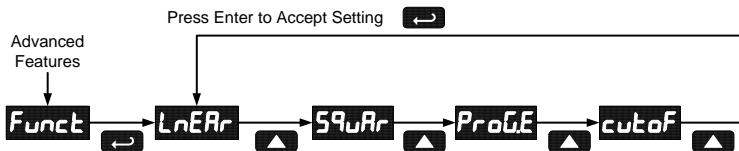
The pulse output K-factor corresponds to the total units (e.g. gallons) needed to generate one pulse. For example, if the K-factor value is set to 10, one pulse is generated for every 10 counts incremented on the display. Likewise, if the K-factor value is set to 100, one pulse is generated for every 100 counts incremented on the display.

If the pulse output exceeds the programmed output frequency, pulses are accumulated as pending and are not lost. Pulses will continue to output until the buffer is emptied or the total is reset from the front panel.



## Math Functions (*LnERr*, *SqURr*, *PrGE*, *CuToF*)

The PD684/PD689 provides a number of functions to condition outputs from linear and non-linear transmitters.



### Linear (*LnERr*)

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

### Square Root (*SqURr*)

The square root function is used to linearize the signal from a differential pressure transmitter and display flow rate in engineering units.

### Programmable Exponent (*PrGE*)

The programmable exponent function is used to linearize the level signal in applications using weirs and flumes and display flow rate in engineering units. Upon selecting programmable exponent (*PrGE*), the meter prompts entry of a 5-digit value between 0.5000 and 3.0000 as the exponent.

### Low-Flow Cutoff (*CuToF*)

The low-flow cutoff feature allows the meter to be programmed so that the often-unsteady output from a differential pressure transmitter, at low flow rates, always displays zero on the meter. The default cutoff is zero to prevent negative readings, but this may be overridden to allow them. The cutoff value may be programmed from -99999 to 99999. Below the cutoff value, the meter will display zero. Selecting either square root or programmable exponent will set the cutoff value to 0. Program the cutoff value to -99999 to disable.

## Internal Calibration ( *iRL* )

- There is **no need to recalibrate** the meter for milliamps when first received from the factory.
- The meter is **factory calibrated** for milliamps prior to shipment. The calibration equipment is certified to NIST standards.

The internal calibration allows the user to scale the meter without applying a signal. The use of a calibrated signal source is necessary to perform the internal calibration of the meter. Check calibration of the meter at least every 12 months.

### Notes:

- The signal source must have a full-scale accuracy of 0.01% or better between 4 and 20 mA in order to maintain the specified accuracy of the PD689.
- Allow the meter to warm up for at least 15 minutes before performing the internal calibration procedure.

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

1. Press and hold the **Menu** button for five **seconds** to access the Advanced features of the meter.
2. Press the **Up** arrow button to scroll to the *Internal calibration* menu ( *iRL* ) and press **Enter/Ack**.
3. The meter displays 4.000 mR. Apply a 4.000 mA signal and press **Enter/Ack**. The display shows both trend arrows for a moment while the meter is accepting the signal.
4. After the signal is accepted, the meter displays 8.000 mR. Apply an 8.000 mA signal and press **Enter/Ack**. The display shows both trend arrows for a moment while the meter is accepting the signal.
5. Continue, as in the previous step, for the remaining signals: 12.000 mA, 16.000 mA, and 20.000 mA.

## 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 previous signal prompt, allowing the appropriate input signal to be applied. The error message might be caused by inadvertently leaving the signal at the previous level.

## Information Menu ( *INF* )





The *Information* menu is located in the *Advanced* features menu, to access *Information* menu see *Advanced Features Menu*, page 31.

It shows software and version number. To determine the software version of a meter:

1. Go to the *Information* menu ( *INF* ) and press **Enter/Ack** button. The number shown is the software number.
2. Press **Enter/Ack** again to display the release version.

