

PD9000 ConsoliDator+ Multivariable Controller

Instruction Manual



- NEMA 4X Panel Mount Multi-Channel Controller
- Convenient Display, Control, & Alarm of Multiple 4-20 mA, Pulse, & Modbus Inputs
- Numeric & Bargraph Color Display (320 x 240 pixels) 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 Inputs
- 64 High & Low Alarms, Combine Multiple Alarms Into Logic AND & OR Alarms
- Simulation & Manual Control Modes for Testing Setup
- Modular Design for Inputs & Outputs 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
- Open Channel Flow Math Formulas for Weirs & Flumes
- Multi-Pump Alternation Control or On / Off Control with Random Varying Set Point
- Programmable Displays, Function Keys & Digital Inputs
- Math Functions: Sum, Diff, Average, Multiply, Divide, % Efficiency, & More
- Modbus Client (Master) & Snooper / Server with 99 Programmable Outputs
- Direct Modbus PV Inputs – Snooper / Server Mode
- Modbus Spoofer Feature to Replace Servers Removed from Network
- 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 & 4X Field Mount Enclosure Accessories
- 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

Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Limited Warranty

Precision Digital Corporation warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Precision Digital's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit. See Warranty Information and Terms & Conditions on www.predig.com for complete details.

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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.

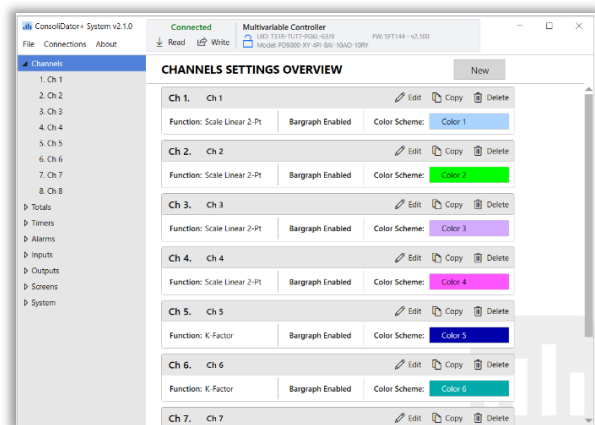


Table of Contents

Introduction.....	7
Ordering Information.....	7
Add-On Features.....	8
Input / Output Cards	8
Setup & Calibration Services	8
Enclosures	8
Accessories.....	9
Specifications	12
General	12
Totalizer	14
Real Time Clock	14
Channel & Math Functions.....	15
List of Engineering Units	16
4-20 mA Analog Inputs	17
Pulse Inputs	17
Modbus Inputs - Server	18
Digital Inputs & Outputs.....	18
Relays	18
4-20 mA Transmitter Outputs	19
Timers.....	19
Modbus Outputs - Server.....	19
Modbus Serial Communications	20
Client & Snooper Settings.....	20
Spoofers Settings	20
Ethernet Communications	21
ConsoliDator+ Software	21
Safety Information	21
Installation.....	21
Unpacking	21
Panel Mounting	22
Mounting Dimensions	23
ConsoliDator+ Configuration Software Installation	24
ConsoliDator+ Software	25
Connections.....	26
Power Connections	27
Analog Output Connections.....	28
Digital Output Connections.....	28
Connections to Power Gas Detector	29
Serial Communication Connections	30
External Keypad Connections	30
Navigating and Editing.....	31
Soft-Keys and Buttons	31
Setup and Programming.....	32
Overview	32
Setup Menu	33
Channel Parameters	34
Data Entry Keypad	35
Setup Channels.....	36
Create New Channel	37
Bargraph, Background & Text Colors.....	38
Live Calibration.....	39
Edit Channel.....	39
Delete Channel.....	39
2-Point Linear Scaling	40
Square Root Scaling	40
Scale Exponent	41

Round Horizontal Tank	41
Open Channel Flow Application	42
Setup Math Functions	43
Open Channel Flow	45
Setup Totalizers	46
Setup Total with Pulse Input Source	46
Setup Accumulated Total (Triggered)	47
Setup Previous Total	47
Setup Daily Total	47
Setup Grand Total	48
Setup Timers	49
Setup Alarms	50
Logic OR Alarm	51
Logic AND Alarm	51
Logic NOR & NAND Alarms	51
Day & Time Alarms	52
Setup Inputs	53
Setup 4-20 mA Inputs	53
Setup Pulse Inputs	54
Setup Digital Inputs	54
Modbus Functionality	56
Setup Modbus Inputs (Server)	56
Setup Modbus Inputs (Client)	57
Setup Modbus Inputs (Snooper)	57
Setup All Outputs	58
Setup 4-20 mA Outputs	58
Setup Relay Output	59
Setup Digital Output	61
Setup Modbus Output (Server)	61
Setup Modbus Output (Client)	62
Setup Modbus Output (Spoofers)	63
Setup Screens	64
Screens Settings	64
Setup System	66
Setup Display	66
Setup Colors	66
Display Settings	66
General Settings	67
Add-On Features	67
Set Password	68
Password Protected Controller	68
Remove Password Protection	68
System Date & Time	69
System Build	69
Modbus Server Settings	70
Modbus Client Settings	70
Modbus Snooper Settings	70
Ethernet Settings	71
Manually Assigned IP Address	71
Custom Units	72
Delete Custom Units	72
Ethernet Port Setup - Full	73
Test Ethernet Communication	75
View Menu	76
View Channel Details	76
View Associated Parameters	77
View Alarm Details	77
View Totals	78

Totals Generated by Non-Rate Inputs	79
View Timers	80
View Alarms	81
Simulate Alarm Condition	81
View Inputs	82
Simulate mA Input	82
View Outputs	83
View mA Outputs	83
View Relays	84
View Alert Messages	84
View Digital Outputs	85
View Modbus Outputs	85
View Screens	86
Operation	87
Viewing Screens	87
Individual Channel View	87
Low & High Alarm Indication	87
Multicolor Bargraph Indication	88
Modbus RTU & ASCII Serial Communication	89
Modbus Register Tables	89
PVs Register Numbers & Addresses	91
Modbus Write Protection	92
Modbus Applications	96
Snooper Mode	96
Relay Control Using Modbus	97
Setup Example #1	97
Setup Example #2	97
Troubleshooting Tips	98

Table of Figures

Figure 1. Front Panel Mount Dimensions	22
Figure 2. Panel Cutout Dimensions	22
Figure 3. Panel Mount Installation	23
Figure 4. Panel Mount Overall Dimension	23
Figure 5. Connection Terminals for a PD9000-GP-4PI-8AI-10AO-10RY	26
Figure 6. Power Connections	27
Figure 7. Transmitters Powered by ConsoliDator+ Isolated 24 VDC Power Supply	27
Figure 8. Transmitter Powered by Ext. Supply or Self-Powered	27
Figure 9. 3-Wire Transmitters Powered Externally	27
Figure 10. Flow Meter Pulse Input Connections	28
Figure 11. Digital Input from Switch Closure and Live Signal	28
Figure 12. Active 4-20 mA Output Powered by Controller	28
Figure 13. Passive 4-20 mA Output Powered by External Supply	28
Figure 14. Digital Outputs Driving 5 V Solid State Relay	28
Figure 15. Two Supplies in Parallel Powering 3-Wire Transmitter	29
Figure 16. Powering 4-Wire Gas Detector & Isolated 4-20 mA Output	29
Figure 17. Relay Connections	30
Figure 18. AC and DC Internal Inductive Loads Protection	30
Figure 19. Low Voltage DC Loads Protection	30
Figure 20. Serial Connections	30
Figure 21. External Keypad Connections	30
Figure 22. Linear Response Graph	40
Figure 23. Square Root Response Graph	40
Figure 24. Exponent Response Graph	41
Figure 25. Round Horizontal Tank Volume Graph	41
Figure 26. Total Relay Sampling Operation	42

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 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 & ASCII, Modbus Enron, 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 the 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	0	0	0	0
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.

Add-On Features

Model	Description
PDK9000-M1	Add-On Feature: ConsoliDator+ Modbus Client/Snooper/Spoofers

Note: Add-On features that are ordered with the ConsoliDator+ will be activated at the factory. Add-On features can be ordered for existing ConsoliDator+ units with a firmware revision of 2.1 or greater at any time. The user will receive a key they can enter into the ConsoliDator+ to unlock the Add-On Feature. See page 67 for instructions on how to enable the *Add-On Features*.

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+

Enclosures

Model	Description
PDA1909	NEMA 4X Plastic Enclosure for One ConsoliDator+ Dimensions: 11.8" x 11.8" x 5.9" (300 mm x 300 mm x 150 mm) (H x W x D)
PDA1939	NEMA 4X Plastic Enclosure for One ConsoliDator+ Dimensions: 17.7" x 13.8" x 7.9" (450 mm x 350 mm x 200 mm) (H x W x D)
PDA2909	NEMA 4 Steel Enclosure for One ConsoliDator+ Dimensions: 12.0" x 12.0" x 6.0" (305 mm x 305 mm x 152 mm) (H x W x D)
PDA2919	NEMA 4 Steel Enclosure for One ConsoliDator+ Dimensions: 14.0" x 12.0" x 8.0" (356 mm x 305 mm x 203 mm) (H x W x D)
PDA2929	NEMA 4 Steel Enclosure for One ConsoliDator+ Dimensions: 16.0" x 14.0" x 10.0" (406 mm x 355 mm x 254 mm) (H x W x D)
PDA3939	NEMA 4X Plastic Enclosure with Clear Cover for One ConsoliDator+ Dimensions: 17.7" x 13.8" x 7.9" (450 mm x 350 mm x 200 mm) (H x W x D)

Accessories

Light / Horn Accessories



Model	Description
MOD-LHRB1	Red Light / Horn and Button with Holes Drilled in Enclosure ⁽¹⁾
MOD-LHGB1	Green Light / Horn and Button with Holes Drilled in Enclosure ⁽¹⁾
MOD-LHYB1	Yellow Light / Horn and Button with Holes Drilled in Enclosure ⁽¹⁾
MOD-LHBB1	Blue Light / Horn and Button with Holes Drilled in Enclosure ⁽¹⁾
MOD-LHWB1	White Light / Horn and Button with Holes Drilled in Enclosure ⁽¹⁾
MOD-LH5CB1	Light / Horn with User Choice of Red, Green, Yellow, Blue or White Light, Button, and Holes Drilled in Enclosure ⁽¹⁾
MOD-LH3LCB1-RYG	Light / Horn with Red, Yellow, Green Light Layers, Button, and Holes Drilled in Enclosure ⁽¹⁾
PDA-LHR	Red Light / Horn
PDA-LHG	Green Light / Horn
PDA-LHY	Yellow Light / Horn
PDA-LHB	Blue Light / Horn
PDA-LHW	White Light / Horn
PDA-LH5C	Light / Horn with User Choice of Red, Green, Yellow, Blue or White Light
PDA-LH3LC-RYG	Light / Horn with Red, Yellow, Green Light Layers

Note:

- This MOD supplies the Light / Horn and Button. The enclosure comes pre-drilled with holes for Light / Horn and Button and the user performs the installation and wiring. ConsoliDator+ and enclosure are sold separately. The Light / Horn hole is located on the top left corner of the enclosure and the Button is located on the bottom left side of the enclosure.

PDA-BUTTON Momentary Pushbutton



Model	Description
PDA-BUTTON1B	NEMA 4X Black Button
PDA-BUTTON1G	NEMA 4X Green Button
PDA-BUTTON1R	NEMA 4X Red Button

PDA9000SH Sun Hood



Model	Description
PDA9000SH	ConsoliDator+ Sun Hood

PDA2360 Control Stations



Model	Description
PDA2360-E	Emergency Stop Button
PDA2361-A	1 Black Ack Button
PDA2361-Q	1 Black Silence Button

Signal Splitter & Conditioner Accessories



Model	Description
PD659-1MA-1MA	Signal Isolator with One 4-20 mA Input and One 4-20 mA Output
PD659-1MA-2MA	Signal Splitter with One 4-20 mA Input and Two 4-20 mA Outputs
PD659-1V-1MA	Signal Conditioner with One 0-10 VDC Input and One 4-20 mA Output
PD659-1MA-1V	Signal Conditioner with One 4-20 mA Input and One 0-10 VDC Output

PDA1024-01 Power Supply

Model	Description
PDA1024-01	24 VDC Power Supply for DIN Rail

Split Core AC Current Transducer

Model	Description
PDA6420	Split Core AC Current Transducer. Input: 30/60/120 AAC; Output 4-20 mA

Panel Mount Buzzer and Light

Model	Description
PDA1000	Panel Mount Buzzer and Light

Snubber 0.01μF/470Ω Flexible Leads

Model	Description
PDX6901	Snubber 0.01μF/470Ω Flexible Leads

Low-Cost Signal Generator

Model	Description
PD9502	4-20 mA or 0-10 VDC, Low-Cost Signal Generator

PD9000-ENC ConsoliDator+ NEMA 4X Plastic and NEMA 4 Steel Enclosures

The PD9000-ENC enclosures provide a convenient way to mount the PD9000 ConsoliDator+ to walls and other vertical structures. The enclosures are available in painted steel and plastic and come pre-cut with one cutout to mount the PD9000. The enclosures are available in various sizes, with the larger enclosures capable of housing other pieces of equipment, such as the PDA1024-01 power supply.

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

Features

- House One ConsoliDator+ PD9000
- Cutout for One ConsoliDator+ Provided
- ConsoliDator+ Mounts in Cover
- Sub-Panels Available
- PDA6909 Pipe Mounting Kit Available
- Light / Horn & Reset Button Available
- UL Listed Plastic Enclosures
- UL Listed, CSA Certified Steel Enclosures

NEMA 4X Plastic Enclosures**PDA1909**

Dimensions: 11.8" x 11.8" x 5.9"
(300 mm x 300 mm x 150 mm)
(H x W x D)

**PDA1939**

Dimensions: 17.7" x 13.8" x 7.9"
(450 mm x 350 mm x 200 mm)
(H x W x D)

**PDA3939**

Dimensions: 17.7" x 13.8" x 7.9"
(450 mm x 350 mm x 200 mm)
(H x W x D)

NEMA 4 Steel Enclosures**PDA2909**

Dimensions: 12.0" x 12.0" x 6.0"
(305 mm x 305 mm x 152 mm)
(H x W x D)

**PDA2919**

Dimensions: 14.0" x 12.0" x 8.0"
(356 mm x 305 mm x 203 mm)
(H x W x D)

**PDA2929**

Dimensions: 16.0" x 14.0" x 10.0"
(406 mm x 355 mm x 254 mm)
(H x W x D)

[Download the PD9000-ENC datasheet for more details.](#)



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

predig.com/documentation-cad

Specifications

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

General

Display	Color; QVGA (320x240 px), 5.7" (145 mm) diagonally, white backlight Bargraph: Twenty divisions Numerical: Up to 15 digits (±999,999,999,999,999) Feet & Inches Format: 99,999' 11.9"
Screen Bargraph	Enable/disable: Channels, totals, timers Bargraph scale: 0 – 100%, independent of channel scale. Twenty divisions: 5% each. Screen: Select to show bargraph or not.
Color Selection	65 colors selection Customize bargraph, panel background, and text for normal and alarm conditions.
Decimal Point	0 to 15 decimal places, user selectable
Engineering Units	User selectable units or custom units Time, Distance, Volume, Pressure, Weight, Temperature, Current, Voltage, Percent, Amps, Volts, Counts, Logic, and Custom, Any unit/unit of time or other units. See page 16 for list of units.
Units Conversion	Units' conversion is supported for channels, totals, timers, and any function using those parameters. Channel scaling must be in the intended base units (e.g. Gallons/min)
Display Update Rate	User selectable: 0.1 to 0.5 sec (10 updates/sec to 2 updates/sec)
Programming Method	Front panel buttons, external buttons, or ConsoliDator+ Software
Number Of Alarms	Up to 64 high or low, Logic AND & OR Automatic (non-latching) or latching On & Off time delays Can be assigned to one or more relays. <i>Note: Alarms are independent from relays.</i>
Alarm Types	Single Source: One input Multi-Source: Two or more inputs Interval: Enter time interval and On Time Day & Time: Select day of the week & time Alarm OR: Any active input alarm triggers the OR alarm Alarm AND: All alarms must be active to trigger the AND alarm
Alarm Ack & Reset	Automatic only (Non-latching) Automatic and manual Manual only (Latching) Manual with Ack only after alarm is cleared (Latching with Clear)
Alarm Indication	1. Bargraph, panel, and text can be set up to change color on alarm 2. Enable internal buzzer 3. Assign external relay to drive a horn
Internal Buzzer	60 dBA @ 24 inches (61 cm) Enable/disable in System – General menu. Associated with alarm Horn setting
External Horn (Sold Separately)	Assign any relay to the Horn function to activate an external horn when alarm condition is detected.
Live Channel Calibration	Live calibration of channels is independent of the input calibration used for scaling.

Input & Output Cards	Max Number of I/O Cards: 7 Analog Inputs: 4/card Pulse Inputs: 4/card Analog Outputs: 5/card Relays: 5/card
Number of Screens	Up to 20 screens with 1 to 8 PVs or items per screen Enable or disable screen title, channel #, and bargraph Automatic or manual scanning Scan time: 1 to >1000 sec, independent for each screen F1-F4 keys are assigned per screen
Function Keys	User programmable (See defaults below) F1 = Previous ← F2 = Next → F3 = Scan/Stop F4 = Ack
Number of Channels	Up to 99 channels Input Source: 4-20 mA, Pulse, Digital, Modbus, another Channel, Total, Timer, Alarm, Date & Time, mA Output, Relay Output, Digital Output, or Modbus Output
Channel Functions	There is an extensive number of functions that can be applied to the inputs, see Channel & Math Functions on page 15
Password	Programmable password restricts modification of programmed settings. View and Setup menus are password protected, function keys and digital inputs are not protected.
Simulation Mode	Inputs, channels, totals, timers, and alarms can be simulated from the View menu or from a function key. Simulation mode is not saved on power down. Alert! message is provided for simulated items.
Manual Control	Analog outputs and relays can be controlled manually from the View menu or from a function key. Manual control mode is not saved on power down. Alert! message is provided for outputs in manual control. Note: If it is necessary to turn relays off and maintain the condition through power cycle, configure the relays to Always Off.
Non-Volatile Memory	Settings stored for a minimum of 10 years.

Power	Three-terminal connector (L, N, GND) AC: 80-264 VAC, 47 to 63 Hz, 60 W max DC: 113-370 VDC, 60 W max (L, N)
User Selectable Based on Wiring	Two-terminal connector (G, 24V) DC: 24 VDC $\pm 10\%$, 60 W max
Backup Power Supply	If AC and DC power are connected, the 24 VDC can be used as backup power in case of AC power failure. Note: DC supply must be 24 V or less; otherwise the system runs on DC power.
Fuse	Unit is protected internally with auto-resettable fuse AC: 1.25 A max DC: 3.7 A max
External Fuse	Recommended external fuse slow-blow 120 VAC: 2.0 A 240 VAC: 1.0 A 24 VDC: 4 A
Isolation & Grounding	1500 V Analog inputs/outputs-to-power line 500 V Analog input-to-input, input-to-output, analog output-to-output All analog inputs and analog outputs are isolated from each other. <i>Note: DC Power is not isolated. DC- is connected to Earth Ground. Digital I/O, USB, and Ethernet are grounded.</i>
Environmental	Operating temperature range: -40 to 60°C (-40 to 140°F) Storage temperature range: -40 to 60°C (-40 to 140°F) Relative humidity: 0 to 90% non-condensing <i>*All functions operate down to -40°C (-40°F.) LCD response is slower, increase display refresh setting.</i>
Internal Fan	Automatic temperature-controlled fan turns on if the inside temperature reaches 50°C and increases the speed as the temperature rises to 60°C.
Internal Heater	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.
Connections	Removable screw terminal blocks Inputs/Outputs: 12 to 24 AWG wire Digital I/O: 16 to 30 AWG RS-485: 12 to 24 AWG wire RJ45 Ethernet connection. USB ports: Micro-USB (Device), cable included.
Tightening Torque	Screw terminal connectors: 5 lb-in (0.56 Nm) Digital I/O terminals: 2.5 lb-in (0.28 Nm)
Enclosure	Enclosure Body: Thermoplastic Polyester, Color: Gray Display Window: Clear Polycarbonate, GE LEXAN HP12W Front Panel Keys: Silicone rubber

Mounting	Panel-mounting frame and twelve screws (provided) Cutout: 10.0" x 10.0" ± 0.05 " (254 mm x 254 mm ± 1.3 mm) (H x W) Panel thickness: 0.07" – 0.35" (1.8 mm – 8.9 mm) Clearance behind panel: 6" (152 mm)
Overall Dimensions	10.85" x 10.85" x 4.87" (276 mm x 276 mm x 124 mm) (H x W x D)
Weight	Ex: PD9000-XY-4PI-8AI-10AO-10RY 7.4 lb (3.4 kg) approx.
Warranty	3 years parts and labor. See Warranty Information and Terms & Conditions on www.predig.com for complete details.

