# DDL

## Large Display Dual-Line 6-Digit Process Meter

Rev. H, 08/2024
Document #9004570; Part #125816-0019

## RUGGED, READABLE, INTUITIVE

The only large display process meter you will ever need. A big, bright 6-digit dual-line LED display that can be seen from 100 feet even in bright sunlight, a built-in 24 VDC power supply, an optional second 40 mA power supply, NEMA 4X rated enclosure and a 6-digit dual-line display, four relays and 4-20 mA output option, advanced signal input conditioning, all easily programmed with your PC.

### Features

0-20 mA, 4-20 mA, 0-5 V, 1-5 V, and ±10 V Field Selectable Inputs with ±0.03% Accuracy

Isolated 24 VDC @ 200 mA Transmitter Power Supply

4 Relays with Interlocking Capability + Isolated 4-20 mA Output Option

Input Power Options: 85-265 VAC / 90-265 VDC or 12-24 VDC / 12-24 VAC

5 Digital Inputs & 4 Digital Outputs Standard

### Field-Ready

Large Display NEMA 4X, IP65 Wall Mounted Meter

SunBright Display

Operating Temperature Range -40 to 65°C

Conformal Coated PCBs for Dust and Humidity Protection

Easy Field Scaling in Engineering Units without Applying an Input

### User-Friendly Display

Large Dual-Line 6-Digit Display, 1.8" (46 mm)

Readable from 100 Feet (30 Meters) Away

Display Input in Two Different Scales

Programmable Display, Function Keys & Digital Input

### Feature-Rich Capabilities

Multi-Pump Alternation Control

Round Horizontal Tank Formula

32-Point, Square Root, or Exponential Linearization

Free PC-Based MeterView Pro Programming Software

Password Protection

### Accessories

RS-232 & RS-485 Serial Communication Options with Modbus RTU

Light/Horn & Button Accessory

Control Station Accessory For Remote Operation

Stainless Steel Sun Hood Accessory

### Certifications & Warranty

UL & C-UL Listed. E160849

508 Industrial Control Equipment

3-Year Warranty

# OVERVIEW

## Front

UV Resistant
Sunlight Readable Display

NEMA 4X, IP65
Rated Enclosure

<sub>c</sub>**UL**<sub>us</sub>
LISTED

**MeterView Pro**
USB Install

**APG**

Extra-Large
1.8" Digits

PV, Max (Peak),
Min (Valley)

Dual-Line
6-Character
Display

User
Configurable
Display

Reset Button
Included with
MOD-PD2LH

Connections and
Function Keys Easily
Accessible Behind
Front Panel Door

## Connections

MA OUT   RELAY1   RELAY2   RELAY3   RELAY4

R   I+   I-    C  NC  NO   C  NC  NO    C  NC  NO   C  NC  NO

P+/P-
24V 10V 5V

SIGNAL

P+  P-  F4  COM V+ mA+

POWER

4-20 mA
Output
Powered
by meter

· Two isolated supplies available even
  on 12/24 VDC input power models
· Removable terminal blocks
· Four (4) form C (SPDT) relays +
  isolated 4-20 mA output option
· Digital Inputs and Outputs +
  RS485 serial communication

MENU  RIGHT   UP   ACK

MENU   RESET  MAX  ENTER

Meter provides
24 VDC power
to the
transmitter

· Universal 85-265 VAC or
  12/24 VDC input power
· Voltage or current inputs
· No jumpers needed for
  V/mA input selection
· Onboard USB for
  PC connection

USB

M-LINK

# THE ONLY LARGE DISPLAY PROCESS METER YOU WILL EVER NEED

The DDL large display process meter boasts specifications, features and functionality that make it the only large display process meter you will ever need. The big, bright 6-digit dual-line LED display that can be seen from 100 feet even in bright sunlight is the first thing you will notice about the DDL. After that, the number one feature that makes the DDL such a useful device is its built-in 24 VDC power supply to drive the transmitter as illustrated by the above diagram. This feature not only saves the cost of an external power supply, but also greatly simplifies wiring. In addition, there is a second 40 mA power supply provided with the 4-20 mA output option, evident also in the above diagram.

The above picture illustrates several other reasons why the DDL is the only large display process meter you will ever need. First off, is the NEMA 4X rated enclosure which means you can install the DDL indoors and outdoors, exposed to moisture, dust and other adverse conditions. The next thing to notice is the 6-digit dual-line display that can display numbers up to 999,999 on the upper line and show either a tag or the input in a different scale on the lower line.

Other key features include four relays and 4-20 mA output option, advanced signal input conditioning like automatic round horizontal tank linearization, function keys, pump alternation capability, and Modbus RTU serial communications. Finally, all these features and capabilities can easily be programmed with free MeterView Pro PC-based software.

**APG**

# ISOLATED TRANSMITTER POWER SUPPLIES

## 24 V @ 200 mA Transmitter Power Supply

One of the most useful standard features of the AC powered DDL is its built-in isolated, 24 V @ 200 mA power supply to power the transmitter. This feature saves money by eliminating an external power supply and also simplifies wiring by reducing the number of devices in the loop. It can be configured for 5, 10, or 24 V (default) by means of a simple internal jumper. This power supply is even available on meters that are powered from DC power (24 V @ 100 mA). To use an external power supply instead of the internal power supply, simply make connections to different terminals on the DDL.

The following diagrams illustrate how to wire the DDL so it will power the transmitter:
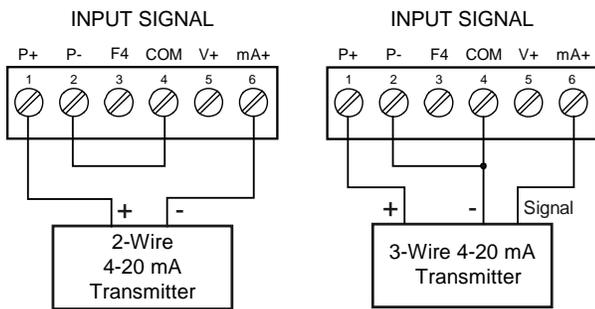


## 24 V @ 40 mA 4-20 mA Output Power Supply

Not only can the DDL power the 4-20 mA input signal, but an additional power supply of 24 V @ 40 mA is provided with the 4-20 mA output option to power the 4-20 mA output.
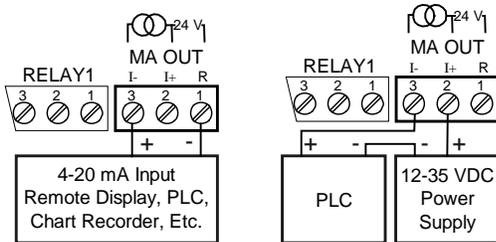


## Resettable Fuse Prevents Current Overload

Another very useful aspect of the DDL is that the current input is protected against current overload by a resettable fuse. 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.

## Other Uses for the Transmitter Power Supplies

The most common use for these two power supplies is for the 200 mA transmitter power supply to power the field transmitter and 40 mA power supply to power the 4-20 mA output from the meter. However, since these two power supplies are isolated they can be used in other ways. For instance, some level transmitters require the use of a heated lens. The DDL's 200 mA power supply could be used to power the heated lens and the DDL's 40 mA power supply could be used to power the 4-20 mA input.
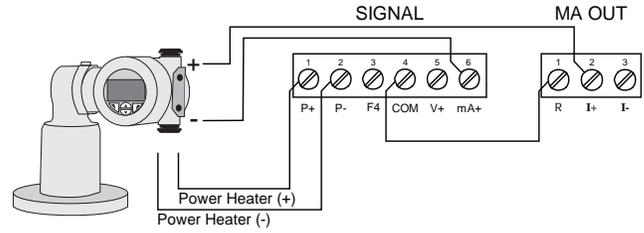


DDL Powers Both Heater and 4-20 Output

## External Power Supply for the Loop

For applications that require an external transmitter power supply, the same DDL is used and merely wired in a different fashion as the following diagrams illustrate:
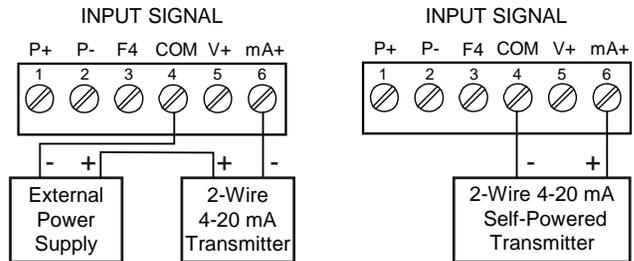


## PDA1024-01 24 VDC Transmitter Power Supply

APG offers the PDA1024-01 for applications that require more than the 200 mA power that the DDL can provide.



