

# PD9000 ConsoliDator+ Multivariable Controller

## Instruction Manual



- NEMA 4X Panel Mount Multi-Channel Controller
- Convenient Display, Control, & Alarm of Multiple 4-20 mA & Pulse Inputs
- Numeric & Bargraph Color Display (320 x 240 px) 5.7" (145 mm)
- Sunlight Readable Display, White Backlight
- Isolated 24 VDC Transmitter Supplies 200 mA / Analog Input; 1,600 mA Max
- 99 Channels, 32 Totalizers, 32 Timers, & 199 Modbus Slave Inputs
- 64 High & Low Alarms, Combine Multiple Alarms Into Logic AND & OR Alarms
- Simulation & Manual Control Modes for Testing Setup
- Modular Design for Input & Output Flexibility
- Up to (28) 4-20 mA Isolated Inputs or Pulse Inputs
- Up to (25) 10 Amp Form C Relays (With Eight Analog or Pulse Inputs)
- Up to (25) Isolated 4-20 mA Outputs (With Eight Analog or Pulse Inputs)
- Operating Temperature Range: -40 to 60°C (-40 to 140°F)
- Pulse, Analog, & Modbus Input Flow Rate / Total / Grand Total Capability
- 50-Point Linearization, Square Root, and Exponent for Open Channel Flow
- Round Horizontal Tank Volume Calculation; Just Enter Diameter & Length
- Multi-Pump Alternation Control or Simple On / Off Control
- Programmable Displays, Function Keys & Digital Inputs
- Math Functions: Sum, Diff, Average, Multiply, Divide, % Efficiency, & More
- Direct Modbus PV Inputs - Slave Mode
- Customize Modbus Outputs to Read Multiple Registers in One Block
- RS-485 Serial Communication with Modbus RTU
- Field Selectable Input Power: 85-264 VAC or 24 VDC
- (20) Screens with up to Eight PVs Each
- Automatic or Manual Scanning
- ConsoliDator+ Configuration Software
- NEMA 4 Field Mount Enclosure Accessory
- Light / Horn & Control Station Accessory for Remote Operation
- 3-Year Warranty



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**CAUTION**

- Read complete instructions prior to installation and operation of the controller.

**WARNINGS**

- Risk of electric shock or personal injury.
- This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Precision Digital Corporation shall not be held liable for damages resulting from such improper use.

**WARNING****Limited Warranty**

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**FREE ConsoliDator+ Configuration Software**

The easiest and quickest way to program your ConsoliDator+ multivariable controller is to use the FREE ConsoliDator+ configuration software.

The ConsoliDator+ configuration software is intuitive, and most customers can get their controller programmed as they like without even looking in the manual.

Once your controller is programmed the way you want it, you can wire it up for your application per the instructions in this manual and install it. If you find that you need to adjust the programming after the controller is installed, you can use the front panel soft keys and the instructions in this manual to do so.

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## Introduction

The ConsoliDator+ is a multi-channel controller that is both easy to use and satisfies a wide variety of process display, alarm, and control applications. It accepts 4-20 mA inputs, flow meter pulse inputs, digital inputs, and Modbus RTU inputs and displays them both in numeric and bargraph format on a large, 5.7" color display. It can be equipped with multiple relays with user-definable actions, 4-20 mA outputs, digital outputs, Modbus RTU, and Ethernet Modbus TCP/IP protocol communication capabilities. Additionally, the controller is equipped with up to 32 timers that can be used to control many processes or events.

The ConsoliDator+ takes full advantage of its color display by allowing the user to customize screen colors for bargraphs, alarm conditions, and input channels.

All this functionality is easily programmed using free software or via the front panel pushbuttons. Choose the model that best suits your application, from monitoring only to fully loaded controllers with an extensive combination of inputs, outputs and communication protocols. The standard product offering is listed in the ordering guide and other models are available for special order.

## Ordering Information

| General Purpose Panel-Mount Models |              |                |                 |        |
|------------------------------------|--------------|----------------|-----------------|--------|
| Model                              | Pulse Inputs | 4-20 mA Inputs | 4-20 mA Outputs | Relays |
| PD9000-GP-4AI                      | 0            | 4              | 0               | 0      |
| PD9000-GP-4AI-10RY                 | 0            | 4              | 0               | 10     |
| PD9000-GP-4AI-5AO-10RY             | 0            | 4              | 5               | 10     |
| PD9000-GP-4AI-20RY                 | 0            | 4              | 0               | 20     |
| PD9000-GP-4AI-5AO-20RY             | 0            | 4              | 5               | 20     |
| PD9000-GP-8AI                      | 0            | 8              | 0               | 0      |
| PD9000-GP-8AI-10RY                 | 0            | 8              | 0               | 10     |
| PD9000-GP-8AI-10AO-10RY            | 0            | 8              | 10              | 10     |
| PD9000-GP-8AI-20RY                 | 0            | 8              | 0               | 20     |
| PD9000-GP-8AI-25RY                 | 0            | 8              | 0               | 25     |
| PD9000-GP-12AI                     | 0            | 12             | 0               | 0      |
| PD9000-GP-12AI-20RY                | 0            | 12             | 0               | 20     |
| PD9000-GP-12AI-10AO-10RY           | 0            | 12             | 10              | 10     |
| PD9000-GP-16AI                     | 0            | 16             | 0               | 0      |
| PD9000-GP-16AI-15RY                | 0            | 16             | 0               | 15     |
| PD9000-GP-16AI-15AO                | 0            | 16             | 15              | 0      |
| PD9000-GP-20AI                     | 0            | 20             | 0               | 0      |
| PD9000-GP-20AI-10RY                | 0            | 20             | 0               | 10     |
| PD9000-GP-20AI-10AO                | 0            | 20             | 10              | 0      |
| PD9000-GP-24AI                     | 0            | 24             | 0               | 0      |
| PD9000-GP-24AI-5RY                 | 0            | 24             | 0               | 5      |
| PD9000-GP-24AI-5AO                 | 0            | 24             | 5               | 0      |
| PD9000-GP-28AI                     | 0            | 28             | 0               | 0      |
| PD9000-GP-4PI                      | 4            | 0              | 0               | 0      |
| PD9000-GP-4PI-5AO                  | 4            | 0              | 5               | 0      |
| PD9000-GP-4PI-5AO-10RY             | 4            | 0              | 5               | 10     |
| PD9000-GP-4PI-4AI-5AO              | 4            | 4              | 5               | 0      |
| PD9000-GP-4PI-4AI-5AO-10R          | 4            | 4              | 5               | 10     |
| PD9000-GP-4PI-8AI-10AO-10RY        | 4            | 8              | 10              | 10     |
| PD9000-GP-8PI                      | 8            | 0              | 0               | 0      |
| PD9000-GP-8PI-10AO                 | 8            | 0              | 10              | 0      |
| PD9000-GP-8PI-10AO-10RY            | 8            | 0              | 10              | 10     |
| PD9000-GP-8PI-8AI-10AO-5RY         | 8            | 8              | 10              | 5      |

G = General Purpose  
P = Panel-Mount  
AI = Analog Input  
PI = Pulse Input

AO = Analog Output  
RY = Relay  
E = Ethernet (Add "-E" at the end of the model number)  
Example: PD9000-GP-4PI-8AI-10AO-10RY-E

Other models are available upon request.

## Input / Output Cards

| Model        | Description                                         |
|--------------|-----------------------------------------------------|
| PDA9000-C4AI | (4) Isolated 4-20 mA Inputs Card for ConsoliDator+  |
| PDA9000-C4PI | (4) Pulse Inputs Card for ConsoliDator+             |
| PDA9000-C5AO | (5) Isolated 4-20 mA Outputs Card for ConsoliDator+ |
| PDA9000-C5RY | (5) Relays Card for ConsoliDator+                   |

## Setup & Calibration Services

| Part Number        | Description                                                                         |
|--------------------|-------------------------------------------------------------------------------------|
| PDN-CALCON+12      | ConsoliDator+ Calibration and Certificate for up to 12 Inputs and Outputs           |
| PDN-CALCON+24      | ConsoliDator+ Calibration and Certificate for up to 24 Inputs and Outputs           |
| PDN-CALCON+36      | ConsoliDator+ Calibration and Certificate for up to 36 Inputs and Outputs           |
| PDN-CALCON+12-DATA | ConsoliDator+ Calibration and Certificate with data for up to 12 Inputs and Outputs |
| PDN-CALCON+24-DATA | ConsoliDator+ Calibration and Certificate with data for up to 24 Inputs and Outputs |
| PDN-CALCON+36-DATA | ConsoliDator+ Calibration and Certificate with data for up to 36 Inputs and Outputs |
| PDN-CSETCON+       | Custom Setup for ConsoliDator+                                                      |

## Accessories

### NEMA 4 Steel Enclosure



| Model                   | Description                                  |
|-------------------------|----------------------------------------------|
| <a href="#">PDA2909</a> | NEMA 4 Steel Enclosure for One ConsoliDator+ |

### PDA9000SH Sun Hood



| Model                     | Description            |
|---------------------------|------------------------|
| <a href="#">PDA9000SH</a> | ConsoliDator+ Sun Hood |

### Light / Horn Accessories



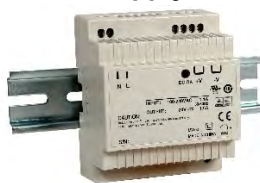
| Model                         | Description                                                              |
|-------------------------------|--------------------------------------------------------------------------|
| <a href="#">PDA-LHR</a>       | Red Light / Horn                                                         |
| <a href="#">PDA-LHG</a>       | Green Light / Horn                                                       |
| <a href="#">PDA-LHY</a>       | Yellow Light / Horn                                                      |
| <a href="#">PDA-LHB</a>       | Blue Light / Horn                                                        |
| <a href="#">PDA-LHW</a>       | White Light / Horn                                                       |
| <a href="#">PDA-LH5C</a>      | Light / Horn with User Choice of Red, Green, Yellow, Blue or White Light |
| <a href="#">PDA-LH3LC-RYG</a> | Light / Horn with Red, Yellow, Green Light Layers                        |

**PDA2360 Control Stations**

| Model                     | Description            |
|---------------------------|------------------------|
| <a href="#">PDA2360-E</a> | Emergency Stop Button  |
| <a href="#">PDA2361-A</a> | 1 Black Ack Button     |
| <a href="#">PDA2361-Q</a> | 1 Black Silence Button |

**Signal Splitter & Conditioner Accessories**

| Model                         | Description                                                       |
|-------------------------------|-------------------------------------------------------------------|
| <a href="#">PD659-1MA-1MA</a> | Signal Isolator with One 4-20 mA Input and One 4-20 mA Output     |
| <a href="#">PD659-1MA-2MA</a> | Signal Splitter with One 4-20 mA Input and Two 4-20 mA Outputs    |
| <a href="#">PD659-1V-1MA</a>  | Signal Conditioner with One 0-10 VDC Input and One 4-20 mA Output |
| <a href="#">PD659-1MA-1V</a>  | Signal Conditioner with One 4-20 mA Input and One 0-10 VDC Output |

**PDA1024-01 Power Supply**

| Model                      | Description                      |
|----------------------------|----------------------------------|
| <a href="#">PDA1024-01</a> | 24 VDC Power Supply for DIN Rail |

**Split Core AC Current Transducer**

| Model                   | Description                                                            |
|-------------------------|------------------------------------------------------------------------|
| <a href="#">PDA6420</a> | Split Core AC Current Transducer. Input: 30/60/120 AAC; Output 4-20 mA |

**PDA-BUTTON Momentary Pushbutton**

| Model                        | Description                |
|------------------------------|----------------------------|
| <a href="#">PDA-BUTTON1B</a> | NEMA 4X Black Reset Button |
| <a href="#">PDA-BUTTON1G</a> | NEMA 4X Green Reset Button |
| <a href="#">PDA-BUTTON1R</a> | NEMA 4X Red Reset Button   |

**Panel Mount Buzzer and Light**

| Model                   | Description                  |
|-------------------------|------------------------------|
| <a href="#">PDA1000</a> | Panel Mount Buzzer and Light |

**Snubber 0.01μF/470Ω Flexible Leads**

| Model                   | Description                        |
|-------------------------|------------------------------------|
| <a href="#">PDX6901</a> | Snubber 0.01μF/470Ω Flexible Leads |

**Low-Cost Signal Generator**

| Model                  | Description                                    |
|------------------------|------------------------------------------------|
| <a href="#">PD9502</a> | 4-20 mA or 0-10 VDC, Low-Cost Signal Generator |

### PDA2909 NEMA 4 Steel Enclosure for One ConsoliDator+

The PDA2909 steel NEMA 4 enclosure provides a convenient way to mount the PD9000 ConsoliDator+ to walls and other vertical structures. This enclosure comes pre-cut with one cutout to mount the PD9000 in. The ConsoliDator+ is mounted in the door of the enclosure thus allowing for programming and operation of the device. No additional mounting hardware other than screws to mount to the wall is needed. The door is hinged and secured with latches.

*Note: The enclosure and ConsoliDator+ are ordered and packaged separately.*



PDA2909 with ConsoliDator+ Installed



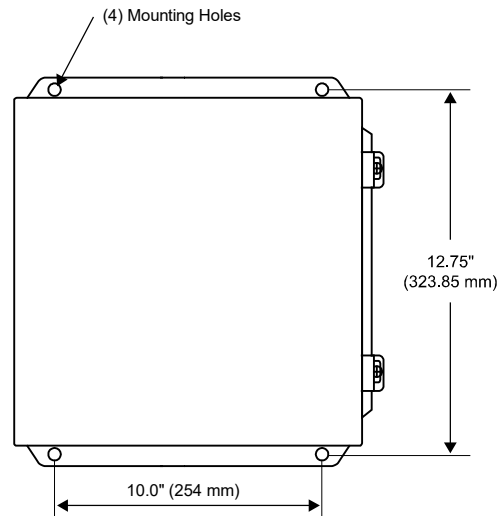
PDA2909 Opened with ConsoliDator+ Installed

### Features

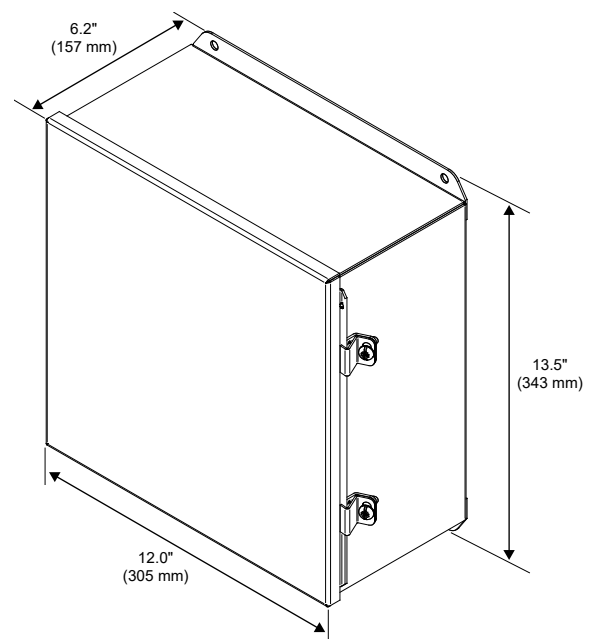
- House One ConsoliDator+ Multi-Variable Controller
- 14-Gauge Steel
- Comes Pre-Cut with One Cutout
- NEMA 4, 12 and 13
- Cover Secured with Screwed Latches
- Hinged Door
- ConsoliDator+ Mounted in Cover
- Mounting Holes Integral to Enclosure
- UL Listed, CSA Certified

### Wall Mounting Dimensions:

The PDA2909 enclosure includes integral mounting flanges at the top and bottom of the enclosure that can be used to mount the enclosures to a wall.



### PDA2909 Overall Dimensions:



## Specifications

Except where noted all specifications apply to operation at 25°C (77°F)

### General

|                                        |                                                                                                                                                                                                                                                                                   |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Display</b>                         | Color; QVGA (320x240 px),<br>5.7" (145 mm) diagonally, white backlight<br>Bargraph: Twenty divisions<br>Numerical: Up to 15 digits<br>(±999,999,999,999,999)<br>Feet & Inches Format: 99,999' 11.9"                                                                               |
| <b>Screen Bargraph</b>                 | Enable/disable: Channels, totals, timers<br>Bargraph scale: 0 – 100%, independent of channel scale. Twenty divisions: 5% each.<br>Screen: Select to show bargraph or not.                                                                                                         |
| <b>Color Selection</b>                 | 65 colors selection<br>Customize bargraph, panel background, and text for normal and alarm conditions.                                                                                                                                                                            |
| <b>Decimal Point</b>                   | 0 to 15 decimal places, user selectable                                                                                                                                                                                                                                           |
| <b>Engineering Units</b>               | User selectable units or custom units<br>Time, Distance, Volume, Pressure, Weight, Temperature, Current, Voltage, Percent, Amps, Volts, Counts, Logic, and Custom, Any unit/unit of time or other units.<br>See page 12 for list of units.                                        |
| <b>Units Conversion</b>                | Units' conversion is supported for channels, totals, timers, and any function using those parameters.<br>Channel scaling must be in the intended base units (e.g. Gallons/min)                                                                                                    |
| <b>Display Update Rate</b>             | User selectable: 0.1 to 0.5 sec<br>(10 updates/sec to 2 updates/sec)                                                                                                                                                                                                              |
| <b>Programming Method</b>              | Front panel buttons, external buttons, or ConsoliDator+ Software                                                                                                                                                                                                                  |
| <b>Number Of Alarms</b>                | Up to 64 high or low<br>Automatic (non-latching) or latching<br>On & Off time delays<br>May be assigned to one or more relays.<br><i>Note: Alarms are independent from relays.</i>                                                                                                |
| <b>Alarm Types</b>                     | Single Source: One input<br>Multi-Source: Two or more inputs<br>Interval: Enter time interval and On Time<br>Day & Time: Select day of the week & time<br>Alarm OR: Any active input alarm triggers the OR alarm<br>Alarm AND: All alarms must be active to trigger the AND alarm |
| <b>Alarm Ack &amp; Reset</b>           | Automatic only (Non-latching)<br>Automatic and manual<br>Manual only (Latching)<br>Manual with Ack only after alarm is cleared (Latching with Clear)                                                                                                                              |
| <b>Alarm Indication</b>                | 1. Bargraph, panel, and text can be set up to change color on alarm<br>2. Enable internal buzzer<br>3. Assign external relay to drive a horn                                                                                                                                      |
| <b>Internal Buzzer</b>                 | 60 dBA @ 24 inches (61 cm)<br>Enable/disable in System – General menu.<br>Associated with alarm Horn setting                                                                                                                                                                      |
| <b>External Horn (Sold Separately)</b> | Assign any relay to the Horn function to activate an external horn when alarm condition is detected.                                                                                                                                                                              |
| <b>Live Channel Calibration</b>        | Live calibration of channels is independent of the input calibration used for scaling.                                                                                                                                                                                            |

|                                        |                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Input &amp; Output Cards</b>        | Max Number of I/O Cards: 7<br>Analog Inputs: 4/card<br>Pulse Inputs: 4/card<br>Analog Outputs: 5/card<br>Relays: 5/card                                                                                                                                                                                                                                |
| <b>Number of Screens</b>               | Up to 20 screens with 1 to 8 PVs or items per screen<br>Enable or disable screen title, channel #, and bargraph<br>Automatic or manual scanning<br>Scan time: 1 to >1000 sec, independent for each screen<br>F1-F4 keys are assigned per screen                                                                                                        |
| <b>Function Keys</b>                   | User programmable (See defaults below)<br>F1 = Previous ←<br>F2 = Next →<br>F3 = Scan/Stop<br>F4 = Ack                                                                                                                                                                                                                                                 |
| <b>Number of Channels</b>              | Up to 99 channels<br>Input Source: 4-20 mA, Pulse, Digital, Modbus, another Channel, Total, Timer, Alarm, Date & Time, mA Output, Relay Output, Digital Output, or Modbus Output                                                                                                                                                                       |
| <b>Password</b>                        | Programmable password restricts modification of programmed settings.<br>View and Setup menus are password protected, function keys and digital inputs are not protected.                                                                                                                                                                               |
| <b>Simulation Mode</b>                 | Inputs, channels, totals, timers, and alarms can be simulated from the View menu or from a function key.<br>Simulation mode is not saved on power down. Alert! message is provided for simulated items.                                                                                                                                                |
| <b>Manual Control</b>                  | Analog outputs and relays can be controlled manually from the View menu or from a function key.<br>Manual control mode is not saved on power down. Alert! message is provided for outputs in manual control.<br><i>Note: If it is necessary to turn relays off and maintain the condition through power cycle, configure the relays to Always Off.</i> |
| <b>Non-Volatile Memory</b>             | Settings stored for a minimum of 10 years.                                                                                                                                                                                                                                                                                                             |
| <b>Power</b>                           | Three-terminal connector (L, N, GND)<br>AC: 80-264 VAC, 47 to 63 Hz, 60 W max<br>DC: 113-370 VDC, 60 W max (L, N)                                                                                                                                                                                                                                      |
| <b>User Selectable Based on Wiring</b> | Two-terminal connector (G, 24V)<br>DC: 24 VDC ±10%, 60 W max                                                                                                                                                                                                                                                                                           |
| <b>Backup Power Supply</b>             | If AC and DC power are connected, the 24 VDC can be used as backup power in case of AC power failure.<br><i>Note: DC supply must be 24 V or less; otherwise the system runs on DC power.</i>                                                                                                                                                           |
| <b>Fuse</b>                            | Unit is protected internally with auto-resettable fuse<br>AC: 1.25 A max<br>DC: 3.7 A max                                                                                                                                                                                                                                                              |

|                                  |                                                                                                                                                                                                                                                                                                                              |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>External Fuse</b>             | Recommended external fuse slow-blow<br>120 VAC: 2.0 A<br>240 VAC: 1.0 A<br>24 VDC: 4 A                                                                                                                                                                                                                                       |
| <b>Isolation &amp; Grounding</b> | 1500 V<br>Analog inputs/outputs-to-power line<br>500 V<br>Analog input-to-input, input-to-output, analog output-to-output<br>All analog inputs and analog outputs are isolated from each other.<br><br><i>Note: DC Power is not isolated. DC- is connected to Earth Ground. Digital I/O, USB, and Ethernet are grounded.</i> |
| <b>Environmental</b>             | Operating temperature range: -40 to 60°C (-40 to 140°F)<br>Storage temperature range: -40 to 60°C (-40 to 140°F)<br>Relative humidity: 0 to 90% non-condensing<br><i>*All functions operate down to -40°C (-40°F.) LCD response is slower, increase display refresh setting.</i>                                             |
| <b>Internal Fan</b>              | Automatic temperature-controlled fan turns on if the inside temperature reaches 50°C and increases the speed as the temperature rises to 60°C.                                                                                                                                                                               |
| <b>Internal Heater</b>           | Automatic temperature-controlled heater located behind the LCD turns on at 0°C, delivering the minimum power. If the temperature drops below -10°C, the heater delivers its maximum power.                                                                                                                                   |
| <b>Connections</b>               | Removable screw terminal blocks<br>Inputs/Outputs: 12 to 24 AWG wire<br>Digital I/O: 16 to 30 AWG<br>RS-485: 12 to 24 AWG wire<br>RJ45 Ethernet connection.<br>USB ports: Micro-USB (Device), cable included.                                                                                                                |
| <b>Tightening Torque</b>         | Screw terminal connectors:<br>5 lb-in (0.56 Nm)<br>Digital I/O terminals: 2.5 lb-in (0.28 Nm)                                                                                                                                                                                                                                |
| <b>Enclosure</b>                 | Enclosure Body: Thermoplastic Polyester, Color: Gray<br>Display Window: Clear Polycarbonate, GE LEXAN HP12W<br>Front Panel Keys: Silicone rubber                                                                                                                                                                             |
| <b>Mounting</b>                  | Panel-mounting frame and twelve screws (provided)<br>Cutout: 10.0" x 10.0" ±0.05"<br>(254 mm x 254 mm ±1.3 mm) (H x W)<br>Panel thickness: 0.07" – 0.35"<br>(1.8 mm – 8.9 mm)<br>Clearance behind panel: 6" (152 mm)                                                                                                         |
| <b>Overall Dimensions</b>        | 10.85" x 10.85" x 4.87"<br>(276 mm x 276 mm x 124 mm)<br>(H x W x D)                                                                                                                                                                                                                                                         |
| <b>Weight</b>                    | Ex: PD9000-XY-4PI-8AI-10AO-10RY<br>7.4 lb (3.4 kg) approx.                                                                                                                                                                                                                                                                   |
| <b>Warranty</b>                  | 3 years parts and labor.                                                                                                                                                                                                                                                                                                     |

## Totalizer

|                                       |                                                                                                                                                                                                                                  |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of Totalizers</b>           | Up to 32 totalizers<br>15 digits with comma separator                                                                                                                                                                            |
| <b>Totalizer Inputs</b>               | Calculates total based on selected rate channel, pulse input, digital input, or triggered event for non-rate channels. Total is stored in non-volatile memory if power is lost.                                                  |
| <b>Maximum Total</b>                  | 18 digits<br>999,999,999,999,999,999                                                                                                                                                                                             |
| <b>Rate Channel Input</b>             | 4-20 mA input, Pulse input, Modbus input                                                                                                                                                                                         |
| <b>Rate &amp; Total Decimal Point</b> | Independent and user selectable from 0 to 15 places                                                                                                                                                                              |
| <b>Totalizer Reset</b>                | Via front panel keys or digital inputs                                                                                                                                                                                           |
| <b>Non-Resettable Total</b>           | Total may be setup to be non-resettable to prevent unintentional reset. This can be changed in the Setup Totals menu.                                                                                                            |
| <b>Total Units Conversion</b>         | Input: Rate channel<br>Total units may be different than rate units. Use the custom units to convert to any unit (e.g. Gallons to MGal: Factor = 0.000001)                                                                       |
| <b>Pulse Input K-Factor</b>           | K-Factor = pulses/units of measure<br>Calculates total directly from pulse input, digital input, or Modbus input.<br>Create rate channel by entering K-Factor, units and time base in sec, min, hr, or day.<br>Decimals: 0 to 15 |
| <b>Count Down</b>                     | Total may be setup to count down from a predetermined value entered by the user                                                                                                                                                  |
| <b>Preset Value</b>                   | Enter the preset value to count up or down<br>Reset total sets total to the preset value; to reset to zero uncheck the Preset box.                                                                                               |
| <b>Roll-Over</b>                      | Enter the value for total to roll-over to 0<br>Example: Roll-Over = 1,000,000<br>Total goes to 0 after 1 million                                                                                                                 |
| <b>Negative Total</b>                 | Allow total value to count below 0 for bi-directional flow based on rate channel                                                                                                                                                 |
| <b>Total Bargraph</b>                 | Bargraph may be scaled to represent the expected maximum total                                                                                                                                                                   |
| <b>Function Keys</b>                  | Screen Setup: Assign F1-F4 to Reset Total, Enter Total, Add To, or Remove From total                                                                                                                                             |

## Real Time Clock

|                                |                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------|
| <b>Date Format</b>             | Month, day, year (e.g. July 16, 2020)                                             |
| <b>Time Format</b>             | 24 hour; 00: Midnight<br>hh:mm:ss                                                 |
| <b>Battery</b>                 | 3 V, P/N: CR2032 included                                                         |
| <b>Display Date &amp; Time</b> | Displayed on the top line of Setup and View menus, including day of the week.     |
| <b>Screens</b>                 | Date & Time can be added to any screen.                                           |
| <b>Channels</b>                | Date & Time can be the input to a channel.<br>Display Format: yyyy/mm/dd hh:mm:ss |

## Channel & Math Functions

|                        |                       |                                                                          |
|------------------------|-----------------------|--------------------------------------------------------------------------|
| <b>Scale Functions</b> | K-Factor              | Converts number of pulses to volume or other units                       |
|                        | Scale Factor          | Apply multiplier to a channel                                            |
|                        | Scale Linear 2-Pt     | Scale a channel                                                          |
|                        | Scale Multi-Point     | Multi-point scaling of a channel                                         |
|                        | Scale Square Root     | Apply square root to a channel – Differential Pressure from two channels |
|                        | Scale Exponent        | Apply exponent for weirs and flumes open channel flow calculation        |
|                        | Round Horizontal Tank | Calculate volume in round horizontal tank with flat ends                 |
|                        | Units Conversion      | Convert base units to any units                                          |
| <b>Math Functions</b>  | Constant              | Assign fixed value                                                       |
|                        | Summation             | Add two or more channels                                                 |
|                        | Difference            | Subtract any two channels                                                |
|                        | Abs Difference        | Difference always positive                                               |
|                        | Absolute Value        | Convert channel value to positive                                        |
|                        | Average               | Find the average of channels                                             |
|                        | Weighted Average      | Assign % weight to two or more channels                                  |
|                        | Multiply              | Multiply two channels                                                    |
|                        | Divide                | Divide two channels                                                      |
|                        | % Efficiency          | Calculate input to output efficiency $((A-B)/A)*100\%$                   |

|                             |                    |                                                                                                                           |
|-----------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Additional Functions</b> | <b>Compare</b>     |                                                                                                                           |
|                             | Greatest           | Greatest value in a group of channels                                                                                     |
|                             | Least              | Smallest value in a group of channels                                                                                     |
|                             | <b>Measure</b>     |                                                                                                                           |
|                             | Tare               | Calculate net value when Tare function is applied via function key                                                        |
|                             | Maximum            | Maximum value reached by the process                                                                                      |
|                             | Minimum            | Minimum value reached by the process                                                                                      |
|                             | Percent (Bargraph) | % bargraph of any: 4-20 mA input, channel, total, timer, or mA output                                                     |
|                             | Duration           | Keep track of time a condition has been present (e.g. high alarm active)                                                  |
|                             | Rate of Change     | Calculates how fast a process is changing /sec, /min, /hr, /day                                                           |
| <b>Filter</b>               | Window Average     | Enter time to calculate the average                                                                                       |
|                             | IIR (First Order)  | Infinite Impulse Response (slow)                                                                                          |
|                             | Cutoff             | PV = 0 below cutoff<br>Flip Side: 0 above (-)                                                                             |
|                             | Limits             | Sets PV's upper & lower limits.                                                                                           |
|                             | <b>Control</b>     |                                                                                                                           |
|                             | Sampler            | Trigger relay sample and select sampling time (e.g. Turn relay on for 30 sec every time total increases by 1,000 Gallons) |
|                             | On-Off Control     | Set on & off control based on process value                                                                               |
|                             | Select A or B      | Switch between 2 inputs                                                                                                   |
|                             | Schedule           | Daily or weekly event                                                                                                     |
|                             | <b>Relays</b>      |                                                                                                                           |
|                             | Cycle Count        | Number of relay cycles since reset                                                                                        |
|                             | Runtime            | Relay runtime (ON) hh:mm:ss                                                                                               |
|                             | <b>Modbus</b>      |                                                                                                                           |
|                             | Time Since Read    | Time since a Modbus master device read a register                                                                         |
|                             | Time Since Write   | Time since a Modbus master wrote to a register                                                                            |

## List of Engineering Units

**None:** No units  
**Time:** seconds, minutes, hours, days & /sec, /min, /hr, /day  
**Distance (Height):** cm, m, Inch, Feet, Ft-In, Yard, km, miles, custom  
**Volume:** Gallons, GAL, L, IGAL, M3, BBL, BUSH, cuYD, cuFt, cuIn, LiBBL, BBBL, HECtL, quarts, pints, fl oz, mL, DT, M/T, custom  
**Pressure:** psi, Pa, bar, hPa, kPa, MPa, GPa, inH2O, cmH2O, inHg, mmHg, atm, kg/cm2, kg/m2, mbar, Mbar, Torr, mTorr, custom  
**Weight:** grams, Oz, Lb, lb, g, kg, ounces, tons, tonnes, custom  
**Temperature:** C, F, K, Ra  
**Percent:** %, PCT, Percent, custom  
**Amps:** mA, Amps, custom  
**Volts:** V, mV, Volts, custom  
**Counts:** Pulses, Cycles, Counts, custom  
**Logic:** ON, OFF, OPEN, CLOSED, YES, NO, START, RUNNING, STOP, STOPPED, PUMP ON, PUMP OFF, OK, OKAY, ERROR, WARNING, custom  
**Custom:** Enter unit's name, type, base unit, and factor.