Totalizer

Number of Totalizers	Up to 32 totalizers 15 digits with comma separator
Totalizer Inputs	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.
Maximum Total	18 digits 999,999,999,999,999,999
Rate Channel Input	4-20 mA input, Pulse input, Modbus input
Rate & Total Decimal Point	Independent and user selectable from 0 to 15 places
Totalizer Reset	Via front panel keys or digital inputs
Non-Resetable Total	Total can be setup to be non-resettable to prevent unintentional reset. This can be changed in the Setup Totals menu.
Total Units Conversion	Input: Rate channel Total units can be different than rate units. Use the custom units to convert to any unit (e.g. Gallons to MGal: Factor = 0.000001)
Pulse Input K-Factor	K-Factor = pulses/units of measure Calculates total directly from pulse input, Modbus input, channel, total, or Modbus output. Create rate channel by entering K-Factor, units and time base in sec, min, hr, or day. Decimals: 0 to 15
Count Down	Total can be setup to count down from a predetermined value entered by the user
Preset Value	Enter the preset value to count up or down Reset total sets total to the preset value; to reset to zero uncheck the Preset box.
Roll-Over	Enter the value for total to roll-over to 0 Example: Roll-Over = 1,000,000 Total goes to 0 after 1 million
Negative Total	Allow total value to count below 0 for bi-directional flow based on rate channel
Total Bargraph	Bargraph can be scaled to represent the expected maximum total
Function Keys	Screen Setup: Assign F1-F4 to Reset Total, Enter Total, Add To, or Remove From total
Previous Total	This is the total prior to the last reset. Multiple previous totals can be set up by selecting a previous total as the input to a new total. The date & time is captured with the previous total.
Daily Total	This is the total for the day, starting at midnight. Daily total can be the input for previous totals to keep a record of a few days. The date is captured with the previous total.
Grand Total	Uses another total as the input and it is setup as non-resettable
Non-Rate Total	This total takes the input from a non-rate channel, a trigger causes the total to increment or decrement based on the settings selected (e.g. Input from weight scale added when digital input is triggered).

Real Time Clock

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

Channel & Math Functions

Scale Functions	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
	Percent (Bargraph)	% bargraph of any: 4-20 mA input, channel, total, timer, or mA output
	Text (Percent)	Text displayed based on the % input value
Math Functions	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
	Exponent	Set the base and the exponent; both can be constants or variables
	Logarithm	Set the base and the value; both can be constants or variables
	Modulo	Set constants or variables for A mod B
	Trigonometry	Sine, cosine, tangent, arc sine, arc cosine, arc tangent. Select the input and angle
	% Efficiency	Calculate input to output efficiency $((A-B)/A)*100\%$

Open Channel Flow Functions	Parshall Flumes	$Q = K H^n$ Enter constant, head variable, exponent, and units
	V-Notch Weirs	$Q = K H^{2.5}$ Enter constant, head variable, and units
	Cipolletti Weirs	$Q = K L H^{1.5}$ Enter constant, crest length, head variable, and units
	Rectangular Weirs w/o Contractions	$Q = K L H^{1.5}$ Enter constant, crest length, head variable, and units
	Rectangular Weirs with Contractions	$Q = K (L - 0.2H) H^{1.5}$ Enter constant, crest length, head variable, and units

Additional Functions	Compare	
	Greatest	Greatest value in a group of channels
	Least	Smallest value in a group of channels
	Middle of 3	Outputs the middle value of three inputs
Measure		
	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
	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
Filter		
	Window Average	Enter time to calculate the average
	IIR (First Order)	Infinite Impulse Response (slow)
	Cutoff	PV = 0 below cutoff Flip Side: 0 above (-)
	Limits	Sets PV upper & lower limits.
	Round	Round (to nearest) Floor (always down) Ceiling (always up) Less (toward zero) More (away from zero)
	Hysteresis	Resists a directional change using a time delay, filters change in the trending direction
	Delay	Enter the number of seconds to delay the output
	Pulse Filter	Use to filter discrete inputs, set minimum and maximum on/off time in seconds

Control	
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 PV
On-Off Control with Random Varying On/Off	Select Randomizer, enter on/off points +/- random variation
Select A or B	Switch between 2 inputs
Select 1,2,3...	Select 1 from 3 or more inputs, works as a selector switch.
Capture	Set a trigger event to capture a value in real time
Schedule	Daily or weekly event The available actions depend on configuration of inputs and outputs
Relays	
Cycle Count	Number of relay cycles since reset
Runtime	Relay runtime (ON) hh:mm:ss
Modbus	
Time Since Read	Time since a Modbus client device read a register
Time Since Write	Time since a Modbus client wrote to a register

List of Engineering 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

Number of Inputs	(4) Analog inputs/card (28) Analog inputs max, no other I/O
Typical Input	4-20 mA
Input Range	0-24 mA
Accuracy	±0.03% of full scale ±1 count
4-20 mA Display Value	Up to six full digits recommended ±999,999 More digits can be used, but the stability will be affected. Increase the filter value and lower the display update rate or use rounding to get a more stable reading.
Transmitter Power Supply	Isolated 24 VDC @ 200 mA/input Max current: 1,600 mA (All inputs) (8) Analog Input @ 200 mA max (28) Analog Input @ 20 mA max Available on AC or DC powered units
Temperature Drift	Better than: 20 ppm/°C from -40 to 60°C ambient
Filter	Window: 0.5, 1, 2, 4, 8 sec, IIR: 16, 32 sec Glitch Filter: Discards a single sample caused by high frequency noise
Filter Bypass	0 to 100 % of full scale Filter is ignored, if the signal change is greater than bypass value
Channel Input Scale Function	Scale Linear 2-Point, Scale Multi-Point (up to 50 points) Scale Square Root Scale Exponent (Open Channel Flow) Scale Factor Round Horizontal Tank (Volume) Units Conversion (mA Input Reading) Percent Bargraph Text (Percent)
Channel Input Live Calibration	Each channel can be calibrated using live calibration signal from a sensor or a calibrator.
Input Protection	Each 4-20 mA input is protected by an auto-resettable fuse, 30 VDC max. The fuse resets automatically after the fault condition is removed.
Input Impedance	125 Ω typical, including auto-resettable fuse
Hart Transparency	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.
Isolation	1500 V: Input-to-power line 500 V: Input-to-input, input-to-output All analog inputs and analog outputs are isolated from each other.
Normal Mode Rejection	100 dB at 50/60 Hz
Common Mode Rejection	90 dB at 50/60 Hz

Pulse Inputs

Number Of Inputs	(4) Pulse inputs/card (28) Pulse inputs max, no other I/O
Input Type	Active Square Wave, NPN, PNP, Reed Switch, Coil (Magnetic Pickup) Normal threshold: 1.2 V (0.8 to 3.0 V) High threshold: 2.5 V (2.0 V to 6.0 V) Coil threshold: 20 mV (Low) or 100 mV (High)
Signal Level	Active Square Wave: 0 to 30 V max Typical: 0 to 5 V Coil: 20 mVp-p to 30 Vp-p (Magnetic Pickup)
Input Impedance	Active, NPN, Reed: 10 kΩ pull-up to 5 V PNP: 10 kΩ pull-down to (S-) Coil: >2 kΩ (20 mV sensitivity), >10 kΩ (100 mV sensitivity)
Isolation	Pulse inputs are not isolated, (S-) terminal is connected to system GND
Input Protection	±36 V, non-isolated
Frequency Response & Signal Level	Active Square Wave 5 V: 0 to 100 kHz Coil (Magnetic Pickup): 0 to 50 kHz <u>Frequency – Signal level (Coil: 20 mV)</u> 20 mVp-p – 100 Hz 100 mVp-p – 10 kHz <u>Frequency – Signal level (Coil: 100 mV)</u> 100 mVp-p – 90 Hz 500 mVp-p – 5 kHz 20 Vp-p – 50 kHz
Minimum Frequency	250 μHz with High Gate = 4,000 sec
Low Gate	1 to 99 sec
High Gate	2 to 4,000 sec (Must be higher than low gate)
Low Speed	100 Hz maximum Used for contact debouncing
Pulse Counter	8,388,607 maximum, used for troubleshooting purposes only
Accuracy	±1 count for K-Factor > 1 or 30 ppm
K-Factor	Programmable pulses/unit of measure with up to 15 decimal resolution
Scale Pulse Input	Scale Linear 2-Point Scale Multi-Point Scaling: 2 to 50 points Scale Factor Units Conversion
Live Calibration	Pulse input channel can be calibrated using live calibration signal from a sensor.

Modbus Inputs - Server

Availability	Standard feature
Number of Inputs	199 Modbus RTU
Scale Modbus Input	Modbus input can be used as the input for creating channels and totals, the same way the 4-20 mA inputs are used.
Data Type	Bit-Logic Signed/Unsigned: 16 (Short), 32 (Long), 64 (Long-Long) Float 32, Float 64 (Double)
Decimal Point	User selectable
Comm Break & Timeout	Specify what value to hold when a communication break occurs and how long to wait for new data before reporting a break condition
Input Action	Specify what should happen when new data is written to the input register (e.g. add value to total).
Modbus Client Snooper Spoofer	See <i>Client & Snooper Settings</i> , page 20. See <i>Spoofing Settings</i> , page 20.

Digital Inputs & Outputs

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

Relays

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

4-20 mA Transmitter Outputs

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

Timers

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

Modbus Outputs - Server

Availability	Standard feature
Data Type	Bit-Logic Signed/Unsigned: 16 (Short), 32 (Long), 64 (Long-Long) Float 32, Float 64 (Double)
Register Numbers	The register numbers are automatically generated based on the Modbus output number and the output's data type. Bit – Logic: 04101 – 04199 Signed/Unsigned 16: 44101 – 44199 Signed/Unsigned 32: 44201 – 44398 Signed/Unsigned 64: 45001 – 45396 Float 32: 44401 – 44598 Float 64: 44601 – 44996
Engineering Units	Select the engineering units for the process variable assigned to the output
Decimal Point	User selectable. For short and long integers this is a multiplier applied to the input value, but it is not displayed on the server's screen. The Modbus client uses this setting to read the correct value from the server. Example: Ch 1 value = 4,379.26 MB Output Data Type: Signed 32 Decimals = 0 → Output = 4,379 Decimals = 3 → Output = 4,379,260
Output Action	Specify what should happen when the output register is read by the client (e.g. Start timer 1).
Modbus Client Snooper Spoof	See <i>Client & Snooper Settings</i> , page 20. See <i>Spoof Settings</i> , page 20.

Modbus Serial Communications

Add-On Features PDK9000-M1	Client, Snooper & Spoofer The Modbus Client is an option in the ConsoliDator+. It can be purchased at the time the order is placed or it can be purchased and enabled at any time. The Modbus Snooper & Spoofer features are part of the Client Add-On feature.
Compatibility	RS-485 (EIA-485)
Modes	Client: Requests data from servers and writes data to servers. Snooper: Listens to the RS-485 network communications and reads the selected registers. Spoofers: A channel is configured to pretend being a device that has been removed from the network. The device ID and register number is used.
Protocols	Modbus RTU or Modbus ASCII Modbus Enron is supported by the Client and the Spoofer modes.
Device Address	1 to 247
Transmit Delay	0 to 999 ms
Receive Timeout	1 to 9 seconds
Baud Rate	1,200 to 115,200 bps
Data	8 bit (1 start bit, 1 stop bit)
Parity	Even, Odd, None with 1 stop bit, or None with 2 stop bits
Modbus Inputs	199 for all modes
Modbus Outputs	99 for all modes. The outputs can be grouped together to be sent as blocks of registers. These Modbus outputs are in addition to the outputs listed in the <i>Modbus Register Tables</i> , see page 89.
Communication Break	Reports a break condition after the response timeout has elapsed. The break condition can be: Zero, a default value, or the text Break. The Client goes into break condition after the server device fails to respond and the timeout has elapsed. The Snooper and Server modes go into break condition after no new data is received within the response timeout window. Alarms can be programmed to go on, off, or stay as is when a break condition is detected. The analog outputs can be setup to generate a fixed mA current when a break condition is detected.

Client & Snooper Settings

Availability	Order Add-On Feature model PDK9000-M1 at any time
Number of Output PVs	99 process variables can be written by the Client mode to Modbus servers. Modbus server outputs are available over the Ethernet port.
Server ID	Enter the server ID or address containing the process variables to be read or written by the Client or read by the Snooper.
Function Code	Select which Modbus function code to use for reading the server device or for writing to a server by the ConsoliDator+ Client.
Register Address	0-65,533 (Base 0) Reg. No. 30001-39999, 40001-49999 Reg. No. 300001-365534 or 400001-465534 Specifies which register(s) to read from the server device.
Data Type	Select the data format used by the server device. Bit – Logic (Coil) Signed/Unsigned: 16 (Short, 2 byte) 32 (Long, 4 byte) 64 (Long Long, 8 byte) Float 32 (4 byte), Float 64 (Double, 8 byte)
Byte Order	ABCD, CDAB, BADC, or DCBA (big-endian, swapped, or little-endian)
Client Poll Time	1.0 to 999.9 sec. Time between read-commands.
Server Response Timeout	99:59:59 hrs.: Time allowed for the server to respond before the Modbus client generates a communication break condition. The timeout should be greater than the poll time. Server/Snooper mode: Time the Modbus input will wait for new data before going into a break condition. If the timeout is disabled, the last value will remain until a new value is received.

Spoofers Settings

Number of Output PVs	99 process variables can be replaced by the ConsoliDator+ Spoofer feature
Number of Input PVs	199 process variables can be written by a client to the Spoofer inputs replacing other Modbus servers.
Server ID	Enter the server ID or address being replaced by the ConsoliDator+ Spoofer.
Function Code	Select the Modbus function code use by the server device.
Register Address	Enter the address 0-65,533 (Base 0) for the process variable of the replaced server.
Data Type	Select the data format used by the server.
Byte Order	Select the byte order ABCD, CDAB, BADC, or DCBA (big-endian, swapped, or little-endian)
Engineering Units	Select the engineering units for the process variable
Decimals	Enter the number of decimals required
Output Action	Select an action to be performed by the controller, when the Spoofer output is read by a Modbus client or leave as None.

Ethernet Communications

Device	Lantronix Xport-05
Protocol	Modbus TCP/IP (Default) Modbus UDP/IP Modbus RTU Over TCP/IP Modbus RTU Over UDP/IP
Port Settings (Do Not Change)	Protocol: RS-232 Baud Rate: 9600 Data Bits: 8 Flow Control: None Parity: None, Stop Bits: 1
Network Stack	IPv4
Ethernet Mac/Phy	10/100 Mbps
Additional Specifications	Refer to the Lantronix Webpage https://www.lantronix.com/products/xport
Ethernet Port Configuration	Download the Lantronix DeviceIntaller software to configure the Ethernet port https://www.lantronix.com/products/xport See page 73 <i>Ethernet Port Setup</i> for instructions.

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.

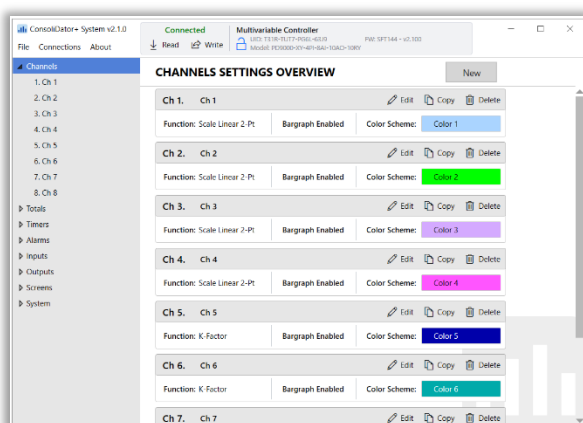
Installation

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.