## OPERATION

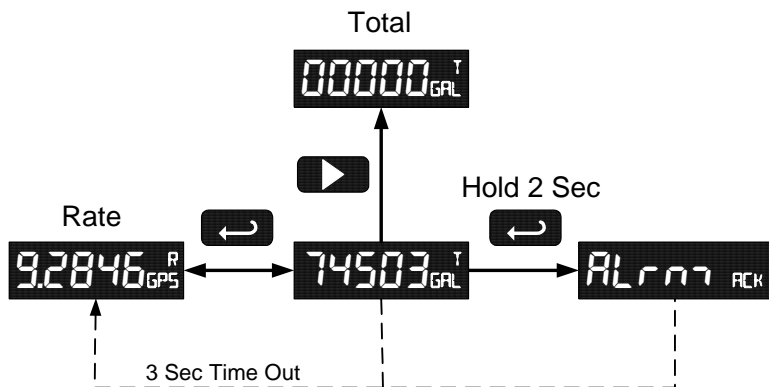
### Front Panel Buttons Operation

Button Symbol	Description
	Press to enter or exit Programming Mode, view settings, or exit Max/Min readings
	Press to reset total (if enabled) Press to reset Max/Min readings
	Press to display Max/Min readings alternately
	Press to toggle between rate and total display (if enabled) Press and hold 2 seconds to acknowledge alarm Press to display Max/Min reading indefinitely while displaying Max/Min

## Rate or Total Display Readings

During operation, the front panel buttons control toggling of rate and total display, total reset, and alarm acknowledge. Depending on setup, some displays and functions may not be allowed.

The corresponding programmed rate and total engineering units are displayed to differentiate between the two. (Default includes **R** & **T**)



Press **Enter** to Toggle Rate/Total



Hold **Enter** 2 Sec to Ack Alarm



Press **Right** to Reset Total



Press **Menu** to Enter Setup Menu



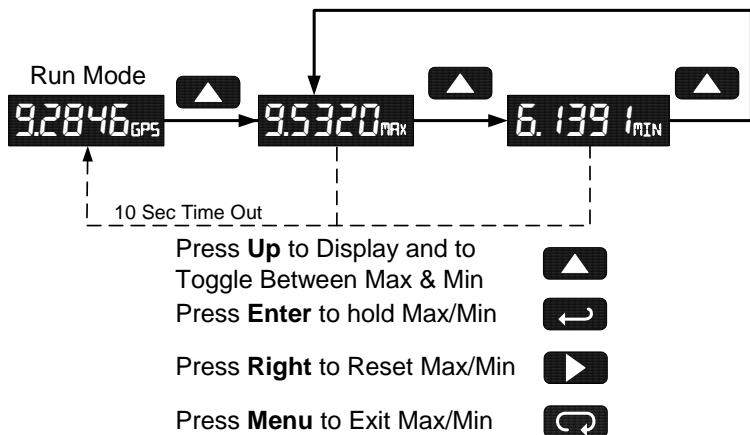
Press **Up** to Enter Max & Min Menu



1. Press **Enter/Ack** to switch between displaying rate and total (if enabled).
2. Press and hold **Enter/Ack** 2 seconds to acknowledge alarm output.
3. Press **Right** to reset total (if enabled).
4. Press **Menu** to enter the setup menu.
5. Press and hold **Menu** 5 seconds to enter *Advanced* menu.
6. Press **Up/Max** to enter Max/Min menu.

## Maximum & Minimum Readings (MAX & MIN)

The maximum and minimum (peak & valley) readings reached by the process are stored in the meter since the last reset or power-up. The meter shows MIN or MAX to differentiate between run mode and max/min display.



7. Press **Up/Max** button to display maximum rate since the last reset/power-up.
8. Press **Up/Max** again to display the minimum rate since the last reset/power-up.
9. Press **Enter/Ack** to hold Max/Min display reading, the meter will continue to track new Max/Min readings.
10. If **Enter/Ack** is not pressed, the Max/Min display reading will time out after ten seconds and the meter will return to display the actual reading.
11. Press **Right/Reset** button to reset Max/Min while reading is being displayed. Max/Min display readings are reset to actual reading.
12. Press **Menu** to return to Rate or Total display (run mode).