**Specifications**
**Output Voltage:** 24 VDC
±10% @ 1.5A rated current
**Dimensions:** 1.40" x 3.50" x 2.10"
(35 mm x 90 mm x 54.5 mm) (W x H x D)

**APG**

# ADVANCED DISPLAY FEATURES

## Dual-Line Makes All the Difference

Display 1 can be programmed to indicate PV, maximum (peak), minimum (valley), alternating maximum/minimum, one of eight alarm set points, or Modbus input. Display 2 can be configured to display engineering units, set points, user defined messages, or simply turned off.

The DDL's dual-line display makes all the difference both when programming the instrument and when using it in the field. When programming the instrument, the dual line display prompts for the needed information and also helps you keep track of where you are in the setup process. When using the instrument, the dual line display provides more information such as displaying the input in two different scales like height and volume for a level application. We call this the Dual-Scale feature.

## Programming Assistance

The DDL's dual-line display makes programming the instrument much easier because the lower line prompts for the needed information and also helps you keep track of where you are in the setup process.

The DDL is prompting for the value for Input 2 and displaying the default value of 20.00 mA. The "2" in 20.00 is brighter than the rest of the digits indicating that it is the number that will be changed by the Up and Right arrows.

The DDL is now prompting for what the user wants Display 2 to be; that is the value that corresponds to 20 mA. In this case Display 2 is currently set to 95.00.

## Superluminous Sunlight Readable Display

The DDL's standard SunBright display features extraordinarily bright LEDs. It is perfect for applications where the meter is in direct sunlight or in applications where visibility may be impaired by smoke, fog, dust, or distance.

## Dual-Scale Display Feature

The DDL has a rather unique, and very flexible dual-scale capability. This is of particular value in level applications where a second scaled display can represent the measured input in a different form (i.e. gallons & height). Both displays are independently scaled and are based on the 4-20 mA input signal. Beyond level, this function has been used for pressure & force, current & power, feet & meters, GPM & CFM, and more.

Gallons & mA                Gallons & Height

Gallons & Percent           Gallons & Head PSI

MeterView Pro can be used to program the DDL to display the input in two different scales:
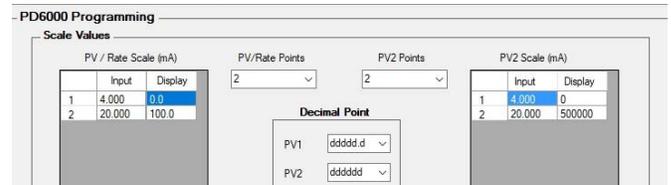
## Rounding Feature for Even Steadier Display

The rounding feature is used to give the user a steadier display with fluctuating signals. It causes the display to round to the nearest value according to the rounding value selected (1, 2, 5, 10, 20, 50, or 100). For example, with a rounding value of 10, and an input of 12346, the display would indicate 12350.

## Toggling Between Reading & Units with Tag

The DDL can also be programmed so the upper line toggles between the reading and units and the lower line displays a tag. For instance, the upper line toggles between 9500 and Gal and the lower line displays Tank 1.

**APG⊞**
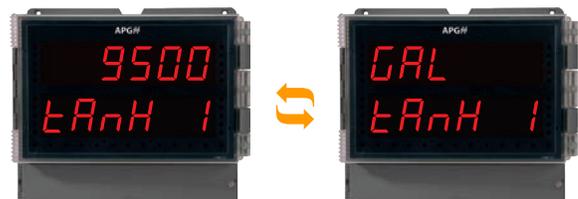
## Other Uses for Lower Line

The lower line can also be used indicate units, a tag, or even a setpoint as the following pictures illustrate:



| Volume in Tank | Gallons & Setpoint | Level in Feet | Pressure Indication |

# QUICK & EASY SCALE & PROGRAMMING METHODS

The DDL can be programmed either via the front panel push buttons or free, PC-based MeterView Pro software. MeterView Pro can be downloaded for free online and the meter is connected to your PC with a provided USB cable, so it is by far the easiest way to program the DDL. The DDL can be calibrated either by applying a known signal or scaled by entering a desired value with the front panel buttons or MeterView Pro software. Most customers will use the scaling method because it is simpler and does not require a calibrated signal source. Selecting the input to be current or voltage is done with the front panel buttons or MeterView Pro software. Once programming is completed it can be locked with a password.

## Free PC-Based MeterView Pro USB Programming Software & Cable



When you connect your DDL to your PC and open MeterView Pro, the software automatically selects the model you are using, and you're ready to start programming immediately. Further simplifying the programming process, the DDL can be powered from the USB port, so no need to apply external power while programming your meter.  In addition to programming, the software will also allow you to monitor and datalog a DDL using your PC. You can also generate and save programming files for later use.

**APG**®

## Setup Screen

- Select Voltage or Current Input
- Activate Dual-Scale (Level) Function
- Select Decimal Point
- Set Line 1 Display Parameters
- Set Line 2 Display Parameters
- Set Analog Output Values
- Enable Manual Control
- Test Relays & Digital Outputs
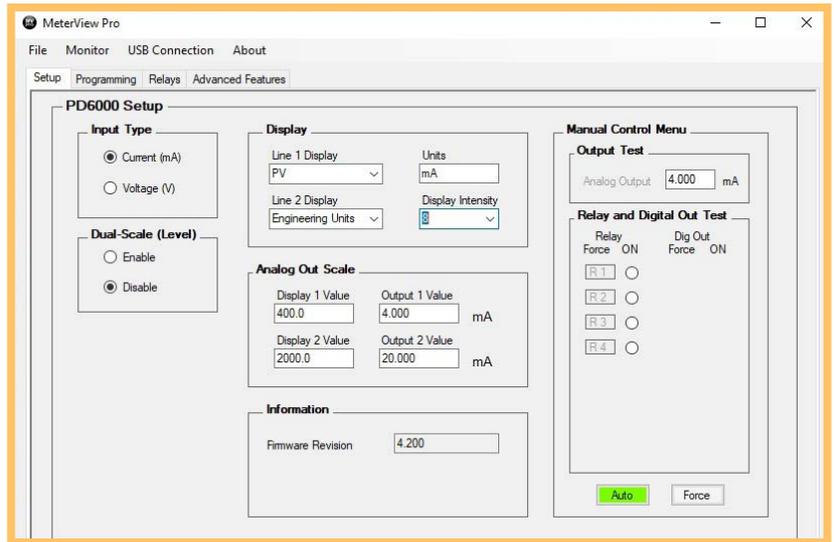


## Programming Screen

- Set Scale Values
- Set the Number of Points (up to 32)
- Import from Excel
- Export to Excel
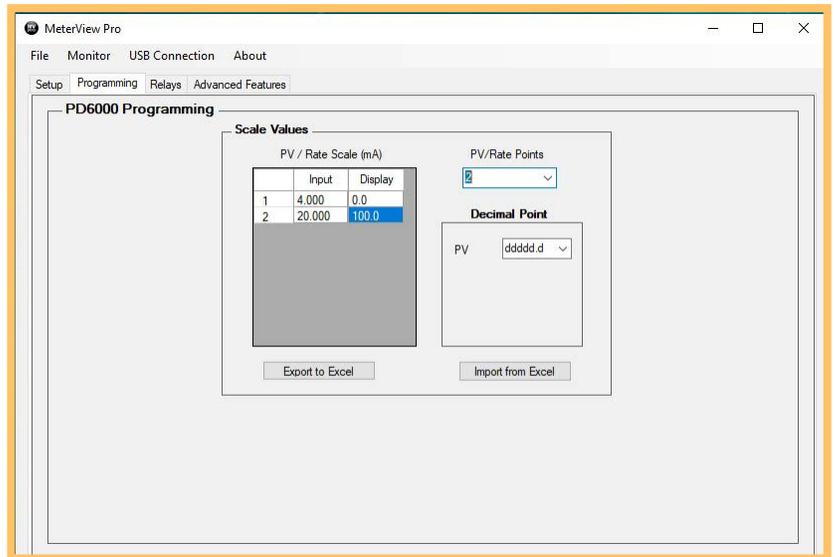


## Relays Screen

- Greatly Simplifies Programming a Variety
  of Relay Features
- Set Relay Action
- Set Sampling Time
- Set Set & Reset Points
- Set On/Off Time Delays
- Set Fail Safe Operation
- Set Input Break Relay Action

**APG**®
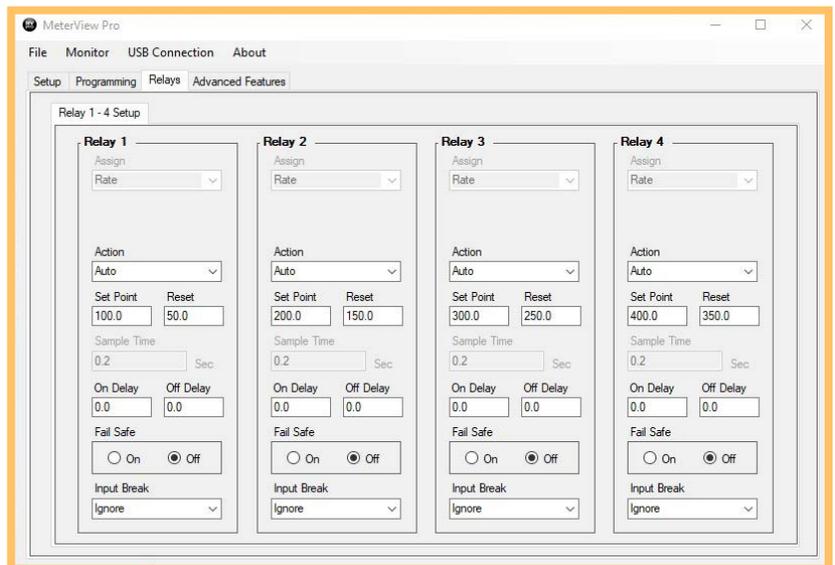
## Save/Open Configuration

At the bottom of most MeterView screens are two tabs:

1. **Get Meter Data:** This reads the programming of the meter that is currently connected to the PC.
2. **Send Meter Data:** Clicking this button, sends current MeterView programming to the meter.