## 4-20 mA Analog Inputs

|                                       |                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of Inputs</b>               | (4) Analog inputs/card<br>(28) Analog inputs max, no other I/O                                                                                                                                                                                                                                                                      |
| <b>Typical Input</b>                  | 4-20 mA                                                                                                                                                                                                                                                                                                                             |
| <b>Input Range</b>                    | 0-24 mA                                                                                                                                                                                                                                                                                                                             |
| <b>Accuracy</b>                       | $\pm 0.03\%$ of full scale $\pm 1$ count                                                                                                                                                                                                                                                                                            |
| <b>4-20 mA Display Value</b>          | Up to six full digits<br>(Recommended) $\pm 999,999$<br>More digits may be used, but the stability will be affected. Increase the filter value and lower the display update rate to get a more stable reading.                                                                                                                      |
| <b>Transmitter Power Supply</b>       | Isolated 24 VDC @ 200 mA/input<br>Max current: 1,600 mA (All inputs)<br>(8) Analog Input @ 200 mA max<br>(28) Analog Input @ 20 mA max<br>Available on AC or DC powered units                                                                                                                                                       |
| <b>Temperature Drift</b>              | Better than:<br>20 ppm/ $^{\circ}\text{C}$ from $-40$ to $60^{\circ}\text{C}$ ambient                                                                                                                                                                                                                                               |
| <b>Filter</b>                         | Window: 0.5, 1, 2, 4, 8 sec,<br>IIR: 16, 32 sec<br>Glitch Filter: Discards a single sample caused by high frequency noise                                                                                                                                                                                                           |
| <b>Filter Bypass</b>                  | 0 to 100 % of full scale<br>Filter is ignored, if the signal change is greater than bypass value                                                                                                                                                                                                                                    |
| <b>Channel Input Scale Function</b>   | Linear 2-Point,<br>Multi-Point (up to 50 points)<br>Square Root<br>Programmable Exponent<br>Scale Factor<br>Round Horizontal Tank (Volume)<br>None (mA Input Reading)                                                                                                                                                               |
| <b>Channel Input Live Calibration</b> | Each channel may be calibrated using live calibration signal from a sensor or a calibrator.                                                                                                                                                                                                                                         |
| <b>Input Protection</b>               | Each 4-20 mA input is protected by an auto-resettable fuse, 30 VDC max.<br>The fuse resets automatically after the fault condition is removed.                                                                                                                                                                                      |
| <b>Input Impedance</b>                | 125 $\Omega$ typical, including auto-resettable fuse                                                                                                                                                                                                                                                                                |
| <b>Hart Transparency</b>              | The controller 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 controller is not affected if a HART communicator is connected to the loop. The controller does not display secondary HART variables. |
| <b>Isolation</b>                      | 1500 V: Input-to-power line<br>500 V: Input-to-input, input-to-output<br>All analog inputs and analog outputs are isolated from each other.                                                                                                                                                                                         |
| <b>Normal Mode Rejection</b>          | 100 dB at 50/60 Hz                                                                                                                                                                                                                                                                                                                  |
| <b>Common Mode Rejection</b>          | 90 dB at 50/60 Hz                                                                                                                                                                                                                                                                                                                   |

## Pulse Inputs

|                                              |                                                                                                                                                                                                                                                                                         |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number Of Inputs</b>                      | (4) Pulse inputs/card<br>(28) Pulse inputs max, no other I/O                                                                                                                                                                                                                            |
| <b>Input Type</b>                            | Active Square Wave, NPN, PNP, Reed Switch, Coil (Magnetic Pickup)<br>Normal threshold: 1.2 V (0.8 to 3.0 V)<br>High threshold: 2.5 V (2.0 V to 6.0 V)<br>Coil threshold: 20 mV (Low) or 100 mV (High)                                                                                   |
| <b>Signal Level</b>                          | Active Square Wave: 0 to 30 V max<br>Typical: 0 to 5 V<br>Coil: 20 mVp-p to 30 Vp-p (Magnetic Pickup)                                                                                                                                                                                   |
| <b>Input Impedance</b>                       | Active, NPN, Reed: 10 k $\Omega$ pull-up to 5 V<br>PNP: 10 k $\Omega$ pull-down to (S-)<br>Coil: $> 2$ k $\Omega$ (20 mV sensitivity), $> 10$ k $\Omega$ (100 mV sensitivity)                                                                                                           |
| <b>Isolation</b>                             | Pulse inputs are not isolated, (S-) terminal is connected to system GND                                                                                                                                                                                                                 |
| <b>Input Protection</b>                      | $\pm 36$ V, non-isolated                                                                                                                                                                                                                                                                |
| <b>Frequency Response &amp; Signal Level</b> | Active Square Wave 5 V: 0 to 100 kHz<br>Coil (Magnetic Pickup): 0 to 50 kHz<br><u>Frequency – Signal level (Coil: 20 mV)</u><br>20 mVp-p – 100 Hz<br>100 mVp-p – 10 kHz<br><u>Frequency – Signal level (Coil: 100 mV)</u><br>100 mVp-p – 90 Hz<br>500 mVp-p – 5 kHz<br>20 Vp-p – 50 kHz |
| <b>Minimum Frequency</b>                     | 250 $\mu\text{Hz}$ with High Gate = 4,000 sec                                                                                                                                                                                                                                           |
| <b>Low Gate</b>                              | 1 to 99 sec                                                                                                                                                                                                                                                                             |
| <b>High Gate</b>                             | 2 to 4,000 sec<br>(Must be higher than low gate)                                                                                                                                                                                                                                        |
| <b>Accuracy</b>                              | $\pm 1$ count for K-Factor $> 1$ or 30 ppm                                                                                                                                                                                                                                              |
| <b>K-Factor</b>                              | Programmable pulses/unit of measure with up to 15 decimal resolution                                                                                                                                                                                                                    |
| <b>Scale Pulse Input</b>                     | Linear 2-Point<br>Multi-Point Scaling: 2 to 50 points                                                                                                                                                                                                                                   |
| <b>Live Calibration</b>                      | Pulse input channel may be calibrated using live calibration signal from a sensor.                                                                                                                                                                                                      |

## Modbus Inputs

|                                 |                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Number of Inputs</b>         | 199 Modbus RTU                                                                                                  |
| <b>Scale Mb Input</b>           | Modbus input may be used as the input for creating channels and totals, the same way 4-20 mA inputs are used.   |
| <b>Data Type</b>                | Bit-Logic<br>Signed/Unsigned: 16 (Short), 32 (Long), 64 (Long-Long)<br><br>Float 32<br>Float 64 (Double)        |
| <b>Decimal Point</b>            | User selectable                                                                                                 |
| <b>Comm Break &amp; Timeout</b> | Specify what value to hold on comm. break and how long to wait for new data before reporting a break condition. |
| <b>Input Action</b>             | Specify what should happen when new data is written to the input register (e.g. add value to total).            |

## Digital Inputs & Outputs

|                                   |                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Digital Inputs</b>             | 5 Inputs, non-isolated, 30 VDC max<br>Standard feature on all ConsoliDator+ models<br>Low: 0 to 1.2 V<br>High: 2.8 to 30.0 V<br>Internal pull-up: 5 k $\Omega$ to 5 V<br>Max pulse frequency: 1 kHz @ 5 Vp-p<br>+5 V terminal: Internal pull-up 100 $\Omega$<br>Note: Pulse inputs may be used as digital inputs |
| <b>Digital Input Types</b>        | Normally open switch: External excitation not required (Current: 1 mA)<br>Open collector: 4.1 V open circuit voltage<br>Logic level: 0 to 30 V                                                                                                                                                                   |
| <b>Assignment &amp; Operation</b> | Active Low or Active High<br>Functions: Remote front panel button, total functions, timer control, alarm functions, screen navigation, horn functions, reset relay information.<br>Digital inputs can be used as input source for channels, totals, and alarms.                                                  |
| <b>Digital Outputs</b>            | 4 Outputs<br>Standard feature on all ConsoliDator+ models<br>Low: 0 V (no load), 1.5 V max @ 10 mA sink (External pull-up)<br>High: 5.0 V (no load), 3.5 V @ 10 mA load<br>Maximum current: 30 mA<br>Output impedance: 100 $\Omega$<br>Output protection: 150 mA auto-resettable fuse<br>Max frequency: 5 Hz     |
| <b>Digital Output Assignment</b>  | Digital outputs require logic units as the input<br>Input sources: Digital input, Modbus input, channel, alarm, horn, always on, or always off                                                                                                                                                                   |
| <b>Input / Output Protection</b>  | $\pm 36$ V, non-isolated                                                                                                                                                                                                                                                                                         |

## Relays

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of Relays</b>             | (5) Relays/card<br>(30) Relays max with (4) analog or (4) pulse inputs, no other I/O                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Rating</b>                       | SPDT (Form C)<br>Resistive load: Rated 10 A @ 120/240 VAC or 8 A @ 30 VDC<br>Inductive load: NO contacts: 1/3 HP, 120 VAC; 30,000 cycles<br>NC contacts: 1/8 HP, 120 VAC; 50,000 cycles<br>Minimum load: 100 mA @ 5 VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Isolation</b>                    | 1500 VAC, 50/60 Hz for 1 min between coil and contacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Deadband</b>                     | 0-100% of full scale, user selectable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Electrical Noise Suppression</b> | TVS diodes & snubbers on all contacts.<br>Recommended additional external snubber: 0.01 $\mu$ F/470 $\Omega$ , 250 VAC (Order: PDX6901)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Assignment &amp; Operation</b>   | Any relay may be assigned to any alarm, channel, total, timer, digital input, Modbus input, pump alternation, horn, always on, or always off.<br>Multiple relays may be assigned to the same alarm or channel. All relays are programmed independently.<br><br>High & Low Alarm: Defined by set and reset points in the Alarm menu<br><br>High or Low Alarm: Assign relay to any alarm or channel for on/off relay control<br><i>Note: Automatic reset only for channel</i><br><br>Multi-Source High or Low Alarm: Assign relay to multi-source alarm to indicate common high or low condition.<br><br>Pulse Action: Set any relay for pulsing on/off timed relay control.<br>Programmable pulse width (on/off time) and on/off delay.<br><br>Sampling: Relay must be assigned to channel setup for Sampler function with user-defined total increment and sampling time.<br><br>Pump Alternation: Any relay may be setup to alternate with any relay in the group. Multiple alternation groups may be setup. |
| <b>Acknowledge</b>                  | Front panel <b>Ack</b> key or digital input acknowledges alarms; relays associated with acknowledged alarm are turned off.<br>Acknowledge all or any alarm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Alarm Relay</b>                  | Assign any relay to be driven by any alarm; acknowledging the alarm turns off the relay (non-fail-safe mode).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Time Delay</b>                   | Programmable on/off delays, 0.0 to 999.9 sec<br>Independent for each relay.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Auto Initialization</b>          | When power is applied to the controller, relays will reflect the state of the input to the controller.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Fail-Safe Operation</b>          | The relay coil is energized when the process variable is within safe limits and the relay coil is de-energized when the alarm condition exists.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## 4-20 mA Transmitter Outputs

|                                   |                                                                                                                                                                                                    |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of Analog Outputs</b>   | (5) Analog outputs/card<br>(35) Analog outputs max with no other I/O cards (Seven I/O slots)                                                                                                       |
| <b>Output Range</b>               | 4.00 to 20.00 mA, nominal                                                                                                                                                                          |
| <b>Calibration</b>                | Factory calibrated for 4-20 mA                                                                                                                                                                     |
| <b>Scaling Range</b>              | Any process range<br>Reverse scaling allowed                                                                                                                                                       |
| <b>Assignment &amp; Operation</b> | Assign to any analog or pulse input, digital input, Modbus input, channel, total, timer, alarm, or fixed value (none).<br><i>Note: Multiple 4-20 mA outputs can be assigned to the same input.</i> |
| <b>Accuracy</b>                   | ±0.03% F.S. ±0.005 mA                                                                                                                                                                              |
| <b>Temperature Drift</b>          | 20 ppm/°C from -40 to 60°C ambient. (Output & Input drifts are separate)                                                                                                                           |
| <b>Output Loop Power</b>          | Powered by controller or externally by 12 to 32 VDC                                                                                                                                                |
| <b>Output Loop Resistance</b>     | Powered by controller: 10 to 600 Ω<br>External 12 VDC: 10 to 200 Ω<br>External 24 VDC: 10 to 600 Ω<br>External 32 VDC: 10 to 1000 Ω                                                                |
| <b>Isolation</b>                  | 1500 V: Output-to-power line<br>500 V: Output-to-output, output-to-input<br>All analog inputs and analog outputs are isolated from each other.                                                     |

## Timers

|                                   |                                                                                                                                                                                                             |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of Timers</b>           | Up to 32                                                                                                                                                                                                    |
| <b>Time Format</b>                | hh:mm:ss with 0 decimals selected<br>Seconds with 1 or more decimals                                                                                                                                        |
| <b>Automatic Actions</b>          | Power Up: Timer action on power up<br>Error: Action when an error is detected<br>Reset: Event causes the timer to reset<br>Start: Event triggers the timer to start<br>Stop: Event causes the timer to stop |
| <b>Start / Stop Reset</b>         | The function keys and digital inputs can be used to start, stop, and reset the timers, regardless of the automatic actions selected.                                                                        |
| <b>Assignment &amp; Operation</b> | Timers can be triggered, stop, and reset, by rising or falling signals from 4-20 mA input, pulse, digital, Modbus input, channel, total, other timers, alarm, mA output, relay, or Modbus output.           |
| <b>Count Down Timer</b>           | Select count down and enter starting time                                                                                                                                                                   |
| <b>Timer Alarm</b>                | Timer can be used to trigger alarms                                                                                                                                                                         |
| <b>Bargraph</b>                   | Select bargraph during setup and scale the bargraph for 0 – 100% target time                                                                                                                                |
| <b>Timer Control</b>              | Access timer control via the <i>View Timer</i> menu or assign a function key to timer control in the <i>Screens</i> menu                                                                                    |
| <b>Timer &amp; Relay</b>          | Timer can be assigned to drive relays based on selected set and reset points                                                                                                                                |

## Modbus® Serial Communications

|                       |                                                           |
|-----------------------|-----------------------------------------------------------|
| <b>Compatibility</b>  | RS-485 (EIA-485)                                          |
| <b>Protocol</b>       | Modbus RTU                                                |
| <b>Device Address</b> | 1 to 247                                                  |
| <b>Transmit Delay</b> | 0 to 99 ms                                                |
| <b>Baud Rate</b>      | 1,200 to 115,200 bps                                      |
| <b>Data</b>           | 8 bit (1 start bit, 1 stop bit)                           |
| <b>Parity</b>         | Even, Odd, None with 1 stop bit, or None with 2 stop bits |

## Ethernet Communications

|                                      |                                                                                                         |
|--------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>Device</b>                        | Lantronix Xport-05                                                                                      |
| <b>Protocol</b>                      | Modbus TCP/IP (Default)<br>Modbus UDP/IP<br>Modbus RTU Over TCP/IP<br>Modbus RTU Over UDP/IP            |
| <b>Port Settings (Do Not Change)</b> | Protocol: RS-232<br>Baud Rate: 9600<br>Data Bits: 8<br>Flow Control: None<br>Parity: None, Stop Bits: 1 |
| <b>Network Stack</b>                 | IPv4                                                                                                    |
| <b>Ethernet Mac/Phy</b>              | 10/100 Mbps                                                                                             |

|                                    |                                                                                                                                                |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ethernet Port Configuration</b> | Download the Lantronix DeviceInstaller software to configure the Ethernet port<br><br>See page 54 <i>Ethernet Port Setup</i> for instructions. |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|

## ConsoliDator+ Software

|                            |                                                                                                                                                                                                                                                                     |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>System Requirements</b> | Windows® 7, 10                                                                                                                                                                                                                                                      |
| <b>Compatibility</b>       | One software version for all models                                                                                                                                                                                                                                 |
| <b>Connection</b>          | Micro-USB                                                                                                                                                                                                                                                           |
| <b>Configuration</b>       | Configure inputs and outputs, channels, totals, timers, alarms, etc.<br>Configure bargraph and panel colors for normal operation, and colors for alarm indication.<br>Save controller settings file on PC for programming other controllers or to restore settings. |

## Safety Information

### ⚠ CAUTION

- Read complete instructions prior to installation and operation of the controller.

### ⚠ WARNINGS

- Risk of electric shock.
- Hazardous voltages exist within enclosure.
- Installation and service should be performed only by trained service personnel.

## Installation

### Unpacking

Remove the instrument from its box. Inspect the packaging and contents for damage. Report any damages to the carrier. If any part is missing or the controller malfunctions, please contact your supplier or the factory for assistance.

## Panel Mounting

- Prepare panel cutout per the dimensions provided
- Locate the panel mounting bracket and screws
- Inspect the controller to assure the gasket is securely in place
- Insert controller in the panel cutout, the latches on the top and bottom should hold it in place
- Insert the panel mounting bracket from the back of the panel, observe the orientation of the piece marked TOP
- Install the 12 screws provided

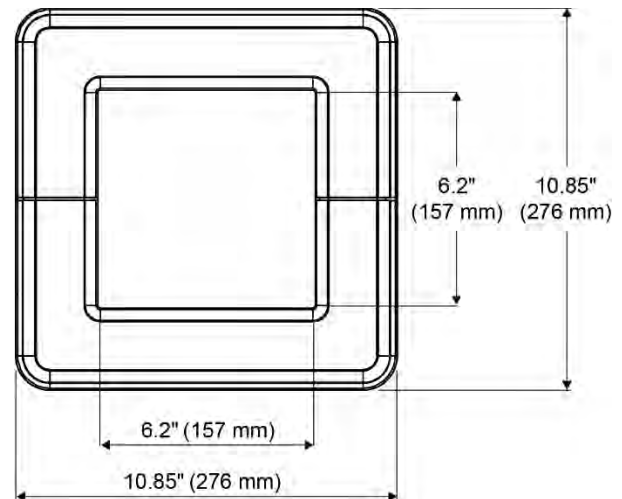


Figure 1. Front Panel Mount Dimensions

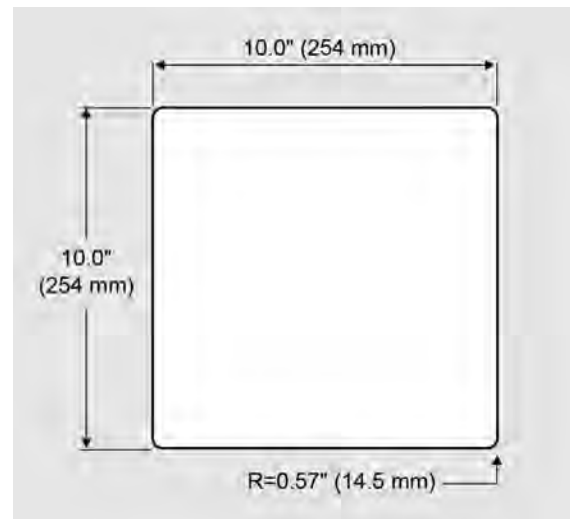


Figure 2. Panel Cutout Dimensions

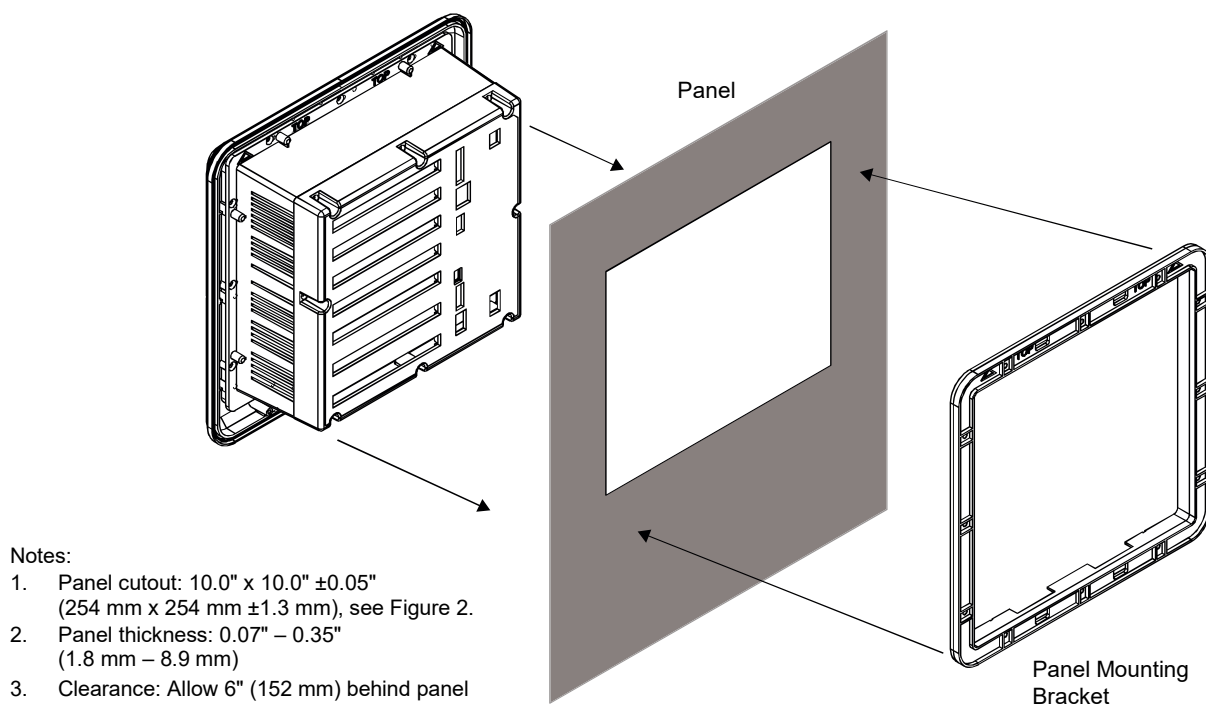


Figure 3. Panel Mount Installation

## Mounting Dimensions

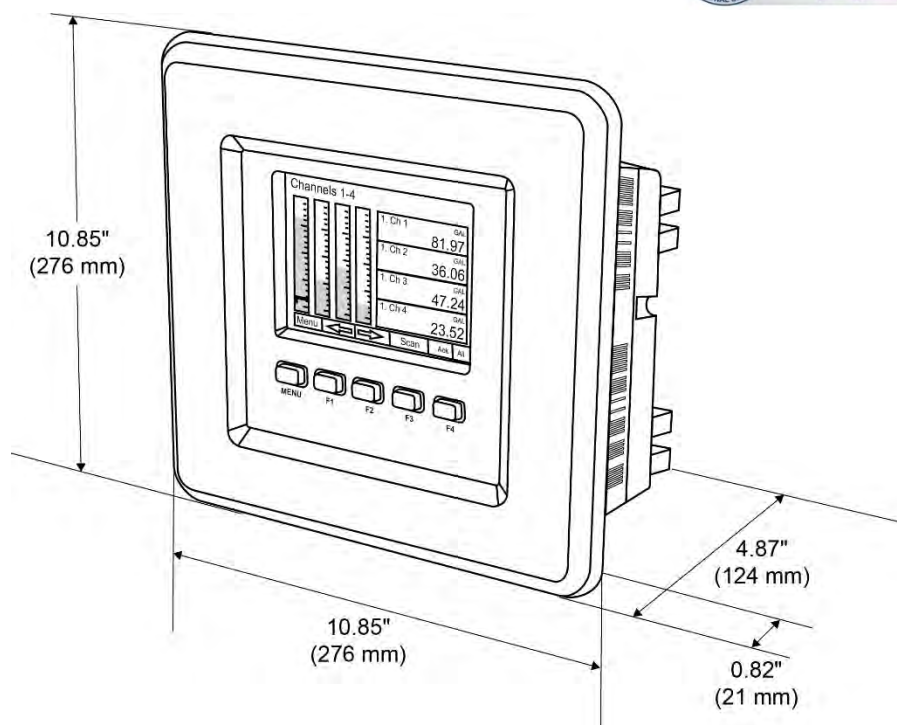


Figure 4. Panel Mount Overall Dimension



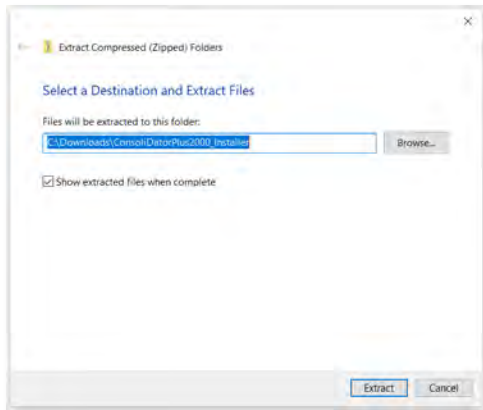
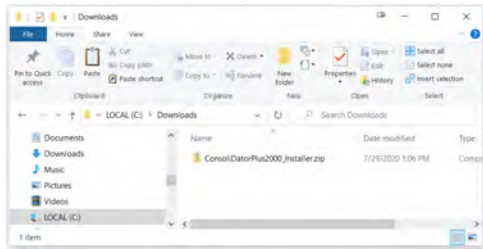
Download free 3-D CAD files of these instruments to simplify your drawings!

[predig.com/documentation-cad](http://predig.com/documentation-cad)

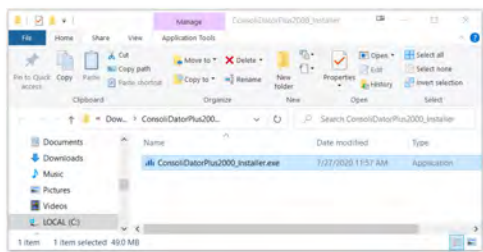
## ConsoliDator+ Configuration Software Installation

We recommend the following sequence for getting the controller into service:

1. Download the latest version of the ConsoliDator+ configuration software from our website or from the included CD.
2. Extract the contents of the *ConsoliDatorPlus2000\_Installer.zip* file into a folder in your computer.



3. Double-click on the executable file *ConsoliDatorPlus2000\_Installer.exe* and follow the on-screen instructions.

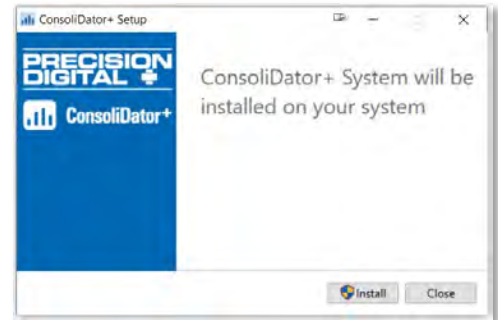


4. Depending on your system, a Windows message might be displayed:

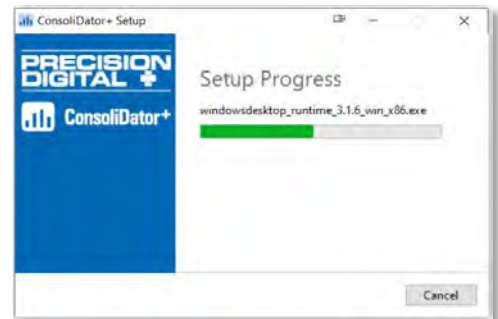
*"Do you want to allow this app from an unknown publisher to make changes to your device?"*

Click **Yes** and proceed with the installation.

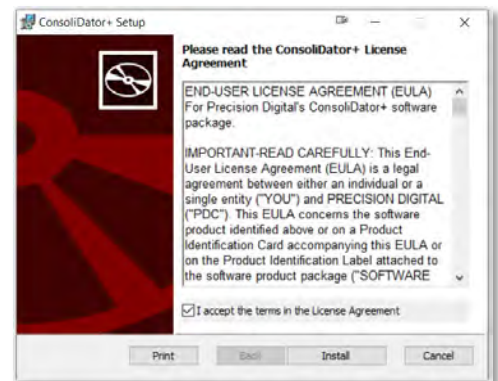
5. Click on *Install* to start the software installation process.



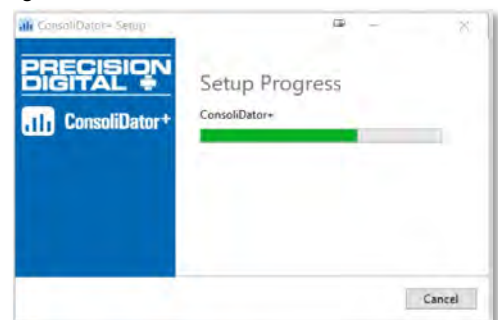
6. If your computer does not have the .NET desktop runtime 3.1, it will be installed automatically.



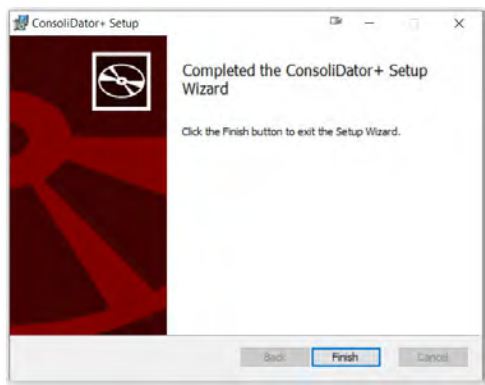
7. If the .NET desktop runtime 3.1 is already installed, it will proceed to the installation of the ConsoliDator+ configuration software.



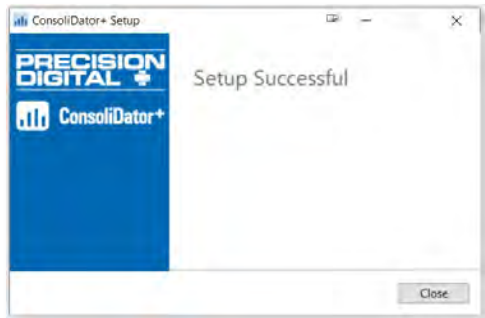
8. Read and accept the software's License Agreement and click on *Install*.