ConsoliDator+ Software

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



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

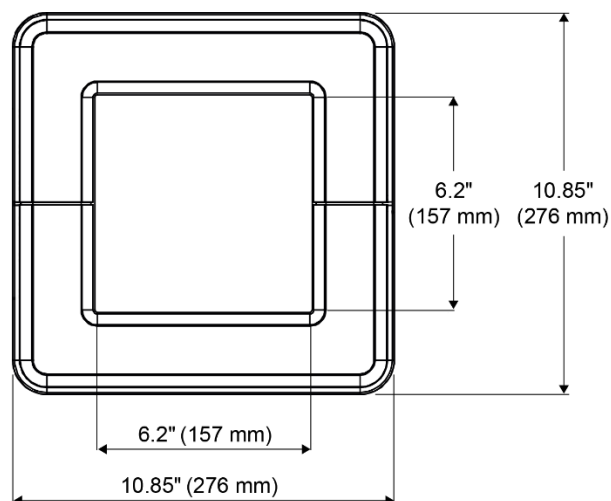


Figure 1. Front Panel Mount Dimensions

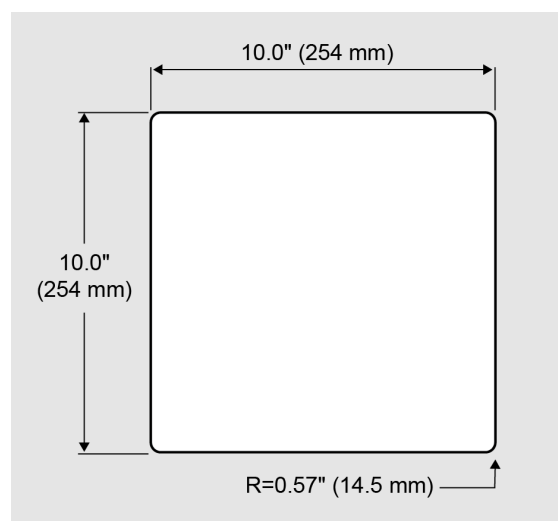


Figure 2. Panel Cutout Dimensions

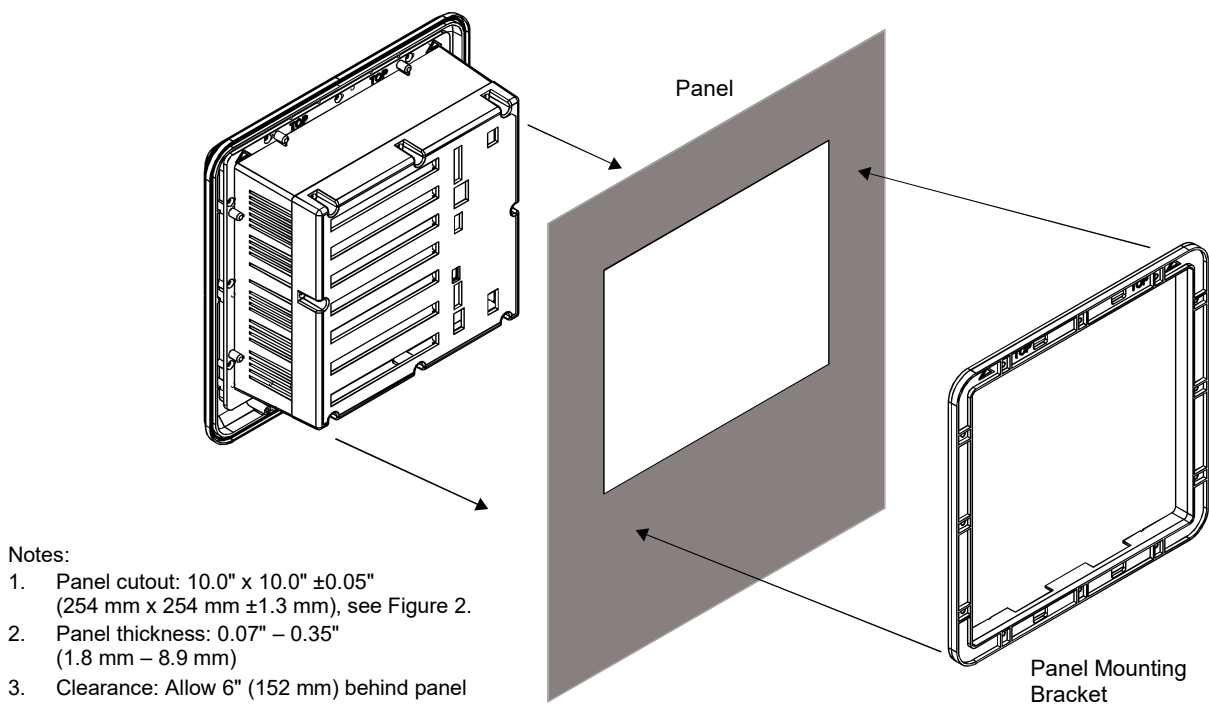


Figure 3. Panel Mount Installation

Mounting Dimensions



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

predig.com/documentation-cad

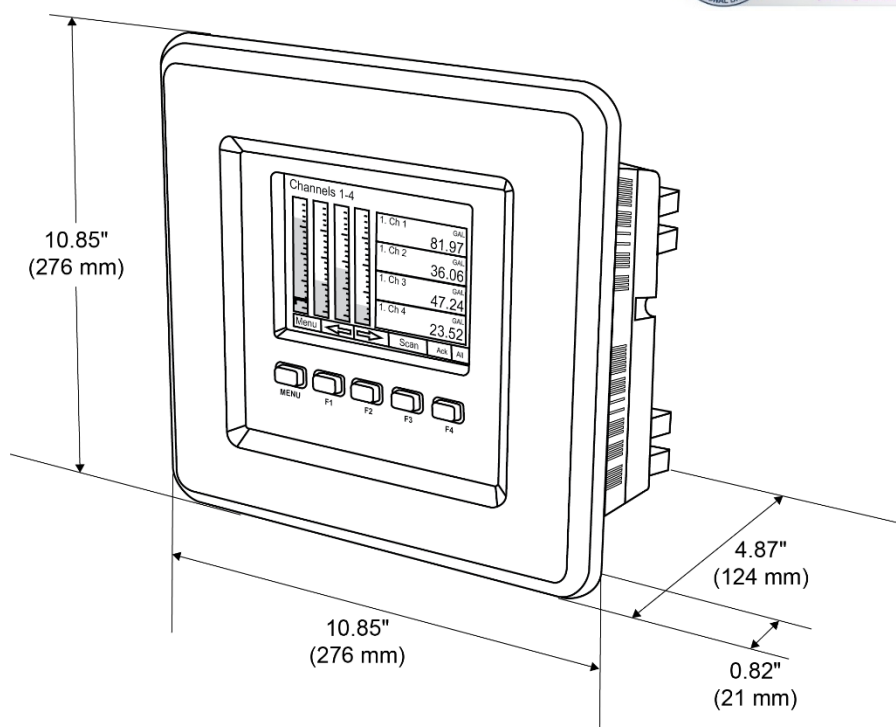
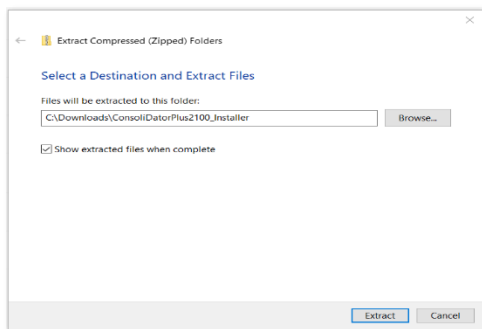
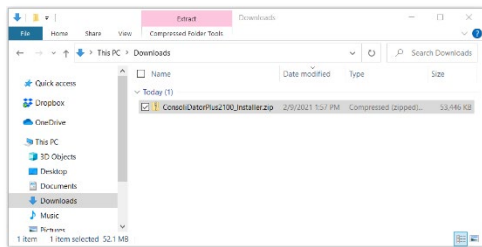


Figure 4. Panel Mount Overall Dimension

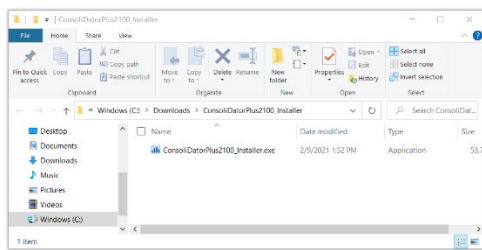
ConsoliDator+ Configuration Software Installation

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

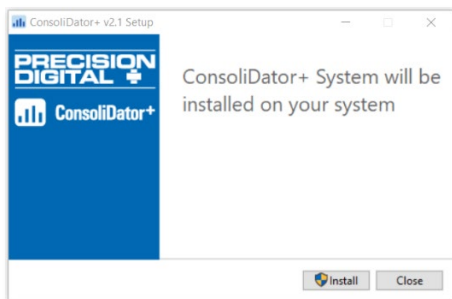
1. Download the latest version of the ConsoliDator+ configuration software from our website predig.com/software or from the included CD.
2. Extract the contents of the *ConsoliDatorPlus2100_Installer.zip* file into a folder in your computer.



3. Double-click on the executable file *ConsoliDatorPlus2100_Installer.exe* and follow the on-screen instructions.



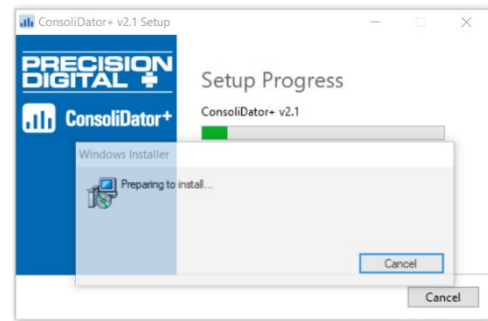
4. This message is displayed. Click on **Install** to start the software installation process.



5. The User Account Control message is displayed. Click **Yes** to proceed with the installation.



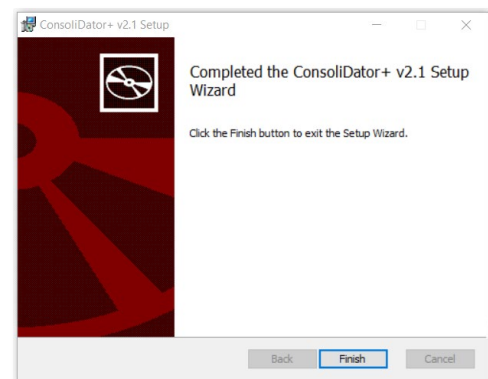
6. The installation progress is displayed.



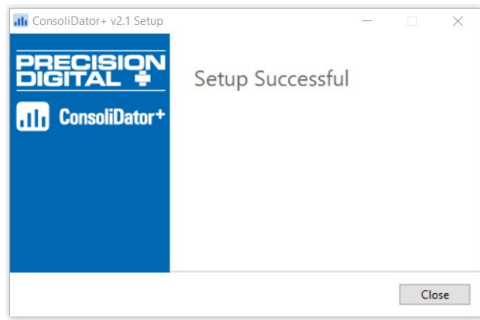
7. Read and accept the End-User License Agreement and click **Install** to proceed.



8. After the software installation is complete, click the **Finish** button.



- 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 or download the latest version from predig.com/software. The ConsoliDator+ configuration software is intuitive, and most customers can get their controller programmed as they like without even looking in the manual.

⚠ WARNINGS

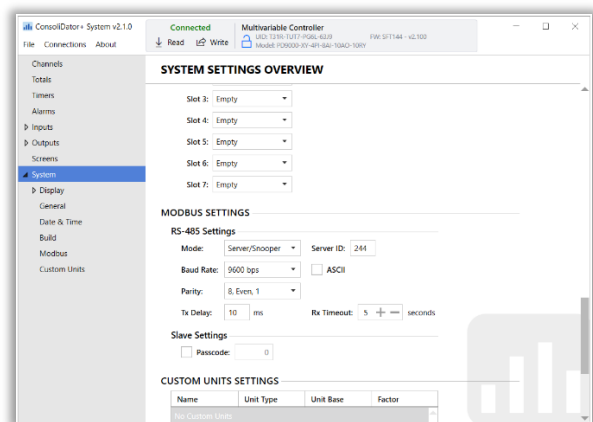
- Only one controller can be connected at a time. Attaching multiple controllers will cause a conflict with the controller software.

ConsoliDator+ Software

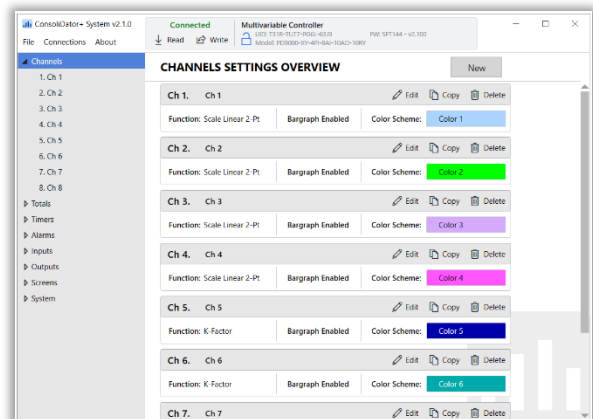
- Connect one end of the provided USB cable to the controller and the other end to the computer.
- Double-click on the ConsoliDator icon



- The application will start displaying the System menu and the connection status.



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



- 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.
- Click on *File* 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, or (25) relays.

If used as a Modbus Client, Snooper, or Server only: (35) 4-20 mA outputs or (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.

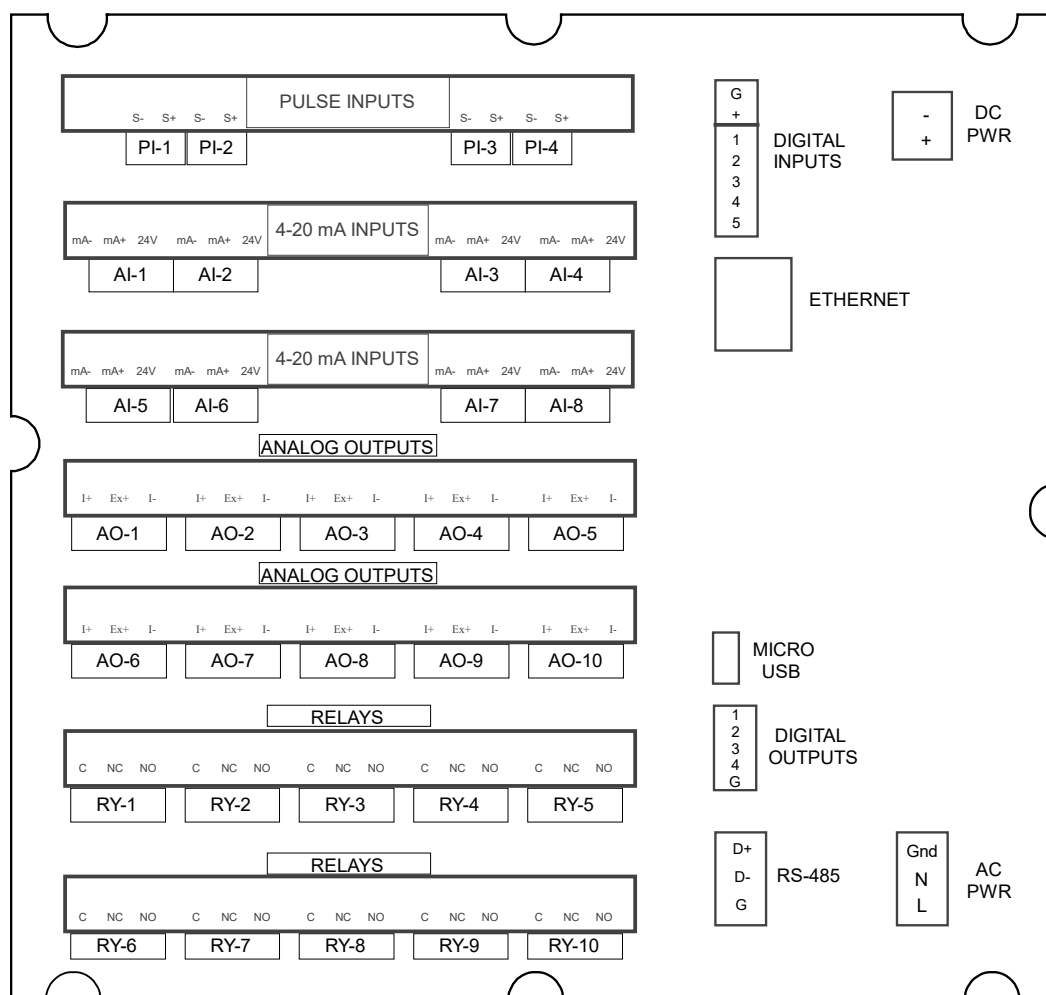


Figure 5. Connection Terminals for a PD9000-GP-4PI-8AI-10AO-10RY

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.

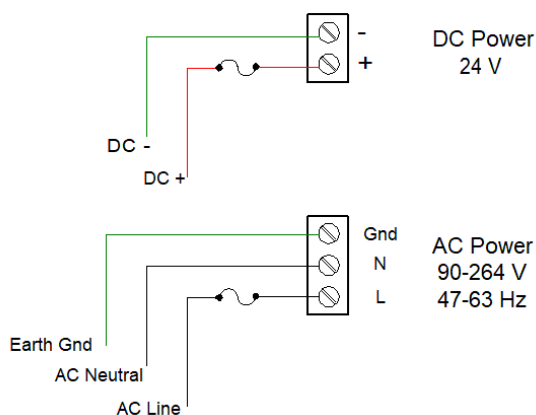


Figure 6. Power Connections

Note:

The controller can 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 can be connected in any of the modes shown below.

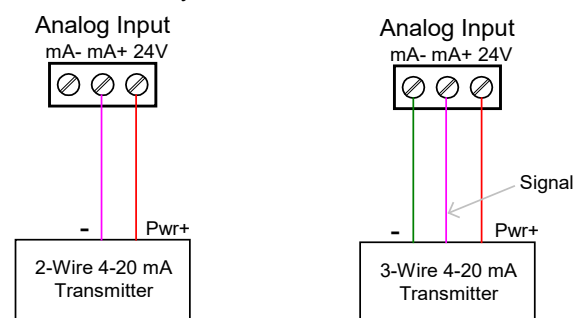


Figure 7. Transmitters Powered by ConsoliDator+ Isolated 24 VDC Power Supply

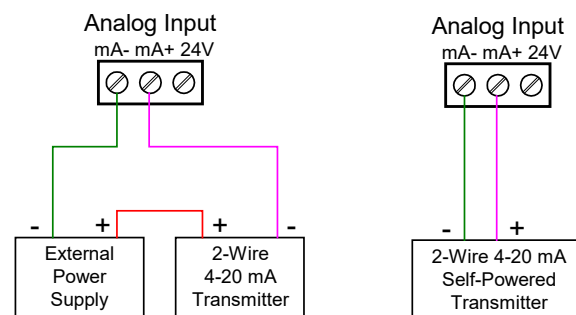


Figure 8. Transmitter Powered by Ext. Supply or Self-Powered

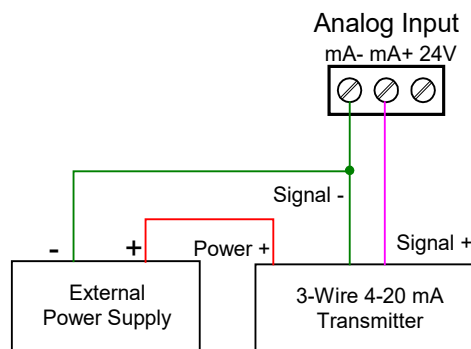


Figure 9. 3-Wire Transmitters Powered Externally

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 pulse input can read many types of signals within the specified voltage and frequency ranges.

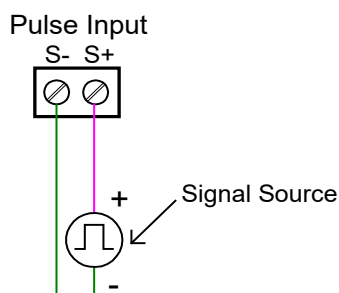


Figure 10. Flow Meter Pulse Input Connections

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 can 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 can be used to provide excitation to some sensors requiring more than the pull-up provided on each digital input terminal.

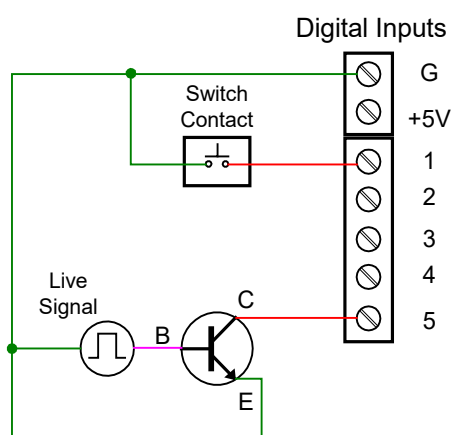


Figure 11. Digital Input from Switch Closure and Live Signal

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 can be powered externally by connecting the positive voltage to the Ex+ terminal.

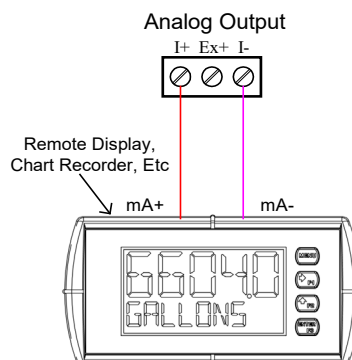


Figure 12. Active 4-20 mA Output Powered by Controller

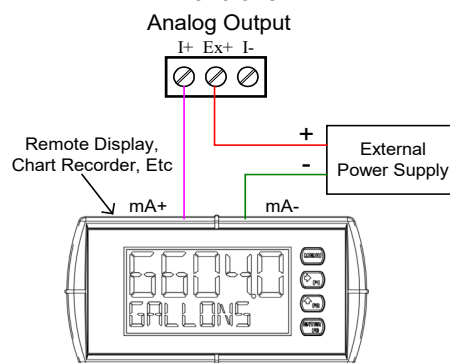


Figure 13. Passive 4-20 mA Output Powered by External Supply

Note: Analog inputs and outputs are isolated from each other

Digital Output Connections

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

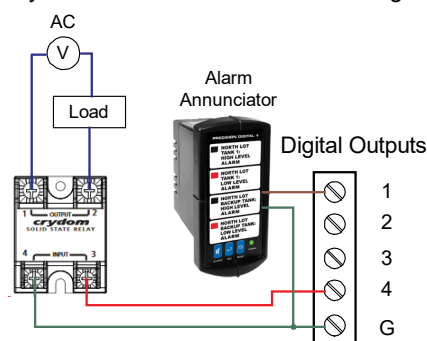


Figure 14. Digital Outputs Driving 5 V Solid State Relay

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.

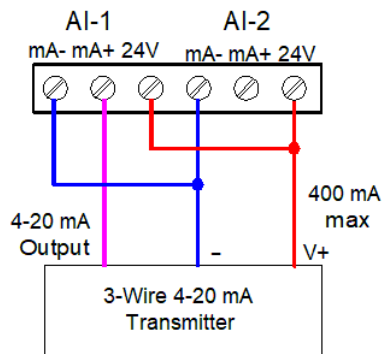


Figure 15. Two Supplies in Parallel Powering 3-Wire Transmitter

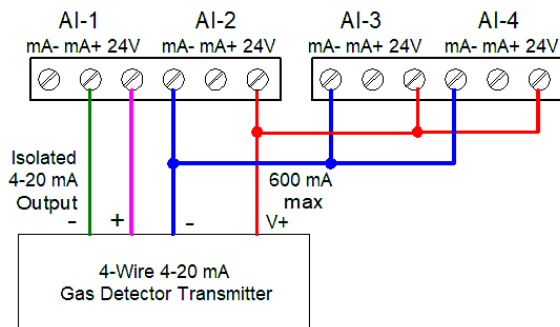


Figure 16. Powering 4-Wire Gas Detector & Isolated 4-20 mA Output

Relay Connections

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

Relay Output

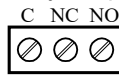


Figure 17. Relay Connections

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.