The configuration file can be sent or retrieved from the directory of your choice. This makes it very easy to program multiple meters with the same programming. It is also a great backup utility as well.
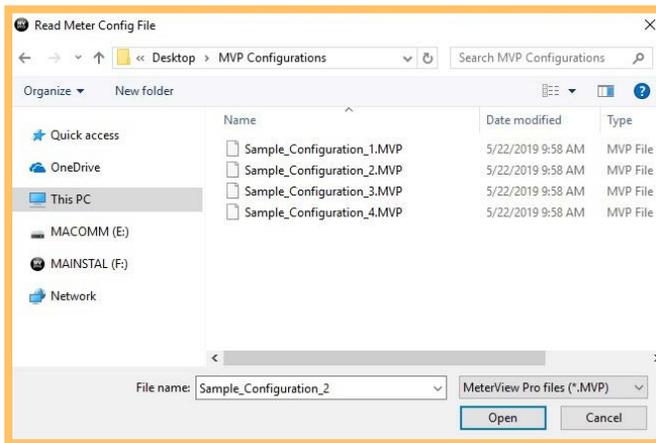


### Specifications

**System Requirements:**
   Microsoft® Windows® 10/11

**Communications:**
   Onboard USB (firmware version 4.0 or higher),
   RS-232 Adapter or RS-485 Adapter

**Meter Address:** 1 - 247

**Reports:**
   · Data logging: Save as CSV file format
   · Configuration: Save as PDC file format or print configuration

**Baud Rate:** 300 - 19,200 bps

**Configuration:** One meter at a time

**Protocol:**
   Modbus RTU (requires firmware version 4.0 or higher)

*Note: Windows® 32/64-bit operating systems

## Password Protection

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

**APG**®

# 4-20 mA OUTPUT & RELAYS

## 4-20 mA Analog Output

The isolated analog retransmission signal can be configured to represent the process variable (PV), maximum (peak) value, minimum (valley) value, the value for any of the eight relay set points, or Modbus input. While the output is nominally 4-20 mA, the signal will accurately accommodate under- and over-ranges from 1 to 23 mA.

The 4-20 mA output can be reversed scaled such that 4 mA represents the high value and 20 mA represents the low value. For instance, a 4-20 mA output signal could be generated as the meter went from 100.0 to 0.0.

For applications where the input was linearized by the DDL, the 4-20 mA output will represent that linearized value.

### Connections

The DDL can provide 40 mA at 24 VDC to power the 4-20 mA output signal or an external power supply can be used:
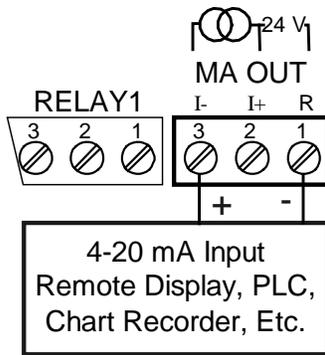


4-20 mA Output Powered by DDL
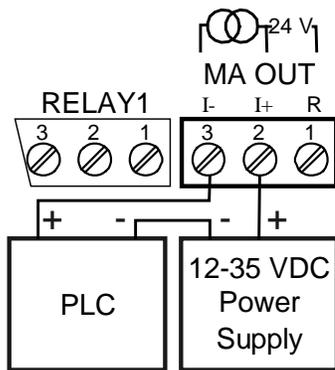


4-20 mA Output Powered by External Power Supply

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.

The 4-20 mA output can either be programmed using the front panel push buttons or free MeterView Pro software.

### Front Panel Push Button Programming

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.
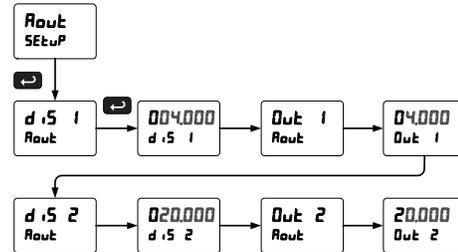


### MeterView Pro Software Programming

When a meter is programmed as shown below, the output will be 4.00 mA when the display reads 0 and the output will be 20.00 mA when the display reads 150000.
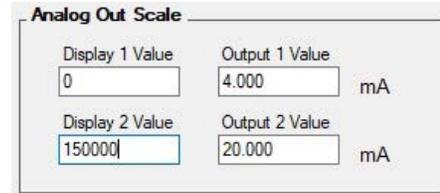


The meter can be set up for reverse scaling as shown below: the output will be 4.00 mA when the display reads 150000 and the output will be 20.00 mA when the display reads 0.
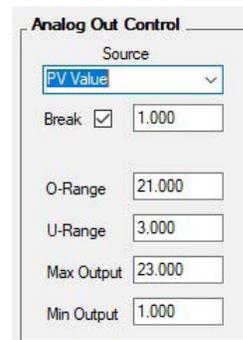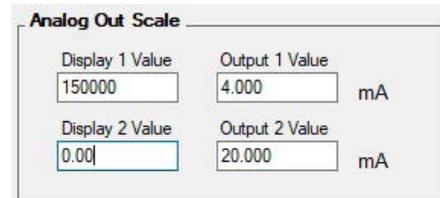




**Source:** Source for generating the 4-20 mA output (e.g. PV)

**Break:** Analog output value when loop break is detected

**Overrange:** Analog output value with display in overrange condition

**Underrange:** Analog output value with display in underrange condition

**Max:** Maximum analog output value allowed regardless of input

**Min:** Minimum analog output value allowed regardless of input

APG®

## Relays for Alarm & Control Applications

Adding relays to the DDL meter turns it into a sophisticated alarm device as well as a powerful, yet simple, alternative to a more complicated PLC system for control applications. One such application would be pump control using the DDL's relays in pump alternation mode. The DDL can be equipped with up to four 3 A Form C (SPDT) internal relays and an additional four more 3 A Form A (SPST) external relays. Relays are highly user-configurable as the following screen shot from MeterView Pro indicates:
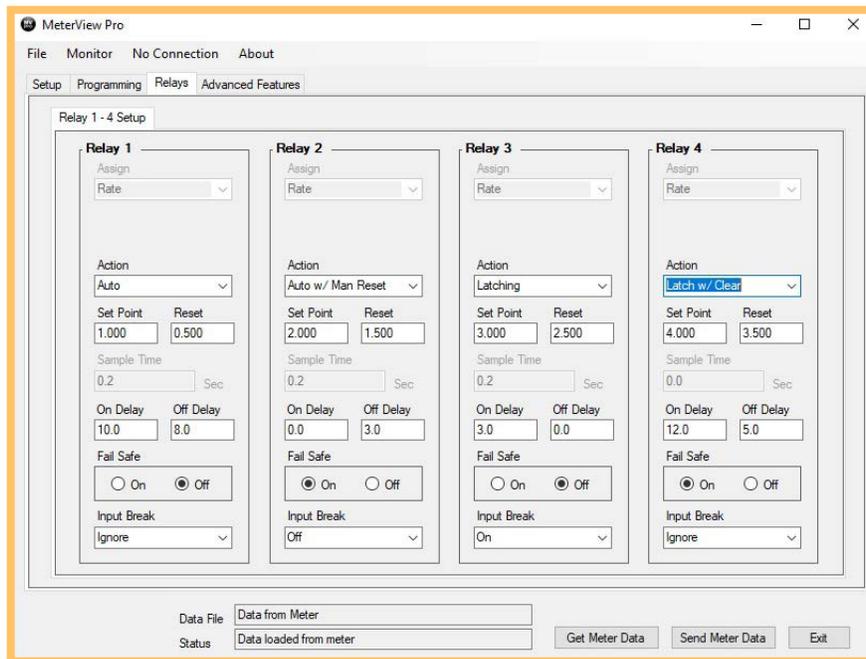


*Values are intended to show programming choices. They are not intended to represent an actual application.