9. Click on *Finish*.



10. After the installation is complete, the following message is displayed. Click *Close* to finish. A ConsoliDator+ icon will be placed on your desktop.



You are now ready to start using the software to configure your ConsoliDator+ controller.

The easiest and quickest way to program your ConsoliDator+ is to use the FREE ConsoliDator+ configuration software available on the included CD.

The ConsoliDator+ configuration software is intuitive, and most customers can get their controller programmed as they like without even looking in the manual.

#### WARNINGS

- Only one controller may be connected at a time. Attaching multiple controllers will cause a conflict with the controller software.

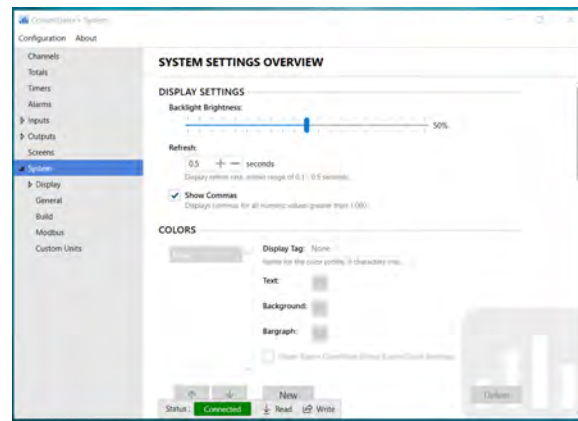
## ConsoliDator+ Software

1. Connect one end of the provided USB cable to the controller and the other end to the computer.

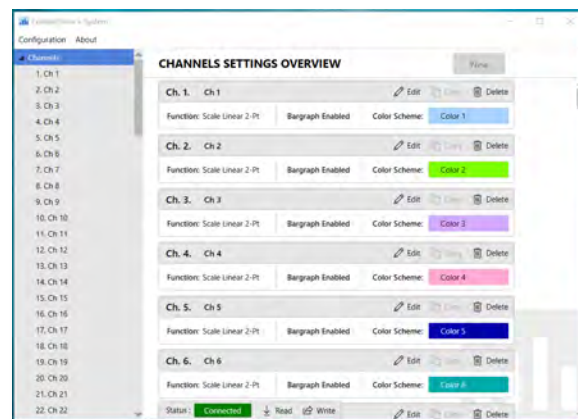
2. Double-click on the ConsoliDator icon



3. The application will start displaying the System menu



4. Click on *Read*, at the bottom of the screen, to read the configuration of the connected controller. After a read the channels settings overview is displayed.



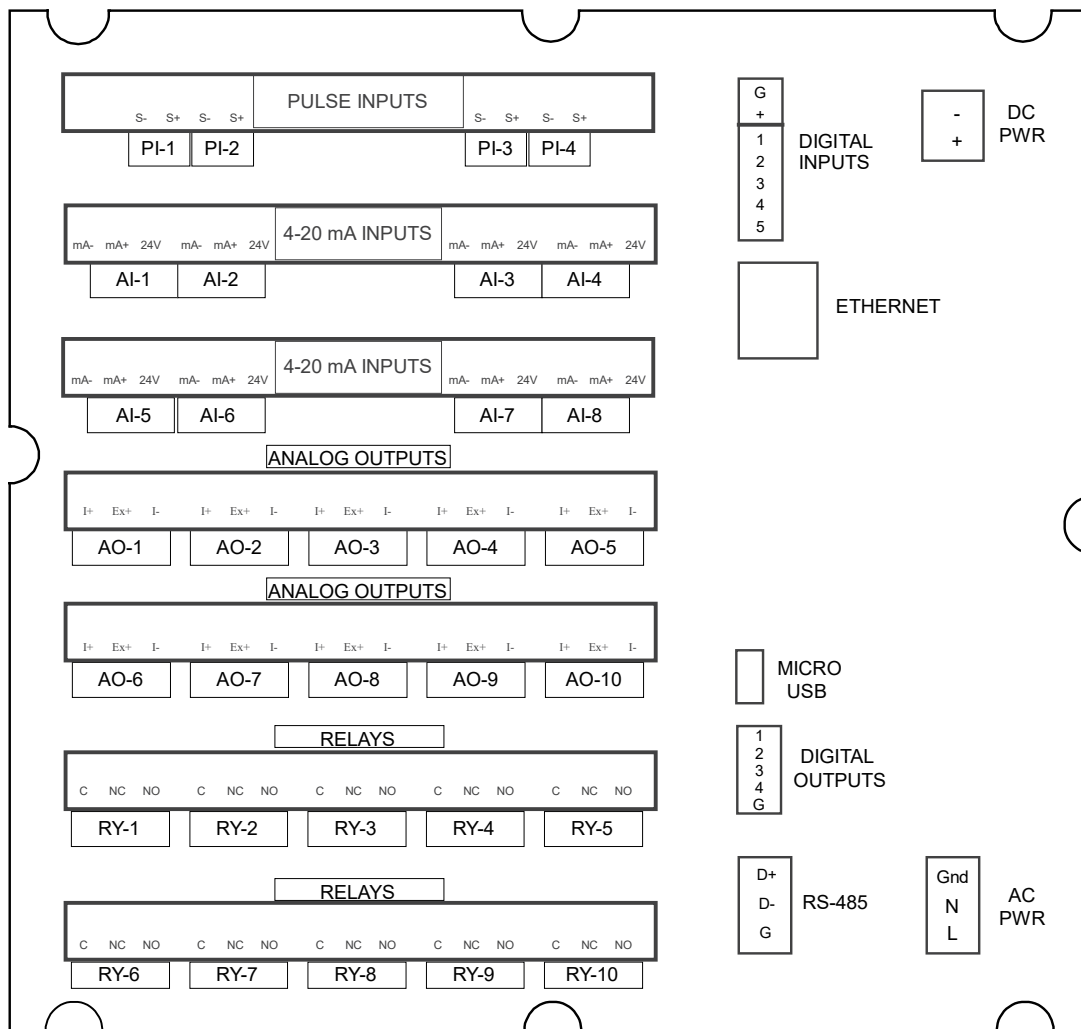
5. You can now begin to configure the ConsoliDator+ for your application, either by editing the existing settings or by starting fresh creating a new configuration.
6. Click on Configuration to save files, open existing files, or to create a new configuration even without a controller connected.

## Connections

The back panel is labeled with the I/O boards that were installed at the factory. The removable connectors are labeled with the connection signal for each terminal. The following diagram shows what the back of the model PD9000-GP-4PI-8AI-10AO-10RY looks like. This model accepts (4) pulse and (8) analog inputs and has (10) 4-20 mA outputs and (10) relays. (5) digital inputs, (4) digital outputs, RS-485 serial capability and USB connections are standard on all ConsoliDator+ models. Ethernet is an option.

If all Input / Output slots are used exclusively for one function, the ConsoliDator+ can accept up to (28) isolated 4-20 mA inputs, (28) pulse inputs, (25) isolated 4-20 mA outputs, and (25) relays. If used as a Modbus slave only: (35) 4-20 mA outputs, (30) relays.

All units can be powered from AC or DC; both power connections can be used at the same time. The DC power supply can serve as backup power if the voltage is 24 V or less, otherwise the controller will run on DC power.



**Figure 5. Connection Terminals for a PD9000-GP-4PI-8AI-10AO-10RY**

### Notes:

- Each 4-20 mA input has its own isolated 24 VDC power supply to power the transmitter.
- Each 4-20 mA output has its own isolated 24 VDC power supply to power the output loop.
- Each relay is Form C and rated at 10 A.
- Input / output connections are made to removable screw connectors.
- Every ConsoliDator+ has five digital inputs (additional digital inputs can be obtained by using the Pulse Inputs).
- Every ConsoliDator+ has four digital outputs.
- Every ConsoliDator+ has RS-485 with Modbus.
- All ConsoliDator+ models can be powered from either AC or DC Power.
- Ethernet with Modbus TCP is an option.
- Micro USB is used for programming the ConsoliDator+.

### CAUTION

- Use copper wire with 60°C or 60/75°C insulation for all line voltage connections. Observe all safety regulations. Electrical wiring should be performed in accordance with all applicable national, state, and local codes to prevent damage to the controller and ensure personnel safety.

## Power Connections

Power connections are made to one of the power terminal connectors. All units are capable of being powered either by AC or by DC for the ranges specified.

### 90-264 VAC Power

- Use three-terminal power connector as shown in Figure 6.
- Unit is protected internally with 1.25 A auto-resettable fuse. 2 A max, slow blow, 250 V min, UL Recognized external fuse recommended.

### 24 VDC Power $\pm 10\%$

- Use two-terminal power connector as shown in Figure 6.
- Unit is protected internally with 3.7 A auto-resettable fuse. 4 A max, slow blow, 50 V min, UL Recognized external fuse recommended.

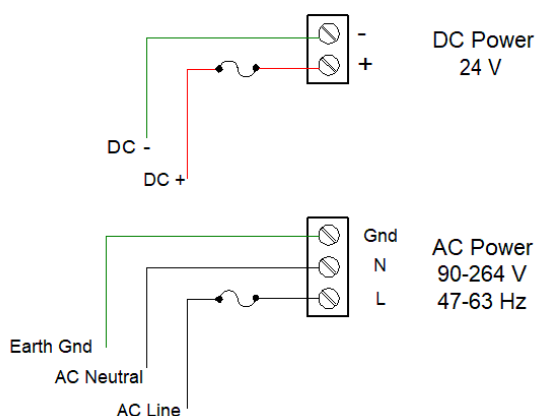


Figure 6. Power Connections

#### Note:

The controller may be powered by AC voltage with the DC power connection used as backup power. The DC power supply must be 24 V or less to work as backup; otherwise the controller runs on DC power.

## Isolated Input Signal Connections

Isolated input signal connections are made to removable screw terminal connectors, which are labeled individually on the back panel of the controller. The back panel shows the type of input card installed in each slot (The top slot is #1 and the bottom is #7). Individual inputs are referenced as PI-1 to PI-4 for pulse inputs and AI-1 to AI-4, AI-5 to AI-8, etc for analog inputs.

### 4-20 mA Analog Input Connections

Analog 4-20 mA Input connections are made to screw terminal connectors (two inputs per connector). The following figures show examples for typical applications. Each of the 4-20 mA inputs may be connected in any of the modes shown below.

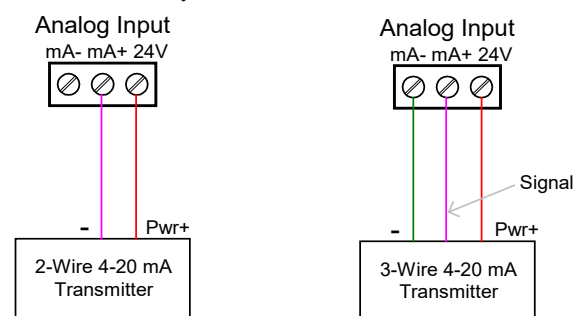


Figure 7. Transmitters Powered by ConsoliDator+ Isolated 24 VDC Power Supply

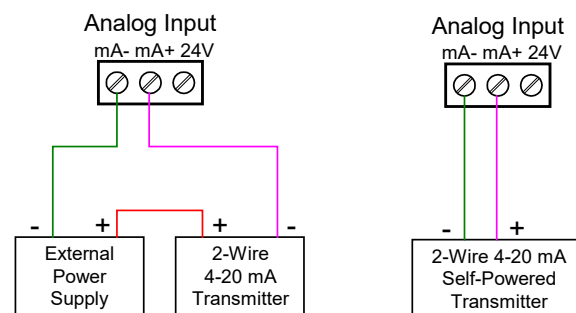


Figure 8. Transmitter Powered by Ext. Supply or Self-Powered

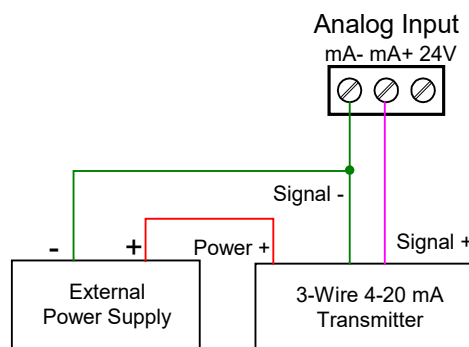


Figure 9. 3-Wire Transmitters Powered Externally

### Flow Meter Pulse Input Connections

Flow Meter Pulse Inputs are wired to four-terminal connectors (two inputs per connector). A square waveform is used in the illustration, but the input is capable of reading many other types of signals within the voltage and frequency ranges specified.

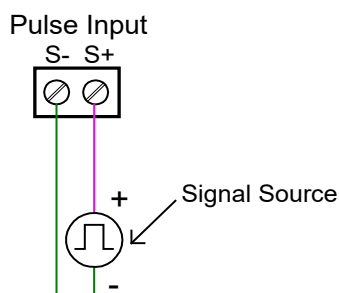


Figure 10. Flow Meter Pulse Input Connections

### Digital Input Connections

Inputs are wired between terminals 1-5 of the digital input connector and the G terminal of the 2-position connector above the digital inputs. Normally open switch contacts may be used as shown in Figure 11. The diagram also shows a Digital Input using an NPN open collector transistor output from a live signal. Logic LO or switch closure appearing across the terminals is interpreted as ON. When using an open collector transistor, a logic HI at the base (marked "B" in Figure 11) will be interpreted as ON. The 2-position connector has a +5 V terminal that may be used to provide excitation to some sensors requiring more than the pull-up provided on each digital input terminal.

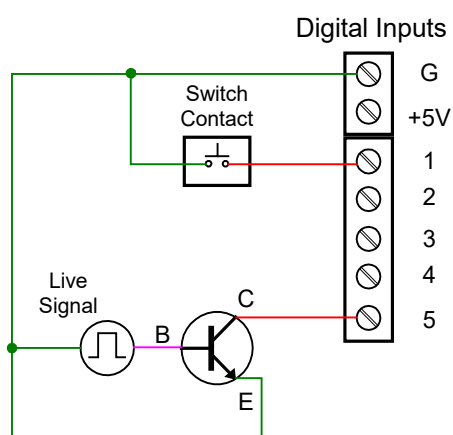


Figure 11. Digital Input from Switch Closure and Live Signal

### Analog Output Connections

The following figures show examples for isolated 4-20 mA transmitter output connections. Terminal connectors are labeled individually. The analog outputs are isolated from each other and from the inputs. They are powered internally to provide an active 4-20 mA output loop. The outputs may be powered externally by connecting the positive voltage to the Ex+ terminal.

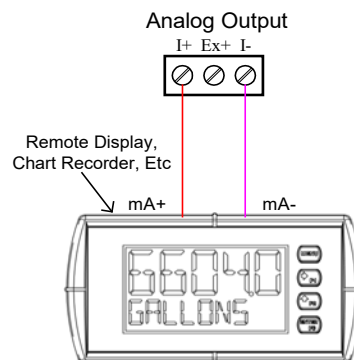


Figure 12. Active 4-20 mA Output Powered by Controller

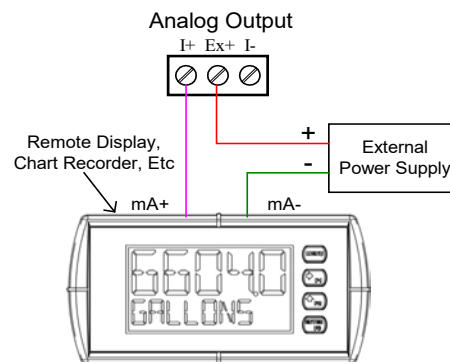


Figure 13. Passive 4-20 mA Output Powered by External Supply

*Note: Analog inputs and outputs are isolated from each other*

### Digital Output Connections

The digital outputs may be used to drive digital inputs, alarm annunciators, or other devices such as solid-state relays that can be driven with low voltage signals.

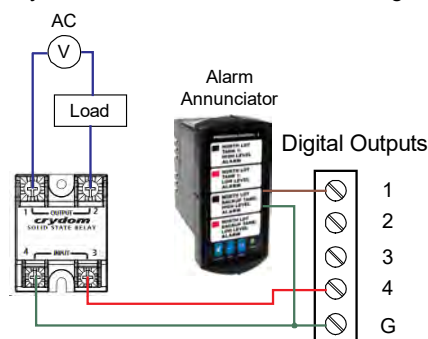
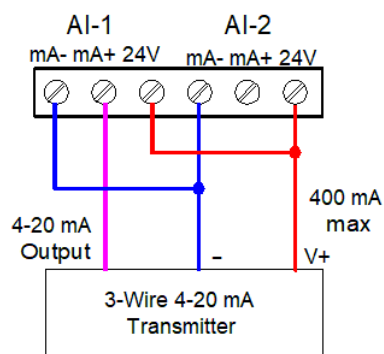


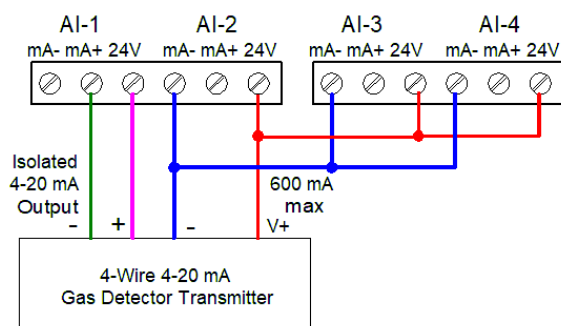
Figure 14. Digital Outputs Driving 5 V Solid State Relay

### Connections to Power Gas Detector

Some sensors requiring more than 200 mA of excitation current can be powered by the ConsoliDator+ by connecting two or more power supplies in parallel as shown in the following diagrams.



**Figure 15. Two Supplies in Parallel Powering 3-Wire Transmitter**



**Figure 16. Powering 4-Wire Gas Detector & Isolated 4-20 mA Output**

## Relay Connections

Relay connections are made to three-terminal connectors labeled individually. There are five relays per card.

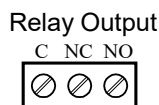


Figure 17. Relay Connections

## Switching Inductive Loads

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

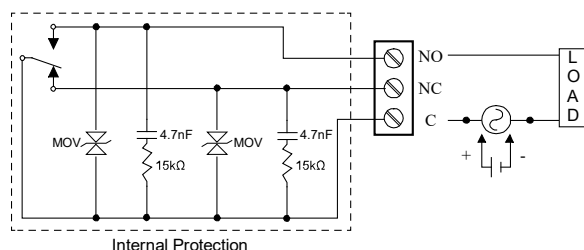


Figure 18. AC and DC Internal Inductive Loads Protection

For additional external protection choose R and C as follows:

R: 0.5 to 1  $\Omega$  for each volt across the contacts

C: 0.5 to 1  $\mu\text{F}$  for each amp through closed contacts

### Notes:

1. Use capacitors rated for 250 VAC.
2. RC networks may affect load release time of solenoid loads. Check to confirm proper operation.
3. Install the RC network at the instrument's relay screw terminals. An RC network may also be installed across the load. Experiment for best results.

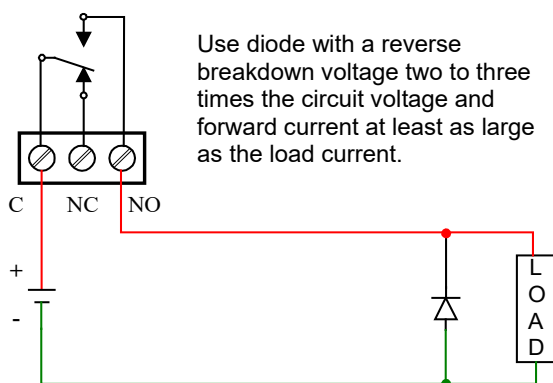


Figure 19. Low Voltage DC Loads Protection

## RC Networks Available from Precision Digital

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

## Serial Communication Connections

The RS-485 port for serial communication (using Modbus protocol) has three terminals labeled D+, D-, and G. It is strongly recommended to use three-wire shielded cable and to always connect the ground terminal to the other equipment's ground to avoid differential voltage between the systems. Distances up to 4000 feet can be reached with RS-485. Up to 32 Modbus devices may be connected to a single RS-485 bus.

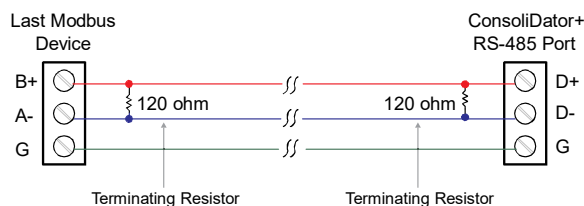


Figure 20. Serial Connections

## Ethernet Option

The Ethernet port is available on the RJ45 connector. This allows the ConsoliDator+ to connect to a local area network.

The Ethernet port option is fully configured using the Lantronix DeviceInstaller software, available for download from the Lantronix's Website.

See page 15 for specifications, page 53 for setup using the ConsoliDator+ software, and page 54 for complete Ethernet Port Setup.

## External Keypad Connections

Normally open pushbuttons may be wired to the digital inputs connector for use when the front panel of the controller is not accessible. The external keys may be assigned to replicate the Menu and F1-F4 function keys.

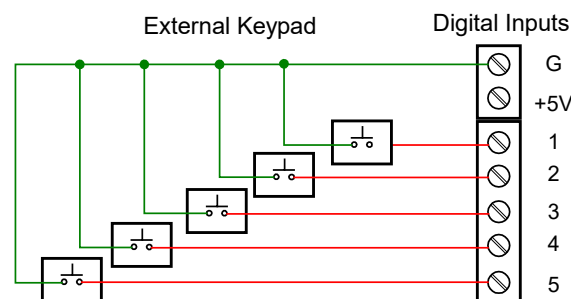


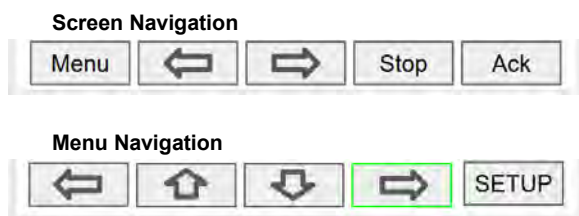
Figure 21. External Keypad Connections

## Navigating and Editing

The device displays various screens throughout programming and operation. Functions are programmed within their respective menu screens and in many cases are accompanied by user prompts.

### Soft-Keys and Buttons

The unit is equipped with five buttons located below the display. The function of each button corresponds to its soft-key, which appears at the bottom of the screen. Buttons assume different functions, which change according to the screen in view.



Selections are highlighted with green background for illustration purposes. The keys below are used to navigate through menus and edit settings. Other special keys appear throughout the programming process.

**Note:**

*This is not a touch-screen display; the pushbuttons must be used to activate the soft-key*

| Key         | Action                                                                   |
|-------------|--------------------------------------------------------------------------|
| Menu        | Enter menu                                                               |
| Right-key → | Step into menu/setting                                                   |
| Left-key ←  | Exit/go back                                                             |
| Down-key ↓  | Next screen/channel/setting                                              |
| Up-key ↑    | Previous screen/channel/setting                                          |
| Stop        | Stop automatic scan                                                      |
| Scan        | Scan screens automatically                                               |
| Ack         | Acknowledge alarms/relays                                                |
| Reset       | Reset total/max/min                                                      |
| Setup       | Enter the Setup menu                                                     |
| Edit        | Modify selection                                                         |
| Enter       | Execute keypad entry                                                     |
| Ok          | Accept setting change                                                    |
| Save        | Save all settings in view                                                |
| Cancel      | Discard changes                                                          |
| Delete      | Delete channel/item                                                      |
| New         | Create new channel/alarm                                                 |
| ←           | Move cursor left                                                         |
| →           | Move cursor right                                                        |
| X→          | Delete to the right                                                      |
| ←X          | Delete to the left                                                       |
| ≡           | Access additional settings or actions                                    |
| Alert!      | View alarm alerts, manually controlled outputs, and simulated parameters |

## Setup and Programming

There is **no need to recalibrate** the instrument when first received from the factory.

The device is **factory calibrated** prior to shipment, for all input types and 4-20 mA outputs. The calibration equipment is certified to NIST standards.

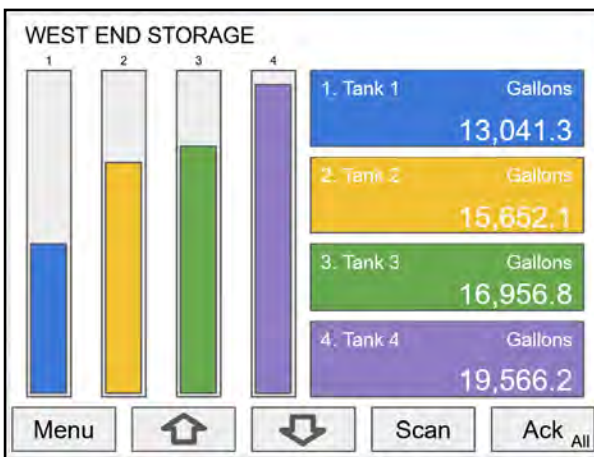
### Overview

Setup and programming are done through the front panel buttons or with the ConsoliDator+ Software. After power and signal connections have been completed and verified, apply power to the instrument.

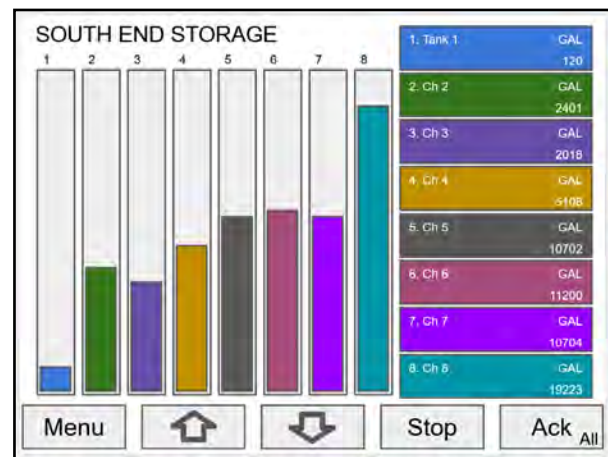
Inputs, outputs, channels, and relays are configured individually. It is recommended that all inputs be configured before channels, outputs, and relays are programmed.

Shown below are typical screens for tank level applications. Actual screens will vary according to the selected configuration. Screens may be edited, deleted, or added to fit the application.

For information on soft-keys and button functions, see Soft-Keys and Buttons on page 25.



Typical screen view displaying 4 channels and 4 bargraphs representing the values of each channel.



Typical screen view displaying 8 channels and 8 bargraphs representing the values of each channel.

Press the **Menu** key to begin setup and programming



The View screen allows a user to view all the settings and values for Channels, Totals, Timers, etc. To program the instrument, press the **Setup** key.

## Setup Menu

The *Setup* menu is the starting point during the programming process for setting up *Channels*, *Totals*, *Timers*, *Alarms*, *Inputs*, *Outputs*, *Screens*, and *System* settings. The number of channels shown on this screen is determined by the number of channels previously configured. More channels may be added to the list, by selecting *New* in the *Setup Channels* menu.



Press **Right Arrow** key to step into channels.



Press **New** key to create a new channel.  
Go to page 31 for details.

## Channel Parameters

The screenshot shows the 'Channel Parameters' screen for 'Rate #1'. The fields and buttons are numbered as follows:

- 1: Channel tag (Rate #1)
- 2: Auto-generated channel # (1)
- 3: Function (Scale Linear 2-Pt)
- 4: Input (AI-1. 2a (mA))
- 5: Units (Gallons/min)
- 6: Decimals (1)
- 7: Scale (Input (mA) and Output (Gallons/min) fields)
- 8: Cutoff (0.0 Gallons)
- 9: Colors button
- 10: Bargraph scale (0%: 0.0, 100%: 10000.0)
- 11: Display bargraph checkbox
- 12: Colors 1 button

Buttons at the bottom: Cancel, Home, Back, Colors, Save.

1. **Channel tag:** Editable
2. **Auto-generated channel #:** Use to re-order channels
3. **Function\*:** This is the function applied to the input source
  - **Scale**
    - Scale Factor
    - Scale Linear 2-Pt
    - Scale Multi-Point
    - Scale Square Root
    - Scale Exponent
    - Round Horz Tank\*
    - Units Conversion\*\*
  - **Math**
    - Constant
    - Summation
    - Difference
    - Absolute Difference
    - Absolute Value
    - Average
    - Weighted Average
    - Multiply
    - Divide
    - % Efficiency
  - **Compare**
    - Greatest
    - Least
  - **Measure**
    - Tare
    - Maximum
    - Minimum
    - Percent (Bargraph)
    - Duration
    - Rate of Change
  - **Filter**
    - Window Average
    - IIR (First Order)
    - Cutoff
    - Limits
  - **Control**
    - Sampler
    - On-Off Control
    - Select A or B
    - Schedule
  - **Relays**
    - Cycle Count
    - Runtime
  - **Modbus**
    - Time Since Read
    - Time Since Write
  - **Other**
    - None (Reserved)
4. **Input:** Source for the channel (PV)
  - mA Input (4-20 mA)
  - Pulse Input
  - Digital Input
  - Modbus Input
  - Channel
  - Total
  - Timer
  - Alarm
  - mA Output
  - Relay Output
  - Digital Output
  - Modbus Output
5. **Units:** Engineering units / time or none
  - None
  - Time
  - Distance (Height)
  - Volume
  - Pressure
  - Weight
  - Temperature
  - Percent
  - Amps
  - Volts
  - Counts
  - Logic
  - Custom
6. **Decimals:** Number of decimals for the PV
7. **Input scale:** Enter input and output values
8. **Cutoff:** PV goes to zero below the cutoff value
9. **Soft keys:** These change based on the screen in place
10. **Bargraph scale:** Set the 0 and 100% values
11. **Display bargraph:** Display on the screen
12. **Colors:** Select the bargraph & panel colors

\*Round Horz Tank: Available only if Input units is distance (height)

\*\*Use for custom units

See Channel & Math Functions on page 12 for details.

Note: Units conversion is available for all units.

## Data Entry Keypad

The system provides a soft keypad for entering values and tags; it contains numbers, alpha characters, and symbols.

1. Ch 1

Function: Scale Linear 2-Pt

Input: AI-1. 2a (mA)

Units: Gallons

Decimals: 1

Scale: Input (mA) Output (Gallons)

1. 4.000 0.0

2. 20.000 10000.0

Cutoff: 0.0 Gallons

Cancel [Up Arrow] [Down Arrow] **Edit** Ok

Press **Edit** key to start editing the channel configuration. The green background indicates the field to be edited. Press **Edit** key again to change the channel's tag, this opens the data entry keypad.

1. Ch 1

Ch 1

[...], A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, Enter, X

[Down Arrow], [=], **[Left Arrow]**, [X=>], Enter

Use the Down Arrow key to navigate to the keypad. Use the [→] and [←] keys to move the cursor and use the X→ key to delete characters. To enter characters in the selected text field, use the **arrow** keys to navigate through the popup keypad.