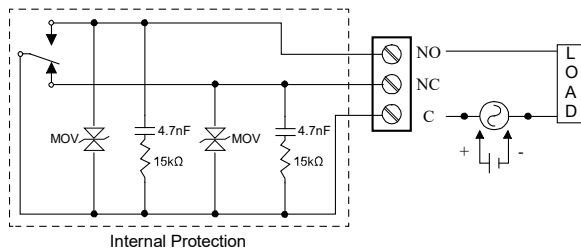


Figure 18. AC and DC Internal Inductive Loads Protection

For additional external protection choose R and C as follows:

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

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

Notes:

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

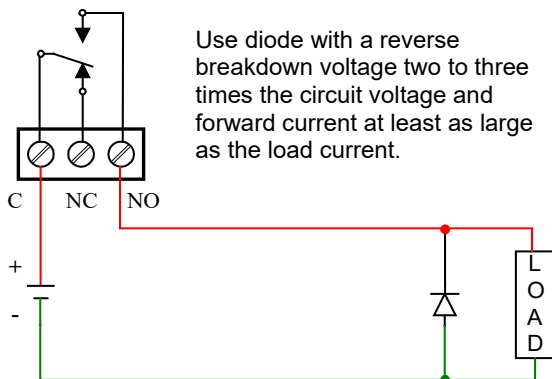


Figure 19. Low Voltage DC Loads Protection

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 can be connected to a single RS-485 bus.

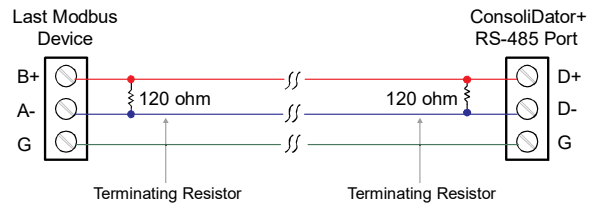


Figure 20. Serial Connections

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 at

www.lantronix.com/products/xport. See page 21 for specifications, page 71 for setup using the ConsoliDator+ software, and page 73 for complete Ethernet Port Setup.

External Keypad Connections

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

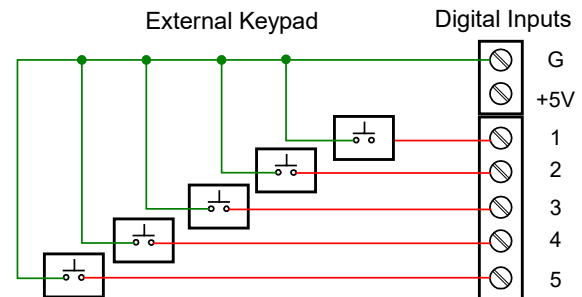


Figure 21. External Keypad Connections

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.

Screen Navigation



Menu Navigation



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!	Flashing red: View new alarm alerts Steady red: Alarm alerts, already viewed
Alert!	Amber: View manually controlled outputs, and simulated parameters

Setup and Programming

There is **no need to recalibrate** the instrument when first received from the factory. Use the *Scale* function to set up the input channels to display your process in engineering units.

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.

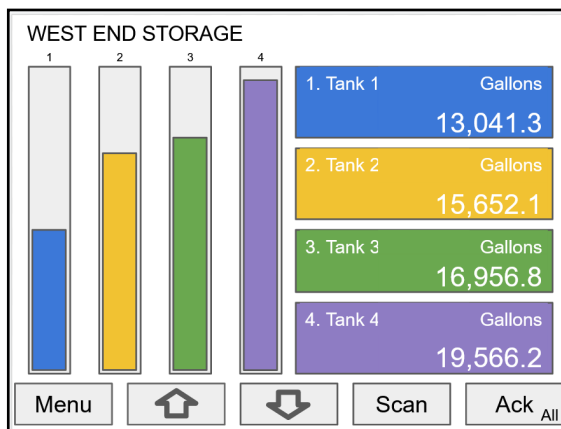
Overview

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.

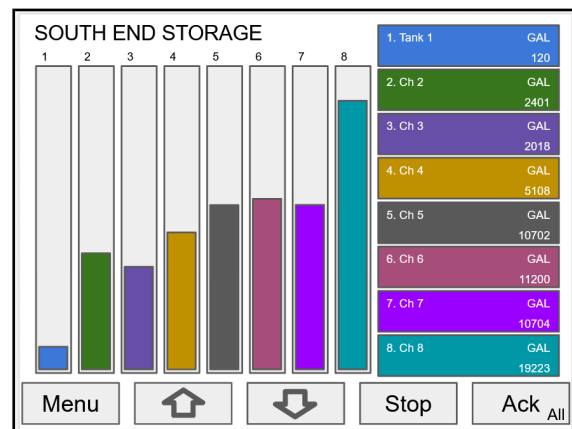
Inputs, outputs, channels, and relays are configured individually. It is recommended that all inputs be configured before channels, outputs, and relays are programmed.

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

For information on soft-keys and button functions, see Soft-Keys and Buttons on page 31.

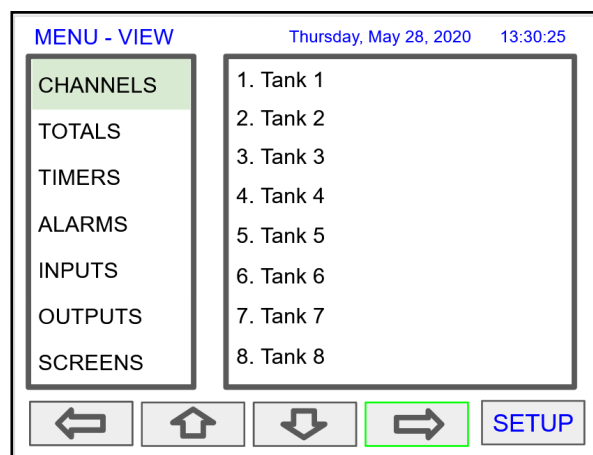


Typical screen view displaying 4 channels and 4 bargraphs representing the values of each channel.



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

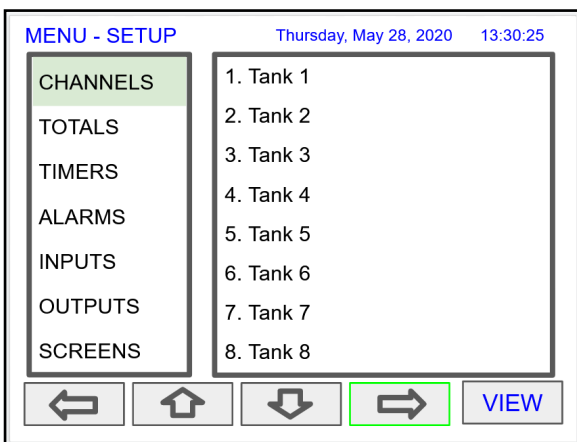
Press the **Menu** key to begin setup and programming



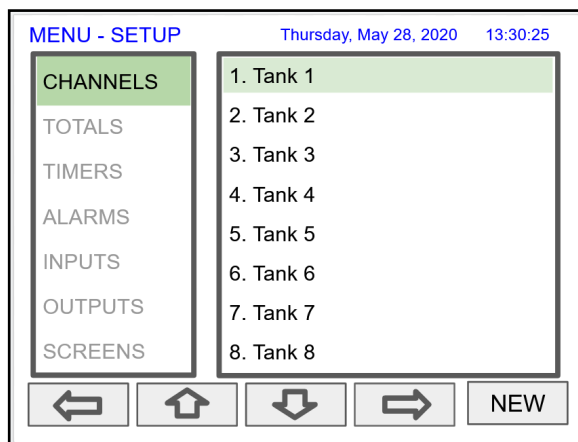
The View screen allows a user to view all the settings and values for Channels, Totals, Timers, etc. To program the instrument, press the **Setup** key.

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 can 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 37 for details.

Channel Parameters

The screenshot shows the 'Channel Parameters' configuration window. Numbered callouts point to various fields and controls:

- 1: Channel tag (Rate #1)
- 2: Channel number (1)
- 3: Function (Scale Linear 2-Pt)
- 4: Input (AI-1. 2a (mA))
- 5: Units (Gallons/min)
- 6: Decimals (1)
- 7: Scale input/output values (4.000, 20.000, 0.0, 10000.0)
- 8: Cutoff (0.0 Gallons)
- 9: Soft keys (Cancel, Home, Up, Down, Colors, Save)
- 10: Bargraph scale (0.0, 10000.0)
- 11: Bargraph checkbox
- 12: Colors (Colors 1)

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
- Percent (Bargraph)
- Text (Percent)

➤ **Math**

- Constant
- Summation
- Difference
- Absolute Difference
- Absolute Value
- Average
- Weighted Average
- Multiply
- Divide
- Exponent
- Logarithm
- Modulo
- Trigonometry
- % Efficiency

➤ **Open Channel Flow**

- Parshall Flumes
- V-Notch Weirs
- Cipolletti Weirs
- Rectangular Weirs w/o Contractions
- Rectangular Weirs with Contractions

➤ **Compare**

- Greatest
- Least
- Middle of 3

➤ **Measure**

- Tare
- Maximum
- Minimum
- Duration
- Rate of Change

➤ **Filter**

- Window Average
- IIR (First Order)
- Cutoff
- Limits
- Round
- Hysteresis
- Delay
- Pulse Filter

See Channel & Math Functions on page 15 for details.

➤ **Control**

- Sampler
- On-Off Control w/Randomizer
- Select A or B
- Select 1,2,3
- Schedule
- Capture

➤ **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

Data Entry Keypad

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

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.

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.

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

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

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

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 can 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 Up Down 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

Flow

Compare

Measure

Filter

Control

Relays

K-Factor

Scale Factor

Scale Linear 2-Pt

Scale Multi-Point

Scale Square Root

Scale Exponent

Round Horz Tank

Units Conversion

Cancel Up Down Left 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

Modbus Input

Channel

Total

Timer

Clock

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 Up Down Left Ok

Select the input source for the channel.

Note: The inputs shown depend on the installed hardware and the configuration.

13. Flow #30 Colors 1

Function: Scale Linear 2-Pt

Input: AI-1. 2a (mA)

Units: Gallons /

Time

Distance

Volume

Pressure

Weight

Temperature

Gallons

GAL

L

IGAL

M3

BBL

Cancel Up Down Left Ok

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

13. Flow #30 Colors 1

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

Cancel Up Down 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 Select 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?

Cancel Ok

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.

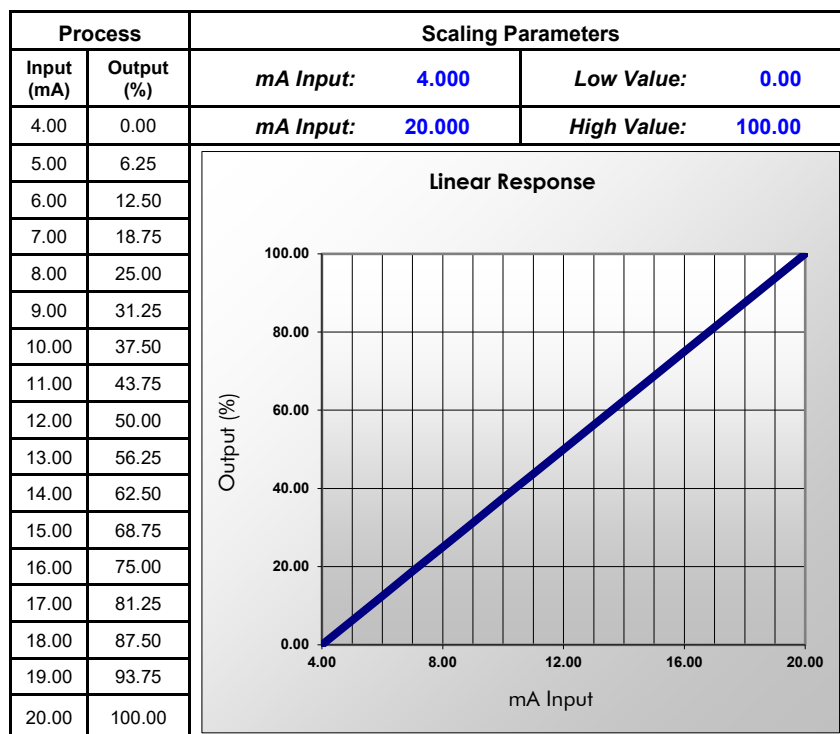


Figure 22. Linear Response Graph

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".

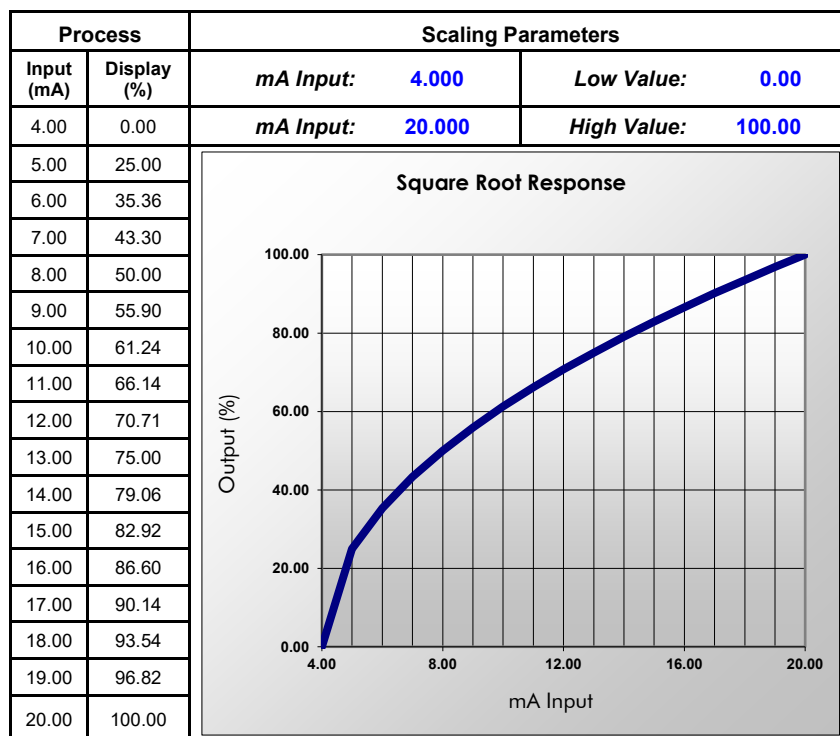


Figure 23. Square Root Response Graph

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".

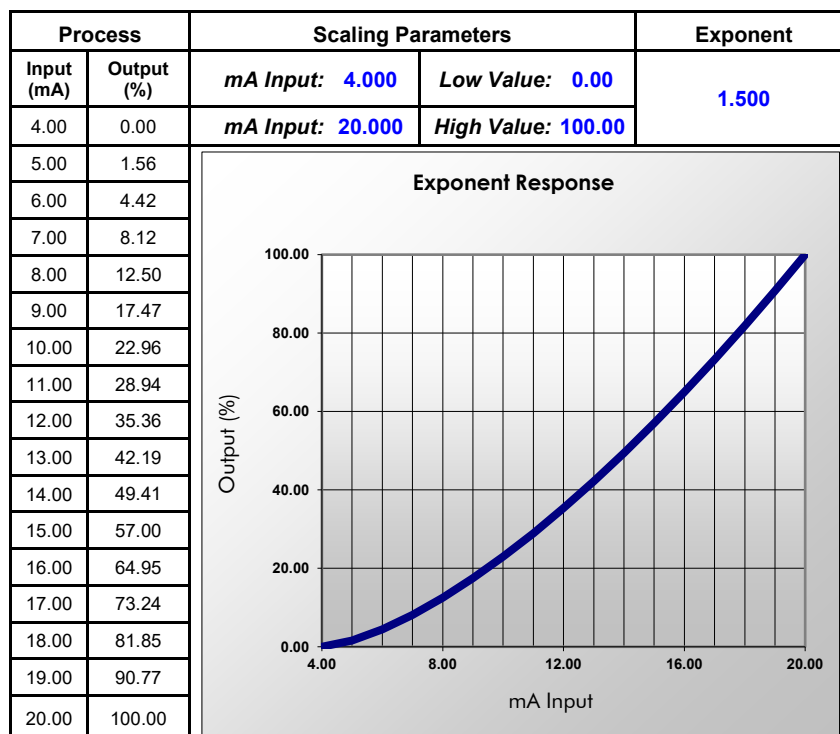


Figure 24. Exponent Response Graph

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 Horz Tank*] from *Function* options.

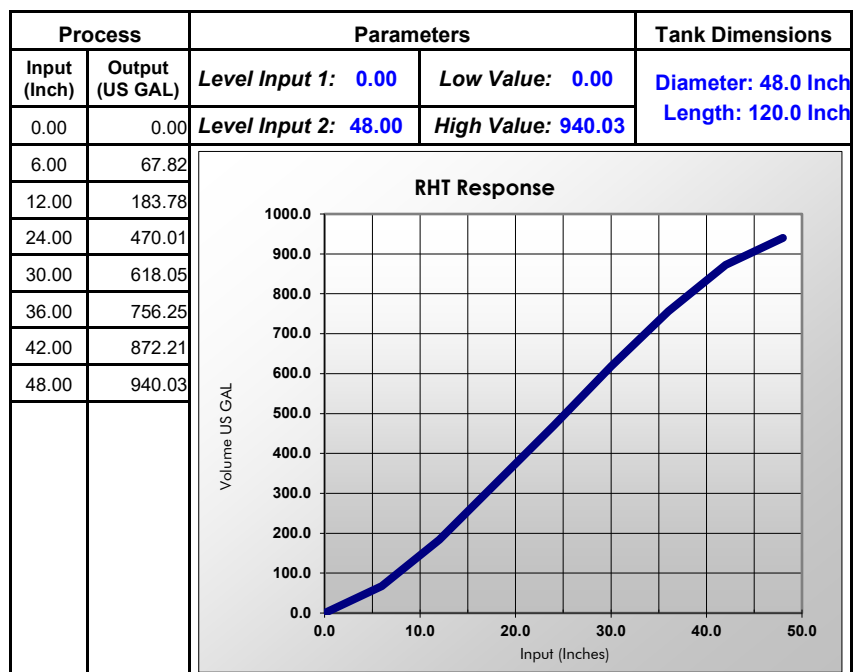


Figure 25. Round Horizontal Tank Volume Graph

Open Channel Flow Application

The ConsoliDator+, in combination with a 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. There are two ways the user can program the ConsoliDator+ for open channel flow applications:

Programmable Exponent: In this method, all the user needs to do is enter the exponent for the weir or flume into the ConsoliDator+ and the controller automatically raises the input signal to that power. 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 ConsoliDator+ as shown in the upper table on the right.

Specific Weir or Flume Function: In this method, the user selects one of the following functions to be applied to the input from a menu in the ConsoliDator+: Parshall Flumes, V-Notch Weirs, Cippolletti Weirs, Rectangular Weirs with or without Contractions. The second table on the right shows the parameters the user then enters.

In addition, a total can be setup as non-resettable and a relay can be programmed to take a sample at user-defined intervals.

Programmable Exponent for Open Channel Flow

Function	Desire	Programming
Open Channel Flow	3" Parshall flume	Use Scale Exponent function Set Exponent to 1.547
Flow Rate 1	Millions of Gallons per Day (MGD)	Set 4 mA: 0 Set 20 mA: 3.508 Custom unit: MG; Time base: day Flow rate units: MG/day
Total 1	Millions of Gallons	Input: Flow Rate 1 Select unit = MG
Sampling Channel 2	Take a 1 pint sample every 100,000 gallons	Input: Total 1 Function: Sampler Sample Interval: 0.1 MG Sample Time: 10 sec
Sampling Relay 1	Turn valve on to take a sample	Input: Channel 2 (On / Off) 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 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.