## MOUNTING DIMENSIONS

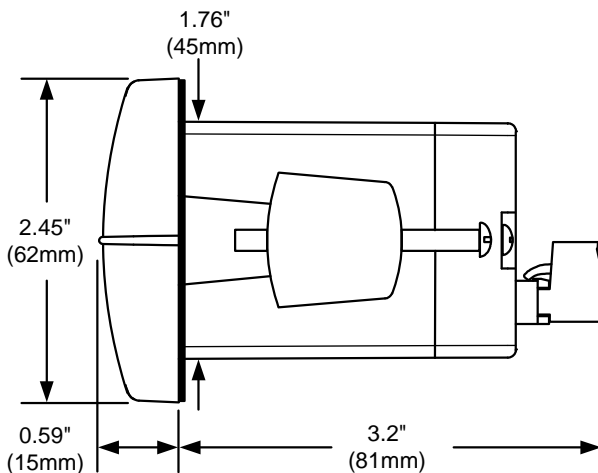


Figure 7. Meter Dimensions – Side View

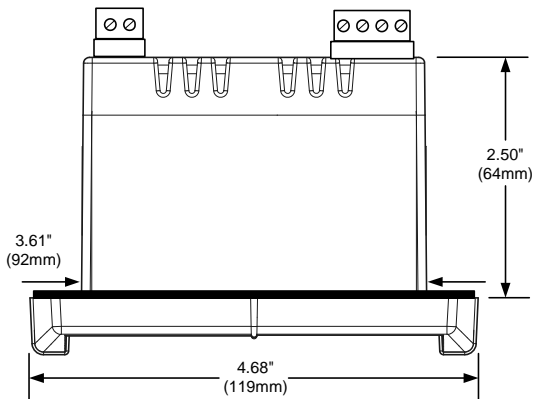


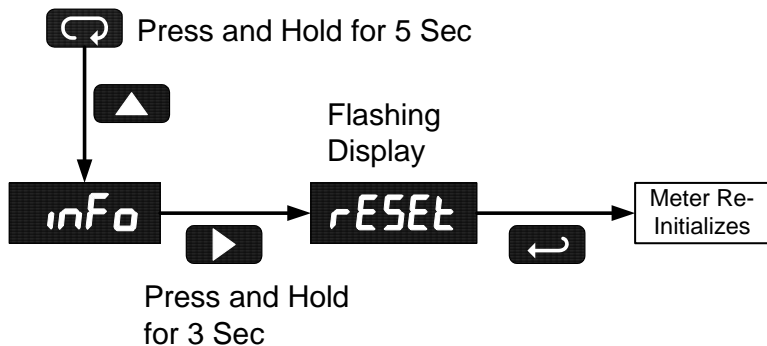
Figure 8. Case Dimensions – Top View

## 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 31.
2. Press **Up** arrow until *inFo* is shown.
3. Press and hold **Right** arrow/Reset for five seconds, press **Enter/Ack** when display flashes *rESEt*.  
Note: If **Enter/Ack** is not pressed within three seconds, display returns to *Information* menu.
4. The meter goes through an initialization sequence (same as on power-up), and loads the factory default settings.



**Factory Defaults & User Settings**

The following table shows the factory setting for most of the programmable parameters on the meter. Next to the factory setting, the user may record the new setting for the particular application.

Model: \_\_\_\_\_ S/N: \_\_\_\_\_ Date: \_\_\_\_\_

<b>Parameter</b>	<b>Display</b>	<b>Default Setting</b>	<b>User Setting</b>
<i>Programming</i>	<b>Prog</b>	Scale	
<i>Input 1</i>	<b>INPt 1</b>	4.000 mA	
<i>Display 1</i>	<b>dSPt 1</b>	4.000	
<i>Input 2</i>	<b>INPt 2</b>	20.00 mA	
<i>Display 2</i>	<b>dSPt 2</b>	20.000	
<i>Decimal point rate</i>	<b>dddd</b>	3 places	
<i>Decimal point total</i>	<b>dddd</b>	none	
<i>Units</i>	<b>un itS</b>	mA – R, mA – T	
<i>Time Base</i>	<b>t.bASE</b>	Minute	
<i>Conversion Factor</i>	<b>tot.CF</b>	1.0000	
<i>Total Reset Function</i>	<b>t rSt</b>	Manual - Enabled	
<i>Display</i>	<b>dSPtY</b>	Rate or Total (r-t)	
<i>Bargraph</i>	<b>GrAPH</b>	On (enabled)	
<i>Bargraph 0%</i>	<b>0 PCT</b>	4.000	
<i>Bargraph 100%</i>	<b>100 PCT</b>	20.000	
<i>Password</i>	<b>PASS</b>	00000 (unlocked)	
<b>Advanced Features</b>			
<i>Output</i>	<b>Out</b>	Off	
<i>Function</i>	<b>Funct</b>	Linear	
<i>Contrast</i>	<b>contr</b>	5 (55555)	
<i>Cutoff</i>	<b>cutOFF</b>	0 (no negative rate)	
<i>Filter</i>	<b>FLtEr</b>	1	
<i>Bypass</i>	<b>bYPAS</b>	0.2	
<i>Trend Arrows</i>	<b>trEnd</b>	On (enabled)	

## TROUBLESHOOTING

The rugged design and the user-friendly interface of the meter should make it unusual for the installer or operator to refer to this section of the manual.