1. Ch 1

R

[...], A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, Enter, X

[Down Arrow], [Up Arrow], [Left Arrow], [Right Arrow], **abc**

To change the character set, navigate to the **three dots** and press the key indicating the next set of characters.

1. Ch 1

Rate #1

[...], ~, !, #, \$, %, ^, \*, +, -, =, <, >, (, ), /, ", ', &, {, }, |, \, ., :, ;, ., ?, @, \_

[Down Arrow], [Up Arrow], [Left Arrow], [Right Arrow], **ABC**

To enter symbols, press the **three dots** and select the desired symbol.

1. Ch 1

Rate #1

[...], a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, Enter, X

[Down Arrow], [Up Arrow], [Left Arrow], [Right Arrow], **Enter**

When done typing the characters in the selected field, press the **Enter** key.

1. Rate #1

Function: Scale Linear 2-Pt

Input: AI-1. 2a (mA)

Units: Gallons/min

Decimals: 1

Scale: Input (mA) Output (Gallons/min)

1. 4.00 0.0

2. 20.00 10000.0

Cutoff: 0.0 Gall

[Down Arrow], [Up Arrow], 4, 5, **6**

To enter numbers, select the numeric keypad, move the cursor to the insertion point and enter the number using the soft keys.

Press **Enter** to accept the changes.

Press the **Save** key to save the changes. The bargraph is automatically adjusted to reflect the scale entered. The bargraph scaling may be changed without affecting the input scaling.

## Setup Channels

The *Setup Channels* menu is used to configure each channel, enter a tag, select the input source, scale the input, and program other settings that will determine the channel's processing capabilities.

- Use the **Arrow** keys to navigate through the existing channels
- Press the **New** key to create a new channel
- Press the **Right Arrow** key to step into the channel setup
- Press the **Edit** key to make changes to a particular channel
- Press the **Delete** key to delete a channel

## Create New Channel

MENU - SETUP Thursday, May 28, 2020 13:30:25

CHANNELS

TOTALS

TIMERS

ALARMS

INPUTS

OUTPUTS

SCREENS

1. Ch 1

2. Ch 2

3. Ch 3

4. Ch 4

5. Ch 5

6. Ch 6

7. Ch 7

8. Ch 8

← ↑ ↓ → New

To create a new channel press the **New** key.

13. untitled

Function: None

Input: None

Cancel ↑ ↓ Edit Save

Press the **Edit** key to edit the channel tag and other settings. Press the **Up** and **Down** arrow keys to select setting to be edited.

13. Flow #30

Function: None

Scale

Math

Compare

Measure

Control

Relays

Modbus

Other

K-Factor

Scale Factor

Scale Linear 2-Pt

Scale Multi-Point

Scale Square Root

Scale Exponent

Round Horizontal Tank

Cancel ↑ ↓ ← Ok

Select the function to be applied to the input and press the **Ok** key.

13. Flow #30

Function: Scale Linear 2-Pt

Input: None

mA Input

Pulse Input

Digital Input

Modbus Input

Channel

Total

Timer

AI-1. 2a (mA)

AI-2. 2b (mA)

AI-3. 2c (mA)

AI-4. 2d (mA)

AI-5. 3a (mA)

AI-6. 3b (mA)

AI-7. 3c (mA)

Cancel ↑ ↓ ← Ok

Select the input source for the channel.

13. Flow #30

Function: Scale Linear 2-Pt

Input: AI-1. 2a (mA)

Units: Gallons /

None

Time

Distance

Volume

Pressure

Weight

Gallons

GAL

L

IGAL

M3

BBL

Cancel ↑ ↓ ← Ok

Select the engineering units, decimal point, enter scale points and press the **Ok** key.

13. Flow #30

Function: Scale Linear 2-Pt

Input: AI-1. 2a (mA)

Units: Gallons/min

Decimals: 0

Scale: Input (mA) Output (Gallons/min)

1. 4.000 0

2. 20.000 30000

Cutoff: 0.0 Gallons

Colors 1

Bargraph

0%: 0

100%: 30000

← ↑ ↓ Edit Save

Select number of decimals, scale the input, enter the cutoff value, select colors for bargraph and text, confirm the bargraph's scale, and press **Save**.

## Bargraph, Background & Text Colors

13. Flow #30 Colors 1

Function: Scale Linear 2-Pt Bargraph

Input: AI-1. 2a (mA) 0%: 0

Units: Gallons/min 100%: 30000

Decimals: 0

Scale: Input (mA) Output (Gallons/min)

|    |        |       |
|----|--------|-------|
| 1. | 4.000  | 0     |
| 2. | 20.000 | 30000 |

☒ Cutoff: 0.0 Gallons

Cancel ↑ ↓ Colors Ok

To select a channel color pattern, navigate to the Colors setting and press the **Colors** key.

Colors Colors 1

Default Text: ■

Colors 1 Background:  

Colors 2 Bargraph: ■

Colors 3

Colors 4 ☒ Show Alarm Condition

Colors 5 Using Alarm Color Settings.

Colors 6

Colors 7

Select ↑ ↓ Edit New

Select a color pattern or press the **Edit** key to make changes to the colors' tag, text, background, and bargraph.

Colors Colors 1

Default Text: ■

Colors 1 Background:  

Colors 2 Bargraph: ■

Colors 3

Colors 4 ☒ Show Alarm Condition

Colors 5 Using Alarm Color Settings.

Colors 6

Colors 7 Manage

Cancel ↑ ↓ Edit Ok

Use the arrow keys to navigate the settings and press **Edit** to make changes.

Colors Colors 1

Default Text: ■

Colors 1 Background:  

Colors 2 Bargraph: ■

Colors 3

Colors 4 ☒ Show Alarm Condition

Colors 5 Using Alarm Color Settings.

Colors 6

Colors 7 Manage

Cancel ↑ ↓ Edit Ok

Press **Edit** to change text color, this applies to the channel tag, units, and value.

Colors Colors 1

Default Text: ■

Colors 1 Background:  

Colors 2 Bargraph: ■

Colors 3

Colors 4 ☒ Show Alarm Condition

Colors 5 Using Alarm Color Settings.

Colors 6

Colors 7 Manage

Cancel ↑ ↓ Edit Ok

Select the desired color and press **Ok**. Navigate to the other settings and make the necessary changes.

Colors Colors 1

Default Text: ■

Colors 1 Background:  

Colors 2 Bargraph: ■

Colors 3

Colors 4 ☒ Show Alarm Condition

Colors 5 Using Alarm Color Settings.

Colors 6

Colors 7 Manage

Cancel ↑ ↓ Save Edit Ok

Press **Save** to save the color changes. Press **Select** to apply the color pattern to the channel. The **Manage** button is used to move or delete colors.

## Live Calibration

1. Channel 1 Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. 2a (mA) 0% : 0

Units: Gallons 100% : 50000

Decimals: 0

Scale: Input (mA) Output (Gallons/min)

1. 3.9982 0

2. 20.000 50000

☒ Cutoff: 0 Gallons

Live Edit

The *Live Calibration* feature is used to calibrate a channel by applying a live calibration signal.

1. From the Setup menu, navigate to the channel to be calibrated.
2. Go to Input 1 entry box
3. Apply Input 1 signal from sensor or calibrator
4. Press & hold the Edit key and press the Live key a few time until a stable reading is displayed.
5. Release the Edit key; the input 1 value has been captured.
6. Repeat the steps above for the additional inputs to be calibrated.
7. Adjust the output values according to the calibrated inputs.
8. Press Save.

## Edit Channel

1. Rate #1 Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. 2a (mA) 0% : 0.0

Units: Gallons/min 100% : 10000.0

Decimals: 1

Scale: Input (mA) Output (Gallons/min)

1. 4.000 0.0

2. 20.000 10000.0

☒ Cutoff: 0.0 Gallons

Cancel Edit Ok

To edit a channel press the **Edit** key and navigate to the setting you want to change, press **Edit** again and make the changes required.

1. Rate #1 Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. 2a (mA) 0% : 0.0

Units: Gallons/hr 100% : 60000

Decimals: 0

Scale: Input (mA) Output (Gallons/hr)

1. 4.000 0

2. 20.000 60000

☒ Cutoff: 0.0 Gallons

Cancel Save

After making all the changes, press the **Save** key.

## Delete Channel

1. Rate #1 Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. 2a (mA) 0% : 0.0

Units: Gallons/min 100% : 10000.0

Decimals: 1

Scale: Input (mA) Output (Gallons/min)

1. 4.000 0.0

2. 20.000 10000.0

☒ Cutoff: 0.0 Gallons

Delete

To delete a channel, press the **Delete** key and follow the instructions.

1. Rate #1 Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. 2a (mA) 0% : 0.0

Units: Gallons/min 100% : 10000.0

Decimals: 1

Scale: Input (mA) Output (Gallons/min)

1. 4.000 0.0

2. 20.000 10000.0

☒ Cutoff: 0.0 Gallons

ARE YOU SURE?

Delete this channel?

Ok Cancel

Press the **Ok** key to delete the channel or the **Cancel** key to cancel delete action.

## 2-Point Linear Scaling

Linear mode refers to basic 2-point scaling of a 4-20 mA signal in engineering units. The graph in Figure 22 shows the display response based on example scaling parameters. For this mode select [Scale Linear 2-Pt] from *Function* options, then enter your scaling parameters.

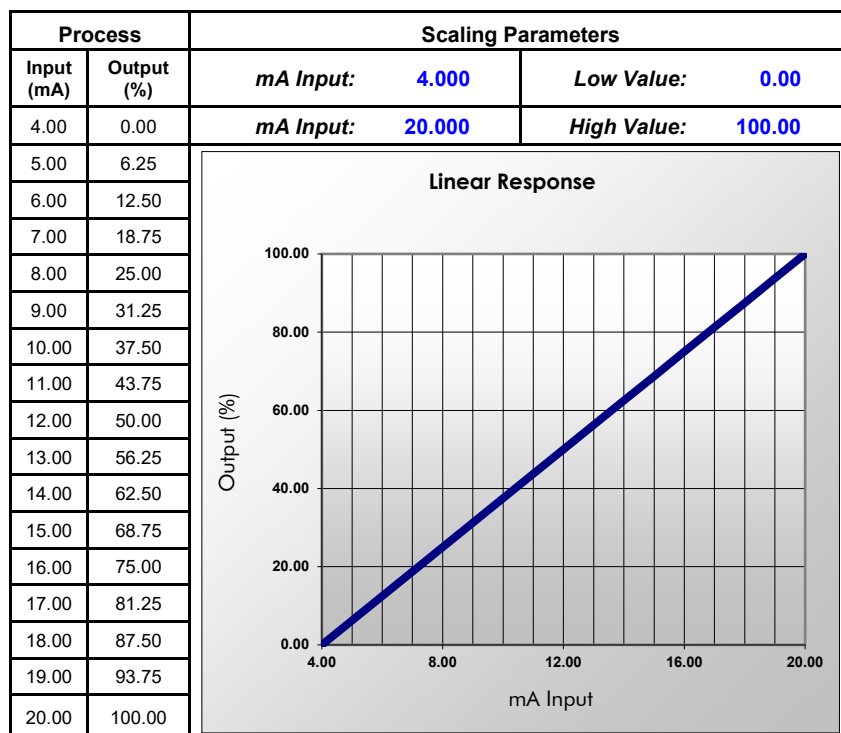


Figure 22. Linear Response Graph

## Square Root Scaling

Square root mode refers to 2-point scaling with square root extraction typically used to linearize the signal from a differential pressure transmitter and display the flow rate in engineering units. The graph in Figure 23 shows the display response based on example scaling parameters. For this mode select [Scale Square Root] from *Function* options.

The square root mode supports low-flow cutoff which can be used to suppress readings below a programmed value. Below the cutoff value, the controller will display "0".

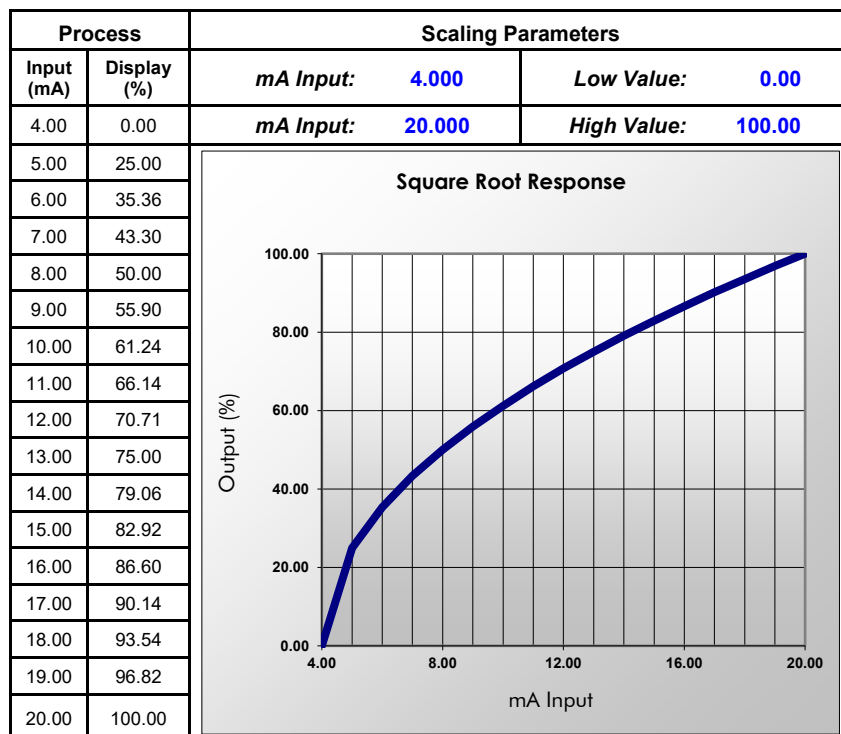


Figure 23. Square Root Response Graph

### Scale Exponent

Exponent mode refers to 2-point scaling with programmable exponent, typically used in open-channel flow applications using weirs and flumes to linearize the signal from a level transmitter and display the flow rate in engineering units. The graph in Figure 24 shows the display response based on example parameters and exponent of "1.5". For this mode select [Scale Exponent] from *Function* options. The exponent mode supports low-flow cutoff which can be used to suppress readings below a programmed value. Below the cutoff value, the controller will display "0".

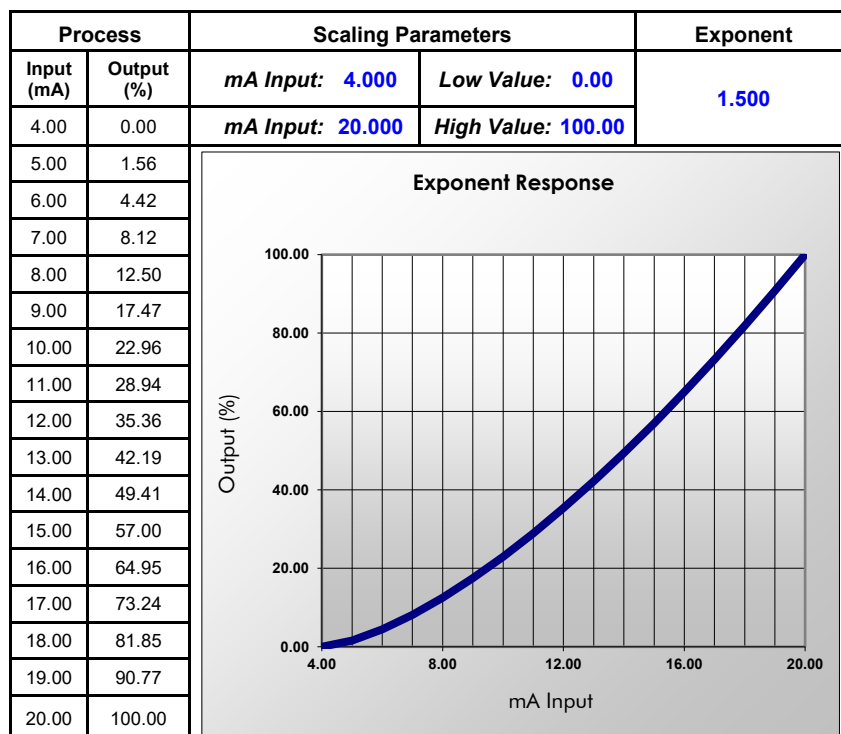


Figure 24. Exponent Response Graph

### Round Horizontal Tank

The *Round Horizontal Tank* (RHT) function calculates the volume of round tank with flat ends, based on the diameter and length dimensions of the tank.

The input source for the channel calculating the volume must be a level channel with units of distance (height). The RHT function linearizes the signal from a level transmitter and displays the volume in engineering units. The graph in Figure 25 shows the display response based on tank example:

Diameter = 48.00 inches

Length = 120.00 inches

For this mode select [*Round Horiz Tank*] from *Function* options.

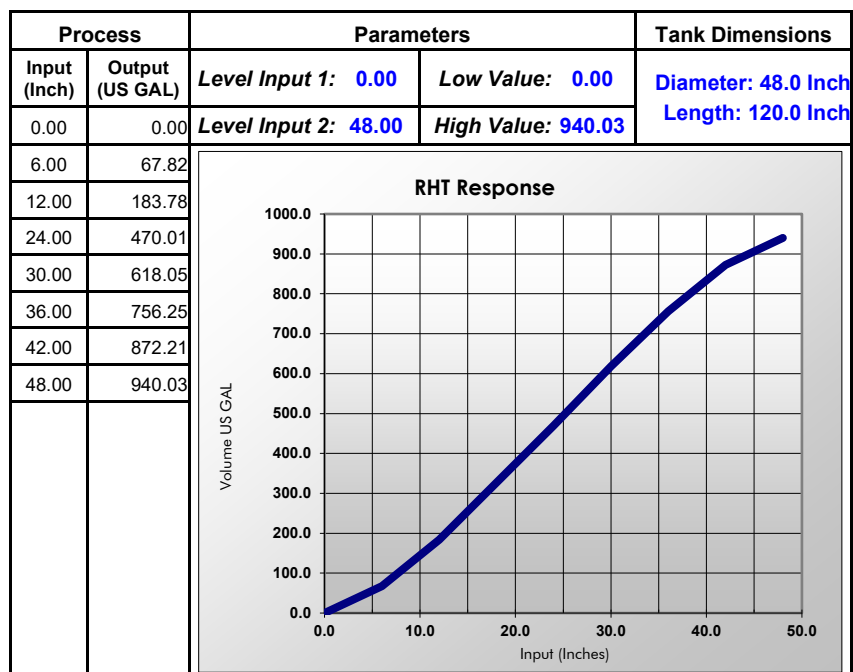


Figure 25. Round Horizontal Tank Volume Graph

## Open Channel Flow Application

The PD9000, in combination with an ultrasonic level transmitter, makes for a practical way to measure and display open channel flow rate and total in most weirs and flumes and take periodic samples. All the user needs to do is enter the exponent for the weir or flume into the PD9000 and the PD9000 automatically raises the input signal to that power. Sampling can be based on the total flow or the flow rate. For instance, to display open channel flow rate and total from a 3-inch Parshall flume and take a one pint sample every 100,000 gallons, the user would program the PD9000 as shown in the table above right.

| Function               | Desire                                           | Programming                                                                            |
|------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------|
| Open Channel Flow      | 3" Parshall flume                                | Set Programmable Exponent to 1.547                                                     |
| Flow Rate 1            | Millions of Gallons per Day (MGD)                | Set 4 mA: 0<br>Set 20 mA: 3.508<br>Create custom unit: MG<br>Time base: day            |
| Total 1                | Millions of Gallons                              | Input: Flow Rate 1<br>Select unit = MG                                                 |
| Sampling Channel 2     | Take a 1 pint sample every 100,000 gallons       | Input: Total 1<br>Function: Sampler<br>Sample Interval: 0.1 MG<br>Sample Time: 10 sec  |
| Sampling Relay 1       | Turn valve on to take a sample                   | Input: Channel 2 (On / Off)<br>Use a timer to count the time needed to take the sample |
| Total 2 Non-Resettable | Program controller so total 2 can never be reset | Input: Flow Rate 1<br>Set total 2 as non-resettable total                              |
| Screen                 | Display flow rate, totals, and relay status      | Set a screen to display rate, total 1, total 2, and relay status.                      |

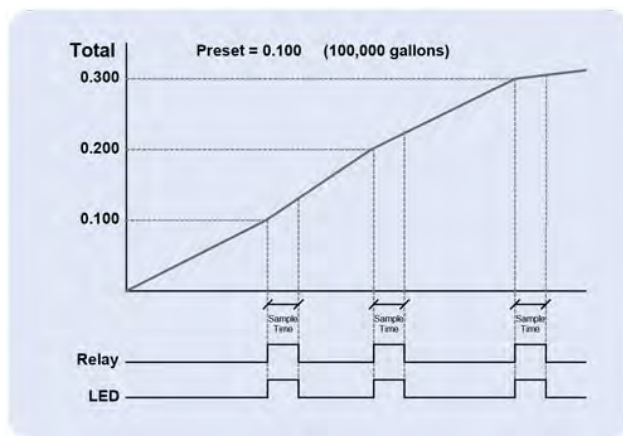


Figure 26. Total Relay Sampling Operation

## Setup Math Functions

There are many math functions that can be applied to any channel, which allows the execution of simple or complex math functions. Math channels can be the source for other math channels, totalizers, alarms, and analog outputs.

### List of Math Functions

1. Constant
2. Summation
3. Difference
4. Absolute Difference
5. Absolute Value
6. Average\*
7. Weighted Average
8. Multiply
9. Divide
10. % Efficiency

\*Average can be used for applications requiring redundancy sensors by selecting the *Exclude Fail Input* feature. Both 4-20 mA inputs must be set to break below a fail level value.

### Additional Functions

#### Scale

K-Factor  
Scale Factor  
Scale Linear 2-Pt  
Scale Multi-Point  
Scale Square Root  
Scale Exponent  
Round Horz Tank  
Units Conversion

#### Compare

Greatest  
Least

#### Measure

Tare  
Maximum  
Minimum  
Percent (Bargraph)  
Duration  
Rate of Change

#### Filter

Window Average  
IIR (First Order)  
Cutoff  
Limits

#### Control

Sampler  
On-Off Control  
Select (A or B)  
Schedule

#### Relays

Cycle Count  
Runtime

#### Modbus

Time Since Read  
Time Since Write

### Application: % Efficiency

Description: Calculate the VOC Destruction Efficiency in a Thermal Oxidizer

Thermal Oxidizer Efficiency =  
(Inlet VOC – Outlet VOC) / Inlet VOC

4-20mA output = 0-100% efficient

Efficiency = ((Ch1 – Ch2)/Ch1)\*100

Ch1 = Inlet VOC

Ch2 = Outlet VOC

AO-1 Source = Ch 20. VOC %Efficiency

AO-1 Scale: 4-20 mA = 0-100% efficiency

VOC: Volatile Organic Components

Select math function for % Efficiency and press **Ok**.

Enter the input sources for the math function, select the units and number of decimals, and press **Ok** and **Save**.

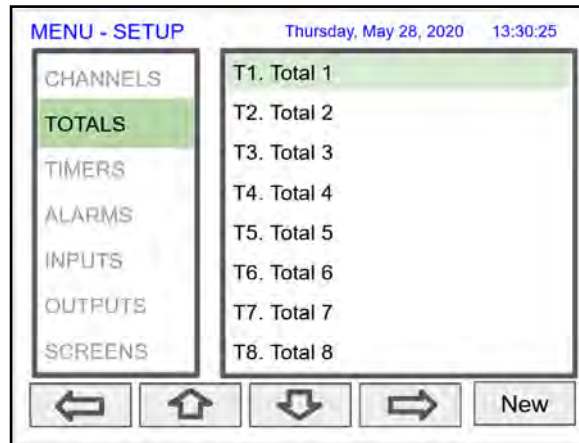
## Setup Totalizers

The totalizers are setup the same way as the channels. The rate from an analog or pulse input channel is integrated over the specified time unit to generate an accumulated total that can be configured to count up or count down. Each total may be configured as "non-resettable"\*, which means the total reset functions are not available for it.

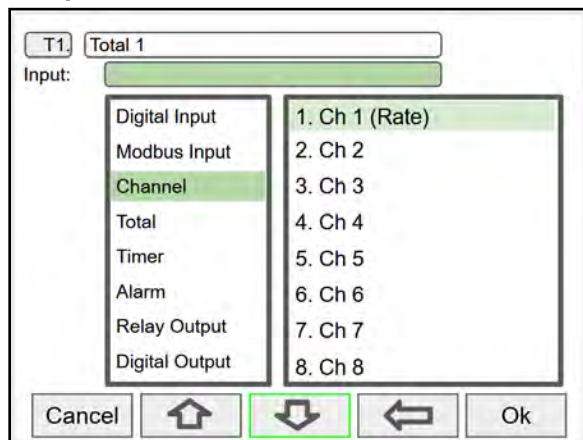
The pulse inputs can be either integrated from a rate channel or they can be directly totaled based on the pulse count and K-Factor value; this is the most accurate method because every pulse is counted.

*\*Note:*

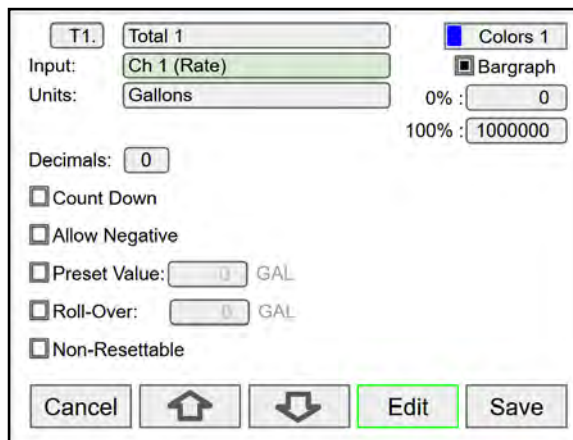
*The non-resettable function can be disabled by the user at any time, after unlocking a password-protected controller.*



### Setup Total with Rate Source



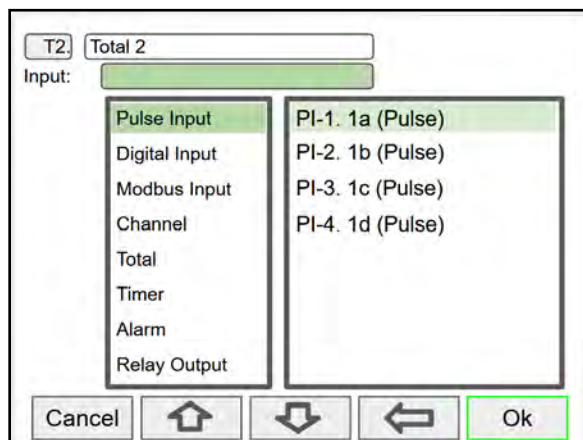
Select the rate input channel for the total and press **Ok**.



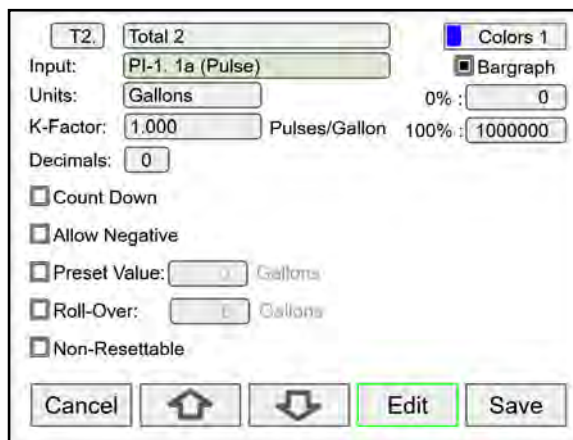
Select total units, count up or down, enter preset and roll-over values, and select non-resettable if required.

*After pressing **Save**, press **Yes** to reset the total to the preset value.*

### Setup Total with Pulse Input Source



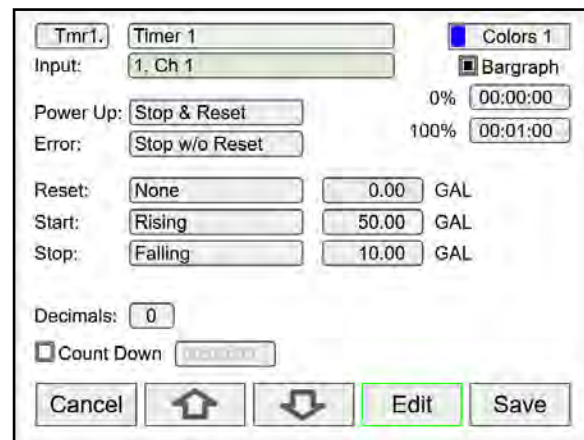
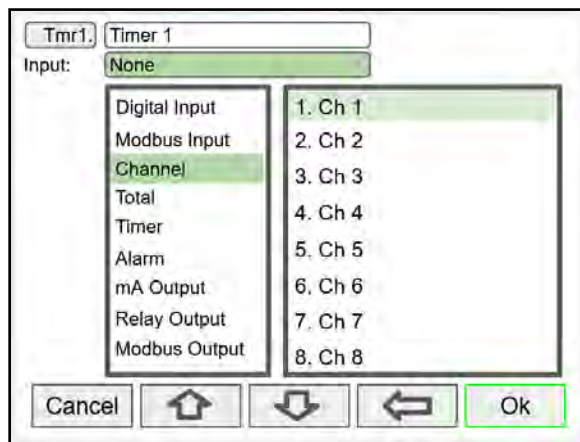
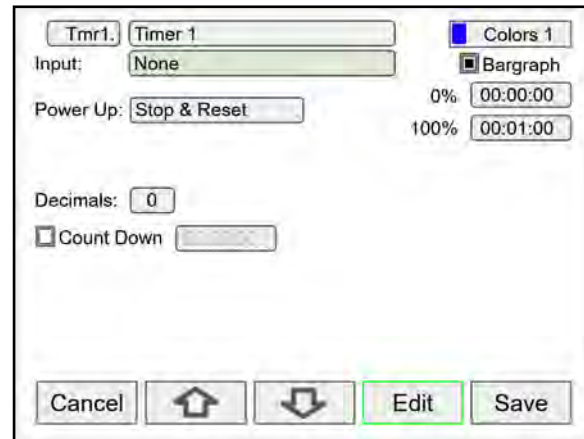
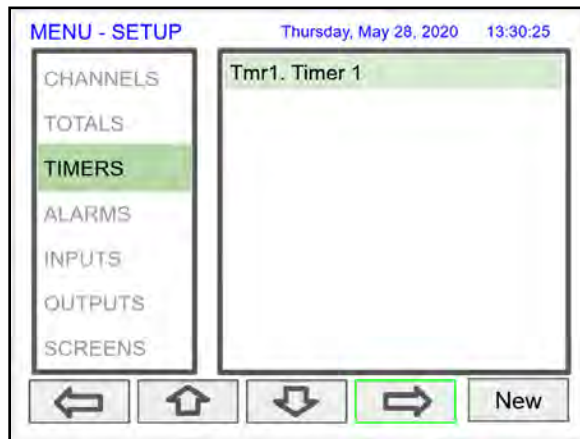
Pulse inputs can be totaled directly without the need to create a rate channel.