### Setting Set and Reset Points (HI / LO Alarms)

All relays are independent of each other and may be programmed as high or low alarms with user desired set and reset points. Setting a set point above a reset point results in a high alarm and setting a set point below a reset point results in a low alarm. Alarms have 0 – 100% deadband and set and reset points may be set anywhere in the range of the meter.

### Resetting the Relays (Action in MV Pro)

All relays are independent of each other and may be programmed to reset (**Action** in MV Pro) in the following ways:

- **Automatic:** Alarm will reset automatically once the alarm condition has cleared.
- **Automatic/Manual:** Alarm will reset automatically once the alarm condition has cleared but can also be reset using the F3 front panel button* at any time.
- **Latching:** Alarm must be reset manually and can be done so at any time. Press the F3 front panel button* at any time to clear the alarm.
- **Latching with Reset after Cleared:** Alarm must be reset manually and can only be done so after the alarm condition has cleared. Press the F3 front panel button* after the alarm condition has cleared to reset the alarm.

\* Or by connecting an external switch to F4 terminal or with an optional digital input.

### Time Delay (On and Off)

In many applications it is desirable to wait before turning off or on a relay – such as waiting for a process to settle before taking action. Each relay on the DDL can be programmed with independent on and off time delays of 0 to 999.9 seconds to achieve this.

### 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.

### Signal Loss or Loop Break Relay Operation

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)

### User Selectable Fail-Safe Operation

All relays are independent of each other and may be programmed for user selectable fail-safe operation. With the fail-safe feature activated, the relays will transfer to the alarm state on power loss to the meter.

**APG**

## Front Panel LEDs

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.

## Manual Output Control

Take control of any output with this feature. All relays can be forced ON or OFF, and the 4-20 mA output signal can be set to any value within its range. When the relays and 4-20 mA output are controlled manually, an LED labeled "M" is turned on and the associated Alarm LEDs (1-8) flash every 10 seconds indicating that the meter is in manual control mode.



**Manual Output Control LED Indicator**

## Sampling Function (PV Triggered Timed Relay)

The sampling function allows the operator to set a relay as a "sampling" relay. When the PV reaches that set point, it will close that relay's contacts for a preset period of time (0.1 to 5999.9 seconds). An example of its use may be for beer/ale fermentation. When the batch reaches a certain pH, the relay contacts would close and by some means (light, horn, etc.) alert someone to take a sample, or provide the trigger to automatically take a sample of the batch. The utility of this function can, of course, be expanded beyond sampling and be used whenever a timed relay output closure is required when the PV reaches a certain set point.

## Interlock Relay(s)

This function allows a process to use one or more very low voltage input signals or simple switch contacts to control the state of one or more internal "interlock" relays. A violation (i.e. loss of input, open switch, or open circuit) forces one or more N/O interlock relay contacts to open. One input can be used in series with a number of interlock switches, or up to eight inputs can be required to force-on one (or more) internal interlock relays. Requires PDA1044 Digital I/O module or use of on-board digital input F4.
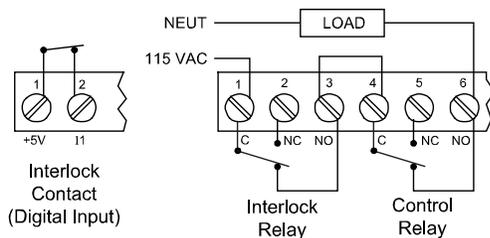


## Switching Inductive Loads

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. APG offers the PDX6901.

## Multi-Pump Alternation

The DDL can be used as a pump controller when combined with a continuous level transmitter. The most common pump control application is shown below: controlling and alternating two pumps and providing high and low-level alarms. The light/horn accessory can be added to provide visual and audible alarm indication.

**APG**®
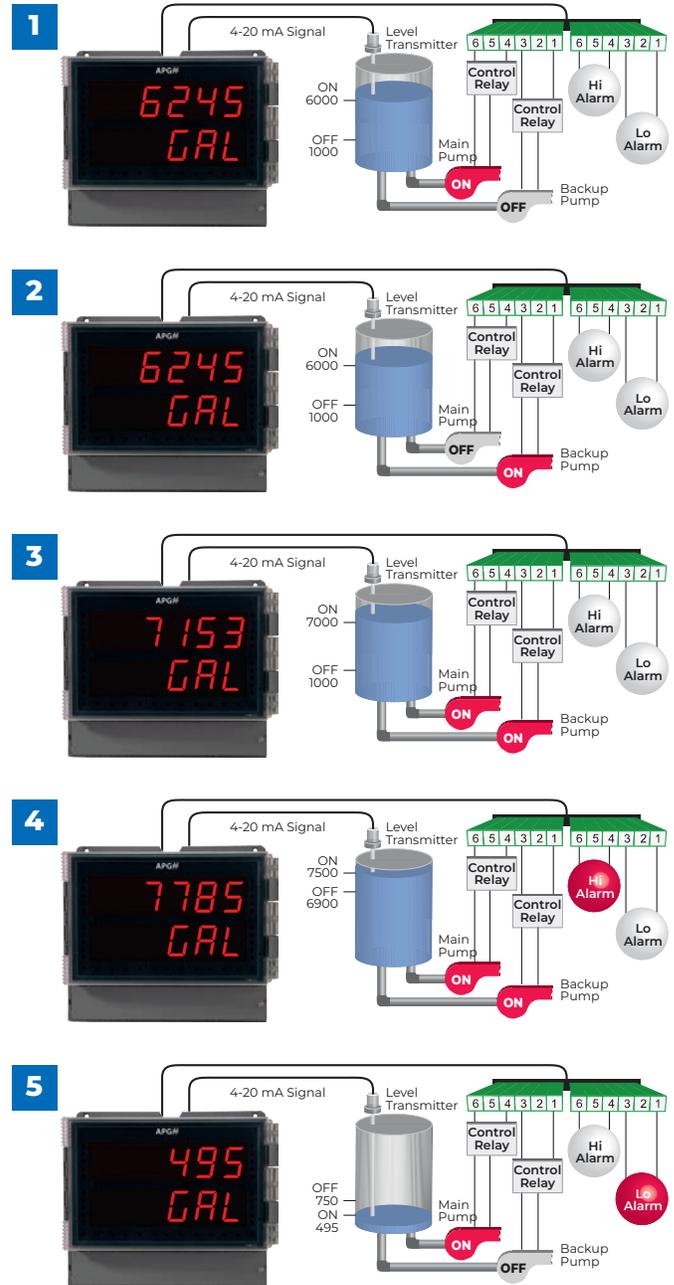
# SIGNAL INPUT CONDITIONING

There are many applications in the industrial world that can't be satisfied with simple, two-point linear scaling so the DDL has advanced linearization capabilities to handle applications like round horizontal tank volume measurement, open channel flow, DP flow, and others. And all of these capabilities are easily programmed using MeterView Pro programming software.

## 32-Point Linearization

The most common way to linearize a non-linear signal is to break it up into smaller ranges that are more linear than the overall range. The DDL is available with up to 32 points of linearization and if dual scale feature is used, the second PV can have up to eight points of linearization. The linearization data can be imported from an Excel spreadsheet or can be exported from MeterView Pro to an Excel spreadsheet. The following screen shot from MeterView Pro shows PV1 with 9 points of linearization and PV 2 with 5 points of linearization:
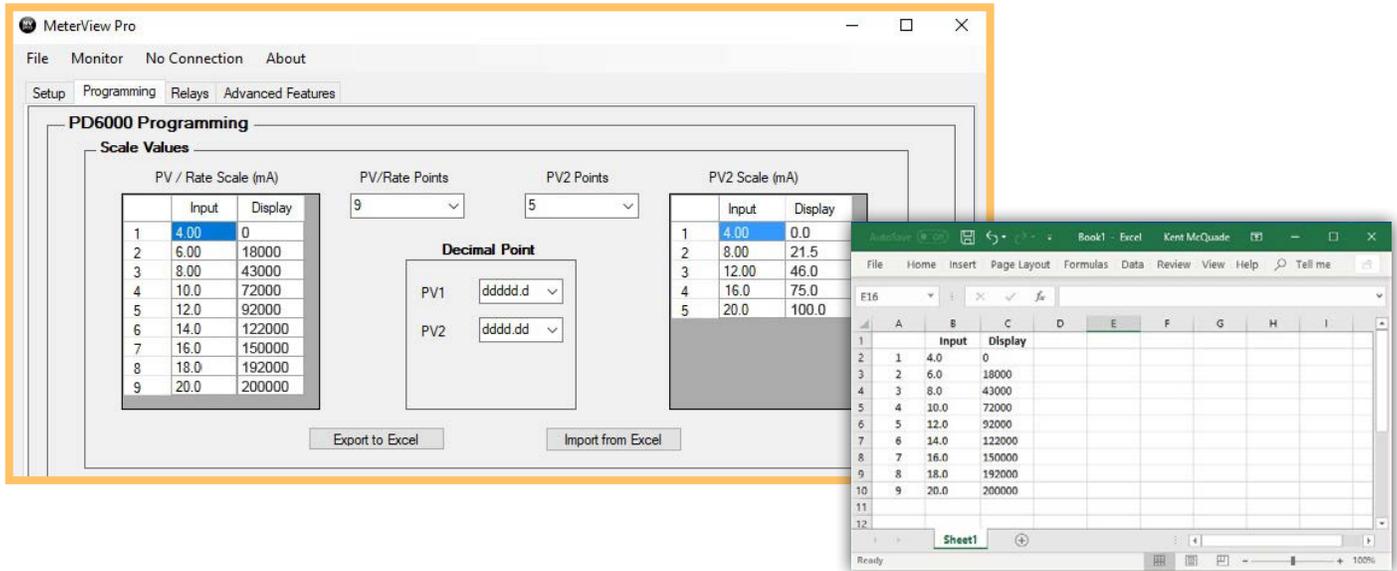