Specific Weir or Flume Function for Open Channel Flow

Function	Desire	Programming
Open Channel Flow	3" Parshall flume	Create Channel 1 to measure head height 4 mA = 0 feet 20 mA = 3.000 feet
Flow Rate 1	Millions of Gallons per Day (MGD)	Create Channel 2 for flow rate Use Flow – Parshall Flumes function Constant K = 0.992 Head = Channel 1 head height Custom unit: MG; Time base: day
Total 1	Millions of Gallons	Input: Flow Rate 1 Select unit = MG
Sampling Channel 2	Take a 1 pint sample every 100,000 gallons	Input: Total 1 Function: Sampler Sample Interval: 0.1 MG Sample Time: 10 sec
Sampling Relay 1	Turn valve on to take a sample	Input: Channel 2 (On / Off) 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 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.

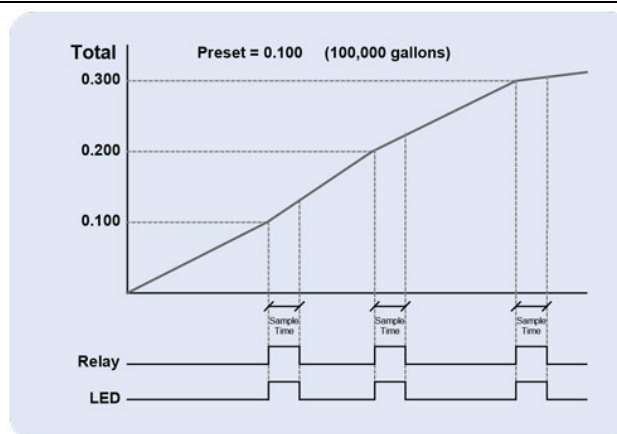


Figure 26. Total Relay Sampling Operation

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. Exponent
11. Logarithm
12. Modulo
13. Trigonometry
14. % Efficiency

*Average can be used for applications requiring redundant sensors by selecting the *Exclude Fail Input* feature. The two 4-20 mA inputs must be set to break below a failed level value.

Application Example: % Efficiency

Description: Calculate the VOC Destruction Efficiency in a Thermal Oxidizer

Thermal Oxidizer Efficiency =

$(\text{Inlet VOC} - \text{Outlet VOC}) / \text{Inlet VOC}$

4-20mA output = 0-100% efficient

Efficiency = $((\text{Ch1} - \text{Ch2}) / \text{Ch1}) * 100$

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

20. VOC %Efficiency

Function: None

Scale	Weighted Average
Math	Multiply
Flow	Divide
Compare	Exponent
Measure	Logarithm
Filter	Modulo
Control	Trigonometry
Relays	% Efficiency

Cancel [Up] [Down] [Left] [Right] Ok

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

20. VOC %Efficiency

Function: %Efficiency

Inputs: $((A-B) / A) \times 100\%$

A: 1. Inlet VOC

B: 2. Outlet VOC

Units: %

Decimals: 1

Colors 1 [X] Bargraph [X]

0% : 0.0

100% : 100.0

Cancel [Up] [Down] Edit Save

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

Additional Functions

Scale

K-Factor
Scale Factor
Scale Linear 2-Pt
Scale Multi-Point
Scale Square Root
Scale Exponent
Round Horz Tank
Units Conversion
Percent (Bargraph)
Text (Percent)

Open Channel Flow

Parshall Flumes
V-Notch Weirs
Cipolletti Weirs
Rectangular Weirs with End Contractions
Rectangular Weirs w/o End Contractions

Compare

Greatest
Least
Middle of 3

Measure

Tare
Maximum
Minimum
Duration
Rate of Change

Filter

Window Average
IIR (First Order)
Cutoff
Limits
Round
Hysteresis
Delay
Pulse Filter

Control

Sampler
On-Off Control
Select (A or B)
Select 1,2,3
Schedule
Capture

Relays

Cycle Count
Runtime

Modbus

Time Since Read
Time Since Write

Random Varying On-Off Control

The *On-Off Control* with the *Randomizer* function is used to prevent grease buildup in tank level control applications.

The controller randomly varies the *On* and *Off* points within the user-selected range.

- Create a channel
- Function: On-Off Control
- Input: Level or volume channel
- Enter On / Off points
- Enter the allowed +/- deviations

14. Random On/Off Color 1

Function: On-Off Control

Input: Tank 1 Level

Break: OFF ☒ Randomizer

On: 20.00 +/- 2.00 Feet

Off: 10.00 +/- 2.00 Feet

On Delay: 0 Seconds

Off Delay: 0 seconds

Units: PUMP ON/PUMP OFF

Cancel Home Up/Down Square Ok

After creating the On-Of Control with Randomizer channel, assign this channel as the input for the relay controlling the pump.

Open Channel Flow

The built-in math formulas in the ConsoliDator+ makes the setup of open channel flow applications an easy task. All you need to know is type of device being used and the formula for calculating the flow rate using the head height.

The first thing to do is to create a channel for measuring the head height of the weir or flume.

This example shows the setup for a 3" Parshall Flume with a maximum head height of 3 feet.

1. Head Height Colors 1

Function: Scale Linear 2-Pt ☒ Bargraph

Input: AI-1. Flume 1 Sensor 0% : 0

Units: Feet 100% : 3.000

Decimals: 3

Scale: Input (mA) Output (Feet)

1. 4.000 0.000

2. 20.000 3.000

☒ Cutoff: 0.0 Feet

Cancel Home Down Colors Ok

Scale the 4-20 mA input

2. Flow Rate

Function: Parshall Flumes

Scale
Math
Flow
Compare
Measure
Filter
Control
Relays

Parshall Flumes
V-Notch Weirs
Cipolletti Weirs
Rectangular Weirs
R-Weirs w/Contraction

Cancel Home Down Left Ok

Select the type of weir or flume installed

2. Flow Rate Colors 1

Function: Parshall Flumes ☒ Bargraph

0% : 0.000

100% : 5.428

Formula: $Q = K H^n$

Constant K: 0.9920

Head: 1. Height Feet

Exponent: 1.547

Units: cuFt / sec Decimals: 3

Cancel Home Down Edit Ok

Enter the constant K, the channel used for measuring the head height and the specified exponent. Select the flow rate units. The Controller calculates the flow rate in the specified engineering units. The units can be changed at any time without making any other changes.

Setup Totalizer Based on Flow Rate

T1. Total Flow Colors 1

Input: 1. Flow Rate ☒ Bargraph

Units: CuFt 0% : 0

100% : 1000000

Decimals: 0

☐ Count Down

☐ Allow Negative

☐ Preset Value: 0 GAL

☐ Roll-Over: 0 GAL

☐ Non-Resettable

Cancel Home Down Edit Save

Setup Screen to Monitor Open Channel Flow

1. Open Channel Flow

1. Head Height

2. Flow Rate

T1. Total Flow

AI-1. Flume 1 Sensor

Add ...

☒ Show Title

☐ Show Channel #

☐ Show Bargraphs

☐ Bargraphs Only

☒ Auto Scan

☒ Dwell Time

Seconds: 5

F1 F2 F3 F4

Left Home Down Edit Delete

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 can 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 Accumulated Total (Triggered)

Selecting a total as the input for a new total enables the *Mode* menu: Totalizer, Previous Total, Daily Total, and Grand Total selections.

The *Totalizer* mode can be used to add the input total to the new total, when a trigger is activated. The trigger can be a digital input, a Modbus input, or any event selected.

Setup Previous Total

The previous total is saved just before the input total is reset.
The date & time when the total was reset is saved.



Multiple previous totals can be saved by using a previous total as the input for a new total. Link previous totals to maintain a history of total resets.

Setup Daily Total

The daily total is automatically reset every day at midnight.

The daily total can be the input to a previous total to save the previous day total. Link previous daily totals to maintain a history of daily totals.

Setup Grand Total

T6.	Grand Total 1	Colors 1
Input:	T1. Total 1	<input checked="" type="checkbox"/> Bargraph
Mode:	Grand Total	0% : 0
Units:	Gallons	100% : 1000000
Decimals:	0	
<input type="checkbox"/> Count Down		
<input type="checkbox"/> Allow Negative		
<input type="checkbox"/> Preset Value: 0 Gallons		
<input type="checkbox"/> Roll-Over: 0 Gallons		
<input checked="" type="checkbox"/> Non-Resettable		
Cancel		
Edit	Save	

The grand total takes the input from another total and it is not affected by resets of the input total. It is normally set up as non-resettable.

Setup Timers

Up to 32 timers can be setup to control and monitor various processes. The timers can 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.

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

CHANNELS
TOTALS
TIMERS
ALARMS
INPUTS
OUTPUTS
SCREENS

Tmr1. Timer 1

Navigation buttons: Left, Up, Down, Right (highlighted), New

Tmr1. Timer 1 Colors 1

Input: None

Power Up: Stop & Reset 0% 00:00:00 100% 00:01:00

Decimals: 0

☐ Count Down 00:00:00

Buttons: Cancel, Up, Down, Edit (highlighted), Save

Tmr1. Timer 1

Input: None

Digital Input
Modbus Input
Channel
Total
Timer
Alarm
Clock
mA Output

1. Ch 1
2. Ch 2
3. Ch 3
4. Ch 4
5. Ch 5
6. Ch 6
7. Ch 7
8. Ch 8

Buttons: Cancel, Up, Down, Left, Ok (highlighted)

Tmr1. Timer 1 Colors 1

Input: 1. Ch 1

Power Up: Stop & Reset 0% 00:00:00 100% 00:01:00

Error: Stop w/o Reset

Reset: None 0.00 GAL

Start: Rising 50.00 GAL

Stop: Falling 10.00 GAL

Decimals: 0

☐ Count Down 00:00:00

Buttons: Cancel, Up, Down, Edit (highlighted), Save

Additional Inputs to control the timer:

- mA Input
- Pulse Input
- Relay Output
- Digital Output
- Modbus Output

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 can 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 can 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 can 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
 - Day & Time
3. Input: This will depend on type selected
 - Type: Single or Multi-Source
 - Digital
 - Modbus
 - Channel
 - Total
 - Timer
 - Type: Alarms AND & OR
 - Inputs: Other alarms
4. Colors: Normal and alarm conditions
5. Sound Horn: Internal buzzer and relay
6. Alert!: Display alert message on Menu key
7. Automatic: Resets when PV crosses the reset point
8. Ack Anytime (Latching): Ack alarm anytime
9. 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)
10. 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 can 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		

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.

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.

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 can be inverted (Not) to create a specialized alarm logic.

Day & Time Alarms

The Day & Time alarm uses the system clock. You can choose to alarm every day, weekdays, or any day of the week at a selected time.

Choose how long the alarm should stay on and if manual acknowledge is allowed.

A16. ☒ Default

Type: ☒ Sound Horn
☒ Alert!

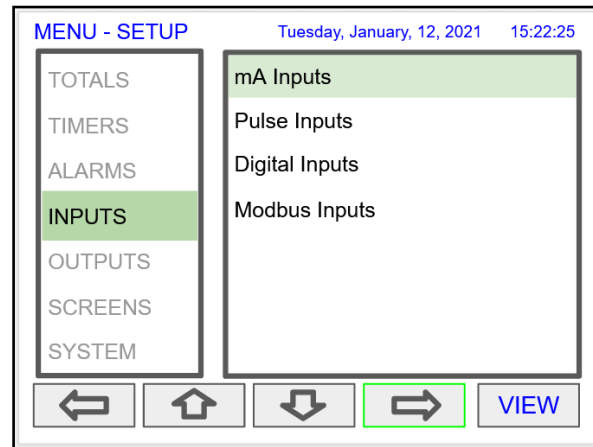
Day: Time:

☐ On Time: seconds

☒ Ack Anytime

Setup Inputs

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



Setup 4-20 mA Inputs

This screen gives you a quick view of the mA inputs connected, the slot # and position, and the actual mA input value.

Press the **Right Arrow** key to set up the selected input.

AI-1. 2a (mA)	4.002	mA
AI-2. 2b (mA)	12.301	mA
AI-3. 2c (mA)	2.902	mA
AI-4. 2d (mA)	16.042	mA
AI-5. 3a (mA)	4.002	mA
AI-6. 3b (mA)	4.003	mA
AI-8. 3c (mA)	11.189	mA
AI-9. 3d (mA)	4.717	mA

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. The bypass value is in % 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.

2b. mA Input 12.301

AI-2: Flume 1 Sensor

Filter: WIN 4 sec

Bypass: 0.5 Percent of Full Scale

☐ Glitch Filter

☐ Break Below: 0.010

☐ Disable Input Channel

Cancel ↩ ↪ Edit

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

Setup Pulse Inputs

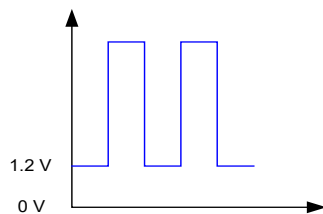
The top line, for each input, shows the slot # and input location (1a = slot #1, first input from the left). It also shows the actual frequency, state of the input, and the number of pulses received since power up, to a maximum of 8,388,607.

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: 08388607

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 can be assigned to perform various user functions, such as trigger alarm, acknowledge alarms, reset total, etc.

Pulse inputs can be used as digital inputs by setting them up according to 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	Start / Stop	OFF
DI-2. Digital Input 2	Reset Total	ON
DI-3. Digital Input 3	Ack Alarm	OFF
DI-4. Digital Input 4	Go To Screen	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 OFF

DI-1:

☒ Active Low

Function:

Buttons: Cancel, Home, Up/Down, 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 (Reset, Add To, ...)
- Timer: Access timer functions (Start, Stop, ...)
- Alarm: Access functions (Ack, Reset, Set Points)
- Screen: Next, Previous, Stop/Scan, Go To, View, ...
- 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:

☒ Active

Function:

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

The available functions depend on the I/O cards installed and the controller's configuration.

Digital Input

DI-1:

☒ Active

Function:

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

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

Acknowledge: The input must cross the reset point to trigger new alarm after it has been acknowledged.

Modbus Functionality

The ConsoliDator+ supports Modbus RTU, Modbus ASCII, Enron Modbus, and Ethernet Modbus TCP/IP.

The *Server* mode is a standard ConsoliDator+ feature; it responds to requests and accepts writes from a Modbus client.

The *Client* mode can request process variables from server devices; the input variables can be scaled, combined with other variables using math functions, and they can be written to other server devices using the Modbus output functions.

The *Snooper* mode can listen and read the process variables being transmitted on the RS-485 bus without causing any disruptions to the network.

The *Spoofers* Modbus output is used to replace Modbus devices that have been removed from the network; there is no need to make changes to the Modbus client's configuration.

Setup Modbus Inputs (Server)

The Modbus *Server* mode is a standard ConsoliDator+ feature. The controller can accept up to 199 Modbus inputs sent by a Modbus Client. The inputs can be used as the source for channels, math functions, alarms, relay control, etc.

- Enter Modbus Input tag
- Type: Select the data type
The register number is displayed to the right
- 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)

The screenshot shows the configuration window for Modbus Input 1 (MB-1) in Server mode. The fields are as follows:

- MB-1:** MB Input 1
- Server:** (Mode selector)
- Type:** Float 32 (highlighted in green)
- Reg. No.:** 46701, 46702
- Units:** Gallons/min
- Decimals:** 2
- Break:** Default
- Default:** 0.00
- Units (for Default):** Gallons/min
- Timeout:** ☒ 00:00:10
- Input Action:** Add To T1. Total 1
- Buttons:** Cancel, Home, Down Arrow, Edit (highlighted in green), Save

Setup Modbus Inputs (Client)

The Modbus *Client* mode is an option in the ConsoliDator+. It can be purchased at the time the order is placed or it can be purchased and enabled at any time. The controller can request up to 199 Modbus values, as inputs from other Modbus devices. The inputs can be used as the source for channels, math functions, alarms, relay control, etc.

- Enter Modbus Input tag
- Mode: Select Client
- Server ID: Enter the device ID to read from
- Address: Enter the register address to be read, the register number is displayed next to the data type
- Enron: Click on Enron to use Modbus Enron protocol
- Type: Select the data type
- Byte Order: Select the byte order for the data
- Units: Select units or enter custom unit
- Decimals: Number of decimals
- Break: Value or condition for comm. break
- Poll Time: Enter the time interval to poll the requested data, it is important to allow enough time to get all the data with each poll.
- Timeout: Select timeout to detect break if new data is not received after the poll.
- Input Action: Select action when new value is received (e.g. Add to Total 1 the value written)

Note:

Make sure to set up the controller as a Modbus Client and configure the serial communication settings before trying to set up the Modbus Client inputs. See Modbus Client Settings, page 70 for details.

Data Types

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

Setup Modbus Inputs (Snooper)

The Modbus *Snooper* mode is part of the Modbus *Client Add-On Features* option in the ConsoliDator+. It can be purchased at the time the order is placed or it can be purchased and enabled at any time.

The controller can read up to 199 Modbus values, as inputs from other Modbus devices being polled by a Modbus Client. The inputs can be used as the source for channels, math functions, alarms, relay control, etc.

- Enter Modbus Input tag
- Mode: Select Snooper
- Server ID: Enter the device ID to read from
- Address: Enter the register address to be read, the register number is displayed next to the data type
- Enron: Click on Enron to use Modbus Enron protocol
- Type: Select the data type
- Byte Order: Select the byte order for the data
- Units: Select units or enter custom unit
- Decimals: Number of decimals
- Break: Value or condition for comm. break
- Timeout: Select timeout to detect break if new data is not received within the specified time window.
- Input Action: Select action when new value is received (e.g. None, if not action is required)

Note:

Make sure to set up the controller as a Modbus Server/Snooper and configure the serial communication settings before trying to set up the Modbus Snooper inputs. See Modbus Snooper Settings, page 70 for details.

Data Types

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

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

The screenshot shows the 'MENU - SETUP' screen with a date and time display of 'Thursday, May 28, 2020 13:30:25'. On the left is a vertical menu with options: CHANNELS, TOTALS, TIMERS, ALARMS, INPUTS, OUTPUTS (highlighted in green), and SCREENS. On the right is a list of output types: mA Output (highlighted in green), Relay Output, Digital Output, and Modbus Output. At the bottom are five navigation buttons: a left arrow, a home icon, a down arrow, a right arrow (highlighted in green), and a 'VIEW' button.

Setup 4-20 mA Outputs

The mA output can be assigned to any analog input, channel, alarm, or digital input. It can 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, the current output value is '19.998'. The configuration fields include:

- AO-1: 4a (mA)
- Input: 1. Ch 1
- Scale: A table with two rows. Row 1: Input (Gallons) 0.0, Output (mA) 4.000. Row 2: Input (Gallons) 10000.0, Output (mA) 20.000.
- Break: 21.600
- Slew Rate: 80.0 mA/sec (checked)
- Minimum: 3.500 (checked)
- Underrange: 3.800 (checked)
- Maximum: 23.000 (checked)
- Overrange: 20.500 (checked)

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

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.*

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

The F4 key can 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.

Relay Assigned to Alarm

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

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

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 can 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 can 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.*

6a: Relay Output

RY-1: Relay 1

Input: 1. Ch 1

☒ Enable Alternation ☒ Alternate on Time: 01:00:00

	Set (On)	Reset (Off)
1.	40.00	25.00
2.	60.00	45.00
3.	80.00	65.00
4.	100.00	85.00

Break: Relay Off On Delay: 0.0 sec

☐ Fail-Safe Off Delay: 0.0 sec

Cancel Home Up/Down Edit Save

Setup the primary alternation relay.

6b: Relay Output

RY-2: 6b. Relay 2

Input: Alternation

Digital	Always Off
Channel	Always On
Total	Horn
Timer	Alternation
Alarm	
Other	

Cancel Home Up/Down Ok

Setup the additional alternation relays.

6b: Relay Output

RY-2: 6b. Relay 2

Input: Alternation

With: RY-1. 6a (Relay)

☐ Fail-Safe

Cancel Home Up/Down Edit Save

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 (Server)

The Modbus output is a standard ConsoliDator+ feature; this is additional to the predetermined Modbus table provided, see *Modbus Register Tables* on page 89.