Select the units and enter the K-Factor provided by the flow meter manufacturer.

## Setup Timers

Up to 32 timers may be setup to control and monitor various processes. The timers may be triggered by any input or output, such as an analog input rising above a certain threshold or a digital input going from low to high.



### Timer Automatic Actions

The automatic timer actions are:

- Power Up: Timer action on power up
- Error: Timer action when an error is detected
- Reset: Event that causes the timer to reset
- Start: Event that triggers the timer to start
- Stop: Event that causes the timer to stop

### Timer Function Keys & Digital Inputs

The function keys and digital inputs may be used to start, stop, and reset the timers, regardless of the automatic actions selected.

### Time Format

The time format is hh:mm:ss with 0 decimals selected. If decimal is other than 0, the time is displayed in seconds with the number of decimals selected.

### Count Down Timer

Select count down and enter the starting time count.

### Timer Bargraph

The bargraph scaling follows the time format selected based on decimal point.

### Timer Colors

Select the colors for normal and alarm conditions.

### Timer Alarms

Alarms may be setup to trigger on timer values, counting up or down. Go to the *Alarms* menu and select a timer as the source for the alarm.

## Setup Alarms

The system is capable of handling up to 64 alarms; they can be driven by a single channel, multiple channels, digital inputs, time interval, or a combination of other alarms into logic AND & logic OR alarms. Set and reset point values determine if it is a high or low alarm and the dead band. Alarms may be setup as latching or non-latching (automatic) with on and off time delays.

1. Tag: 15-character user-defined
2. Type: Select alarm type
  - Single Source
  - Multi-Source
  - Time Interval
  - Alarms OR
  - Alarm AND
3. Input: This will depend on type selected  
 Type: Single and Multi-Source
  - Digital
  - Modbus
  - Channel
  - Total
  - Timer
 Type: Alarms AND & OR  
 Inputs: Other alarms
4. Automatic: Resets when PV crosses the reset point
5. Ack Anytime (Latching): Ack alarm anytime
6. Break: Alarm status when sensor/comm. break is detected (e.g. Input < 0.01 mA)
  - Alarm On
  - Alarm Off
  - Stay (Maintain the state before the break)
7. On/Off Delays

### Multi-Source Alarm

*This alarm type behaves as a logic OR; if any of the sources crosses the set point, the alarm goes on.*

*If the first source is digital (logic), only sources with digital value (on = 1, off = 0) are available for selection.*

*If the first source is a PV channel or timer, digital inputs may be added as source.*

### Latching & Non-Latching Alarms

| Reset (Ack)               | Ack Anytime | Automatic |
|---------------------------|-------------|-----------|
| Auto & Manual             | X           | X         |
| Auto Only                 | 0           | X         |
| Manual Only               | X           | 0         |
| Manual Only After Cleared | 0           | 0         |

Automatic reset and Ack anytime  
 Relay assigned to Horn activates on alarm condition

Automatic only: Alarm resets automatically at the reset point

Latching: Acknowledge only after the alarm condition has cleared

Manual Ack (Latching): Select Ack Anytime only

### Logic OR Alarm

The inputs for the logic OR alarm are any existing alarms, regardless of the source or type.

Any active alarm in the group triggers the OR alarm.

The OR alarm can be used as a summary alarm.

The screenshot shows the configuration screen for alarm A13, titled "Hi Alarm OR". The "Type" is set to "Alarm OR". The "Inputs" list contains four entries: "1. High Alarm 1", "2. High Alarm 2", "3. High Alarm 3", and "4. High Alarm 4". On the right, there are checkboxes for "Sound Horn", "Alert!", "Automatic", and "Ack Anytime", all of which are checked. Below these, the "Break" is set to "Alarm Off", and both "On Delay" and "Off Delay" are set to "0.0 sec". At the bottom, there are buttons for "Insert", a home icon, a down arrow icon, "Edit", and "Ok" (which is highlighted with a green border).

### Logic AND Alarm

The inputs for the logic AND alarm are any existing alarm, regardless of the source or type.

All alarms in the group must be active to trigger the AND alarm.

The screenshot shows the configuration screen for alarm A14, titled "Hi Alarm AND". The "Type" is set to "Alarm AND". The "Inputs" list contains four entries: "1. High Alarm 1", "2. High Alarm 2", "3. High Alarm 3", and "4. High Alarm 4". On the right, there are checkboxes for "Sound Horn", "Alert!", "Automatic", and "Ack Anytime", all of which are checked. Below these, the "Break" is set to "Alarm Off", and both "On Delay" and "Off Delay" are set to "0.0 sec". At the bottom, there are buttons for "Insert", a home icon, a down arrow icon, "Edit", and "Ok" (which is highlighted with a green border).

### Logic NOR & NAND Alarms

To create a NOR alarm, select an existing OR alarm and apply the **Not** function available during Setup – Edit.

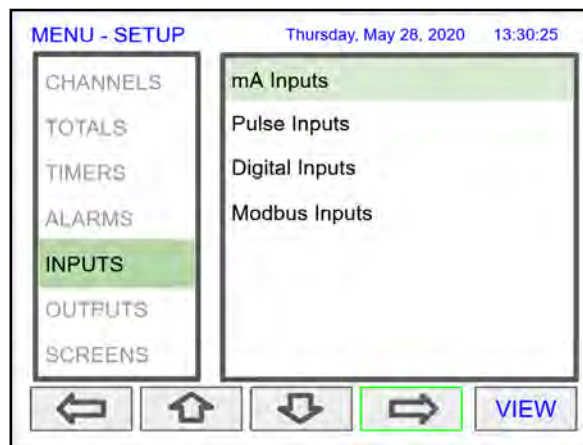
The same applies to the NAND alarm.

Any input alarm may be inverted (Not) to create a specialized alarm logic.

The screenshot shows the configuration screen for alarm A15, titled "Hi Alarm NOR". The "Type" is set to "Alarm OR". The "Inputs" list contains one entry: "13. Hi Alarm OR" with a "Not" checkbox checked next to it. On the right, there are checkboxes for "Sound Horn", "Alert!", "Automatic", and "Ack Anytime", all of which are checked. Below these, the "Break" is set to "Alarm Off", and both "On Delay" and "Off Delay" are set to "0.0 sec". At the bottom, there are buttons for "Insert", a home icon, a "Not" button (highlighted with a green border), "Edit", and "Ok".

## Setup Inputs

The *Setup Inputs* screen is used to configure the hardware inputs, assigning a user-defined tag, and setting filter values.



### Setup 4-20 mA Inputs

The top line, for each input, shows the slot # and input location (2b = slot #2, second input from the left). It also shows the actual current input.

The next line shows the input type and # (AI-2) with the default tag, which can be changed at any time.

- Filter\*: Select filter time
- Bypass: If the signal change is greater than the bypass value, the reading jumps to the actual value  $\pm$  Bypass % of full scale.
- Glitch Filter: Eliminates short duration noise spikes
- Break Below: Set the mA value at which a break is reported to the system.
- Disable Input Channel: This turns off the power to the input, but the settings are saved for future use. This should only be used to save power on unused inputs.

*\*Need more filtering?  
If you need a more stable reading,  
select IIR 16 sec or IIR32 sec setting.*

| Input   | Reading   |
|---------|-----------|
| 2a (mA) | 4.002 mA  |
| 2b (mA) | 12.301 mA |
| 2c (mA) | 2.902 mA  |
| 2d (mA) | 16.042 mA |
| 3a (mA) | 4.002 mA  |
| 3b (mA) | 4.003 mA  |
| 3c (mA) | 11.189 mA |
| 3d (mA) | 4.717 mA  |

2b. mA Input 12.301

AI-2: 2b (mA)

Filter: WIN 4 sec

Bypass: 0.5 Percent of Full Scale

☐ Glitch Filter

☐ Break Below: 0.010

☐ Disable Input Channel

Cancel Edit

## Setup Pulse Inputs

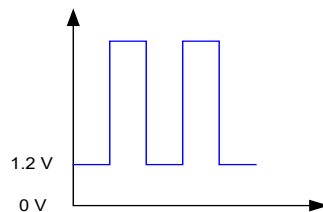
The top line, for each input, shows the slot # and input location (1a = slot #1, first input from the left). It also shows the actual frequency, state of the input, and the number of pulses received since power up, to a maximum of 65,535.

The next line shows the input type and # (PI-1) with the default tag, which can be changed at any time.

- Type: Select the pulse input type.
- Low Gate: this is the time window used to calculate and update the rate.
- High Gate: This is the time window used to calculate slow rates before the rate goes to zero.
- Low Speed: This setting is used as a de-bounce filter for contact closure or switch inputs.

### Threshold:

*Is the voltage level at which a transition from high to low is detected. For example, the "Active 1.2V Thrshld" setting will detect a square wave signal when it falls below 1.2 V.*



1a: Pulse Input 9999.99 Hz

PI-1: 1a (Pulse) Counter: 065535

Type: Active 1.2V Thrshld

Low Gate: 1

High Gate: 2

☐ Low Speed, 100 Hz max

Edit

1a: Pulse Input

PI-1: 1a (Pulse)

Type: Active 1.2V Thrshld

Low Gate: 1

High Gate: 2

☐ Low Speed, 100 Hz

Active 1.2V Thrshld

NPN 1.2V Thrshld

PNP 1.2V Thrshld

Reed Switch

Coil 20 mV Thrshld

Active 2.5V Thrshld

NPN 2.5V Thrshld

PNP 2.5V Thrshld

Coil 100 mV Thrshld

Ok

## Setup Digital Inputs

The digital inputs may be assigned to perform various user functions, such as trigger alarm, acknowledge alarms, reset total, etc.

Pulse inputs may be used as digital inputs by setting them up according the type of input they are intended to accept. For example, to accept a contact closure the pulse input must be setup for *Reed Switch* type input.

Setup Digital Input

|                       |     |
|-----------------------|-----|
| DI-1. Digital Input 1 | OFF |
| DI-2. Digital Input 2 | ON  |
| DI-3. Digital Input 3 | OFF |
| DI-4. Digital Input 4 | OFF |
| DI-5. Digital Input 5 | ON  |
| PI-1. 1a (Pulse)      | ON  |
| PI-2. 1b (Pulse)      | ON  |
| PI-3. 1c (Pulse)      | ON  |
| PI-4. 1d (Pulse)      | ON  |

→

## Digital Input Functions

Digital Input

DI-1: Digital Input 1

☒ Active Low

Function: None

Cancel [Up Arrow] [Down Arrow] **Edit** Ok

A digital input can be used to execute one of the listed functions and at the same time, it can be used to trigger an alarm or to totalize (count) how many times the function has been executed (e.g. Reset Total).

- None: Use digital input (DI) to trigger an alarm or timer
- Button: Digital input behaves as a front panel button
- Channel: Tare, Reset Tare, Reset Max, Reset Min
- Total: Access total functions
- Timer: Access timer functions
- Alarm: Access functions (Ack, Reset, Set Points)
- Screen: Next, Previous, Stop/Scan
- Horn: Silence, Snooze, Test
- Relay: Reset relay information

*Note: The elements to be acted upon must be created before trying to setup the digital input; otherwise it is not available in the list of functions to execute. For example, to assign the digital input to tare a channel, a Tare Channel must be created first.*

Digital Input

DI-1: Alarm

☒ Active

Function: Alarm

Ack Alarm  
Reset Alarm  
Set Points

Cancel [Up Arrow] [Down Arrow] [Left Arrow] **[Right Arrow]**

Digital Input

DI-1: Alarm - Ack Alarm

☒ Active

Function: Ack Alarm

Reset Alarm  
Set Points  
All  
A1. High Alarm 1  
A2. High Alarm 2  
A3. High Alarm 3  
A4. High Alarm 4  
A5. High Alarm 5  
A6. High Alarm 6  
A7. High Alarm 7

Cancel [Up Arrow] [Down Arrow] [Left Arrow] **Ok**

*Alarm Reset: The alarm condition is cleared, allowing the alarm to trigger again based on input.*

*Acknowledge: Input must cross reset point to trigger new alarm.*

## Setup Modbus Inputs

The controller can accept up to 199 Modbus inputs that may be used as the source for channels, math functions, alarms, relay control, etc. Once the data type is selected, the register number is displayed to the right.

- Enter Modbus Input tag
- Type: Select the data type
- Decimals: Number of decimals
- Units: Select units or enter custom unit
- Break: Value or condition for comm. break
- Timeout: Select timeout to detect break
- Input Action: Select action when new value is received (e.g. Add to Total 1 the value written)

### Data Types

Bit – Logic (Coil)  
Signed/Unsigned 16 (Short), 32 (Long), 64 (Long Long)  
Float 32, Float 64 (Double)

MB-1: MB Input 1

Type: Float 32 Reg. No. 46701, 46702

Decimals: 2

Units: GAL

Break: Default Default: 0.00 GAL

☐ Timeout:

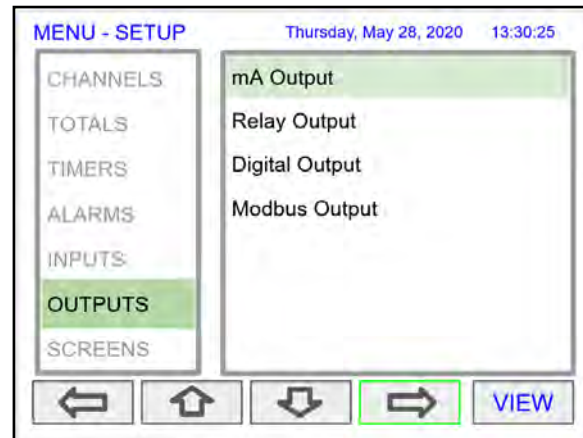
Input Action: Add To T1. Total 1

Cancel [Up Arrow] [Down Arrow] **Edit** Save

## Setup All Outputs

The Setup Outputs screen is used to configure the hardware outputs, assigning a user-defined tag, scaling the mA outputs, associating relays with alarms, and configuring the digital outputs.

- mA Output: Configure analog outputs
- Relay Output: Configure relay outputs
- Digital Output: Configure digital outputs
- Modbus Output: Configure Modbus outputs



## Setup 4-20 mA Outputs

The mA output may be assigned to any analog input, channel, alarm, or digital input. It may be scaled to any input and output value.

The top line indicates the slot # and position of the analog output (4a = slot #4, first position from the left). It also displays the actual mA output.

- AO-1: Analog output 1
- Input: Select source for the mA output
- Scale: Enter input and output values
- Break: mA output when sensor or communications break is detected
- Minimum: The minimum output allowed
- Maximum: The maximum output allowed
- Slew Rate: Rate of change in mA/sec
- Underrange: mA value when the PV goes below the low range value by more than 1%.
- Overrange: mA value when the PV goes above the high range value by more than 1%.

The screenshot shows the '4a: mA Output' configuration screen. At the top right, it displays '19.998'. The configuration fields are as follows:

- AO-1:
- Input:
- Scale:
 

|    | Input (Gallons)                      | Output (mA)                         |
|----|--------------------------------------|-------------------------------------|
| 1. | <input type="text" value="0.0"/>     | <input type="text" value="4.000"/>  |
| 2. | <input type="text" value="10000.0"/> | <input type="text" value="20.000"/> |
- Break:  ☒ Slew Rate:
- ☒ Minimum:  ☒ Underrange:
- ☒ Maximum:  ☒ Overrange:

At the bottom are five buttons: 'Cancel', a home icon, a down arrow, an 'Edit' button (highlighted with a green box), and 'Save'.

## Setup Relay Output

The relays can be driven by alarms, digital inputs, Modbus inputs, channels, totals, and timers. If the input source is a channel, set and reset points must be entered. These are the available settings depending on the source selected.

- Input: Select the source to drive the relay
- Set & Reset: Enter values to turn on & off the relay for Channel, Total, or Timer Input
- Pulse Output: Pulse relay on/off when set is active
- Break\*: The relay state when break is detected
- Fail-Safe: Relay energized under normal conditions
- Relay Status & Runtime: hh:mm:ss

*Function: Select **Other** to set relay to always on, always off, drive a relay-horn, or to alternate with another relay.*

| Relay           | Status |
|-----------------|--------|
| RY-1. Relay 1   | ON     |
| RY-2. Relay 2   | ON     |
| RY-3. Relay 3   | OFF    |
| RY-4. Relay 4   | OFF    |
| RY-5. Relay 5   | ON     |
| RY-6. Relay 6   | ON     |
| RY-7. Relay 7   | OFF    |
| RY-8. Relay 8   | OFF    |
| RY-9. Relay 9   | ON     |
| RY-10. Relay 10 | OFF    |

Buttons: Cancel, Home, Up, Down, Right, RY-1 OFF

The F4 key may be used to momentarily turn on/off the relays. To manually control the relays, go to the View Menu to set the relay to be permanently on or off.

Select the input source to drive the relay and enter the required parameters according to the input.

6a: Relay Output  
RY-1: 6a. (Relay)  
Input: A1. High Alarm 1

|               |                  |
|---------------|------------------|
| Digital Input | A1. High Alarm 1 |
| Modbus Input  | A2. High Alarm 2 |
| Channel       | A3. High Alarm 3 |
| Total         | A4. High Alarm 4 |
| Timer         | A5. High Alarm 5 |
| Alarm         | A6. High Alarm 6 |
| Other         | A7. High Alarm 7 |

Buttons: Cancel, Home, Up, Down, Left, Ok

## Relay Assigned to Alarm

6a: Relay Output  
RY-1: 6a. Relay 1  
Input: A1. High Alarm 1  
Runtime: 659:20:50

☐ Enable Alternation

On Delay: 0.0 sec  
Off Delay: 0.0 sec

☐ Pulse Output  
On Time: 0.0 sec  
Off Time: 0.0 sec

☐ Fail-Safe

Buttons: Cancel, Home, Up, Down, Edit, Rset RY-1

The relay runtime & cycle count can be reset (cleared) from the relay setup screen.

*\*Note: Break needs to be set in the analog input menu.*

## Relay Assigned to Channel

6b: Relay Output  
RY-2: 6b. Relay 2  
Input: Ch 2

☐ Enable Alternation

Set (On): 200.0 GAL/sec  
Reset (Off): 150.0 GAL/sec

On Delay: 0.0 sec  
Off Delay: 0.0 sec

☐ Pulse Output  
On Time: 0.0 sec  
Off Time: 0.0 sec

Break: Off

☐ Fail-Safe

Buttons: Cancel, Home, Up, Down, Edit, Save

Relays not assigned to alarms are used for automatic on/off control based on set & reset point; they cannot be acknowledged.

### Pump Alternation Relays

To setup a group of relays for pump alternation control, follow these steps.

1. Select the primary alternating relay
2. Select the input for alternation (e.g. Ch 1)
3. Enable alternation
4. Enable alternate on time and enter time
5. Enter the On & Off alternation points according to the number of relays to alternate
6. Select relay condition when input break is detected\*
7. Select fail-safe, if desired (Reverses the relay contacts state: NO closes and NC opens)
8. Enter the On & Off time delays
9. After saving the primary relay configuration, navigate to the next relay and configure it to alternate with the primary relay

Setup the primary alternation relay.

### Alternation Input Sources

Most level control applications use channels as the input. The channel is setup to read the signal from a level transmitter and display the level either in height or volume units. The continuous level monitoring allows for selecting multiple alternation points.

If the input is other than a channel, the alternation is limited to only one pump on at one time. A level switch could be connected to a digital input and the digital input will alternate the pumps for each on/off cycle.

### Set (On) & Reset (Off) Points

Up to eight alternation points may be entered to alternate eight relays per group. The On & Off points determine if pumps are on when the level rises or when it falls.

### On & Off Time Delays

To prevent turning pumps off and on at the same time, it's recommended to use On delays. The On & Off delays are common to all the relays in the alternation group.

### Alternation Groups

An alternation group is made up of a primary relay and any number of relays selected to alternate with it.

Multiple alternation groups may be setup using different sources for each group. A relay should NOT be assigned to more than one group.

### Alternate on Time

This is the maximum time any relay in the group will be continuously on. After the alternation time has elapsed, the relay will turn off and another relay will turn on. This feature is useful for applications where the level is maintained with one pump for a long time. Depending of the setup and conditions, it will help distribute the load among the pumps in the group.

### Break

If *Relay On* is selected, only one of the alternation relays will be on when a break is detected\*.

\*Note: Break needs to be set in the analog input menu.

Setup the additional alternation relays.

Select the primary relay to alternate with.

### Alternation Sequence

The first relay on is the first relay off, when more than one relay are activated. The lowest reset point (Off) is used for the alternation cycle.

### Setup Digital Output

The Digital Output menu allows assigning the 4 outputs to various events generated by digital inputs, On/Off channels, alarms, and horn on state.

- Edit the digital output tag
- Select the input
- Select the Break condition
- Invert Output logic

### Setup Modbus Output

The *Modbus Output* menu allows assigning up to 64 Modbus register sets (1 to 4) to output any of the values available in the system (e.g. PV channels, Totals, Relay Runtime, etc.) and selecting the desired data type from bit-logic to float 64.

The function code is 0x03 and the registers are base-1 (e.g. Reg. Address 4400 = Reg. Number 44401).

- Edit the Modbus Output tag
- Select the source for the output
- Select the data type
- The register number is assigned by the system

Select the input for Modbus Output.

Select the data type.

The register number is provided for each data type.

## Setup Screens

The *Setup Screens* menu is used to setup the screens that will be displayed during operation and to setup the actions assigned to the function keys F1-F4.

### Screens Settings

Up to eight PVs and/or alarms may be displayed per screen. The screens can be setup to scan automatically, display bargraphs, and program the function keys to be used while the screen is visible.

These are the available settings:

- Title: User-defined title or tag
- Channels and alarms: Up to eight/screen
- Show Title: Select to display the title
- Show Channel #: Select to display the channel #
- Show Bargraphs: Select to display the bargraphs
- Bargraph Only: Select to display only the bargraphs
- Auto Scan: Select to scan the screens automatically
- Dwell Time: Number of seconds the screen is displayed before moving to the next screen
- F1 – F4: Assign functions to be executed by the function keys

*Note:*

*The function keys F1 – F4 can be customized according to the screen in view.*

### Setup Function Keys

The function keys are setup independently for each screen; this allows the customization of the function keys according to the process values being displayed. For example, if totals are being displayed, one function key can be setup to reset one or all totals.

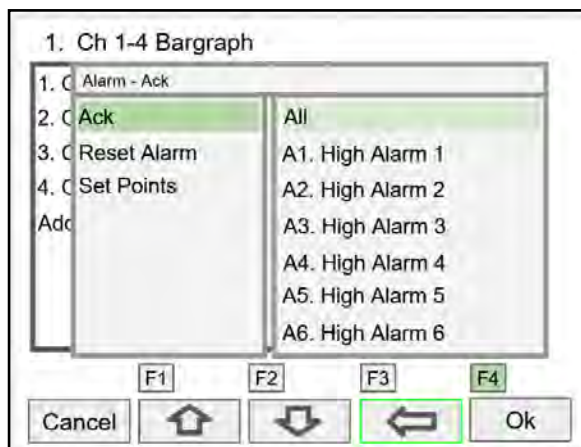
**Note:**

*Functions are available for selection only if the appropriate parameter has been set up. Example: If there are no channels with Tare, Max, or Min, Channel will not appear in the list for selection of a function.*

- Channel
  - Tare (If applicable)
  - Minimum
  - Maximum
- Total
  - Reset Total
  - Reset (Confirm)
  - Enter Total
  - Add To
  - Remove From
- Timer
  - Timer Control
  - Reset
  - Start (Reset)
  - Start (No Reset)
  - Stop (Reset)
  - Stop (No Reset)
  - Start (R) / Stop
  - Start / Stop
  - Start / Stop (R)
  - Start (R) / Stop (R)
  - Start / Reset
  - Stop / Reset
- Alarm
  - Ack
  - Reset Alarm
  - Set Points
- Screens
  - Previous Screen
  - Next Screen
  - Scan / Stop
  - Go to Screen
  - View Channel
  - View Total
  - View Timer
  - View Alarm
  - View Date & Time
  - View mA Input
  - View Pulse Input
  - View Digital Input
  - View Modbus Input
  - View mA Output
  - View Relay Output
  - View Digital Output
  - View Modbus Output

**Note:**

*The View function can be used to go to any of the listed parameters or to the View screen for all parameters of the same type (e.g. View - all the channels).*



F4 Assigned to Acknowledge All Alarms

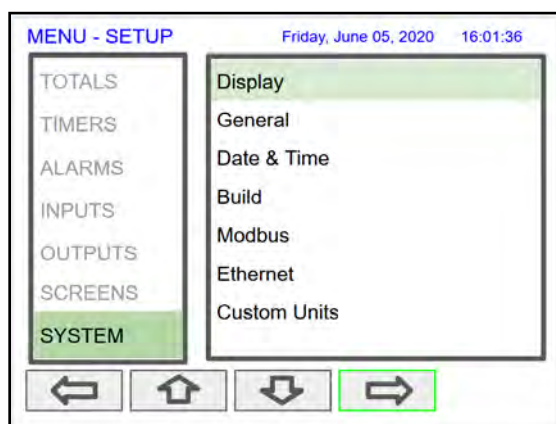
- Simulate
  - mA Input
  - Pulse Input
  - Digital Input
  - Modbus Input
  - Channel
  - Total
  - Timer
  - Alarm
- Horn
  - Silence
  - Snooze
  - Test
- mA Output
  - Manual
  - Hold (Manual)
  - Automatic
  - Manual / Auto
  - Hold / Auto
- Relay
  - Reset Info
  - Reset Info (Confirm)
  - Force ON
  - Force OFF
  - Manual ON
  - Manual OFF
  - Hold (Manual)
  - Automatic
  - Manual ON / Auto
  - Manual OFF / Auto
  - Hold / Auto

## Setup System

The *Setup System* menu is used to configure settings that are used throughout the system.

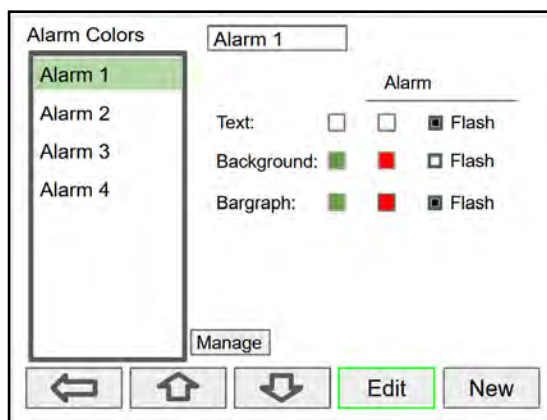
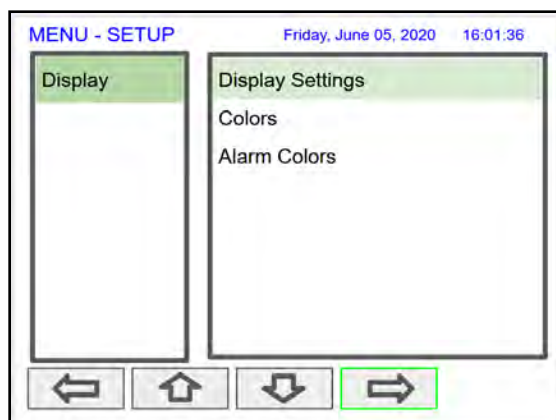
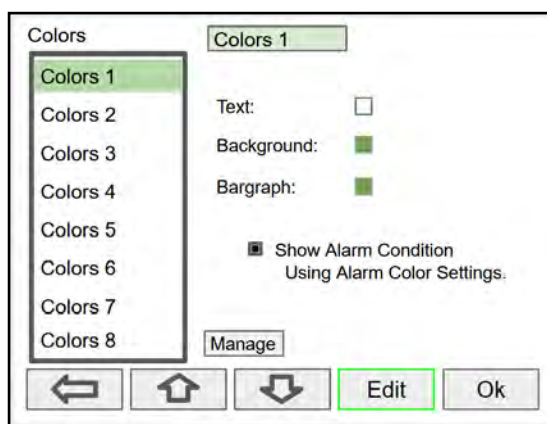
### Setup Display

The System *Display* menu is used to adjust the display settings, setup colors for parameters, bargraphs, and alarms.



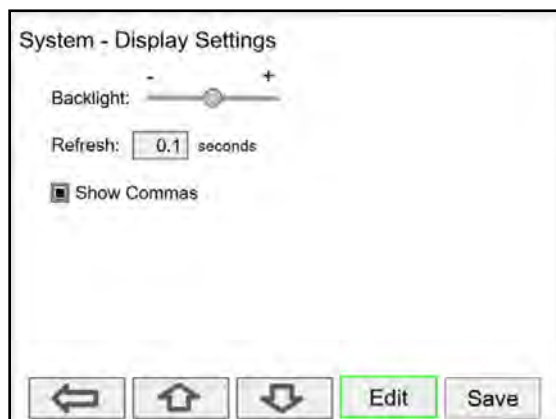
### Setup Colors

The *Colors* menu is used to select the colors for text, values, and bargraphs associated with the parameter being displayed.



The *Alarm Colors* menu is used to select the colors and behavior of the alarms' text, alarm panel background, and the bargraph indicator for set and reset points.

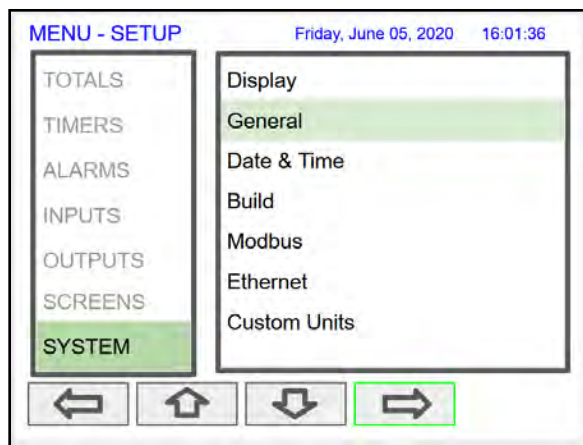
### Display Settings



The *Display Settings* menu is used to adjust the backlight brightness, refresh rate and to enable or disable the display of commas for all numeric values.