Scale values can also be imported from an Excel spreadsheet.

## Specialized Linearization Functions

In addition to the generic 32- and 8-point linearization functions, the DDL is also available with specialized functions for round horizontal tanks, open channel flow, and DP flow.
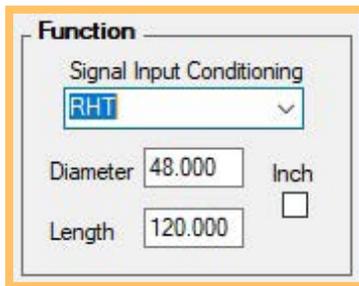
| Round Horizontal Tank | Programmable Exponent | Square Root Extraction |
|---|---|---|
|  |  |  |
| The user enters the diameter and length of a flat-ended round horizontal tank resulting in a display of volume. | The input is raised to an exponent progrmmable by the user resulting in a display of open channel flow rate. | The square root of the input is taken resulting in a display of flow rate. |
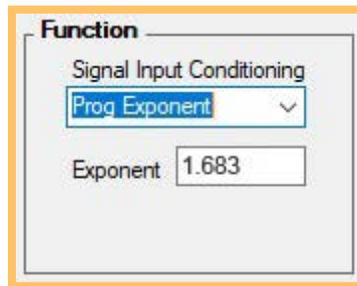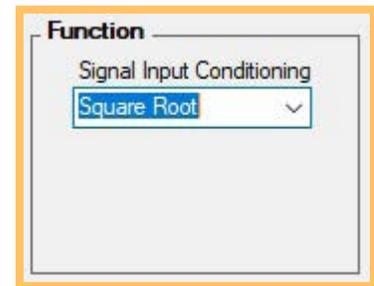
APG

## Round Horizontal Tank Volume Linearizer
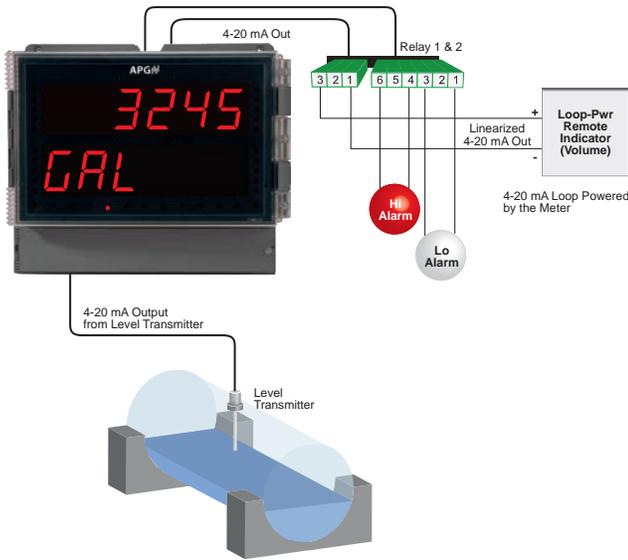


In this application, a level sensor is measuring the height in the round horizontal tank and the DDL is converting that signal to volume using the RHT function. All the user has to do is input the diameter and length of the tank and the meter converts the signal to volume.

## DP Flow via Square Root Extraction
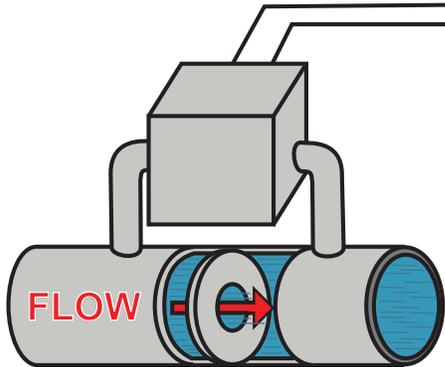


In this application, the DDL is displaying flow rate by extracting the square root from the 4-20 mA signal from a differential pressure transmitter. The user selectable low-flow cutoff feature gives a reading of zero when the flow rate drops below a user selectable value.

## Linear 4-20 mA Analog Output

For applications where the input was linearized by the DDL, the 4-20 mA output will represent that linearized value.

## Open Channel Flow Rate Indication



In this application, a level sensor is measuring the height in a weir and the DDL is converting that signal to flow rate using the programmable exponent function. All the user has to do is input the corresponding exponent for their weir and the meter will convert the signal to flow.

The following information is required for programming the DDL for open channel flow rate:

1. The exponent value associated with the flow calculation for the specific weir or flume being used.

2. The zero head, or water depth, mA value from the level transmitter.

3. The mA value from the transmitter for the maximum head, and the flow rate at that level. The level transmitter is normally programmed to provide 20 mA at the maximum head value and flow rate.

**Example:**

A 120° V-notch weir flow formula for millions of gallons per day is shown below.

$$MGD = 2.798 \, H^{2.5}$$

The exponent component is 2.5.

The level transmitter has been programmed so that at zero head, when the water level is at the base of the V-notch, the output is 4 mA.

The level transmitter has been programmed so that at the top of the V-notch, at 2.00 ft, the output is 20 mA.[1]

The coefficient of the flow equation (2.798 in the above example), is not needed for programming the meter; the scaling function of the meter incorporates the coefficient and the head height automatically.

1. Isco Open Channel Flow Measurement Handbook, Sixth Edition, ed. Diane K. Walkowiak, M.A. (Teledyne Isco, Inc., 2006), 168-169.

**APG**

# DIGITAL COMMUNICATIONS

## Modbus RTU Serial Communications

With the purchase of a serial communication adapter, DDL meters can communicate with any Modbus Master device using the ever-popular Modbus communications protocol that is included in every meter. In addition to the typical Modbus capabilities of reading PVs and writing set points, below are some examples of other things that can be done with the meter's Modbus communications:

- Send a 6-character message to lower display upon an event
- Convert a digital value to a 4-20 mA signal
- Remote user control (i.e. change set points, acknowledge alarms)
- Input a Modbus digital PV (in place of analog input)
- Remote override of any or all relays and analog outputs

Modbus PV Input                    Remote Message

## Additional Communication Modules

In addition to RS-485 communications which is a standard feature, the DDL is available with serial communications modules for RS-232 and USB.

**PDA7485-I**
RS-232 to
RS-422/485
Isolated
Converter

**PDA8485-I**
USB to
RS-422/485
Isolated
Converter

*All adapters and connectors supplied with appropriate cables.

# ON-BOARD DIGITAL INPUTS AND OUTPUTS

The DDL includes five (5) digital inputs and four (4) digital outputs standard. Since the DDL is a large display meter it is often mounted in areas where it is not convenient to access the programming buttons. The digital inputs can be set up to mimic the four programming buttons on the DDL meter, thus making it possible to mount remote buttons for programming in a more convenient location. In addition, the digital inputs can also be used to reset the total, operate the tare feature, reset the tare, and more. The digital outputs can be used to drive alarming devices or as a means to communicate alarm conditions with a PLC.