The *Modbus Output* menu allows assigning up to 99 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
- Engineering units
- Number of decimals
- Output Action

Select the input to be used for the Modbus Output

Additional Inputs not shown above:

- mA Input
- Digital Output

Select the data type

The register number is provided for each data type

Setup Modbus Output (Client)

The Modbus outputs from a ConsoliDator+ Client can be written to Modbus servers or they can be read using the Ethernet TCP/IP port. The outputs are posted periodically on a schedule or on demand by triggering a user function (e.g. F1 function: Output (Post) - MO-1).

Process variables can be read by the Client, scaled, combined with other variables using the math functions, and the results can be written to another ConsoliDator+ or any other Modbus server, such as a digital panel meter.

The *Modbus Output* menu allows assigning up to 99 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.

- Enter a tag for the process variable
- Select Client mode
- Select the input needed for the Modbus output

MO-1: MB Output 1 Client

Input: Ch 1

Pulse Input	1. Ch 1
Digital Input	2. Ch 2
Channel	3. Ch 3
Total	4. Ch 4
Timer	5. Ch 5
Alarm	6. Ch 6
mA Output	7. Ch 7
Relay Output	8. Ch 8

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

MO-1: MB Output 1 Client

Input: Ch 1

Server ID: 247 Address: 71 ☐ Enron

Function Code: 06/16

Type: Float 32 Reg. No. 40071, 40072

Byte Order: ABCD

Units: Gallons/min Decimals: 1

☒ Post Time: 10.0 seconds

Output Action: None

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

Enter all the parameters needed to write to a Modbus server (e.g. Modbus server panel meter)

- Server ID
- Register Address (Base 0)
- Select Enron, if applicable
- Function Code
- Data Type – Reg. No. displayed automatically
- Byte Order
- Engineering Units and decimals to be used
- Post Time: How often to write to the server
- Output Action: Select from many actions available or leave as None

MO-1: MB Output 1 Client

Input: Ch 1

Server ID: 247 Address: 71 ☐ Enron

Function Code: 06/16

Type: Float 32 Reg. No. 40071, 40072

Byte Order: Bit - Logic

Units: Signed 16

☒ Post Time: Signed 32

Decimals: 1

Output Action: Signed 64

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

The data type must match the type required by the server device; otherwise the value will not be correct.

Setup Modbus Output (Spoof)

The Modbus Spoof feature is part of the Modbus Client/Snooper add-on feature. To enable this feature, you must purchase a PDK9000-M1 and enter the key in the System – General menu. The controller must be configured as a Modbus Server/Snooper in the System – Modbus menu. See page 67 for instructions on how to enable the *Add-On Features*.

The Spoof Modbus output is used to replace Modbus devices that have been removed from the network; there is no need to make changes to the client's configuration.

The *Modbus Output* menu allows assigning up to 99 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 supported function codes are: 0x01, 02, 03, 04. For outputting the value from a channel use function code 0x03, enter the registers address base-0 (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 displayed automatically

Select the input for Modbus Output.

Select the data type.

Enron protocol and Float 64 data type selected.

Every time the Modbus output is read by the client, the Total 1 is reset.

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 can 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.

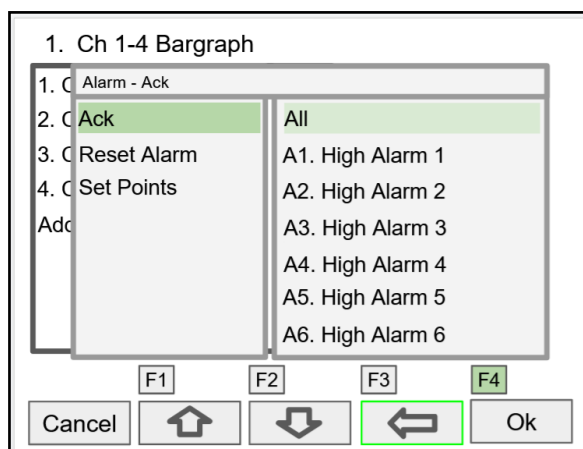
Note:

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

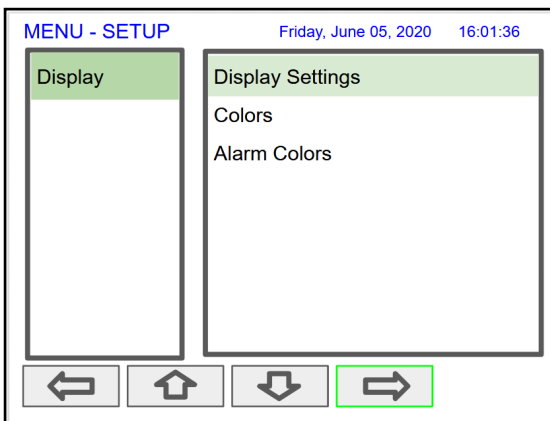
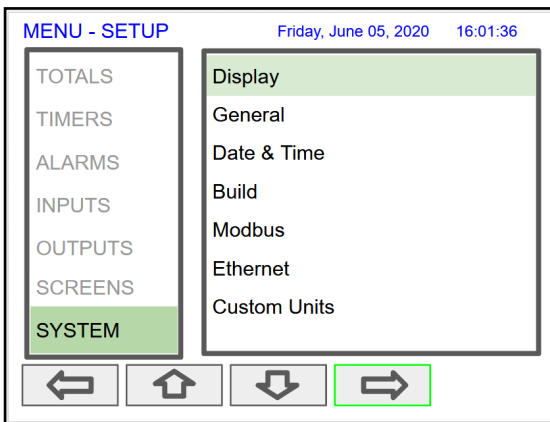
- Simulate
 - mA Input
 - Pulse Input
 - Digital Input
 - Modbus Input
 - Channel
 - Total
 - Timer
 - Alarm
- Horn
 - Silence Horn
 - Snooze Horn
 - Horn Test
- mA Output
 - Manual
 - Hold (Manual)
 - Automatic
 - Manual / Auto
 - Hold / Auto
- Relay
 - Reset Info
 - Reset Info (Confirm)
 - Force ON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

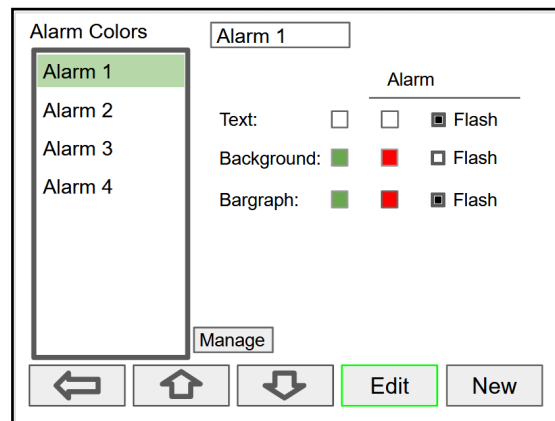
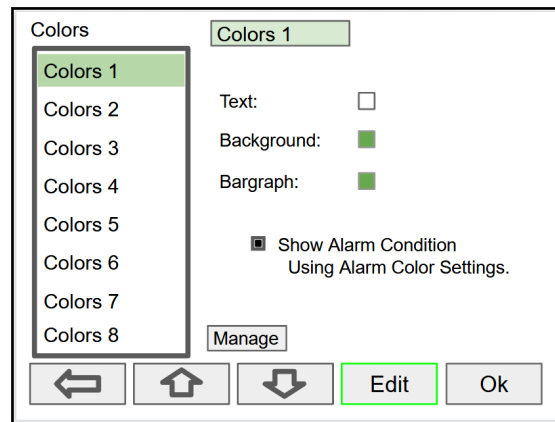
Setup Display

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



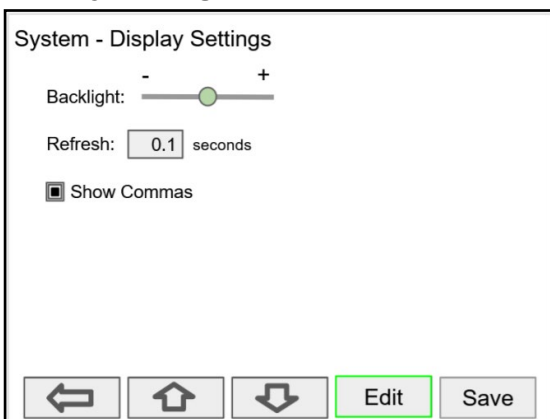
Setup Colors

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.

- Device Tag: Edit the device tag (saved on Enter)
- Device UID: Device unique ID
- System Info: Firmware number and version
- Feature Add-Ons: List of add-on features enabled. A unique key is needed to enable add-on features.
- 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 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.

Add-On Features

The Add-On Features can be enabled at the factory or they can be purchased and enabled by the user at any time. A unique key code is required to enable Add-On Features (e.g. Order P/N: PDK9000-M1).

Add-on features are available on version 2.100 & up.

Example: To purchase the *Modbus Client/Snooper* Add-On Feature, follow these steps.

1. Obtain the Device UID (Unique ID), the graphic to the left shows the location of the Device UID.
2. Place an order for PDK9000-M1 and provide the Device UID
3. A unique key code will be sent to you
4. Go to the System - General Settings
5. Navigate to the Features Add-Ons area
6. Press the Add-On key and enter the unique alphanumeric key received
7. The added feature will be displayed in this window. Press any arrow to move to other settings or exit

Set Password

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

System - General Settings

Device Tag: Multivariable Controller

Device UID: TKU3 - GYRT - KPQH - WCTP

System Info: SFT144 - v2.100

Feature Add-Ons: Modbus Client / Snooper

Buttons: Save Backup, Restore Backup, Load Defaults, Set Password, Clear Password

Enable Buzzer: ☐ Beeping

Navigation: Back, Home, Forward, Set Pwd (highlighted)

System - General Settings

Device Tag: Multivariable Controller

Device UID: TKU3 - GYRT - KPQH - WCTP

System Info: SFT144 - v2.100

Feature Add-Ons: Modbus Client / S

Set Password dialog: 1 0 0 0

Buttons: Save Backup, Restore Backup, Load Defaults, Set Password, Clear Password

Enable Buzzer: ☐ Beeping

Navigation: Back, Home, Forward, Set Pwd (highlighted)

System - General Settings

Device Tag: Multivariable Controller

Device UID: TKU3 - GYRT - KPQH - WCTP

System Info: SFT144 - v2.100

Feature Add-Ons: Modbus Client / S

Set Password dialog: 1 0 0 0

Buttons: Save Backup, Restore Backup, Load Defaults, Set Password, Clear Password

Enable Buzzer: ☐ Beeping

Navigation: Back, Home, Forward, 1, 0, 0, 0, Enter (highlighted)

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.

System - Date & Time

Date: June 10, 2020

Time: 15:15:46




Edit

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.

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 press Rebuild.

System - Build

Model Number: PD9000-XY-4PI-8AI-10AO-10RY

Slot #	Description	SFT #	Ver.
1.	(4) Pulse Inputs	146	1.001
2.	(4) 4-20 mA Inputs	145	1.001
3.	(4) 4-20 mA Inputs	145	1.001
4.	(5) 4-20 mA Outputs	148	1.000
5.	5) 4-20 mA Outputs	148	1.000
6.	5) Relay Outputs	147	1.000
7.	5) Relay Outputs	147	1.000


Rebuild

Modbus Server Settings

The *Modbus Server* settings must match the settings of other devices on the bus. The Modbus ID must be unique for each device on the bus.

Modbus Write Protection

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

Note: The Modbus passcode is different than the main password used to protect access to the Setup and View menus.

System - Modbus Settings

RS-485 Settings:

Mode: Server ID:



Baud Rate: ☐ ASCII

Parity:

Tx Delay: ms

Server Settings:

☐ Passcode:

Cancel  

Modbus Client Settings

The *Modbus Client* settings must match the settings of other devices on the bus.

The Rx Timeout is used for devices that are slow to respond, such as wireless Modbus servers.

Modbus Write Protection

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

Note: The Modbus passcode is different than the main password used to protect access to the Setup and View menus.

System - Modbus Settings

RS-485 Settings:

Mode: ☐ ASCII



Baud Rate:

Parity:

Tx Delay: ms Rx Timeout: seconds

Server Settings:

☐ Passcode:

Cancel  

Modbus Snooper Settings

The *Modbus Snooper* settings must match the settings of other devices on the bus. The Snooper works also as a server, responding to request from a Modbus client. A unique server ID must be assigned to it.

The Rx Timeout is used for devices that are slow to respond, such as wireless Modbus servers.

Modbus Write Protection

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

Note: The Modbus passcode is different than the main password used to protect access to the Setup and View menus.

System - Modbus Settings

RS-485 Settings:

Mode: Server ID:



Baud Rate: ☐ ASCII

Parity:

Tx Delay: ms Rx Timeout: seconds

Server Settings:

☐ Passcode:

Cancel  

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 the *System* menu are sufficient to establish Ethernet communications using the TCP or UDP protocols.

For more advanced setup, refer to the instructions provided under *Ethernet Port Setup* on page 73.

Note:

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

System - Ethernet Settings

Lantronix XPort Device

MAC Address: 0080A3D50F9E

☒ DHCP (for automatic IP Address)

IP Address: 0.0.0.0

Port: 10001

Protocol: TCP

Advanced Setup

HTTP Port: 80

Telnet Port: 9999

Cancel



Edit

Ok

Dynamic Host Configuration Protocol (DHCP) is a network management protocol used to automate the process of configuring devices on IP networks, thus allowing them to use any communication protocol based on UDP or TCP.

Manually Assigned IP Address

To assign a static IP address, you must obtain it from your network administrator.

Uncheck the DHCP box and enter the IP Address.

Port: Do not change unless directed by IT administrator

Protocol: Select TCP or UDP

Advanced Setup settings is for information only.

For complete setup of the Ethernet port, follow the instructions below.

System - Ethernet Settings

Lantronix XPort Device

MAC Address: 0080A3D50F9E

☐ DHCP (for automatic IP Address)

IP Address: 192.168.5.32

Port: 10001

Protocol: TCP

Advanced Setup

HTTP Port: 80

Telnet Port: 9999

Cancel



Edit

Ok

Custom Units

Custom units can be created either in the System menu or when a parameter is created in the Setup - Channels menu. 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

Examples:

- For 5-gallon bottles, the factor is 0.2
($1/5 = 0.2$)
- For one million gallons, the factor is 0.000001
($1/1,000,000$)

The screenshot shows the 'Custom Units' dialog box. At the top, there is a list of units: '5-Gallon' and 'Volume'. The '5-Gallon' unit is selected and highlighted in green. Below the list, there is a 'Custom Unit:' section with four input fields: 'Label:' (5-Gallon), 'Type:' (Volume), 'Base:' (Gallons), and 'Factor:' (0.2). At the bottom of the dialog, there are five buttons: 'Cancel', a home icon, a down arrow icon, 'Edit' (highlighted in green), and 'Ok'.

Delete Custom Units

Custom units can only be deleted if they are not 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.

The screenshot shows the 'Custom Units' dialog box. At the top, there is a list of units: '5-Gallon', 'Bucket', and 'MG'. The 'MG' unit is selected and highlighted in green. Below the list, there is a 'Custom Unit:' section with four input fields: 'Label:' (MG), 'Type:' (Volume), 'Base:' (Gallons), and 'Factor:' (0.000001). Below these fields is a 'Delete' button. At the bottom of the dialog, there are five buttons: 'Cancel', a home icon, a down arrow icon, 'Delete' (highlighted in green), and 'Ok'.

Ethernet Port Setup - Full

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

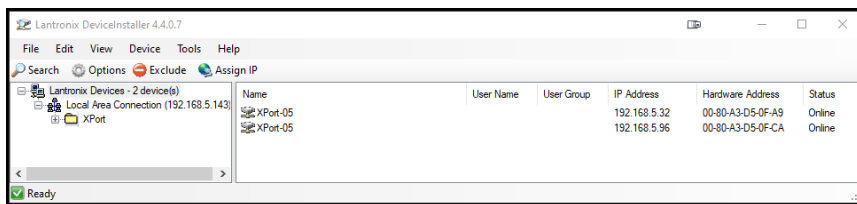
<https://www.lantronix.com/products/xport>

Follow these steps, after installation of the DeviceInstaller software.

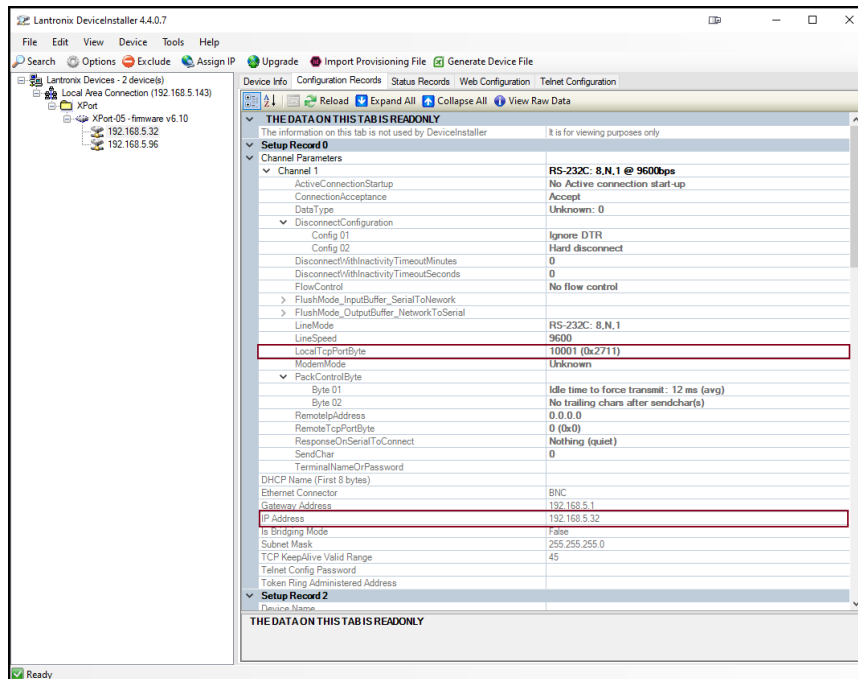
1. Connect an Ethernet cable to the Local Area Network
2. Launch the Lantronix DeviceInstaller; it will search for XPort devices on the Local Area Network (LAN) and display their status.
3. If no controller is found, click on **Options**, and select the type of connection being used (e.g. Wi-Fi).
4. 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.