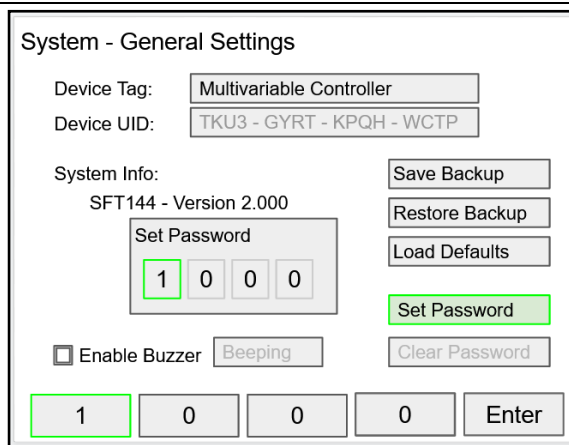
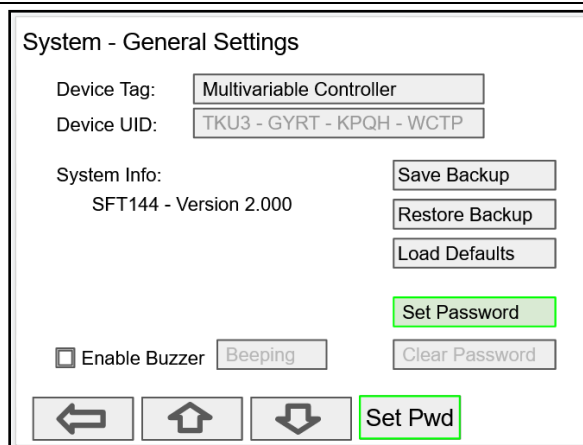
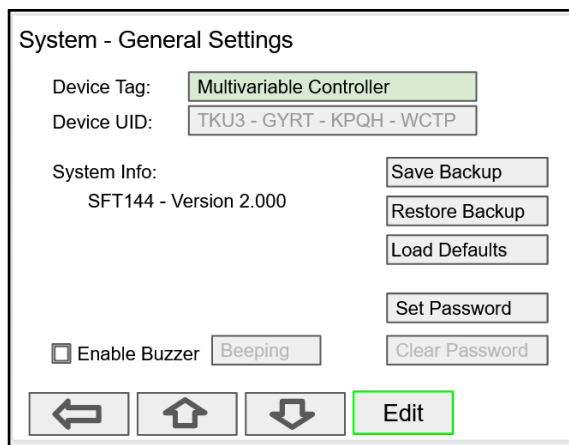
## General Settings

The *General Settings* menu contains the settings listed below.



## Set Password

The user may enter a 4-digit password to protect the system from unintentional changes.



- Device Tag: Edit the device tag (saved on Enter)
- Device UID: Device unique Id
- Enable Buzzer: Enable/disable internal buzzer\*
- Save Backup: The current configuration is saved
- Restore Backup: Load backup configuration
- Load Defaults: Load factory defaults
- Set Password: Enter password to lock the system
- Clear Password: Remove the current password

\*Buzzer Sound Options:

Beeping  
Alarm  
Solid  
Warble  
Carousel

*Note: The internal buzzer is associated with the alarm's Horn setting, which is available to drive any relay.*

## Password Protected Controller

The correct 4-digit password is required to make changes to the system.

If the password is not correct after 3 attempts, the system will not allow new tries until a timeout elapses. The timeout will continue increasing for every 3 new unsuccessful tries.

## Remove Password Protection

To remove the password protection:

1. Enter the correct password
2. Go to the **System** menu – **General Settings**
3. Navigate to the **Clear Password** button
4. Press the **Clr Pwd** key

### CAUTION

- The function keys and the digital inputs are not password protected.

## System Date & Time

The date & time of the system can be easily adjusted in the System menu.

## Modbus Settings & Passcode Protection

The *Modbus* settings must be configured to match the settings of other devices on the bus. The Modbus Id must be unique to each device on the bus.

Select **Passcode** and enter a Modbus passcode between 0 and 9999 to prevent unauthorized writes to the controller.

This is different than the main password used to protect access to the *Setup* and *View* menus.

## System Build

The *Build* menu provides the model number and it shows the I/O cards installed with their location in the seven available slots.

| Slot # | Description         | SFT # | Ver.  |
|--------|---------------------|-------|-------|
| 1.     | (4) Pulse Inputs    | 146   | 1.000 |
| 2.     | (4) 4-20 mA Inputs  | 145   | 1.000 |
| 3.     | (4) 4-20 mA Inputs  | 145   | 1.000 |
| 4.     | (5) 4-20 mA Outputs | 146   | 1.000 |
| 5.     | 5) 4-20 mA Outputs  | 146   | 1.000 |
| 6.     | 5) Relay Outputs    | 146   | 1.000 |
| 7.     | 5) Relay Outputs    | 146   | 1.000 |

If an I/O card is removed permanently, pressing the *Rebuild* key clears the information from the slot. This should also be done if a different card is installed.

## Replacing I/O Cards

In case that an I/O card fails, follow these steps:

- 1) Save a backup copy of the configuration
- 2) Remove the defective card
- 3) Install the new card in the same slot where the defective card was
- 4) It is not necessary to click Rebuild

## Ethernet Settings

The *Ethernet* menu provides basic information about the Ethernet port and allows the user to program a static IP Address, the port number, and the protocol to be used.

The settings provided in *System* menu are sufficient to establish Ethernet communications using TCP or UDP protocols.

For more advanced setup, refer to the instructions provided under *Ethernet Port Setup* on page 54.

### Note:

*If DHCP is selected, the device obtains a new IP address automatically most of the time when the power is cycled. This is not displayed on the controller.*

## Ethernet Port Setup - Full

The Ethernet port option is fully configured using the Lantronix DeviceInstaller software, available for download from the Lantronix's Website.

### CAUTION

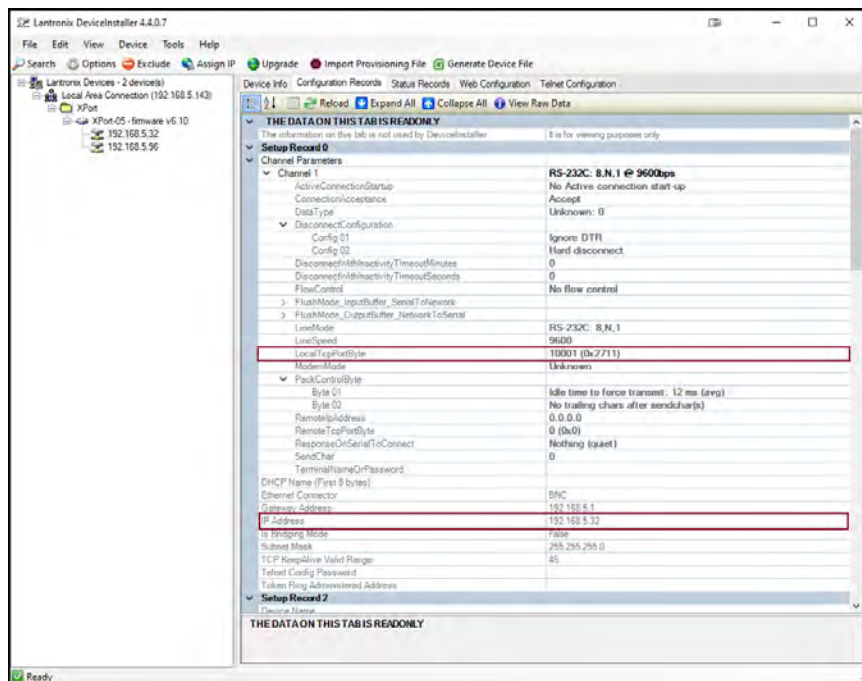
- Consult with your IT department to configure the Ethernet port and maintain network security.

Follow these steps, after installation of the DeviceInstaller software.

1. Connect an Ethernet cable to the Local Area Network
2. Launch the Lantronix DeviceInstaller; it will search for XPort devices on the Local Area Network (LAN) and display their status.
3. If no controller is found, click on **Options**, and select the type of connection being used (e.g. Wi-Fi).
4. If more than one controller is connected to the network, determine which is the new controller by the assigned IP address. If necessary, disconnect the new controller and click **Device – Search**, take note of the IP addresses listed. Next, connect the new controller to the LAN and repeat the search; check the list to see which the new IP address is.

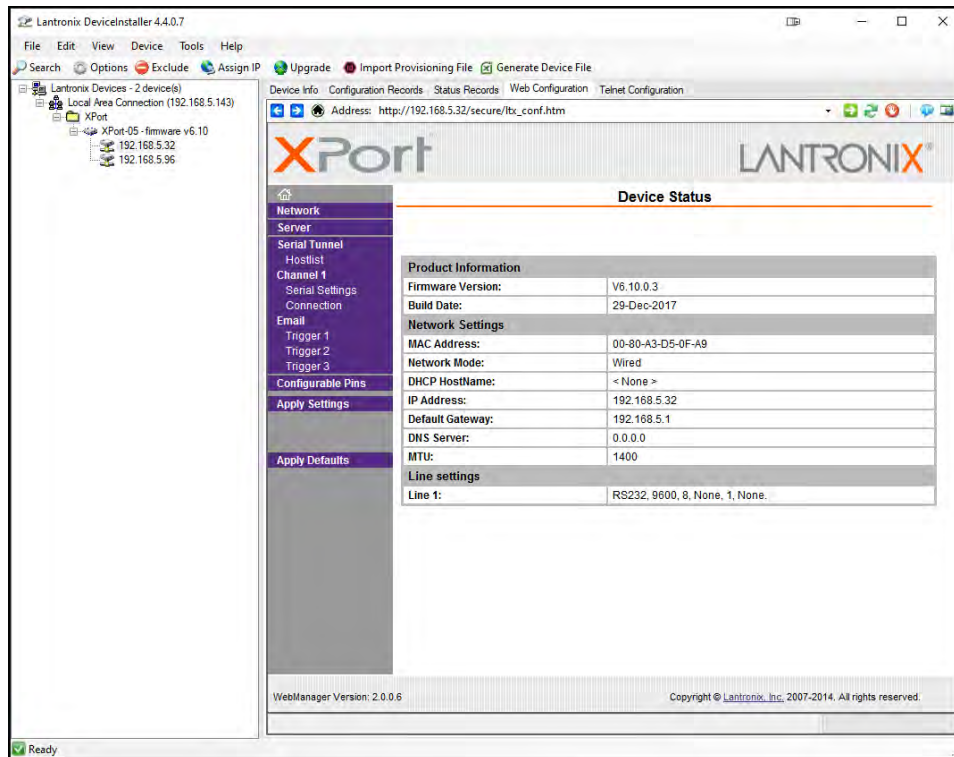


5. Double-click on the new device IP Address to be configured.

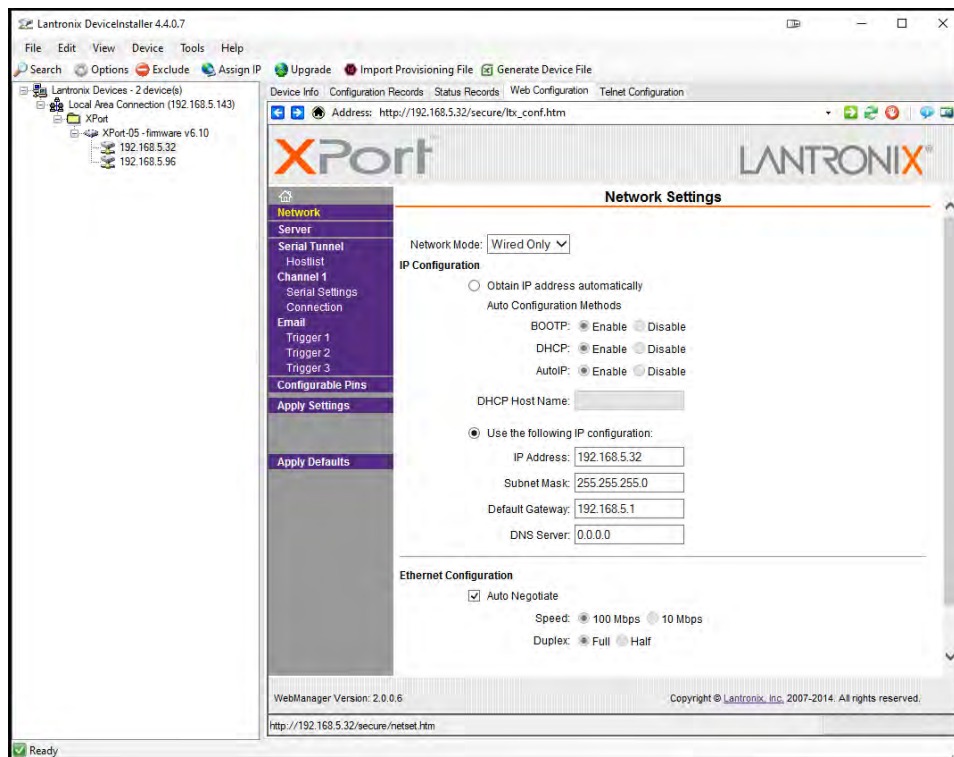


To communicate with a device connected over a LAN, you need the IP Address and the Local TCP Port.

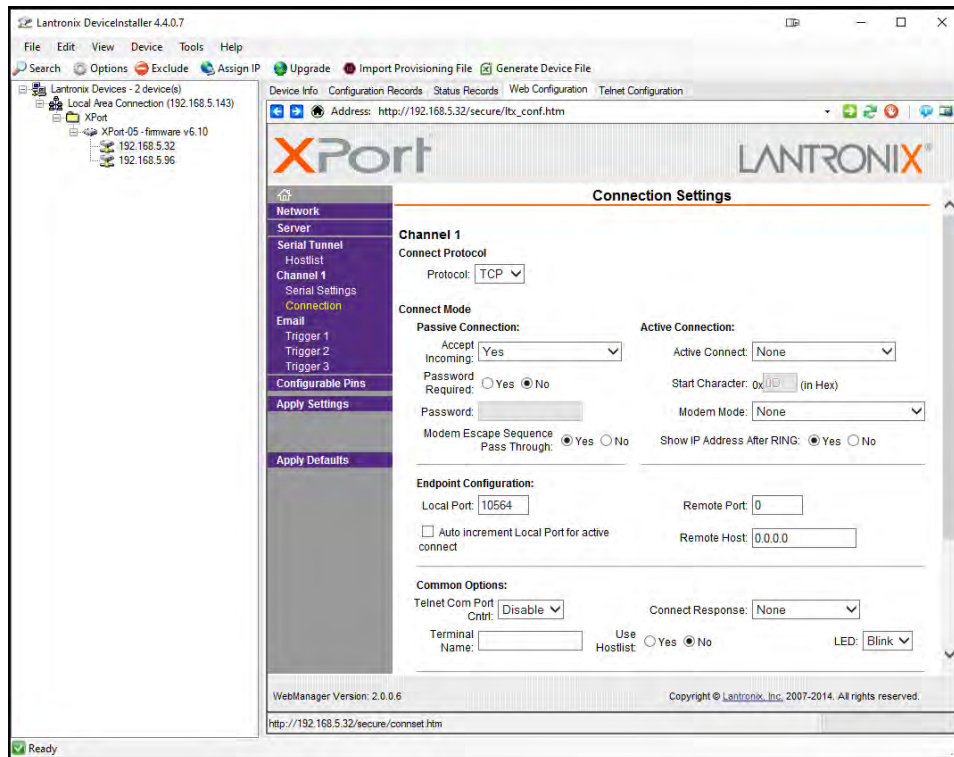
6. Click on **Configuration Records** to find these settings, see the example above.  
IP Address: 192.168.5.32; Local TCP Port: 10001 (0x2711)



7. Click on **Web Configuration**



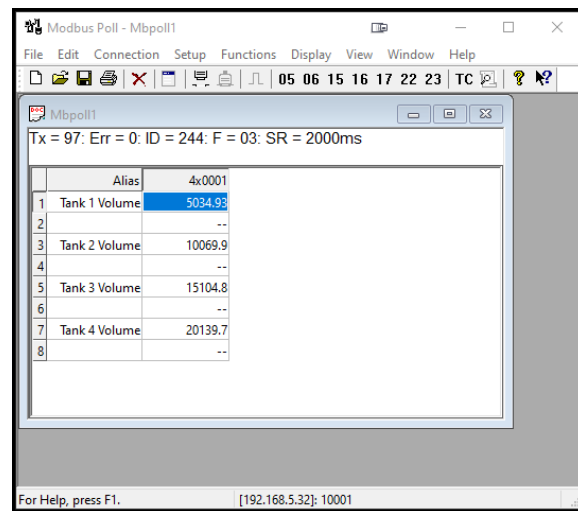
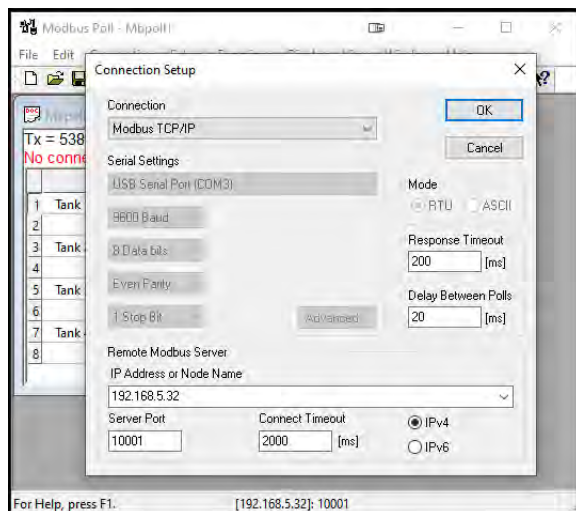
8. Click on **Network** to assign a new IP Address



9. Click on **Channel 1 – Connection** to select the protocol: TCP or UDP.  
Note: For UDP protocol, select **Datagram Type: 01**
10. Under **Endpoint Configuration**, enter the **Local Port** to be used to access the controller locally or from a remote location. This should be provided by your company's IT department.
11. Click **OK** and then click **Apply Settings** for settings to be sent to the Ethernet device.

## Test Ethernet Communication

Modbus Poll is an app that makes it easy to test your Ethernet connection. Below are some screenshot examples for Modbus TCP/IP connection.



## Custom Units

Custom units made be created either in the System menu or when a parameter is created. Follow these steps to create a custom unit:

- Go to the *System* menu – *Custom Units*
- Select *New*
- Enter a label for the unit (8 characters max)
- Select the unit type or *None*
- Select the base unit
- Enter the conversion factor

Custom Units

5-Gallon Volume

Custom Unit:

Label: 5-Gallon

Type: Volume

Base: Gallons

Factor: 0.2

Cancel [Home Icon] [Down Arrow Icon] Edit Ok

## Delete Custom Units

Custom units can only be deleted if they are not been used anywhere in the system.

To delete a custom unit, simply select the unit, navigate to the Delete button, and press *Ok* to delete.

The Delete button is not available if the custom unit is being used.

Custom Units

5-Gallon Volume

Bucket Volume

Custom Unit:

Label: 5-Gallon

Type: Volume

Base: Gallons

Factor: 0.2

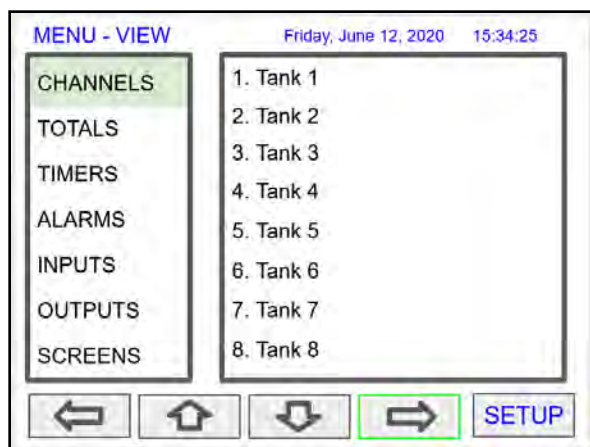
Delete

Cancel [Home Icon] [Down Arrow Icon] Delete Ok

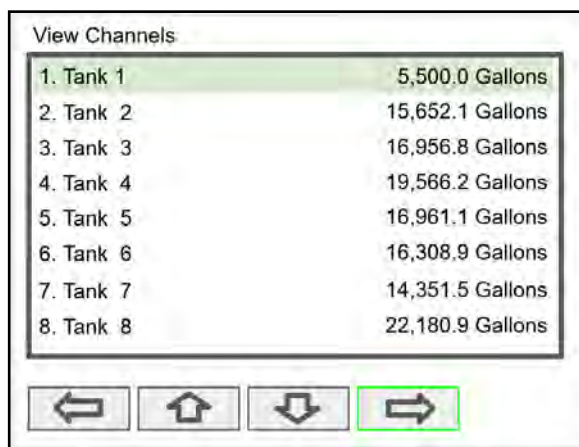
## View Menu

The *View* menu is used to view individual channels, totals, timers, alarms, inputs, outputs, and screens. For example, it provides the details for the current PV, what inputs are the sources for the channel and what outputs are associated with the channel.

Accessing the individual parameters through the *View* menu also allows the simulation of the various parameters for testing purposes as well as the manual control of the relays and analog outputs.



Press the **Right Arrow** key to step into viewing any channel.

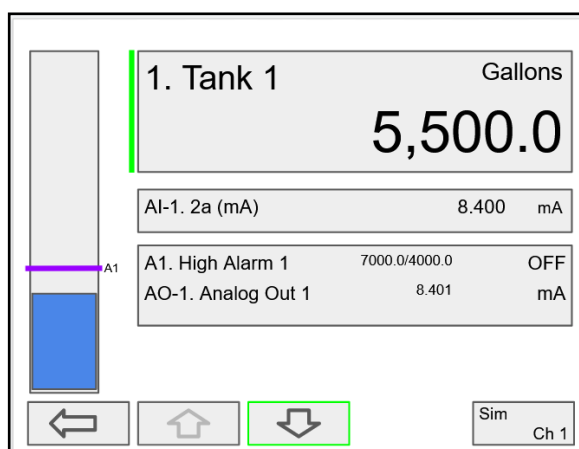


Select any channel using the **Up** or **Down Arrow** keys and Press the **Right Arrow** key again to step into viewing the channel details.

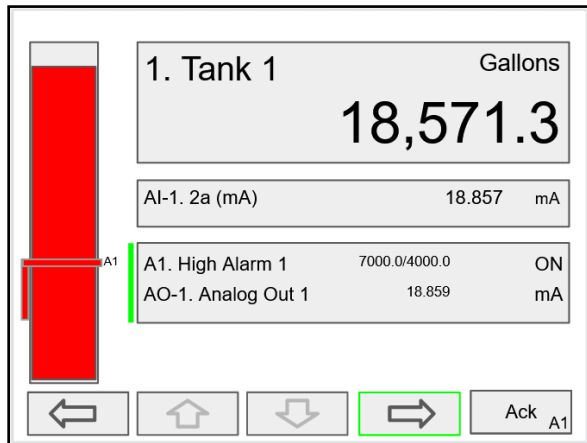
## View Channel Details

Stepping into a channel allows the viewing of additional details for the inputs and outputs associated with that channel. It is also possible to simulate the selected parameter.

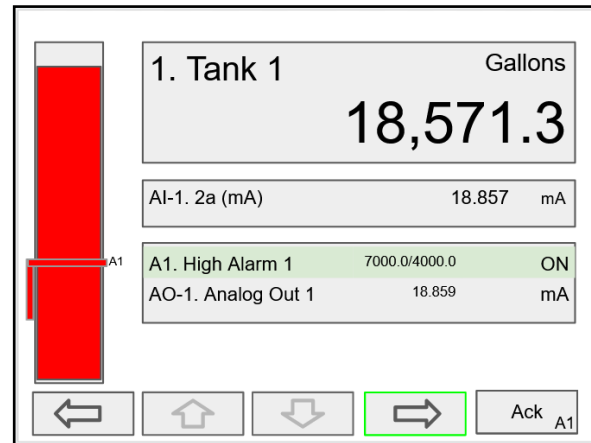
- Channel number and tag
- PV and units
- View the channel input source
- View alarms associated with channel
- View analog outputs assigned to channel
- Simulate the channel or analog input
- Step into any associated parameter



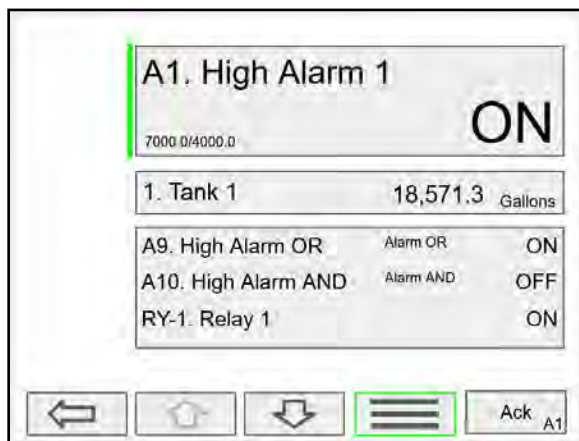
Press the **Down Arrow** key to navigate to the channel input source and then down again to view alarms and analog outputs.

**View Associated Parameters**

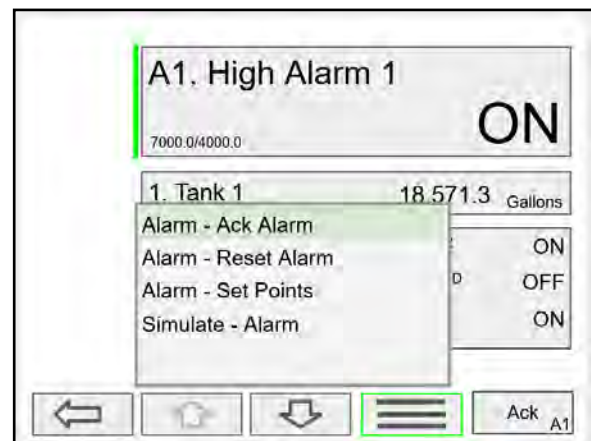
Press the **Right Arrow** key to select the alarm.



Press the **Right Arrow** key again to view alarm's details.

**View Alarm Details**

Press the **3-Bar** key to access the available options.

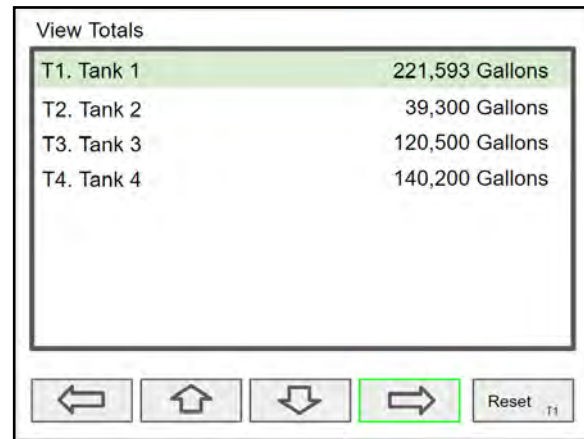


Alarm view options: acknowledge alarm, reset alarm, change set/reset points, and simulate an alarm condition.

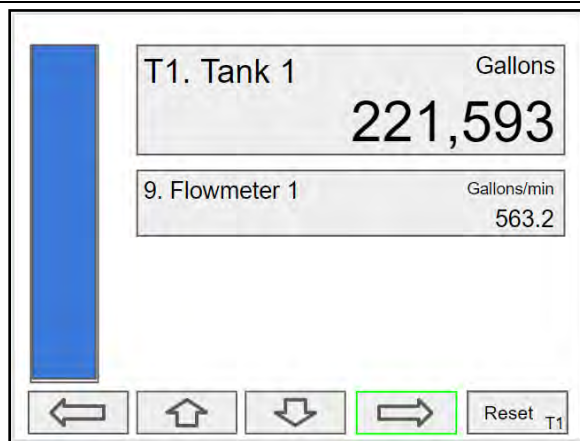
## View Totals

The *View Totals* menu displays the value of all the totals and allows resetting each total individually.

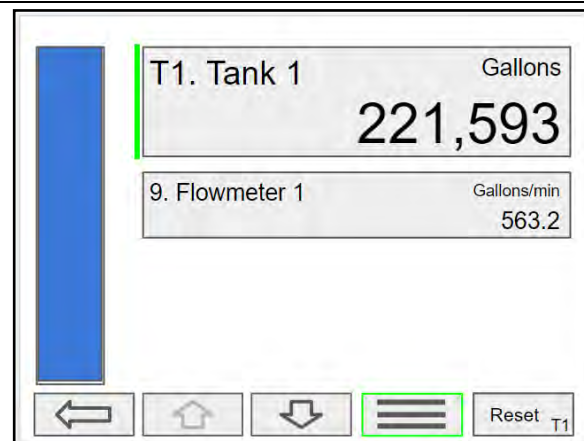
- Total number and tag
- Accumulated total and units
- Reset total key
- View source for total
- View alarms associated with total
- View analog outputs assigned to total



Press **Right Arrow** key to step into details of the selected total and view the source and associated outputs.

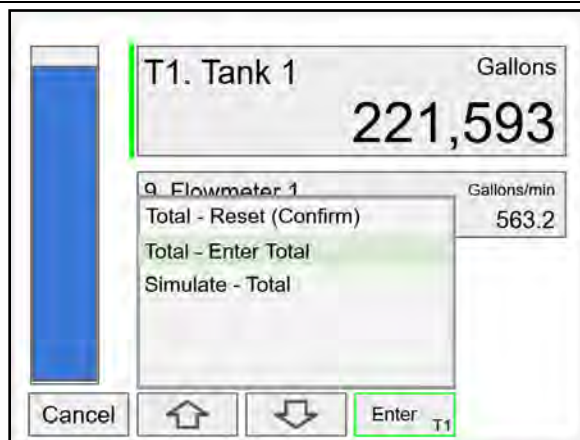


Press the **Right Arrow** key to select Total 1.

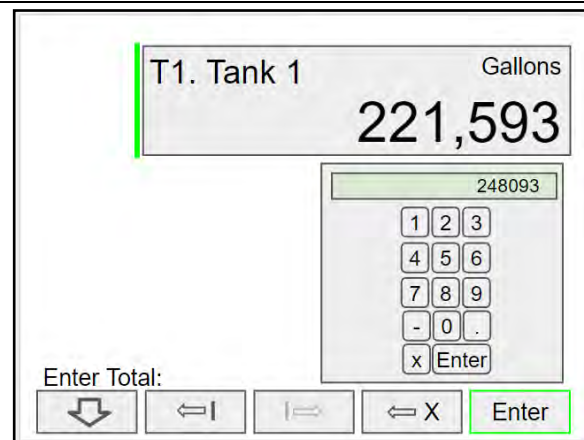


Press the **3-Bar** key to enter a new total, reset the total, or simulate a value for the total.

Totals not associated with a rate channel have additional features: Add to or remove from the total.



Press the **Enter** key to enter a new total.



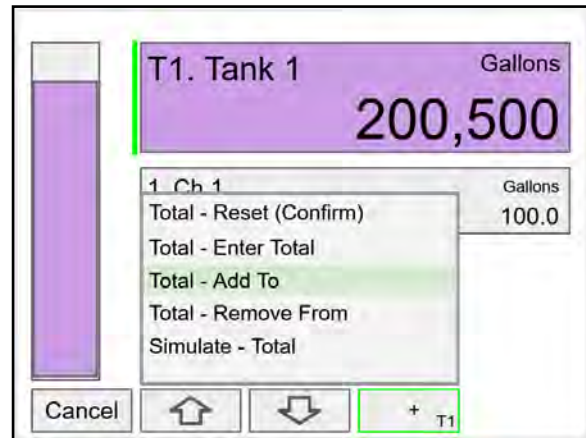
Using the numbers keypad, enter a new total and then press the **Enter** key to save.