4 Digital Inputs          F4 Terminal for
& 4 Digital Outputs        Digital Input
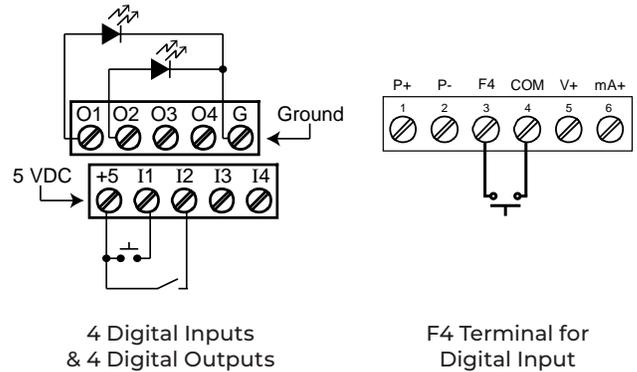
See page 18 for more details on what can be done with the digital inputs and outputs.

APG

# PHYSICAL FEATURES

The most striking physical feature of the DDL is its dual-line 6-digit display with 1.8" high super-bright LEDs. These allow the display to be read from up to 100 feet away, even in bright sunlight.

The DDL is designed for ease-of-use in industrial applications where it will be exposed to wet, dusty, hot, cold and other adverse conditions. The DDL is housed in a rugged NEMA 4X enclosure, can operate over a wide temperature range, includes removable screw terminal connectors, and is UL Listed for electrical safety. All of these features are backed by a 3-year warranty.

## Super-Bright 1.8" High LED Display

The DDL features super-bright 1.8" high LEDs; three times the height of standard digital panel meters.



1.8"
46 mm

0.6"
15 mm

**Standard Panel Meter**

**DDL Large Display**

## Type 4X / NEMA 4X Front Panel

Not only does the DDL's front panel UL Type 4X approval indicate it is waterproof, but it also indicates it is rugged. Part of the UL Type 4X test is to drop a 2 inch solid stainless steel ball from 8 feet on top of the meter's cover.

**APG**®

## Integral Holes for Wall Mounting

The DDL's back panel includes four holes for convenient wall mounting.
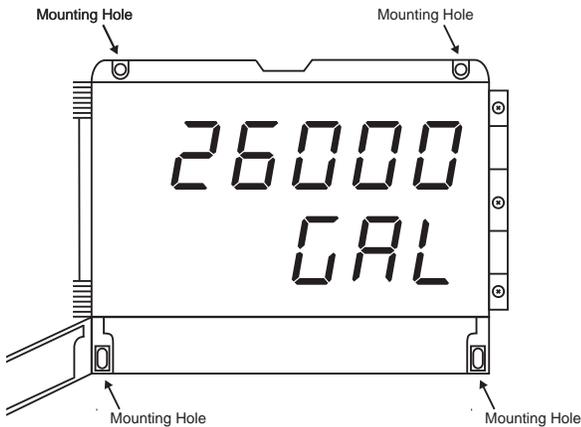


Integral Holes Locations

## Pipe Mounting Kit

The meter can also be mounted to a pipe using the optional pipe mounting kit (PDA6260). This kit includes two mounting plates, two U-bolts, and the necessary nuts and bolts. See DDL manual for instructions.
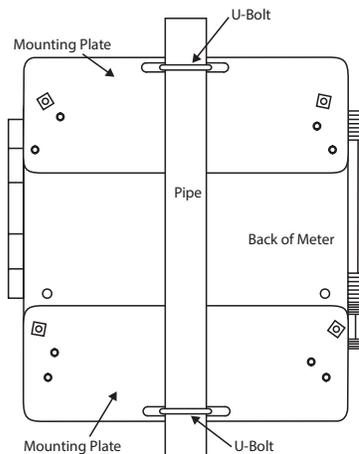


Vertical Pipe Mounting
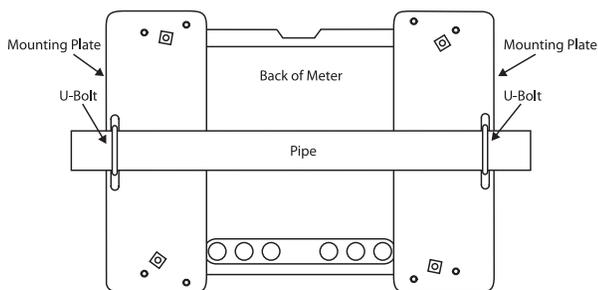


Horizontal Pipe Mounting

## USB Port for Easy Connection to MeterView Pro Free Software



## Wide Operating Temperature Range

The DDL can operate from -40 to 65°C (-40 to 149°F) meaning it can be installed in a wide variety of indoor and outdoor industrial applications. And over this range the DDL will drift no more than 0.005% of calibrated span/°C max from 0 to 65°C ambient and 0.01% of calibrated span/°C max from -40 to 0°C ambient.

## Removable Screw Terminal Connectors

Industrial applications require screw terminal connections for easy field wiring and the DDL goes one step further in convenience by also making them removable.

## UL Listing for Electrical Safety

**UL & C-UL Listed:** USA & Canada
UL 508 Industrial Control Equipment
**UL File Number:** E160849
**Front Panel:** UL Type 4X, NEMA 4X, IP65
**Low Voltage Directive:**
EN 61010-1. Safety requirements for measurement, control, and laboratory use.

APG®

# OPERATIONAL FEATURES

## Function Keys, F4 Terminal, Digital Inputs

There are two ways the user can interact with the DDL to perform a variety of useful functions:

### 1. Three Function Keys Under the Front Cover

The default settings for the function keys are:

| ▶ F1 | ▲ F2 | ↵ F3 |
|---|---|---|
| Reset Max/Min Reading | Display Max/Min Reading | Acknowledge Relays |

### 2. Built-in Digital Inputs/Outputs

The DDL comes with five digital inputs and four digital outputs. The digital inputs can operate with the tare, reset tare, or interlock relays feature, force relays on from a signal from a PLC or relay on other equipment, and much more. The digital inputs can also be used to mimic the programming buttons, which are located behind a door and generally not accessible during operation. The digital outputs can be used to send signals to PLCs and other devices.
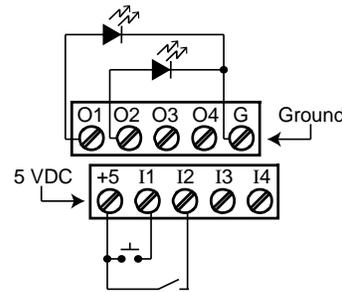


4 Digital Inputs & 4 Digital Outputs
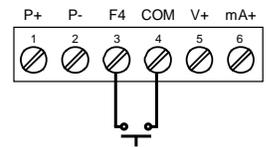
F4 Terminal for Digital Input

The digital inputs are particularly useful for resetting the relays and a reset button is mounted on the DDL door as shown below:



Reset Button

**APG**

## Function Key, Digital Inputs, & Digital Outputs Descriptions

The following table describes the actions that the function keys and digital inputs can be programmed to perform. The table also describes how the digital outputs can be used to remotely monitor the meter's alarm relay states, or the states of a variety of actions and functions executed by the meter.

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

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

FK: Function Keys          DI: Digital Inputs          DO: Digital Outputs

**APG**®

## Remote Operation of Front Panel Buttons

The DDL's programming buttons are located behind a door and generally not accessible during operation. Digital inputs are provided that can be wired to remote buttons to operate the programming buttons in a convenient location. MeterView Pro provides an easy way to do this programming:
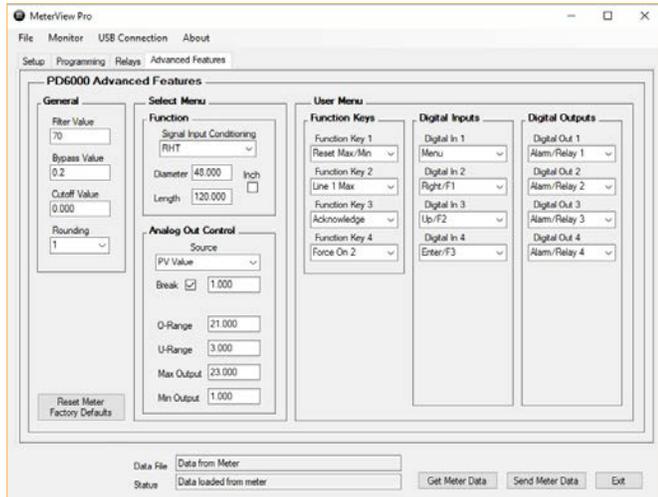


## Tare

The tare function zero's out the display. In the case of scale weight, tare is used to eliminate container weight and provide net weight readings. There are two tare functions; Capture Tare and Reset Tare. When the capture tare function is used, the display reading is offset by the displayed amount to make the displayed value zero. This modified display value is the net value. The originally displayed value without the tare offset is the gross value. Both may be chosen as a display option. Reset tare removes the display offset.



| Before tare | After capture tare | After reset tare |
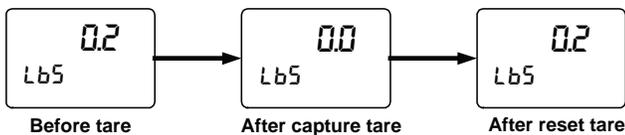
Reset tare removes the display offset of the net value, and the gross and net values become the same until a new capture tare is entered.