If the meter is not working as expected, refer to the recommendations below.

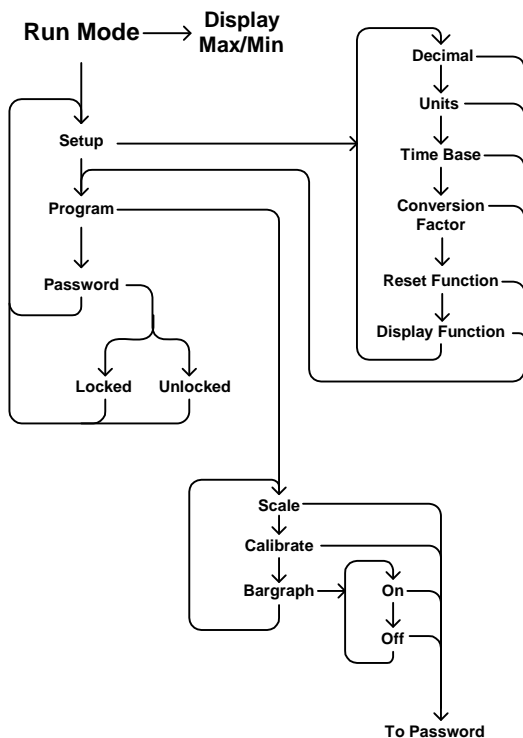
### Troubleshooting Tips

Symptom	Check/Action
No display or faint display	<ol style="list-style-type: none"> <li>1. Check connections.</li> <li>2. Increase contrast setting in <i>Advanced</i> menu.</li> <li>3. Perform hard reset by temporarily shorting S+ and S- terminals for a few seconds.</li> </ol>
Rate display unsteady	Increase filter setting in <i>Advanced</i> menu.
Not able to change setup or programming, <i>Lcd</i> is displayed	Meter is locked, enter correct five-digit password to unlock
Meter displays error message during calibration ( <i>Error</i> )	Check: <ol style="list-style-type: none"> <li>1. Signal connections</li> <li>2. Minimum input span requirements</li> </ol>
Meter displays <ul style="list-style-type: none"> <li>• 99999</li> <li>• -99999</li> </ul>	Check: <ol style="list-style-type: none"> <li>1. Input signal within range.</li> <li>2. When using square root or programmable exponent, cutoff must be 0 or greater.</li> </ol>
Display stuck showing a number and <i>MAX</i> or <i>MIN</i>	Press <b>Menu</b> to exit Max/Min display readings.
Display response is too slow	Check filter and bypass values to see if they can be lowered.
If the display locks up or the meter does not respond at all	Perform hard reset by temporarily shorting S+ and S- terminals for a few seconds and then removing short.
Display shows blurry, hard-to-read digits in below freezing temperatures (less than -18°C or 0°F).	Increase the filter setting to 10 or greater and the bypass setting to 50 or greater. This will slow the display response rate, but digits will be steady and appear more clearly.
Other symptoms not described above	Call Technical Support for assistance.

## **OTHER PRECISION DIGITAL PRODUCTS**

<b>Model</b>	<b>Description</b>
PD118	MINIMUX <sup>®</sup> 8 Channel Scanner/Multiplexer
PD154	VIGILANTE <sup>®</sup> II Four Point Annunciator with First-Out
PD158	VIGILANTE <sup>®</sup> II Eight Point Annunciator with First-Out
PD202-253	Digital Pressure Gauges
PD603	Saber Low-Cost 1/8 DIN Process Meter
PD644	Javelin D High-Voltage DC Panel Meter
PD650	2.3" LED NEMA 4X Large Display Process Meter
PD655	1.0" LED NEMA 4X Large Display Process Meter
PD656	0.8" LED Exp-Proof Large Display Process Meter
PD660	Low-Cost NEMA 4X Loop Powered Meter
PD661	Low-Cost Exp-Proof Loop Powered Meter (FM & CSA)
PD675	4½ Digit Loop Powered NEMA 4X Meter (FM & CSA)
PD677	4½ Digit Loop Powered Exp-Proof Meter
PD683	Loop-Powered Panel Meter for Safe Area
PD685	3½ Digit Loop Powered NEMA 4X Meter (General Purpose)
PD686	3½ Digit Loop Powered NEMA 4X Meter (FM & CSA)
PD687	3½ Digit Loop Powered Exp-Proof Meter (FM & CSA)
PD688	FM & CSA Approved Loop-Powered Panel Meter
PD690	1/8 DIN Universal Process Meter (UL Listed)
PD691	1/8 DIN Universal Strain Gauge Meter (UL Listed)
PD692	1/8 DIN Analog Input Flow Totalizer (UL Listed)
PD693	1/8 DIN Freq/Pulse Input Flow Totalizer (UL Listed)
PD697	NEMA 4X Loop-Powered Flow Rate/Totalizer
PD698	Exp-Proof Loop-Powered Flow Rate/Totalizer (FM & CSA)
PD743	Saber T Low-Cost TC & RTD Temperature Meter
PD750	TC & RTD Temperature Meter (UL Listed)
PD751-752	10 Ω Cu & 120 Ω Ni RTD Temperature Meters (UL Listed)
PD765	Trident Process & Temperature Meter (UL Listed)
PD865	Snooper Modbus RTU Serial Input Meter
PD940-981	Consolidator <sup>®</sup> Multi-Channel Controllers
PD540 Series	Digital Temperature Controllers
PD550 Series	Programmable Temperature Controllers
PD560 Series	Digital Temperature Meters
PD570 Series	Temperature Limit Controller