CAUTION

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

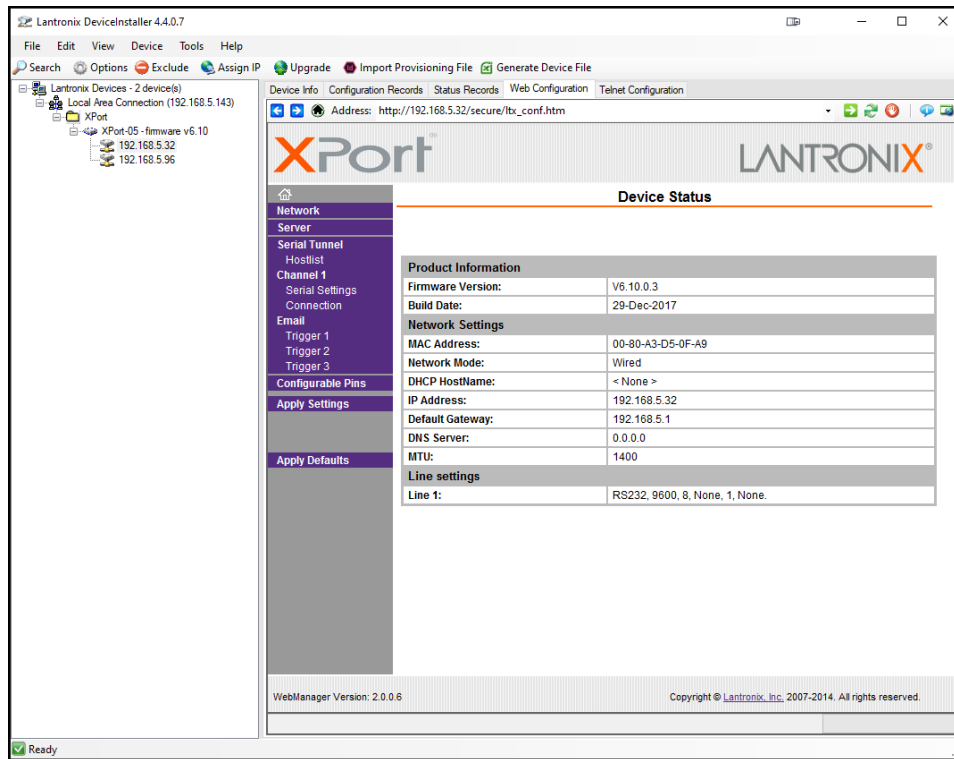


5. Double-click on the new device IP Address to be configured.

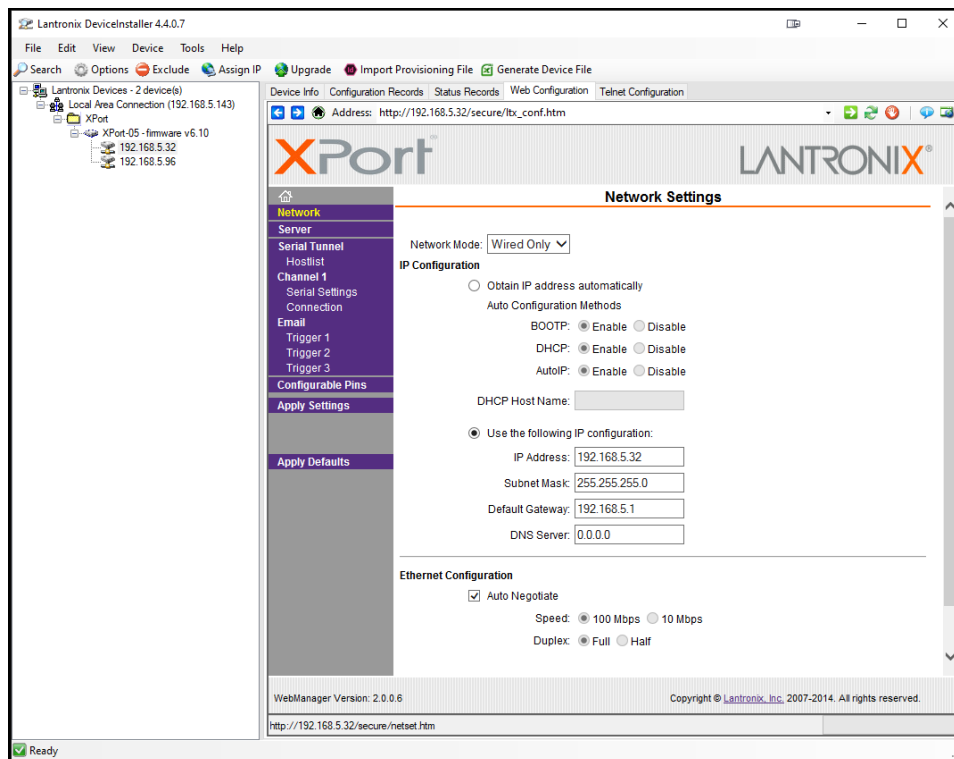


To communicate with a device connected over a LAN, you need the IP Address and the Local TCP Port.

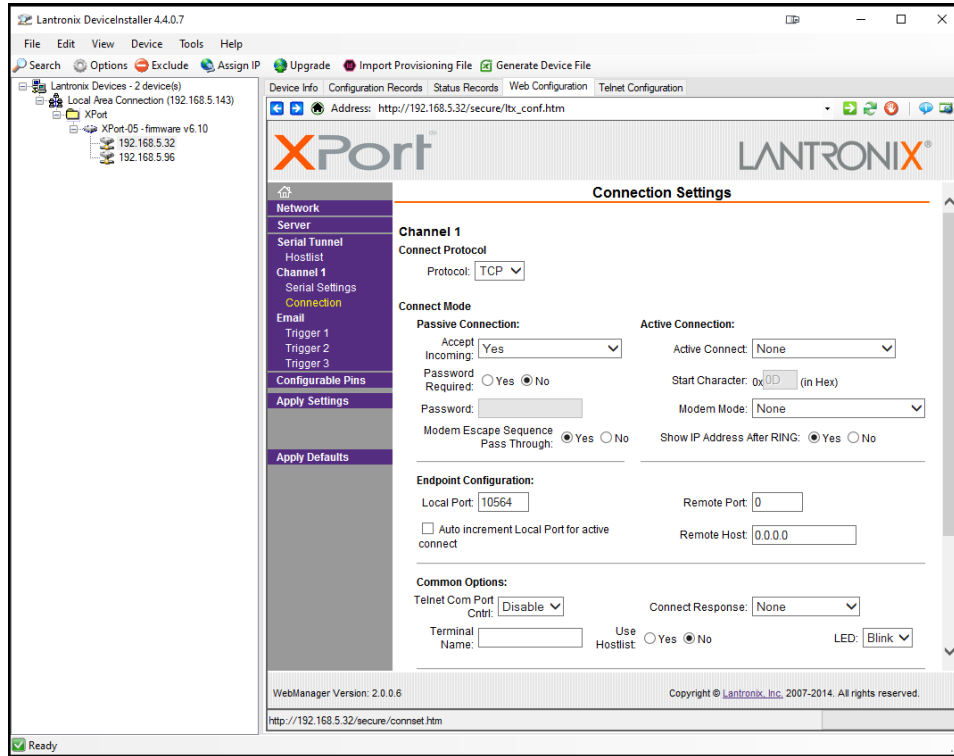
6. Click on **Configuration Records** to find these settings, see the example above.
IP Address: 192.168.5.32; Local TCP Port: 10001 (0x2711)



7. Click on **Web Configuration**



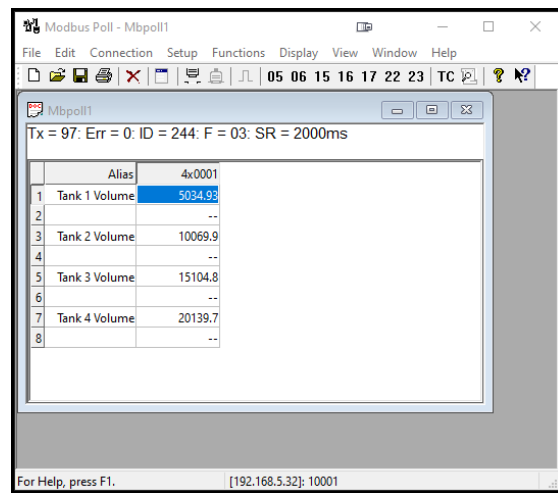
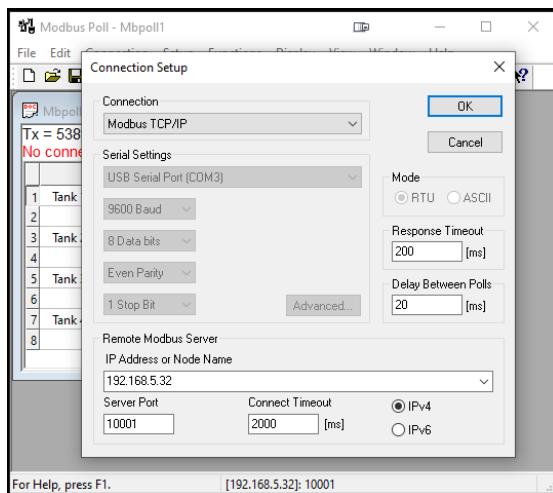
8. Click on **Network** to assign a new IP Address



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.

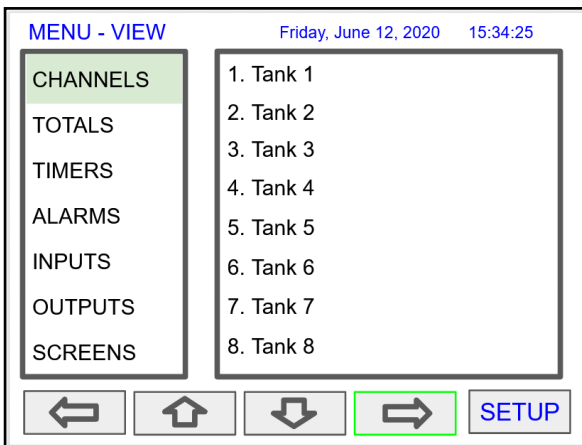


Note: You may download a free trial copy of Modbus Poll from <https://www.modbustools.com/>

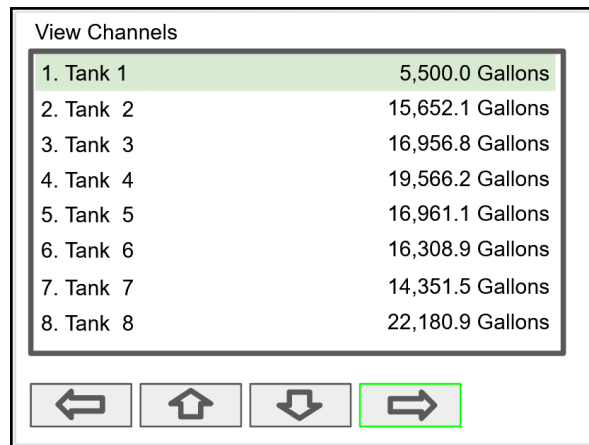
View Menu

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, analog outputs, timers, alarms, and the reset of totals.



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

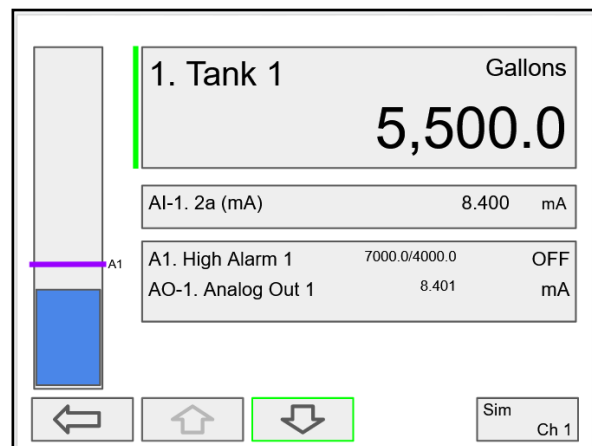


Select any channel using the **Up** or **Down Arrow** keys and Press the **Right Arrow** key again to step into viewing the channel details.

View Channel Details

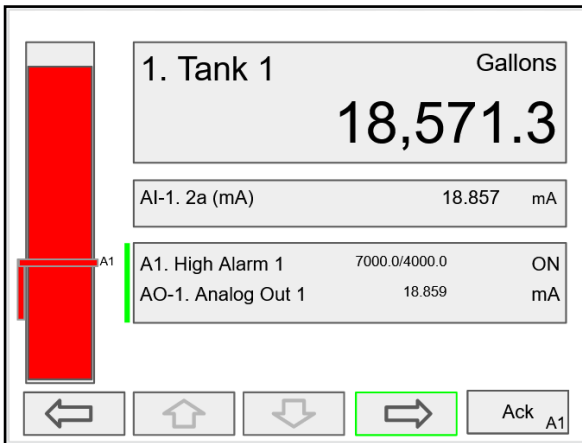
Stepping into a channel allows the viewing of additional details for the inputs and outputs associated with that channel. It is also possible to simulate the selected parameter.

- 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

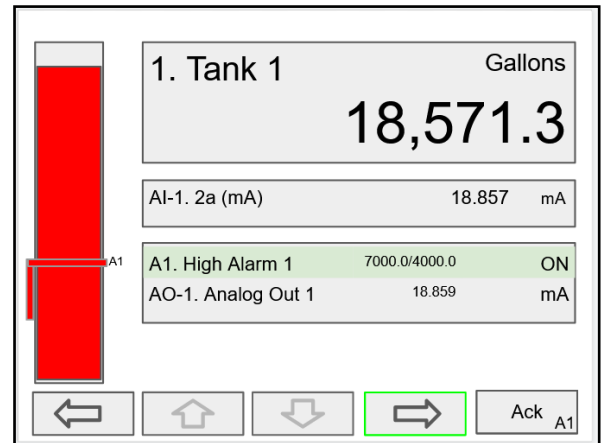


Press the **Down Arrow** key to navigate to the channel input source and then down again to view alarms and analog outputs.

View Associated Parameters

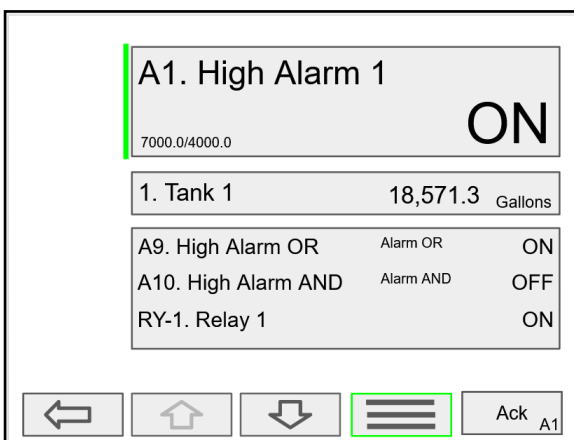


Press the **Right Arrow** key to select the alarm.

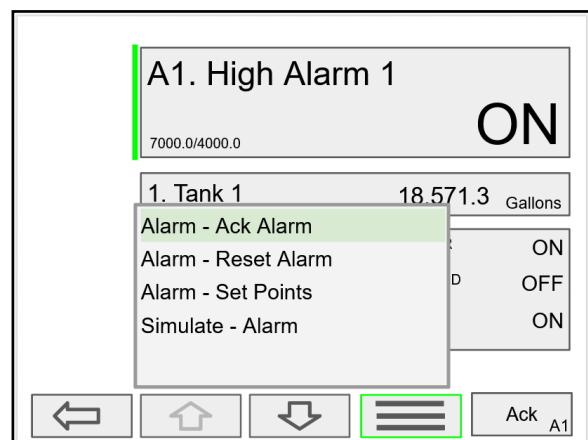


Press the **Right Arrow** key again to view alarm's details.

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

View Totals

T1. Tank 1	221,593 Gallons
T2. Tank 2	39,300 Gallons
T3. Tank 3	120,500 Gallons
T4. Tank 4	140,200 Gallons

Navigation buttons: Left Arrow, Up Arrow, Down Arrow, Right Arrow (highlighted), Reset T1

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

T1. Tank 1 Gallons
221,593

9. Flowmeter 1 Gallons/min
563.2

Navigation buttons: Left Arrow, Up Arrow, Down Arrow, Right Arrow (highlighted), Reset T1

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

T1. Tank 1 Gallons
221,593

9. Flowmeter 1 Gallons/min
563.2

Navigation buttons: Left Arrow, Up Arrow, Down Arrow, 3-Bar (highlighted), Reset T1

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.

T1. Tank 1 Gallons
221,593

9. Flowmeter 1 Gallons/min
563.2

Options menu:
Total - Reset (Confirm)
Total - Enter Total (highlighted)
Simulate - Total

Navigation buttons: Cancel, Up Arrow, Down Arrow, Enter T1 (highlighted)

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

T1. Tank 1 Gallons
221,593

248093

Keypad:
1 2 3
4 5 6
7 8 9
- 0 .
x Enter

Enter Total:
Navigation buttons: Down Arrow, Left Arrow, Right Arrow, X, Enter (highlighted)

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

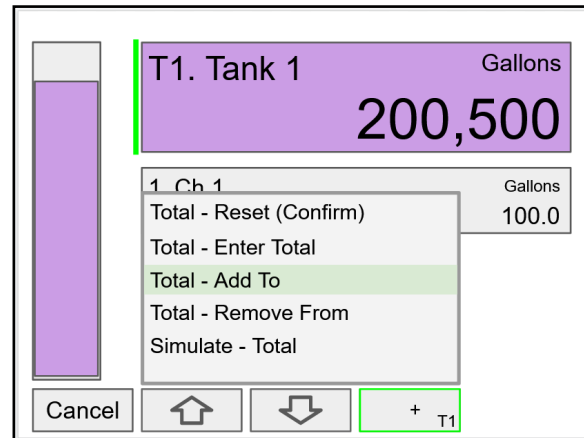
Totals Generated by Non-Rate Inputs

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
- New Total 1 = 200,600 gallons

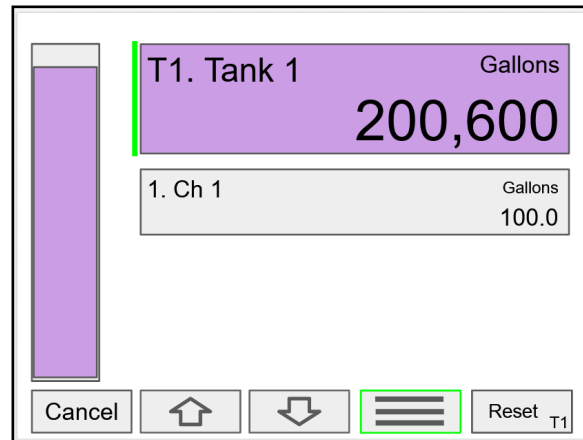


The total in Tank 1 has been incremented by 100 gallons.

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, connected to a digital input, to trigger the *Add To* or *Remove From* features.

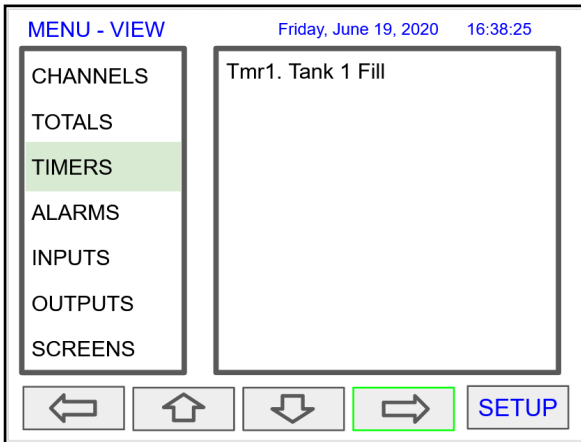
- Digital Input 1
- Function: Add To – T1. Total 1
- Connect a switch between DI-1 and G terminal
- Every time the switch closes, adds 100 gallons to the total 1



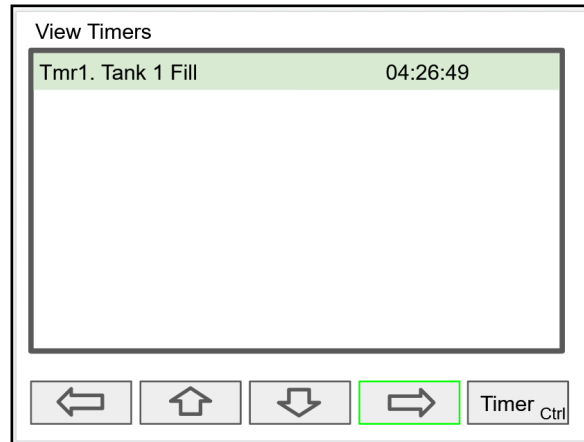
View Timers

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

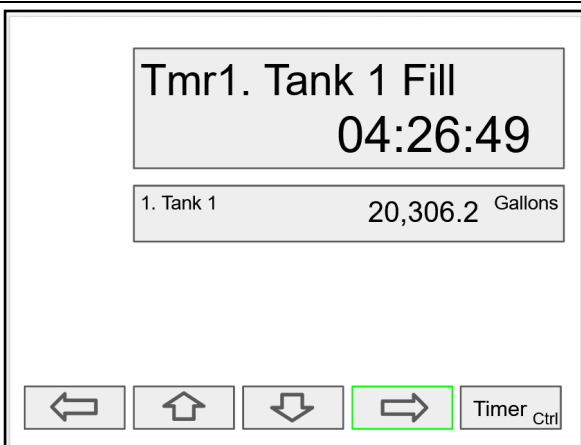
Press the **Right Arrow** key to step into the details of the selected timer and view the associated inputs and outputs.