## Max / Min Display

Max/Min (or Peak/Valley) is standard on the DDL series meter. Either display can be configured to show either maximum or minimum excursion since last reset. The displays can also be configured to toggle between Max and Min values. Both values can be simply reset from the front panel.

## MeterView Pro Monitoring & Datalogging Software

Not only does free MeterView Pro software greatly simplify setup and programming of the meter, it can also be used to monitor and datalog your process.
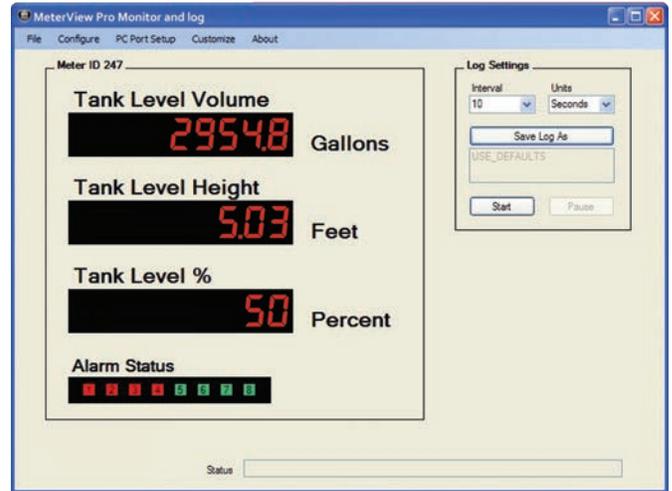


- Custom Tags: i.e. Tank Level Volume
- Custom Units: i.e. Gallons, Feet, Percent
- Alarm Status Indicators

### Datalog Report

Collected data logger information can be sent to a CSV file for importing into a spreadsheet program. Below is an example of one such file. Of course, once within the spreadsheet, much can be done to customize the data.



### Relay Control

Relays can be controlled from MeterView Pro for testing purposes. This is commonly done to determine whether the relays are functioning properly. In the **Setup** window, under **Relay and Digital Out Test** you have the option of selecting the relays you want in an ON state or OFF state and also whether you want to leave the relays in manual control or to return them to automatic operation.

APG

# DIMENSIONS

## Front and Side View

Units: Inches (mm)

Mounting Hole          Mounting Hole

4.77
(121.2)

**26000**
**GAL**

10.63
(270)

Connection
Cover Screw

12.59
(319.7)

Front View

2.63
(67)

Side View
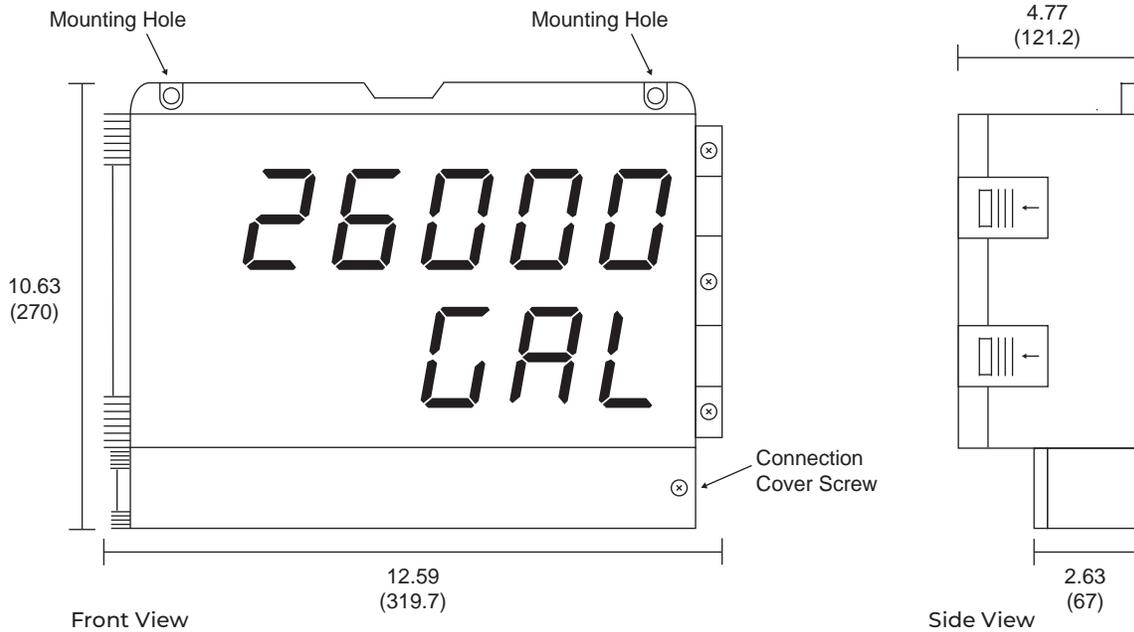
## Wall Mounting Holes Location

10.43
(265)

9.8
(249)

11.14
(283)

## Conduit Holes Location

0.744 (18.9)
Drill or Punch-Out Holes
(4 Places)

Plugged
Holes

Unplugged
Holes

Bottom View

# CONNECTIONS

MA OUT    RELAY1    RELAY2    RELAY3    RELAY4

R   I+   I-    1    2    3    4    5    6    1    2    3    4    5    6
              C   NC   NO   C   NC   NO   C   NC   NO   C   NC   NO

P+/P-
24V 10V 5V

SIGNAL
1    2    3    4    5    6
P+   P-   F4   COM  V+  mA+

~
+    -
POWER

RS-485
RX
TX
PWR

DIGITAL I/O

-         +

4-20 mA
Output
Powered
by meter

MENU  RIGHT   UP    ACK

MENU   F1      F2    F3
       RESET   MAX   ENTER

· Two isolated supplies available even
  on 12/24 VDC input power models
· Removable terminal blocks
· Four (4) form C (SPDT) relays +
  isolated 4-20 mA output option
· Digital Inputs and Outputs +
  RS485 serial communication

+              -

Meter provides
24 VDC power
to the
transmitter

· Universal 85-265 VAC or
  12/24 VDC input power
· Voltage or current inputs
· No jumpers needed for
  V/mA input selection
· Onboard USB for
  PC connection

USB

M-LINK
1
2
3
4
5
6
7
8

**Connector Labeling for Fully Loaded DDL**

**APG**®

# SPECIFICATIONS

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

## General

| | |
|---|---|
| Display | Dual-line: 1.8" (46 mm) high, red LEDs |
| | 6 digits per line (-99999 to 999999), with lead zero blanking |
| Display Intensity | Eight user selectable intensity levels. Default value is six. |
| Display Update Rate | 5/second (200 ms) |
| Overrange | Display flashes 999999 |
| Underrange | Display flashes -99999 |
| Display Assignment | Display Line 1: PV1, PV2, PCT, PV & units, gross weight, net & gross weight, max/min, max & min, set points, or Modbus input. |
| | Display Line 2: Same as Display Line 1; plus units, tag or turned off. |
| 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. |
| Rounding | Select 1, 2, 5, 10, 20, 50, or 100 (e.g. rounding = 10, value = 123.45, display = 123.50). |
| Tare | Tare function zeros out the meter to remove the for weight of a container. Tare function can be assigned to a function key, F4 terminal, or a digital input. |
| Password | Three programmable passwords restrict modification of programmed 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. |
| Non-Volatile Memory | All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost. |
| Power Options | 85-265 VAC 50/60 Hz; 90-265 VDC, 20 W max; 12-24 VDC, 12-24 VAC, 15 W max. Powered over USB for configuration only. |
| 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 | Operating temperature range: -40 to 65°C (-40 to 149°F) |
| | Storage temperature range: -40 to 85°C (-40 to 185°F) |
| | Relative humidity: 0 to 90% non-condensing |
| | Note: Printed circuit boards are conformally coated. |
| Connections | Power, signal, relays, mA out: Removable screw terminal blocks accept 12 to 22 AWG wire. |
| | RS-485: Removable screw terminal block accepts 16 to 30 AWG wire. |
| | Digital I/O: Non-removable screw terminal blocks accept 16 to 30 AWG wire. |
| Enclosure | UL Type 4X, IP65 rated. Polycarbonate & glass blended plastic case, color: gray. Includes four PG11 through-hole conduit openings, with two factory installed PG11, IP68, black nylon threaded hole plugs with backing nuts. |
| Mounting | Wall Mounting: Four (4) mounting holes provided for mounting meter to wall. |
| | Pipe Mounting: Optional pipe mounting kit (PDA6260) allows for pipe mounting. Sold separately. |
| Tightening Torque | Power, signal, relays, mA out terminals: 5 lb-in (0.56 Nm) |
| | Digital I/O and RS-485: 2.2 lb-in (0.25 Nm) |
| Overall Dimensions | 10.63" x 12.59" x 4.77" (270 mm x 319.7 mm x 121.2 mm) (W x H x D) |
| Weight | 6.10 lbs (2.76 kg) |
| Warranty | 3 years parts & labor. See Warranty Information and Terms & Conditions on www.apgsensors.com for complete details. |