### Totals Generated by Non-Rate Inputs

For totals generated using non-rate inputs; it is possible to add or remove from the total using the **3-Bar** key on the *View Total* screen.

This type of total requires the use of an external trigger such as a digital input, function key, or a Modbus signal. For example, if the input to T1 is Ch 1, which is displaying the volume in a container, as provided by the weight being measured by a load cell with a 4-20 mA output, which is the input to channel 1.

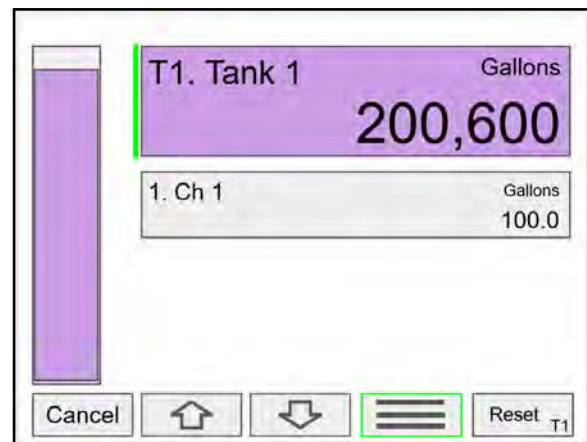
- Total 1 = 200,500 gallons
- Channel 1 = 100.0 gallons
- Press function key *Add To* (+ T1)
- 100 gallons is added to Total 1



The total in Tank 1 has been incremented by 100 gallons.

The *Remove From* feature can be used to decrement the volume inside a storage tank.

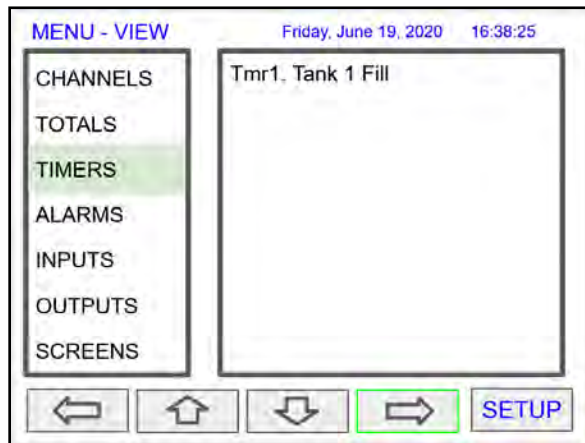
Normally these operations are done automatically by using a proximity switch or a limit switch to trigger the *Add To* or *Remove From* features.



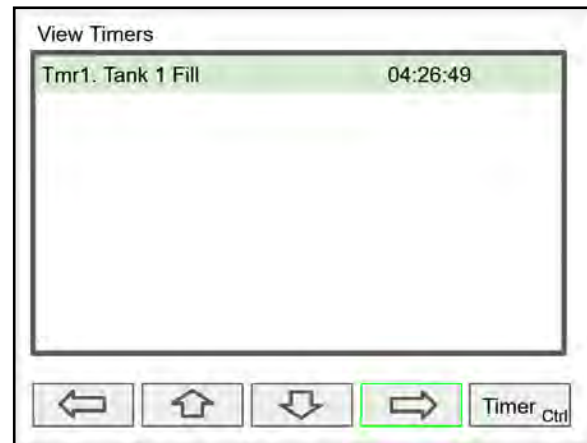
## View Timers

The *View Timers* menu displays the value of the existing timers.

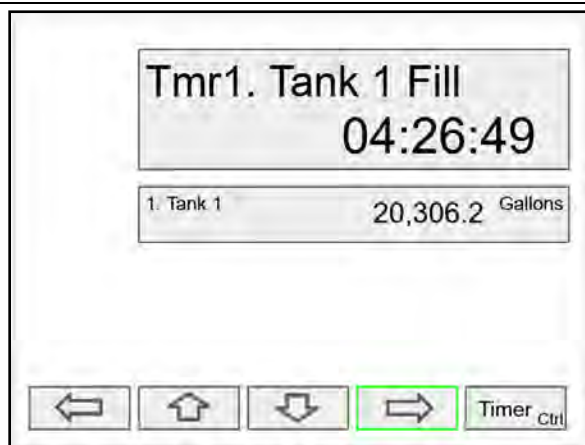
Press the **Right Arrow** key to step into the details of the selected timer and view the associated inputs and outputs.



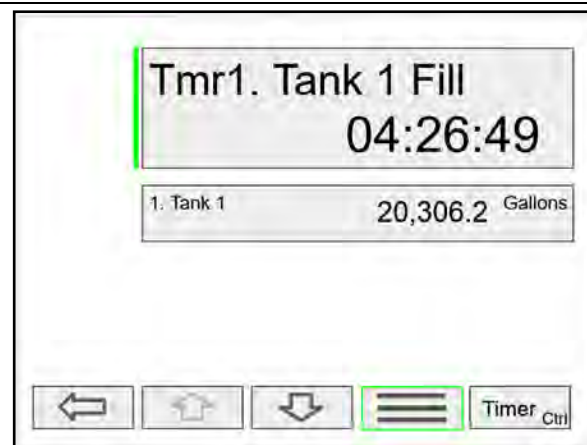
Press the **Right Arrow** key to step into viewing timer.



Press the **Right Arrow** key to view timer details.



Press the **Right Arrow** key to select timer.



Press the **3-Bar** key to choose Timer Control, Reset, Start, Stop, or Simulate.



Press the **Reset** key to reset the timer, select *Timer Control* for additional functions. Use the *Simulate* function to simulate the timer rising, falling, or jump to a specific value using the keypad.



Press the **TIMER CONTROL** key (shown in the timer details screen) to access all timer control buttons.

## View Alarms

The *View Alarms* menu displays the status of all the alarms and the details for each alarm.

Under the alarm details view, it is possible to reset an acknowledged alarm, change the set/reset points, or simulate an alarm condition.

- Alarm # and tag
- Set/Reset points
- Source for the alarm
- Outputs associated with the alarm
- Acknowledge the alarm
- Reset the alarm
- Simulate alarm condition

| View Alarms      |               |     |
|------------------|---------------|-----|
| A1. High Alarm 1 | 7000.0/4000.0 | ON  |
| A2. High Alarm 2 | 7000.0/4000.0 | OFF |
| A3. High Alarm 3 | 7000.0/4000.0 | ON  |
| A4. High Alarm 4 | 7000.0/4000.0 | ON  |
| A5. High Alarm 5 | 7000.0/4000.0 | OFF |
| A6. High Alarm 6 | 7000.0/4000.0 | ON  |
| A7. High Alarm 7 | 7000.0/4000.0 | OFF |
| A8. High Alarm 8 | 7000.0/4000.0 | ON  |

Press the **Right Arrow** key to view the alarm details.

Press the **3-Bar** key to select Ack Alarm, Reset Alarm, change Set Points, or Simulate Alarm condition.

Press the **Set Point** key to change the Set Points. This re-initializes the alarm to reflect the new set point.

## Simulate Alarm Condition

Press the **Simulate** key to simulate an alarm condition.

Press the **+** key to turn on the alarm; note that alarm 13 and relay 1 also turned on. Press **Ok** key to maintain simulation or press **Real** to cancel simulation.

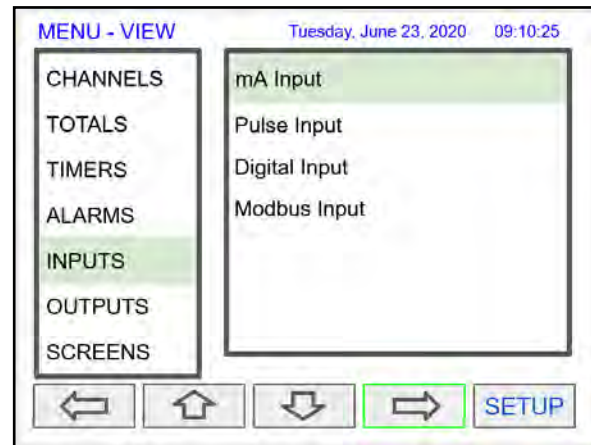
## View Inputs

The *View Inputs* menu displays the values and status of all the inputs and the details of the associated channels. Input simulation is also available in the input details.

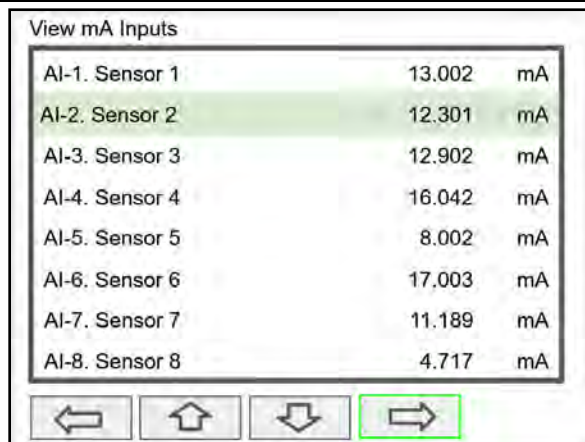
- Input # and tag
- mA input value
- Pulse input frequency
- Digital input status
- Modbus input value
- Associated channel(s)
- Input simulation

### CAUTION

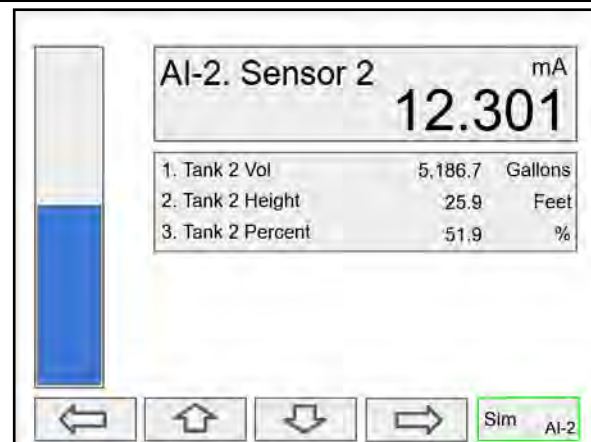
Manual control and simulation states are not saved on power cycle. On power up the controller initializes to the actual process conditions.



Press the **Right Arrow** key to select the mA Input.

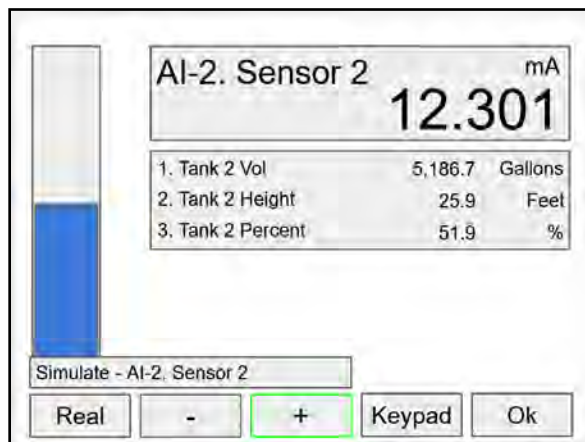


Press the **Right Arrow** key to view the mA Input details.

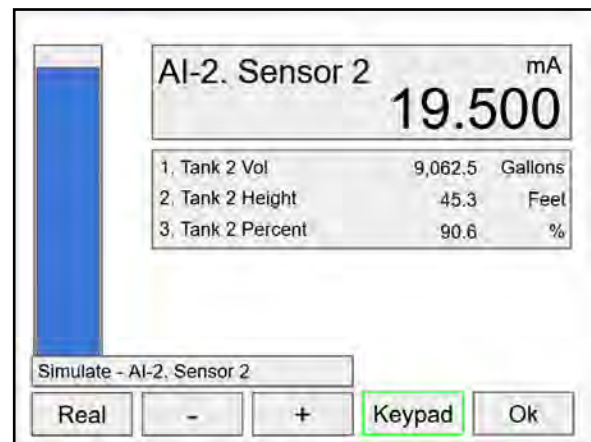


The above screen shows the Analog Input 2 details and the associated channels.

## Simulate mA Input



Use the **+** / **-** keys to ramp up and down or use the keypad to jump to any value within the range. Press the **Ok** key to maintain the input in simulation mode.



All the parameters associated with the simulated input follow the simulated value. Press the **Real** key to cancel simulation and return to the actual sensor signal.

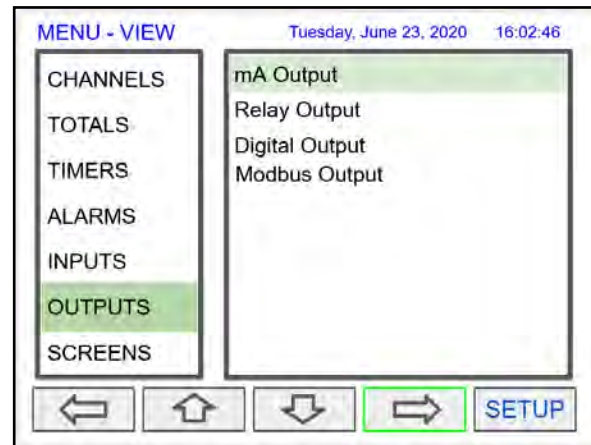
## View Outputs

The *View Outputs* menu displays the values and status of all the outputs and the details of the associated channels.

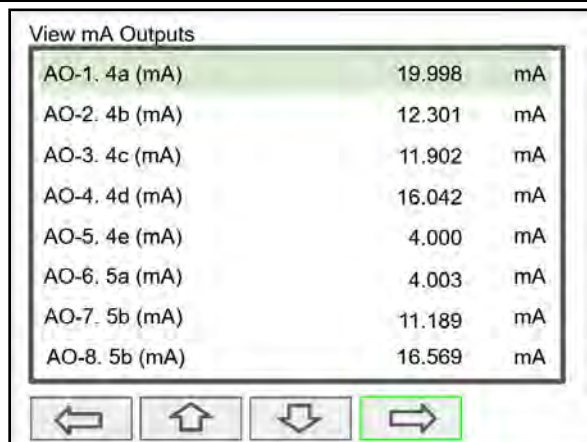
- Output # and tag
- mA output value
- Relay output status
- Digital output status
- Number of cycles & runtime
- Associated input
- Manual control of relays
- Manual control of 4-20 mA outputs

### CAUTION

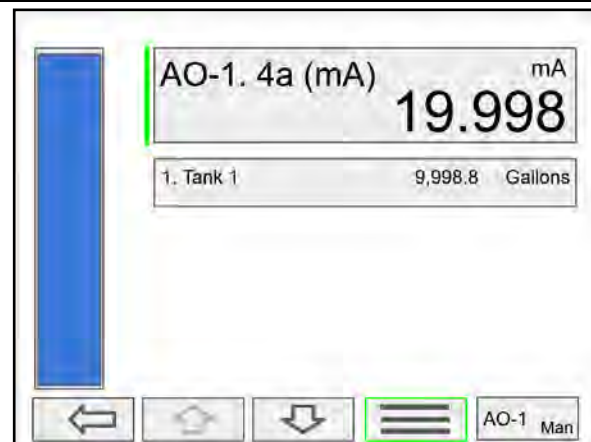
Manual control and simulation states are not saved on power cycle. On power up the controller initializes to the actual process conditions.



Press the **Right Arrow** key to select the mA Output.

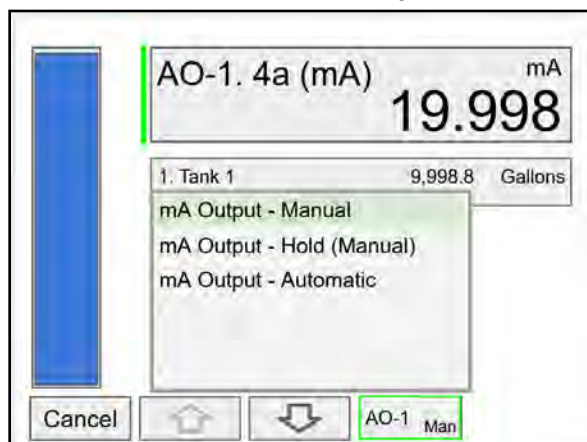


Press the **Right Arrow** key to view the mA Output details.

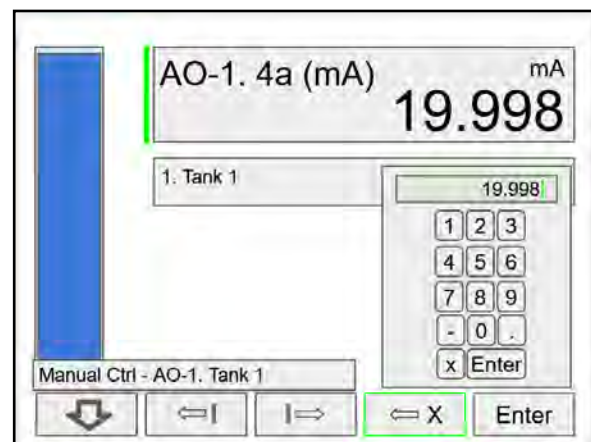


Press the **3-Bar** key to access Analog Output controls. Manual control, hold current value, return to automatic.

## Manual Control of 4-20 mA Output



Select **Manual** to control the analog output manually; select **Automatic** to exit manual control.



Use the keypad to enter a value for the analog output or use the **+ / -** keys to ramp up and down in small steps.

## View Relays

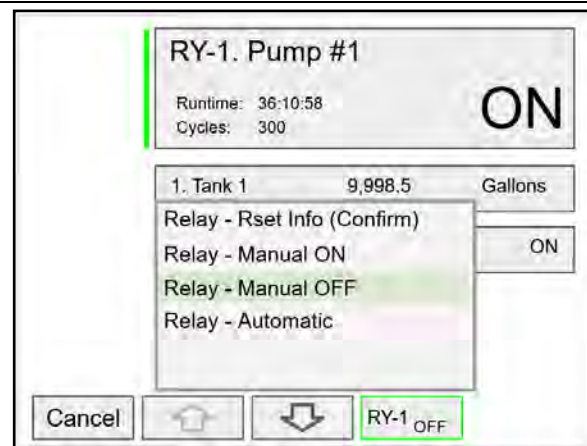
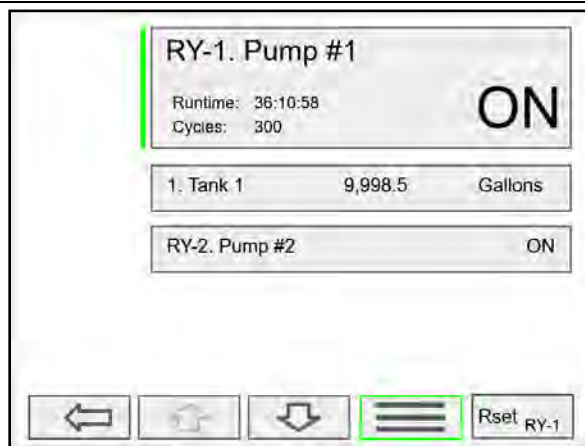
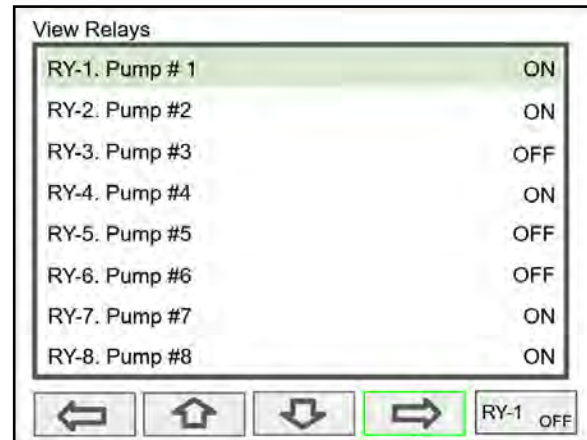
The *View Relays* menu allows the user to view the details for all the relays. The F4 key can be used to turn on and off the selected relay (momentarily).

Press the **Right Arrow** key to view the relay details.

- Relay # and tag
- Status
- Runtime
- Number of Cycles
- Reset relay runtime & cycles count
- Parameters associated with the relay
- Other relays used in pump alternation
- Manual control of relays

### CAUTION

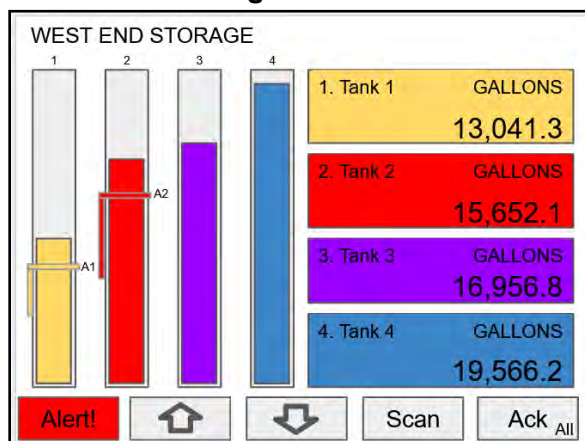
Manual control and simulation states are not saved on power cycle.



Press the **Manual OFF** to turn off relay 1; Pump #1 will go off and remain off until the relay 1 is put back in automatic mode.

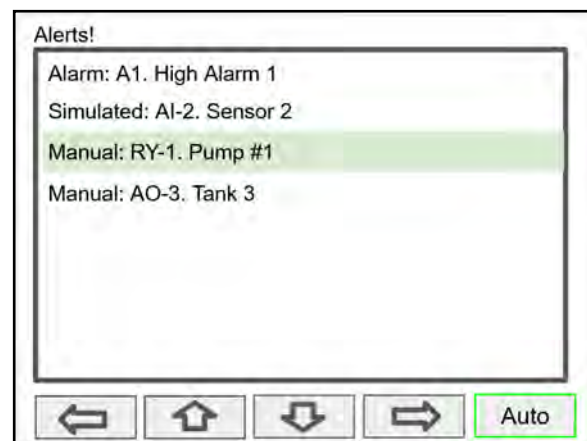
An Alert! message is displayed in place of the Menu key anytime an item is in manual control or simulation mode.

## View Alert Messages



If Alerts are enabled for alarms, the **Menu** key displays a flashing Alert! message on red background.

Simulated parameters and manual control outputs, automatically generate alert messages displayed on a yellow background.



The Alerts! Screen allows the user to acknowledge alarms, return outputs to automatic mode, and navigate to any of the listed items to view the details.

## View Digital Outputs

The *View Digital Outputs* screen displays the status of the digital outputs and shows the association with the parameters used to drive the outputs.

| View Digital Outputs   |  |     |
|------------------------|--|-----|
| DO-1. Digital Output 1 |  | OFF |
| DO-2. Digital Output 2 |  | ON  |
| DO-3. Digital Output 3 |  | OFF |
| DO-4. Digital Output 4 |  | OFF |



## View Modbus Outputs

The *View Modbus Outputs* screen displays the Modbus outputs set up by the user; it shows the register number and the parameter used to generate each output.

| View Modbus Outputs |              |        |  |
|---------------------|--------------|--------|--|
| MO-1. Sensor 1 mA   | 44401, 44402 | 10.989 |  |
| MO-2. Sensor 2 mA   | 44403, 44404 | 12.005 |  |
| MO-3. Sensor 3 mA   | 44405, 44406 | 15.892 |  |
| MO-4. Sensor 4 mA   | 44407, 44408 | 19.589 |  |

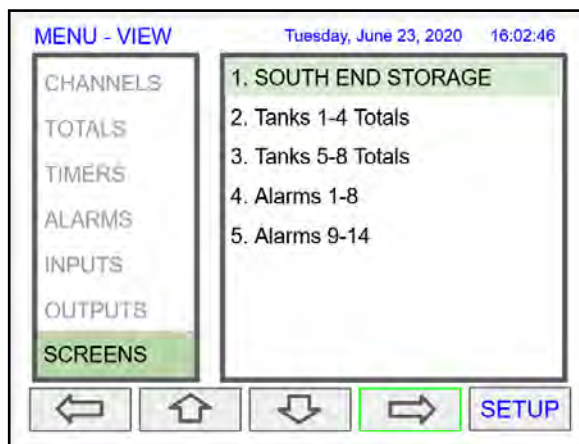


### CAUTION

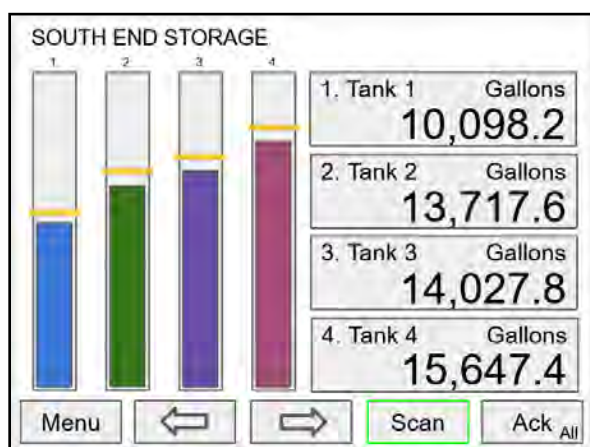
Manual control and simulation states are not saved on power cycle. On power up the controller initializes to the actual process conditions.

## View Screens

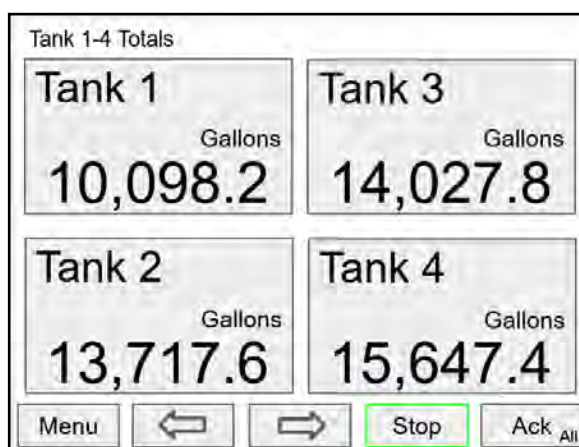
With the View Screens menu, the user can go to any available screen and view the details. The screens can be scanned continuously or can be stopped to stay on a selected screen at anytime.



Press the **Right Arrow** key to view details of the selected view screen.



Press the **Scan** key to have all available screens continue to scan.



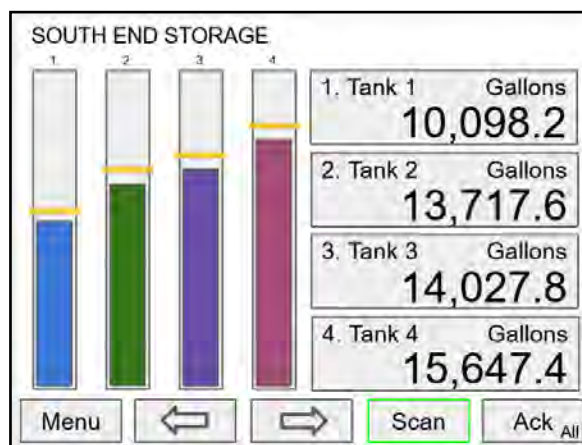
Press the **Stop** key to have all available screens stop scanning and stay on the current screen.

## Operation

### Viewing Screens

The controller displays various screens with bargraphs, numerical values, and relay status throughout operation, according to the user-selected setup. There are two basic modes of operation: Automatic scan or manual scan. The controller initializes in automatic scan mode. Press Stop key to stop the automatic scan and use the Left or Right Arrow keys (Previous or Next) to navigate through the various screens. Press the Scan key to resume automatic scanning.

The bargraphs are optional, they are enabled or disabled during *Screens* setup. The scaling of the bargraph is done during the setup of each channel and it can be different than the channel scaling values.



### Individual Channel View

To view the details of any channel, press the Menu key and then press Right Arrow key to view the channels. Select the channel of interest. Navigate through the different items using the navigation keys. A green bar indicates the selected item, press the Right Arrow key to step into and see more details about the inputs and outputs related to the channel in view.

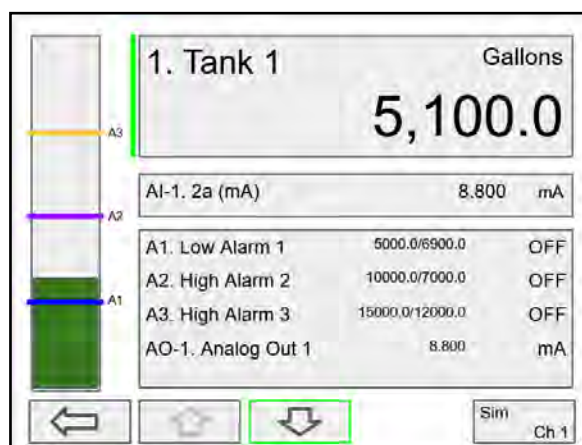
If applicable, alarms may be acknowledged, and totals may be reset from these screens. Simulation and manual control are also available on the *View* screens.

### Low & High Alarm Indication

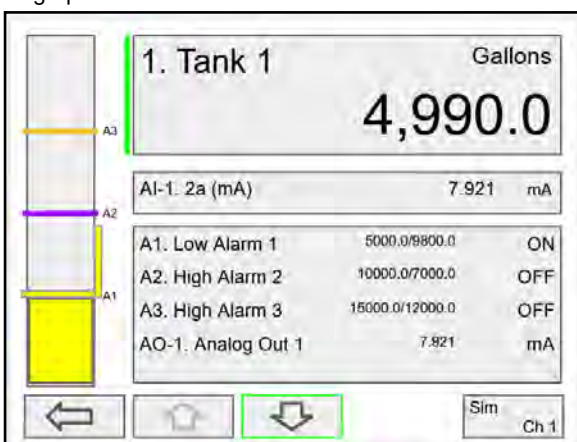
The alarm set points are indicated by a line at the corresponding value on the bargraph. Color selection is done in the *Setup – Alarm* menu or in the *System – Display* menu.

**Active High Alarm:** Indicated by horizontal and vertical lines. The bottom of the vertical line is the reset point of the high alarm. The high alarm is indicated on the left side of the bargraph.

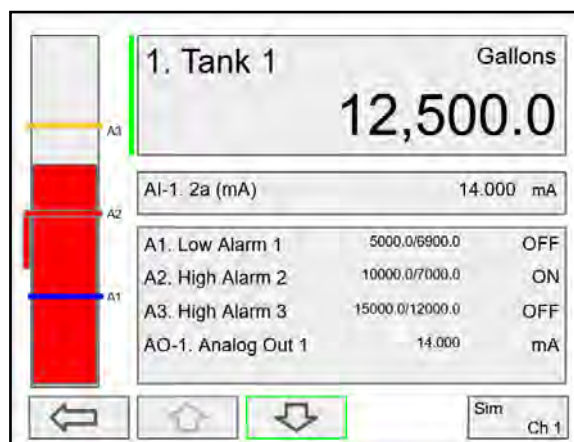
**Active Low Alarm:** Indicated by horizontal and vertical lines. The top of the vertical line is the reset point of the low alarm. The low alarm is indicated on the right side of the bargraph.