## QUICK USER INTERFACE REFERENCE GUIDE



<b>Pushbutton</b>	<b>Function</b>
<b>Menu</b>	Go to Programming Mode or leave Programming, Advanced Features, and Max/Min Modes.
<b>Right Arrow</b>	Move to next digit or decimal point position. Reset Total.
<b>Up Arrow</b>	Move to next selection or increment digit. Go to Max/Min Mode.
<b>Enter/Ack</b>	Accept selection/value and move to next selection. Toggle Rate/Total.
	Hold to Acknowledge Alarm.

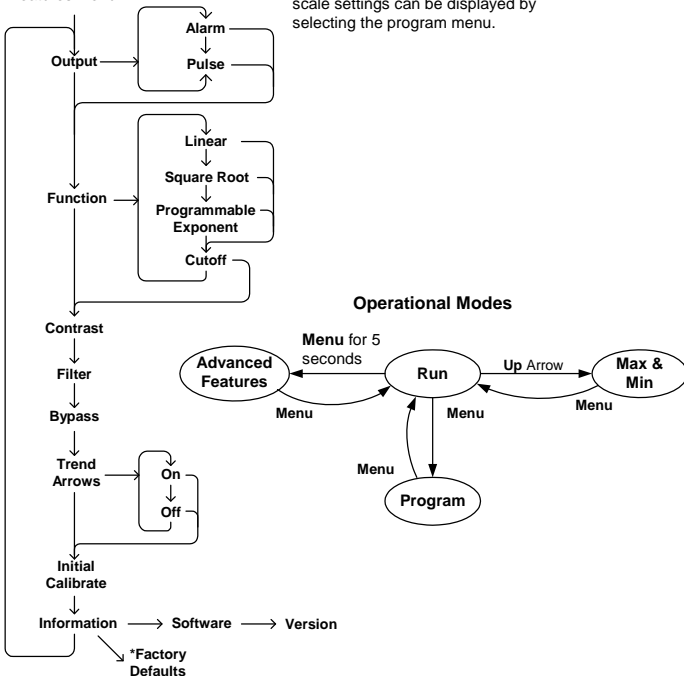
**Menu** held for 5 seconds enters Advanced Features

### Max/Min Mode

While in Run Mode, pressing **Up Arrow** will initiate Max/Min Mode. **Up Arrow** toggles between Max & Min displays, and **Right Arrow** resets the Max/Min to the current value. Press **Menu** or wait 10 seconds to return to Run Mode. Pressing **Enter/Ack** will disable the 10 second timeout and continuously display Max or Min.

Press & hold **Menu** for 5 seconds to access Advanced Features Menu

When a password is enabled, parameter settings are locked, but scale settings can be displayed by selecting the program menu.



\*Access by holding **Right/Reset** for 3 seconds

## How to Contact Precision Digital

- For Technical Support:  
Call: (800) 610-5239 or (508) 655-7300  
Fax: (508) 655-8990  
Email: [support@predig.com](mailto:support@predig.com)
- For Sales Support:  
Call: (800) 343-1001 or (508) 655-7300  
Fax: (508) 655-8990  
Email: [sales@predig.com](mailto:sales@predig.com)
- For the latest version of this manual please visit:  
**[www.predig.com](http://www.predig.com)**