## Process Input

| | |
|---|---|
| Inputs | Field selectable: 0-20 mA, 4-20 mA ±10 V (0-5 V, 1-5 V, 0-10 V) Modbus PV (Slave) |
| Isolated Transmitter Power Supply | Terminals P+ & P-: 24 VDC ±10%. |
| | All models selectable for 24, 10, or 5 VDC supply (internal jumper J4). 85-265 VAC models rated @ 200 mA max, 12-24 VDC powered models rated @ 100 mA max. |
| | 5 & 10 VDC supply rated @ 50 mA max. |
| Accuracy | ±0.03% of calibrated span ±1 count, square root & programmable exponent accuracy range: 10-100% of calibrated span |
| Temperature Drift | 0.005% of calibrated span/°C max from 0 to 65°C ambient, 0.01% of calibrated span/°C max from -40 to 0°C ambient |
| Input Signal Conditioning | Linear, square root, programmable exponent, or round horizontal tank volume calculation |

**APG**

| | |
|---|---|
| Multi-Point Linearization | 2 to 32 points for PV or PV1<br>2 to 8 points for PV2 (Dual-scale Level feature) |
| Programmable Exponent | User selectable from 1.0001 to 2.9999 for open channel flow |
| Round Horizontal Tank | Diameter & Length: 999.999 inch or cm calculates volume in gallons or liters respectively. |
| Low-Flow Cutoff | 0.1 to 999,999 (0 disables cutoff function). Point below at which display always shows zero. |
| Decimal Point | Up to five decimal places or none:<br>**d.ddddd**, **d.dddd**, **d.ddd**, **d.dd**, **d.d**, or **dddddd** |

| Calibration Range | Input Range | Minimum Span Input 1 & 2 |
|---|---|---|
| | 4-20 mA | 0.15 mA |
| | ±10 V | 0.10 V |
| | 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 internal resettable fuse impedance) |
| Input Overload | Current input protected by an internal resettable fuse, 30 VDC max. Fuse resets automatically after fault is removed. |
| HART Transparency | The meter does not interfere with existing HART communications; it displays the 4-20 mA primary variable and it allows the HART communications to pass through without interruption. The meter is not affected if a HART communicator is connected to the loop. The meter does not display secondary HART variables. |

## Relays

| | |
|---|---|
| Rating | 2 or 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. |
| Deadband | 0-100% of span, user programmable |
| High or Low Alarm | User may program any alarm for high or low trip point. Unused alarm LEDs and relays may be disabled (turn off). |
| Relay Operation | Automatic (non-latching), latching (requires manual acknowledge) with/without clear, sampling (based on time), pump alternation control (2 to 4 relays), Off (disable unused relays and enable interlock feature, manual on/off control mode). |
| Relay Reset (Acknowledge) | User selectable via front panel buttons or digital inputs.<br>1. Automatic reset only (non-latching), when input passes the reset point.<br>2. Automatic + manual reset at any time (non-latching).<br>3. Manual reset only, at any time (latching).<br>4. Manual reset only after alarm condition has cleared (latching).<br>Note: Front panel button or digital input may be assigned to acknowledge relays programmed for manual reset. |

| | |
|---|---|
| Time Delay | 0 to 999.9 seconds, on & off relay time delays. 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 |

## Isolated 4-20 mA Transmitter Output

| | |
|---|---|
| Output Source | Process variable (PV), max, min, set points 1-4, Modbus input, or manual control mode |
| Scaling Range | 1.000 to 23.000 mA for any display range |
| Calibration | Factory calibrated:<br>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,<br>0.8 µA/°C max from -40 to 0°C ambient<br>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. All models rated @ 40 mA 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 |

| | |
|---|---|
| Additional 4-20 mA Outputs | The PD659-1MA-2MA can split the optional 4-20 mA output into two isolated 4-20 mA outputs |
| 0-10 VDC Output | The PD659-1MA-1V can convert the optional 4-20 mA output to a 0-10 VDC output |

## USB Connection

| | |
|---|---|
| Function | Programming only |
| Compatibility | USB 2.0 Standard, Compliant |
| Connector Type | Type B receptacle |
| Cable | USB Type A-B cable |
| Driver | Microsoft® Windows® 10/11 |
| Power | USB port provides power to the meter. <u>DO NOT</u> apply AC or DC power to the meter while the USB port is in use. |

## RS-485 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) |

**APG**®

## Digital Input (F4)

| | |
|---|---|
| Function | Remote operation of front-panel buttons, acknowledge/reset relays, reset max/min values. |
| Contacts | 3.3 VDC on contact. Connect normally open contacts across F4 to COM. |
| Logic Levels | Logic High: 3 to 5 VDC<br>Logic Low: 0 to 1.25 VDC |

## Modbus RTU Serial Communications

| | |
|---|---|
| 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 DDL Modbus Register Tables located at www.apgsensors.com for details.

## MeterView Pro Software

| | |
|---|---|
| Availability | Download from www.apgsensors.com |
| System Requirements | Microsoft® Windows® 10/11 |
| Communications | USB 2.0 (for programming only)<br>(Standard USB A to USB Type B)<br><br>RS-485 to USB converter<br>(programming, monitoring, and data logging) |
| Configuration | Configure meters one at a time |
| Power | USB port provides power to the meter.<br><u>DO NOT</u> apply AC or DC power to the meter while the USB port is in use. |

## Digital Inputs & Outputs

| | |
|---|---|
| Function | Terminals provided for remote operation of all four programming / operation buttons (use PDA2364-MRUE control station).  Other uses include acknowledge/reset relays and reset max/min values. |
| Channels | 4 digital inputs & 4 digital outputs |
| Digital Input Logic | **High:** 3 to 5 VDC<br>**Low:** 0 to 1.25 VDC |
| Digital Output Logic | **High:** 3.1 to 3.3 VDC<br>**Low:** 0 to 0.4 VDC |
| Source Current | 10 mA maximum |
| Sink Current | 1.5 mA minimum |
| +5 V Terminal | To be used as pull-up for digital inputs only. Connect normally open push buttons across +5 V & DI 1-4. |

## 4-Relay Expansion Module

| | |
|---|---|
| Relays | Four Form A (SPST) rated 3 A @ 30 VDC and 125/250 VAC resistive load; 1/14 HP (≈ 50 watts) @ 125/250 VAC for inductive loads. |

## 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<br>Safety requirements for measurement, control, and laboratory use |

## EU Declaration of Conformity

For reference, a Declaration of Conformity is available at www.apgsensors.com

**APG**®

# ORDERING INFORMATION

| DDL Standard Display Models | | |
|---|---|---|
| **85-265 VAC Model** | **12-24 VDC Model** | **Options Installed** |
| DDL-A00 | DDL-D00 | No options |
| DDL-D00 | DDL-D14 | 4 Relays & 4-20 mA Output |
| Note: 24 V Transmitter power supply standard on all models. | | |

| Accessories | |
|---|---|
| **Model** | **Description** |
| MOD-PD2LHRB1 | Red(2) Light / Horn / 1 Reset Button Mounted & Wired to DDL(1) |
| PDA-BUTTON1R | Reset Button |
| PDA-LHR | Red(2) Light / Horn |
| PDA1024-01 | 24 VDC Transmitter Power Supply |
| PDA1002 | 6" DIN Rail Mounting Kit |
| PDA6260 | Pipe Mounting Kit |
| PDA7485-I | RS-232 to RS-422/485 Isolated Converter |
| PDA8485-I | USB to RS-422/485 Isolated Converter |
| PDAPLUG2 | Plastic Conduit Plug |
| PDX6901 | Suppressor (snubber): 0.01 µF/470 Ω, 250 VAC |

1. Instruments supplied with MOD-PD2LH will not include UL or C-UL marking and the transmitter power supply has less than 200 mA to power the transmitter when it is also powering the Light / Horn. See Transmitter Power Supply specification on MOD-PD2LH manual for details.
2. For other light color options see the MOD-PD2LH manual (LIMMODPD2LH).

| PDA2360 Series Control Stations | |
|---|---|
| **Model** | **Description** |
| PDA2360-E | Emergency Stop Button |
| PDA2361-A | 1 Black Ack Button |
| PDA2361-Q | 1 Black Silence Button |
| PDA2364-MRUE | 4 Black Buttons: Menu, Right, Up, Enter |

**Your Local Distributor is:**

## Disclaimer

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

**APG**