Alarm set points are indicated by horizontal lines.



Low alarm indication

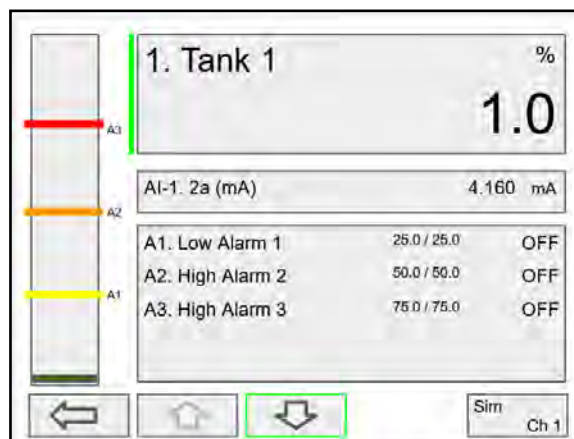


High alarm indication

### Multicolor Bargraph Indication

The bargraph may be configured to show different colors depending on the value of the process variable. The following example illustrates the use of colors:

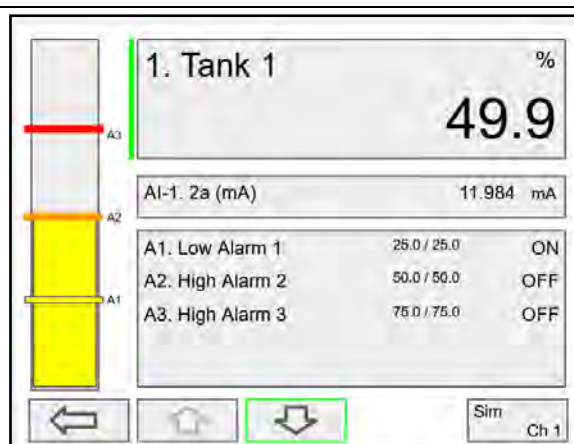
| Process Variable % | Bargraph Color | Set Pt | Reset Pt |
|--------------------|----------------|--------|----------|
| < 25               | Green          | N/A    | N/A      |
| > 25               | Yellow         | 25.0   | 25.0     |
| > 50               | Amber          | 50.0   | 50.0     |
| > 75               | Red            | 75.0   | 75.0     |



Color changes above the set point for each alarm



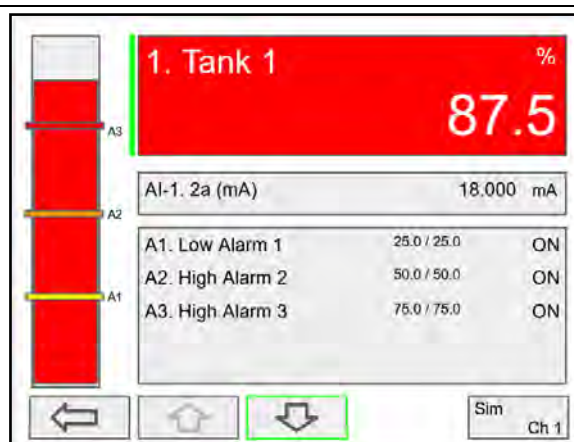
The bargraph shows green below the the first set point



The bargraph changes to yellow above set point 1



The bargraph changes to orange above set point 2



The bargraph changes to red above set point 3.

The panel for the value can also be configured to change colors at the specified levels.

## Modbus® RTU Serial Communication

The controller is equipped with serial communication capability as a standard feature. Baud Rate, Parity, Slave ID (Address) and Transmit Delay are entered in the *System* menu, which appears in the main *Setup* menu. The baud rate and parity selected must match the settings for all other devices on the network. The Slave ID must be unique, so it will not interfere with other devices. The controller supports the following Modbus functions:

| Command | Name                        | Description                                           |
|---------|-----------------------------|-------------------------------------------------------|
| 01      | Read Coils (0x)             | Read coil value                                       |
| 03      | Read Holding Register (4x)  | Read multiple bytes from holding registers.           |
| 04      | Read Input Register (3x)    | Read multiple bytes from input registers.             |
| 05      | Write Single Coil (Bit)     | Set single coil value control                         |
| 15      | Write Multiple Coils (Bits) | Set multiple coil value control                       |
| 06      | Write Single Register       | Set single value into specified holding register.     |
| 16      | Write Multiple Registers    | Set multiple values into specified holding registers. |

The multi-channel controller can also work as a “Modbus Display/Controller” by writing the desired value to the selected Modbus input (MB-1 to MB-199). The Modbus input can be used the same way a 4-20 mA input is used; it can be brought into a channel to be displayed and generate alarms to control relays, generate 4-20 mA outputs, and Modbus outputs (MO-1 to MO-64).

## Modbus Register Tables

Table 1. Default Register Numbers / Addresses

| Reg. Number | Reg. Address | Description       | Data Type | Function Codes | R/W |
|-------------|--------------|-------------------|-----------|----------------|-----|
| 40001       | 0            | Channel (1) Value | Float     | 03, 04         | R   |
| 40003       | 2            | Channel (2) Value | Float     | 03, 04         | R   |
| 40005       | 4            | Channel (3) Value | Float     | 03, 04         | R   |
| 40007       | 6            | Channel (4) Value | Float     | 03, 04         | R   |
| 40009       | 8            | Channel (5) Value | Float     | 03, 04         | R   |
| 40011       | 10           | Channel (6) Value | Float     | 03, 04         | R   |
| 40013       | 12           | Channel (7) Value | Float     | 03, 04         | R   |
| 40015       | 14           | Channel (8) Value | Float     | 03, 04         | R   |
| 40017       | 16           | Total (1) Value   | Float     | 03, 04         | R   |
| 40019       | 18           | Total (2) Value   | Float     | 03, 04         | R   |
| 40021       | 20           | Total (3) Value   | Float     | 03, 04         | R   |
| 40023       | 22           | Total (4) Value   | Float     | 03, 04         | R   |
| 40025       | 24           | Timer (1) Value   | Float     | 03, 04         | R   |
| 40027       | 26           | Timer (2) Value   | Float     | 03, 04         | R   |
| 40029       | 28           | Timer (3) Value   | Float     | 03, 04         | R   |
| 40031       | 30           | Timer (4) Value   | Float     | 03, 04         | R   |
| 40033       | 32           | Alarm (1) Status* | Short     | 03, 04         | R   |
| 40034       | 33           | Alarm (2) Status* | Short     | 03, 04         | R   |
| 40035       | 34           | Alarm (3) Status* | Short     | 03, 04         | R   |
| 40036       | 35           | Alarm (4) Status* | Short     | 03, 04         | R   |
| 40037       | 36           | Alarm (5) Status* | Short     | 03, 04         | R   |
| 40038       | 37           | Alarm (6) Status* | Short     | 03, 04         | R   |
| 40039       | 38           | Alarm (7) Status* | Short     | 03, 04         | R   |
| 40040       | 39           | Alarm (8) Status* | Short     | 03, 04         | R   |

\*Alarm Status: 0: Off, 1: On, 2: On & Acknowledged

The table above contains some predefined registers and data types used.

The following table contains the definitions of all accessible registers with their corresponding data type.

Table 2. Device Tag, Date &amp; Time, Info

| Reg. Number   | Reg. Address | Description              | Data Type        | Function Codes | R/W | Comments                                                                                                                                                       |
|---------------|--------------|--------------------------|------------------|----------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40041 - 40056 | 40-55        | Device Tag               | String (32 char) | 03, 04         | R   | Null terminating string<br>Write 00 for the last char                                                                                                          |
|               |              | RTC Date & Time          |                  |                |     |                                                                                                                                                                |
| 40061         | 60           | Year                     | Short            | 03, 04         | R   | 20 = 2020                                                                                                                                                      |
| 40062         | 61           | Month                    | Short            | 03, 04         | R   |                                                                                                                                                                |
| 40063         | 62           | Day                      | Short            | 03, 04         | R   |                                                                                                                                                                |
| 40064         | 63           | Hour                     | Short            | 03, 04         | R   |                                                                                                                                                                |
| 40065         | 64           | Minute                   | Short            | 03, 04         | R   |                                                                                                                                                                |
| 40066         | 65           | Second                   | Short            | 03, 04         | R   |                                                                                                                                                                |
|               |              |                          |                  |                |     |                                                                                                                                                                |
| 40073         | 72           | SFT No.                  | Short            | 03, 04         | R   |                                                                                                                                                                |
| 40074         | 73           | SFT Version              | Short            | 03, 04         | R   |                                                                                                                                                                |
|               |              |                          |                  |                |     |                                                                                                                                                                |
| 40081         | 80           | Program Id               | Short            | 06, 16         | W   | Program is executed when Program Id is written.<br>Program parameters may be written either before or with the Program Id.<br>See <i>Table 4.</i> for details. |
| 40082 - 40099 | 81 - 98      | Program Parameters (x18) | Various          | 06, 16         | W   |                                                                                                                                                                |

## PV's Register Numbers & Addresses

The PV's register numbers and register addresses are calculated based on the formulas provided below. The values are available in various data types. Examples of register addresses (base 0) are provided on the right column. Register numbers refer to PLC Addresses (base 1). Function Code 03 Read Holding Registers (4x) are shown on this table and used throughout the system; other functions are also supported as indicated in the Function column.

The Modbus input registers can be configured under the *Setup – Inputs – Modbus* menu and the Modbus output registers can be mapped under the *Setup – Outputs – Modbus* menu; this allows assigning any parameter to the Modbus output registers and selecting the data type for input and output registers.

**Table 3. PV's Register Numbers & Register Addresses**

| Reg. Number      | Reg. Address    | Channel (N = 1 ... 99)              | Data Type    | Bits | Function       | R/W | Reg. Address Examples      |
|------------------|-----------------|-------------------------------------|--------------|------|----------------|-----|----------------------------|
| 00101 + (N - 1)  | 100 + (N - 1)   | Channel (N) Value                   | Bit          | 1    | 01, 02         | R   | Ch1 = 100                  |
| 40101 + (N - 1)  | 100 + (N - 1)   | Channel (N) Value                   | Short        | 16   | 03, 04         | R   | Ch1 = 100                  |
| 40201 + 2(N - 1) | 200 + 2(N - 1)  | Channel (N) Value                   | Long         | 32   | 03, 04         | R   | Ch2 = 202                  |
| 40401 + 2(N - 1) | 400 + 2(N - 1)  | Channel (N) Value                   | Float        | 32   | 03, 04         | R   | Ch3 = 404                  |
| 40601 + 4(N - 1) | 600 + 4(N - 1)  | Channel (N) Value                   | Double       | 64   | 03, 04         | R   | Ch4 = 612                  |
| 41001 + 4(N - 1) | 1000 + 4(N - 1) | Channel (N) Value                   | Long Long    | 64   | 03, 04         | R   | Ch99 = 1392                |
|                  |                 | <b>Total (N = 1 ... 32)</b>         |              |      |                |     |                            |
| 42101 + (N - 1)  | 2100 + (N - 1)  | Total (N) Value                     | Short        | 16   | 03, 04         | R   | Total 1 = 2100             |
| 42201 + 2(N - 1) | 2200 + 2(N - 1) | Total (N) Value                     | Long         | 32   | 03, 04         | R   | Total 1 = 2202             |
| 42301 + 2(N - 1) | 2300 + 2(N - 1) | Total (N) Value                     | Float        | 32   | 03, 04         | R   | Total 1 = 2302             |
| 42401 + 4(N - 1) | 2400 + 4(N - 1) | Total (N) Value                     | Double       | 64   | 03, 04         | R   | Total 1 = 2404             |
| 42601 + 4(N - 1) | 2600 + 4(N - 1) | Total (N) Value                     | Long Long    | 64   | 03, 04         | R   | Total 32 = 2724            |
|                  |                 | <b>Timer (N = 1 ... 32)</b>         |              |      |                |     |                            |
| 43101 + (N - 1)  | 3100 + (N - 1)  | Timer (N) Value (sec)               | Short        | 16   | 03, 04         | R   | Timer 1 = 3100             |
| 43201 + 2(N - 1) | 3200 + 2(N - 1) | Timer (N) Value (sec)               | Long         | 32   | 03, 04         | R   | Timer 1 = 3202             |
| 43301 + 2(N - 1) | 3300 + 2(N - 1) | Timer (N) Value (sec)               | Float        | 32   | 03, 04         | R   | Timer 1 = 3302             |
| 43401 + 4(N - 1) | 3400 + 4(N - 1) | Timer (N) Value (sec)               | Double       | 64   | 03, 04         | R   | Timer 32 = 3524            |
|                  |                 | <b>Alarm (N = 1 ... 64)</b>         |              | 64   |                |     |                            |
| 43601 + (N - 1)  | 3600 + (N - 1)  | Alarm (N) Status                    | Short        |      | 03, 04         | R   | 0: Off, 1: On, 2: On & Ack |
|                  |                 | <b>Modbus Output (N = 1 ... 64)</b> |              |      |                |     |                            |
| 04101 + (N - 1)  | 4100 + (N - 1)  | Modbus Output (N) Value             | Bit (0 or 1) | 1    | 01, 02         | R   | MO-1 = 4100                |
| 44101 + (N - 1)  | 4100 + (N - 1)  | Modbus Output (N) Value             | Short        | 16   | 03, 04         | R   | MO-1 = 4100                |
| 44201 + 2(N - 1) | 4200 + 2(N - 1) | Modbus Output (N) Value             | Long         | 32   | 03, 04         | R   | MO-1 = 4202                |
| 44401 + 2(N - 1) | 4400 + 2(N - 1) | Modbus Output (N) Value             | Float        | 32   | 03, 04         | R   | MO-1 = 4402                |
| 44601 + 4(N - 1) | 4600 + 4(N - 1) | Modbus Output (N) Value             | Double       | 64   | 03, 04         | R   | MO-1 = 4604                |
| 45001 + 4(N - 1) | 5000 + 4(N - 1) | Modbus Output (N) Value             | Long Long    | 64   | 03, 04         | R   | MO-64 = 5252               |
|                  |                 | <b>Modbus Input (N = 1 ... 199)</b> |              |      |                |     |                            |
| 06101 + (N - 1)  | 6100 + (N - 1)  | Modbus Input (N) Value              | Bit (0 or 1) | 1    | 01, 02, 05, 15 | R/W | MB-1 = 6100                |
| 46101 + (N - 1)  | 6100 + (N - 1)  | Modbus Input (N) Value              | Short        | 16   | 03, 04, 06, 16 | R/W | MB-1 = 6100                |
| 46301 + 2(N - 1) | 6300 + 2(N - 1) | Modbus Input (N) Value              | Long         | 32   | 03, 04, 16     | R/W | MB-1 = 6302                |
| 46701 + 2(N - 1) | 6700 + 2(N - 1) | Modbus Input (N) Value              | Float        | 32   | 03, 04, 16     | R/W | MB-1 = 6702                |
| 47101 + 4(N - 1) | 7100 + 4(N - 1) | Modbus Input (N) Value              | Double       | 64   | 03, 04, 16     | R/W | MB-1 = 7104                |
| 47901 + 4(N - 1) | 7900 + 4(N - 1) | Modbus Input (N) Value              | Long Long    | 64   | 03, 04, 16     | R/W | MB-199 = 8692              |

## Modbus Write Protection

The Modbus write passcode protection can be enabled in the *System – Modbus* menu. This protection prevents writing to the registers, unless the unlock code 1 is sent to register 81 followed by the passcode sent to register 82. The protection is automatically restored after 30 seconds of Modbus – write inactivity. See page 53 for details.

**Table 4. Program Parameters for Special Functions**

| Reg. Number   | Reg. Address | Description             | Data Type        | Function | R/W | Program Code | Comments                                                                                 |
|---------------|--------------|-------------------------|------------------|----------|-----|--------------|------------------------------------------------------------------------------------------|
| 40081         | 80           | Program Id              |                  |          |     |              | Program is executed when Program Id is written.                                          |
| 40082 - 40099 | 81 - 98      | Program Parameters (x8) |                  |          |     |              | Program parameters may be written either before or with the Program Code.                |
| 40081         | 80           | Unlock Modbus Passcode  | Short            | 06, 16   | W   | 1            | Locks again after 30 seconds.                                                            |
| 40082         | 81           | Modbus Passcode         | Short            | 06, 16   | W   |              | Cleared upon execution. Must be re-written with each Unlock.                             |
| 40081         | 80           | Set RTC Date & Time     | Short            | 06, 16   | W   | 6            |                                                                                          |
| 40082         | 81           | Year                    | Short            | 06, 16   | W   |              | 0..99                                                                                    |
| 40083         | 82           | Month                   | Short            | 06, 16   | W   |              | 1..12                                                                                    |
| 40084         | 83           | Day                     | Short            | 06, 16   | W   |              | 1..31                                                                                    |
| 40085         | 84           | Hour                    | Short            | 06, 16   | W   |              | 0..23<br>Program Code plus parameters ending at Hour will set Minute and Second to zero. |
| 40086         | 85           | Minute                  | Short            | 06, 16   | W   |              | 0..59<br>Program Code plus parameters ending at Minute will set Second to zero           |
| 40087         | 86           | Second                  | Short            | 06, 16   | W   |              | 0..59                                                                                    |
| 40081         | 80           | Channel - Get Tag       | Short            | 06, 16   | W   | 11           |                                                                                          |
| 40082         | 81           | Channel (N)             | Short            | 06, 16   | W   |              |                                                                                          |
| 40083 - 40090 | 82 - 89      | Tag                     | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                                  |
| 40081         | 80           | Reset Channel           | Short            | 06, 16   | W   | 12           |                                                                                          |
| 40082         | 81           | Channel (N)             | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                |
| 40083         | 82           | Thru Channel (N)        | Short            | 06, 16   | W   |              | 0 to ignore                                                                              |
| 40081         | 80           | Set Channel             | Short            | 06, 16   | W   | 13           | Tare, Capture, Switch                                                                    |
| 40082         | 81           | Channel (N)             | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                |
| 40083         | 82           | Thru Channel (N)        | Short            | 06, 16   | W   |              | 0 to ignore                                                                              |
| 40081         | 80           | Total - Get Tag         | Short            | 06, 16   | W   | 27           |                                                                                          |
| 40082         | 81           | Total (N)               | Short            | 06, 16   | W   |              |                                                                                          |
| 40083 - 40090 | 82 - 89      | Tag                     | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                                  |

| Reg. Number   | Reg. Address | Description            | Data Type        | Function | R/W | Program Code | Comments                                                                                                                                                 |
|---------------|--------------|------------------------|------------------|----------|-----|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40081         | 80           | Reset Total            | Short            | 06, 16   | W   | 28           |                                                                                                                                                          |
| 40082         | 81           | Total (N)              | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                                                                                |
| 40083         | 82           | Thru Total (N)         | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40081         | 80           | Timer - Get Tag        | Short            | 06, 16   | W   | 41           |                                                                                                                                                          |
| 40082         | 81           | Timer (N)              | Short            | 06, 16   | W   |              |                                                                                                                                                          |
| 40083 - 40090 | 82 - 89      | Tag                    | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                                                                                                  |
| 40081         | 80           | Timer                  | Short            | 06, 16   | W   | 42           |                                                                                                                                                          |
| 40082         | 81           | Timer (N) - Reset      | Short            | 06, 16   | W   |              | 0 to not Reset<br>Program Code with parameters will ignore remaining parameters.<br>Program Code with single Timer (N) will Reset without Start or Stop. |
| 40083         | 82           | Timer (N) - Start      | Short            | 06, 16   | W   |              | 0 to not Start<br>Program Code with two Timer (N) registers will Reset and Start; and ignore Stop.                                                       |
| 40084         | 83           | Timer (N) - Stop       | Short            | 06, 16   | W   |              | 0 to not Stop                                                                                                                                            |
| 40085         | 84           | Thru Timer (N) - Reset | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40086         | 85           | Thru Timer (N) - Start | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40087         | 86           | Thru Timer (N) - Stop  | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40081         | 80           | Alarm - Get Tag        | Short            | 06, 16   | W   | 55           |                                                                                                                                                          |
| 40082         | 81           | Alarm (N)              | Short            | 06, 16   | W   |              |                                                                                                                                                          |
| 40083 - 40090 | 82 - 89      | Tag                    | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                                                                                                  |
| 40081         | 80           | Reset Alarm            | Short            | 06, 16   | W   | 56           |                                                                                                                                                          |
| 40082         | 81           | Alarm (N)              | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                                                                                |
| 40083         | 82           | Thru Alarm (N)         | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40081         | 80           | Ack Alarm              | Short            | 06, 16   | W   | 57           |                                                                                                                                                          |
| 40082         | 81           | Alarm (N)              | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                                                                                |
| 40083         | 82           | Thru Alarm (N)         | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |
| 40081         | 80           | Alarm - Start          | Short            | 06, 16   | W   | 58           | Interval alarms                                                                                                                                          |
| 40082         | 81           | Alarm (N)              | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters.                                                                                |
| 40083         | 82           | Thru Alarm (N)         | Short            | 06, 16   | W   |              | 0 to ignore                                                                                                                                              |

| Reg. Number   | Reg. Address | Description        | Data Type        | Function | R/W | Program Code | Comments                                                                  |
|---------------|--------------|--------------------|------------------|----------|-----|--------------|---------------------------------------------------------------------------|
| 40081         | 80           | Alarm - Stop       | Short            | 06, 16   | W   | 59           | Interval alarms                                                           |
| 40082         | 81           | Alarm (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Alarm (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | Alarm - Restart    | Short            | 06, 16   | W   | 60           | Interval alarms                                                           |
| 40082         | 81           | Alarm (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Alarm (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | Horn - Silence     | Short            | 06, 16   | W   | 73           | Horn Off until new trigger.                                               |
| 40081         | 80           | Horn - Snooze      | Short            | 06, 16   | W   | 74           | Horn Off until new trigger, or until Seconds.                             |
| 40082         | 81           | Seconds            | Short            | 06, 16   | W   |              |                                                                           |
| 40081         | 80           | Horn - Test        | Short            | 06, 16   | W   | 75           | Horn Off until Seconds.                                                   |
| 40082         | 81           | Seconds            | Short            | 06, 16   | W   |              |                                                                           |
| 40081         | 80           | Relay - Get Tag    | Short            | 06, 16   | W   | 82           |                                                                           |
| 40082         | 81           | Relay (N)          | Short            | 06, 16   | W   |              |                                                                           |
| 40083 - 40090 | 82 - 89      | Tag                | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                   |
| 40081         | 80           | Relay - Reset Info | Short            | 06, 16   | W   | 83           |                                                                           |
| 40082         | 81           | Relay (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Relay (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | Relay - Automatic  | Short            | 06, 16   | W   | 84           |                                                                           |
| 40082         | 81           | Relay (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Relay (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | Relay - Manual ON  | Short            | 06, 16   | W   | 85           |                                                                           |
| 40082         | 81           | Relay (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Relay (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | Relay - Manual OFF | Short            | 06, 16   | W   | 86           |                                                                           |
| 40082         | 81           | Relay (N)          | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Relay (N)     | Short            | 06, 16   | W   |              | 0 to ignore                                                               |

| Reg. Number   | Reg. Address | Description          | Data Type        | Function | R/W | Program Code | Comments                                                                  |
|---------------|--------------|----------------------|------------------|----------|-----|--------------|---------------------------------------------------------------------------|
| 40081         | 80           | Relay - Manual Hold  | Short            | 06, 16   | W   | 87           |                                                                           |
| 40082         | 81           | Relay (N)            | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru Relay (N)       | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | mA Out - Get Tag     | Short            | 06, 16   | W   | 92           |                                                                           |
| 40082         | 81           | mA Out (N)           | Short            | 06, 16   | W   |              |                                                                           |
| 40083 - 40090 | 82 - 89      | Tag                  | String (16 char) | 03, 04   | R   |              | Null terminated string.                                                   |
| 40081         | 80           | mA Out - Automatic   | Short            | 06, 16   | W   | 93           |                                                                           |
| 40082         | 81           | mA Out (N)           | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru mA Out (N)      | Short            | 06, 16   | W   |              | 0 to ignore                                                               |
| 40081         | 80           | mA Out - Manual      | Short            | 06, 16   | W   | 94           |                                                                           |
| 40082         | 81           | mA Out (N)           | Short            | 06, 16   | W   |              |                                                                           |
| 40083 - 40084 |              | value (N)            | float            | 06, 16   | W   |              |                                                                           |
| 40081         | 80           | mA Out - Manual      | Short            | 06, 16   | W   | 95           |                                                                           |
| 40082         | 81           | mA Out (N)           | Short            | 06, 16   | W   |              |                                                                           |
| 40083         | 82           | value x 100 (N)      | Short            | 06, 16   | W   |              | For 4.00 mA, write 400. For 16.5 mA, write 1650.                          |
| 40081         | 80           | mA Out - Manual Hold | Short            | 06, 16   | W   | 96           |                                                                           |
| 40082         | 81           | mA Out (N)           | Short            | 06, 16   | W   |              | Program Code with only single parameter will ignore remaining parameters. |
| 40083         | 82           | Thru mA Out (N)      | Short            | 06, 16   | W   |              | 0 to ignore                                                               |

## Relay Control Using Modbus

To control the relays via Modbus, use the Write Single Coil command [command code 05] or Write Multiple Coils [command code 15] and send either the "ON" or "OFF" to the Modbus input associated with the target relay.

### Setup Example #1

Follow this example to set up Modbus Input to control a relay and configure the system to display messages related to the status of the device being controlled, in this case a pump.

Setup – MB-1.

1. Tag: Modbus Input 1
2. Type: Bit – Logic (Reg. No. 06101 or Reg. Address 06100)
3. Units: Logic = PUMP ON / PUMP OFF
4. Break: Default = OFF

Setup – RY-1.

1. Tag: Relay 1
2. Input: MB-1. Modbus Input 1

Setup – Create Screen

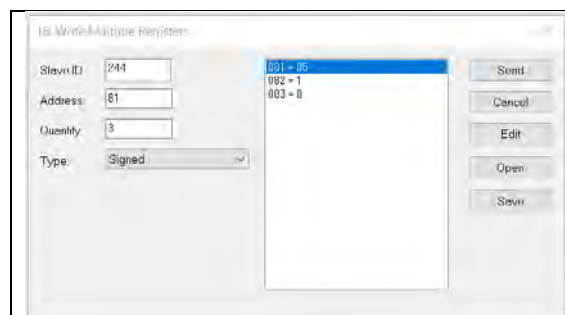
1. Title: Pumps
2. MB-1. Modbus Input 1
3. RY-1. Relay 1
4. F3: Assign to Force On RY-1
5. F4: Assign to Force Off RY-1

Operation: Write "1" to Reg. 06101 to turn relay 1 On; write "0" to turn relay 1 Off.

### Setup Example #2

Follow this example to control the relays directly from Modbus using special program functions. You can control one or all relays with one command.

|       |    |                    |       |        |   |    |                                                                           |
|-------|----|--------------------|-------|--------|---|----|---------------------------------------------------------------------------|
| 40081 | 80 | Relay - Automatic  | Short | 06, 16 | W | 84 |                                                                           |
| 40082 | 81 | Relay (N)          | Short | 06, 16 | W |    | Program Code with only single parameter will ignore remaining parameters. |
| 40083 | 82 | Thru Relay (N)     | Short | 06, 16 | W |    | 0 to ignore                                                               |
|       |    |                    |       |        |   |    |                                                                           |
| 40081 | 80 | Relay - Manual ON  | Short | 06, 16 | W | 85 |                                                                           |
| 40082 | 81 | Relay (N)          | Short | 06, 16 | W |    | Program Code with only single parameter will ignore remaining parameters. |
| 40083 | 82 | Thru Relay (N)     | Short | 06, 16 | W |    | 0 to ignore                                                               |
|       |    |                    |       |        |   |    |                                                                           |
| 40081 | 80 | Relay - Manual OFF | Short | 06, 16 | W | 86 |                                                                           |
| 40082 | 81 | Relay (N)          | Short | 06, 16 | W |    | Program Code with only single parameter will ignore remaining parameters. |
| 40083 | 82 | Thru Relay (N)     | Short | 06, 16 | W |    | 0 to ignore                                                               |



- 1) To manually turn on relay 1 write:
  - a. Reg. 40081: 85
  - b. Reg. 40082: 1
  - c. Reg. 40083: 0 (last relay, if more than one)
- 2) To manually turn off relay 1 write:
  - a. Reg. 40081: 86
  - b. Reg. 40082: 1
  - c. Reg. 40083: 0 (last relay, if more than one)
- 3) To return relays to normal operation write commands for automatic control.
  - a. Reg. 40081: 84

## Troubleshooting Tips

| Symptom                                                                         | Check/Action                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No display or only backlight is visible, but outputs still function normally.   | <ol style="list-style-type: none"> <li>1. Ambient temperature is below -40°C and affects LCD visibility.</li> <li>2. Grounding is inadequate or not connected. Check earth ground continuity.</li> </ol>                                                           |
| "BREAK" is displayed                                                            | Check the 4-20 mA input; if less than the break value (e.g. 0.01 mA), it displays BREAK. This can be changed in the Input menu.                                                                                                                                    |
| Display response seems slower than normal                                       | Ambient temperature is too cold: Consider installing a heater with the instrument.                                                                                                                                                                                 |
| Display reading is unstable, it fluctuates too much                             | <ol style="list-style-type: none"> <li>1. Check signal source stability</li> <li>2. Increase filter value</li> <li>3. Decrease the display refresh rate (increase time)</li> </ol>                                                                                 |
| mA input not responding to signal changes (value frozen)                        | <ol style="list-style-type: none"> <li>1. Cycle the power or</li> <li>2. Go to setup mA input and disable input channel, then enable the input channel</li> <li>3. Check that back cover is fully seated, and all I/O cards are tightly fixed in place.</li> </ol> |
| Display locks up or the instrument does not respond at all                      | Cycle the power to reboot the microprocessor.                                                                                                                                                                                                                      |
| Settings reprogrammed, but instrument behavior remains as previously programmed | Cycle the power to reboot the microprocessor.                                                                                                                                                                                                                      |
| Relay and status do not respond to signal                                       | <ol style="list-style-type: none"> <li>1. Check if relays are in manual control mode.</li> <li>2. Check Setup menu alarm set and reset points.</li> </ol>                                                                                                          |
| Writing to Modbus Input register failed                                         | Check register number or register address being used <ol style="list-style-type: none"> <li>1. If using PLC address (Base 1) use register number (e.g. 46701)</li> <li>2. If using Base 0 address, use register address (e.g. 6700)</li> </ol>                     |
| Controller does not communicate with another device.                            | Check baud rates and parity settings. Make sure all serial devices have matching parameters.                                                                                                                                                                       |
| Other symptoms not described above                                              | Call Technical Support for assistance.                                                                                                                                                                                                                             |

|                  |  |
|------------------|--|
| Model:           |  |
| Serial Number:   |  |
| System Password: |  |