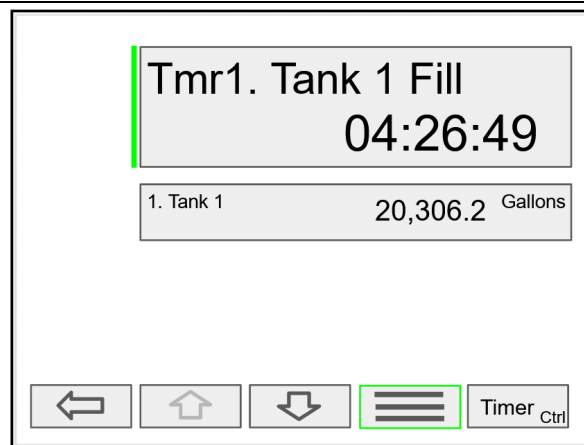
Press the **Right Arrow** key to step into viewing timer.



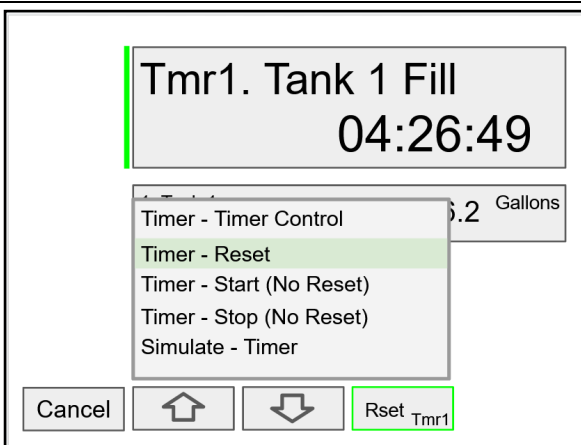
Press the **Right Arrow** key to view timer details.



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.

A1. High Alarm 1 **ON**
7000.0/4000.0

1. Tank 1 7,190.6 Gallons

A13. High Alarm OR Alarm OR ON
A14. High Alarm AND Alarm AND OFF
RY-1. Relay 1 ON

← ↑ ↓ **≡** Ack A1

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

A1. High Alarm 1 **ON**
7000.0/4000.0

1. Tank 1 7,190.6 Gallons

Alarm - Ack Alarm
Alarm - Reset Alarm
Alarm - Set Points
Simulate - Alarm

Cancel ↑ ↓ **Set Pt A1**

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

Simulate Alarm Condition

A1. High Alarm 1 **OFF**
8000.0/4000.0

1. Tank 1 7,190.6 Gallons

Alarm - Ack Alarm
Alarm - Reset Alarm
Alarm - Set Points
Simulate - Alarm

Cancel ↑ ↓ **Sim A1**

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

A1. High Alarm 1 **ON**
8000.0/4000.0

1. Tank 1 7,190.6 Gallons

A13. High Alarm OR Alarm OR ON
A14. High Alarm AND Alarm AND OFF
RY-1. Relay 1 ON

Simulate - A1. High Alarm 1

Real - **+** Keypad Ok

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.

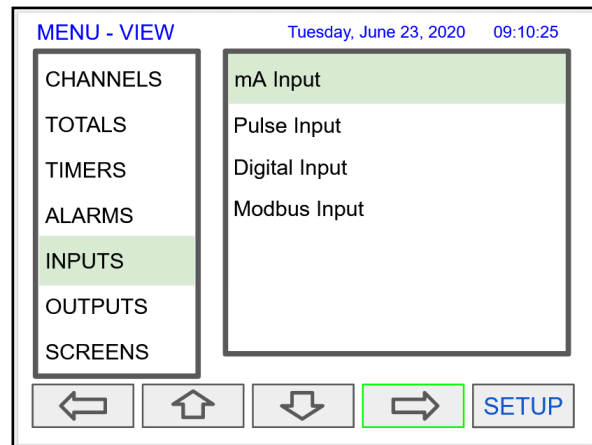
View Inputs

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.

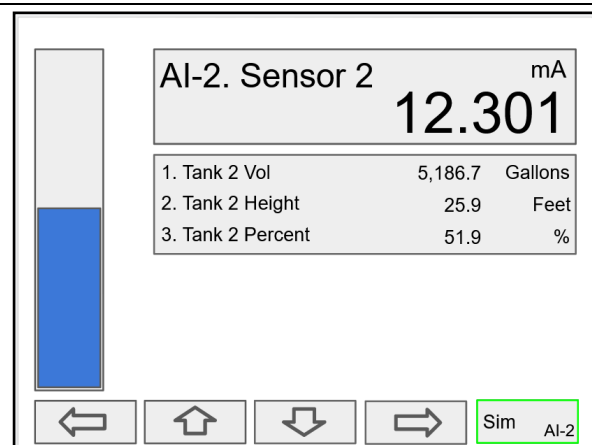


Press the **Right Arrow** key to select the mA Input.

View mA Inputs

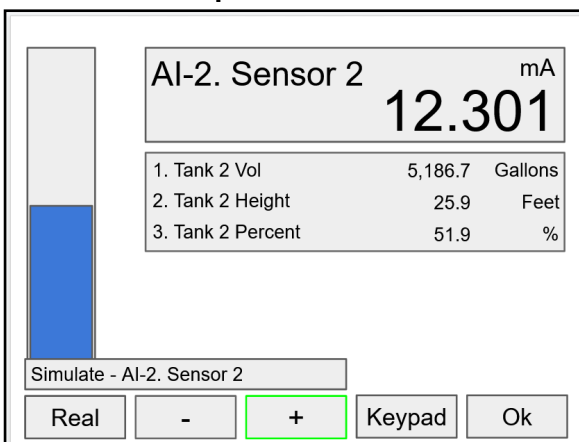
AI-1. Sensor 1	13.002	mA
AI-2. Sensor 2	12.301	mA
AI-3. Sensor 3	12.902	mA
AI-4. Sensor 4	16.042	mA
AI-5. Sensor 5	8.002	mA
AI-6. Sensor 6	17.003	mA
AI-7. Sensor 7	11.189	mA
AI-8. Sensor 8	4.717	mA

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

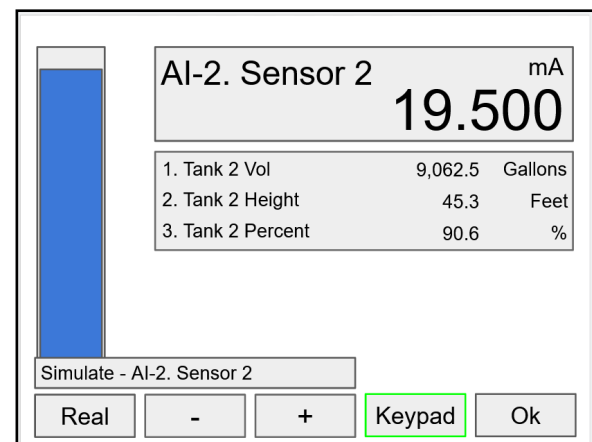


The above screen shows the Analog Input 2 details and the associated channels.

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.

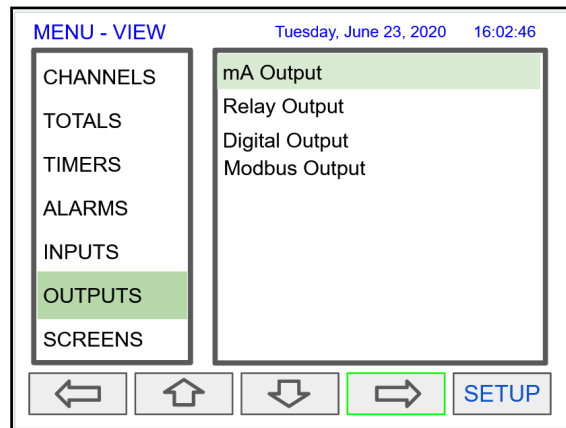
View Outputs

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.



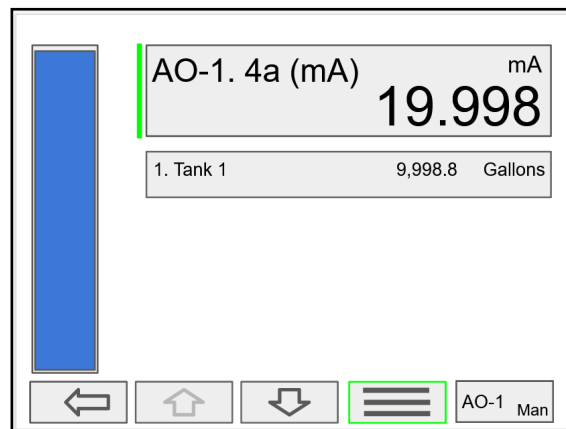
Press the **Right Arrow** key to select the mA Output.

View mA Outputs

View mA Outputs

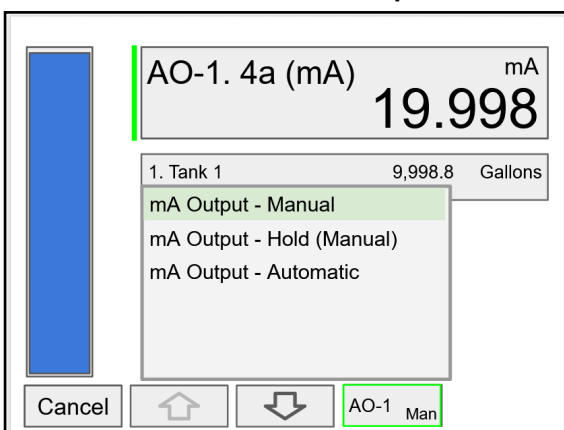
AO-1. 4a (mA)	19.998	mA
AO-2. 4b (mA)	12.301	mA
AO-3. 4c (mA)	11.902	mA
AO-4. 4d (mA)	16.042	mA
AO-5. 4e (mA)	4.000	mA
AO-6. 5a (mA)	4.003	mA
AO-7. 5b (mA)	11.189	mA
AO-8. 5b (mA)	16.569	mA

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

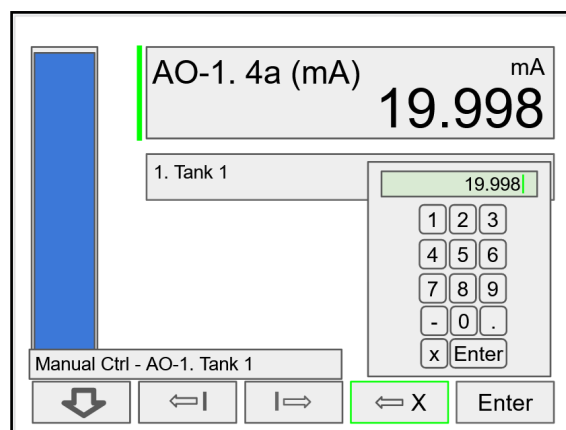


Press the **3-Bar** key to access Analog Output controls. Manual control, hold current value, return to automatic.

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.

View Relays

RY-1. Pump # 1	ON
RY-2. Pump #2	ON
RY-3. Pump #3	OFF
RY-4. Pump #4	ON
RY-5. Pump #5	OFF
RY-6. Pump #6	OFF
RY-7. Pump #7	ON
RY-8. Pump #8	ON

Navigation buttons: Left Arrow, Home, Up Arrow, Right Arrow (highlighted), RY-1 OFF

RY-1. Pump #1

Runtime: 36:10:58
Cycles: 300

ON

1. Tank 1	9,998.5	Gallons
-----------	---------	---------

RY-2. Pump #2 ON

Navigation buttons: Left Arrow, Home, Up Arrow, Down Arrow, Menu (highlighted), Rset RY-1

RY-1. Pump #1

Runtime: 36:10:58
Cycles: 300

ON

1. Tank 1	9,998.5	Gallons
-----------	---------	---------

Relay - Rset Info (Confirm)
Relay - Manual ON
Relay - Manual OFF (highlighted)
Relay - Automatic

Navigation buttons: Cancel, Home, Up Arrow, Down Arrow, RY-1 OFF (highlighted)

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

WEST END STORAGE

1. Tank 1	GALLONS	13,041.3
2. Tank 2	GALLONS	15,652.1
3. Tank 3	GALLONS	16,956.8
4. Tank 4	GALLONS	19,566.2

Alert! (highlighted)

Navigation buttons: Home, Up Arrow, Down Arrow, Scan, Ack All

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.

Alerts!

Alarm: A1. High Alarm 1
Simulated: AI-2. Sensor 2
Manual: RY-1. Pump #1 (highlighted)
Manual: AO-3. Tank 3


Navigation buttons: Left Arrow, Home, Up Arrow, Down Arrow, Right Arrow, Auto (highlighted)

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	

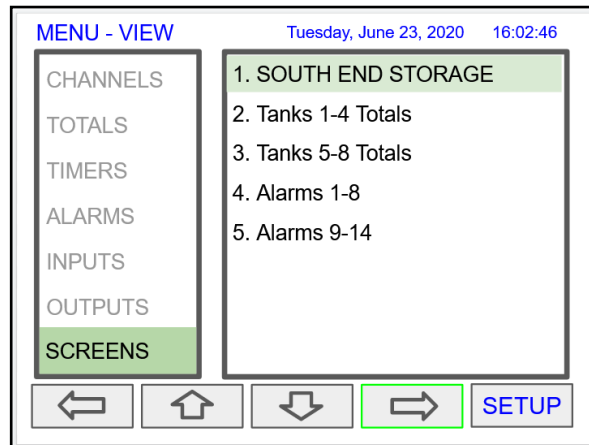


CAUTION

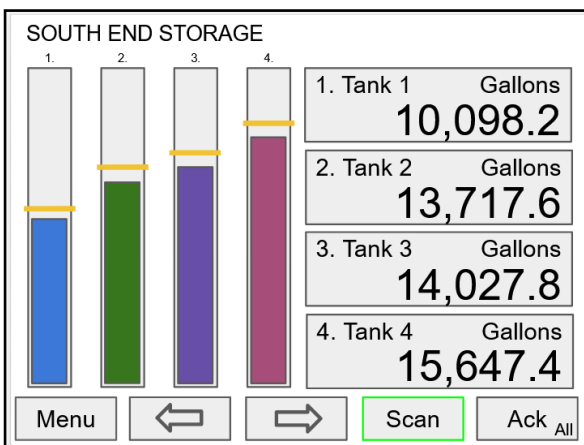
- Manual control and simulation states are not saved on power cycle. On power up the controller initializes to the actual process conditions.

View Screens

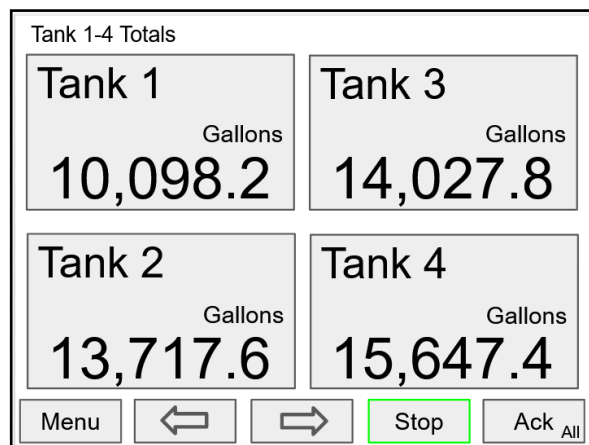
With the View Screens menu, the user can go to any available screen and view the details. The screens can be scanned continuously or can be stopped to stay on a selected screen at anytime.



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.



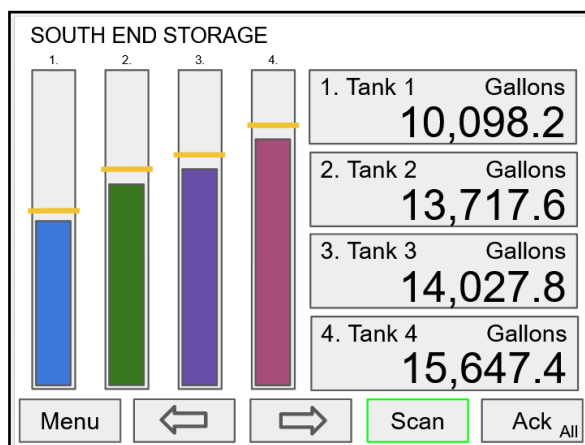
Press the **Stop** key to have all available screens stop scanning and stay on the current screen.

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.

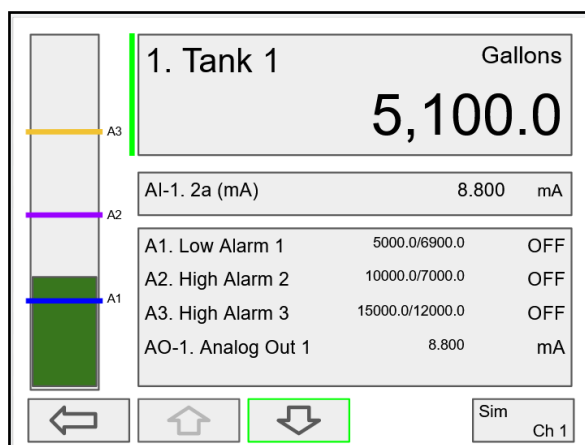
If applicable, alarms can be acknowledged, and totals can be reset from these screens. Simulation and manual control are also available on the *View* screens.

Low & High Alarm Indication

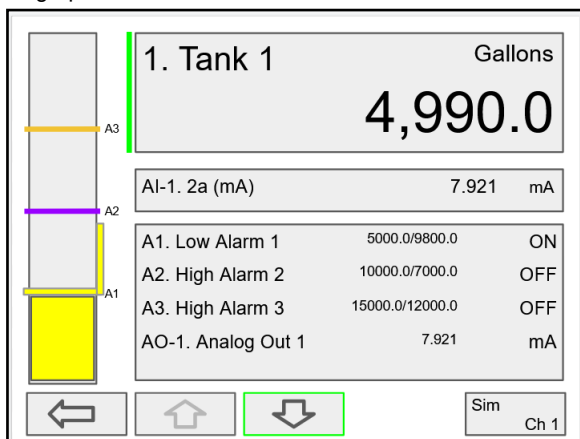
The alarm set points are indicated by a line at the corresponding value on the bargraph. Color selection is done in the *Setup – Alarm* menu or in the *System – Display* menu.

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.

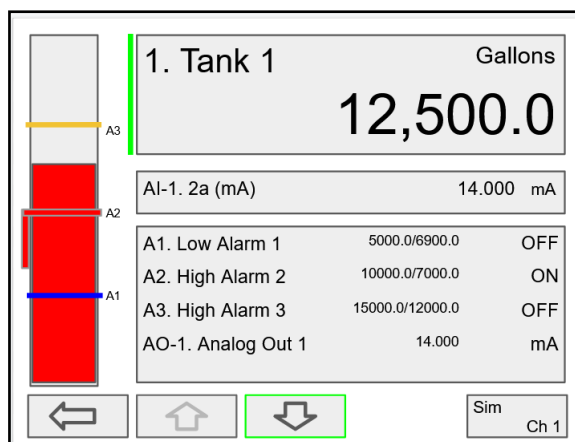
Active Low Alarm: Indicated by horizontal and vertical lines. The top of the vertical line is the reset point of the low alarm. The low alarm is indicated on the right side of the bargraph.



Alarm set points are indicated by horizontal lines.



Low alarm indication



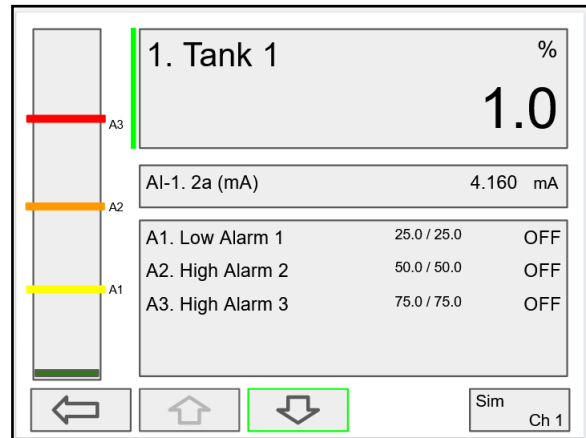
High alarm indication

Multicolor Bargraph Indication

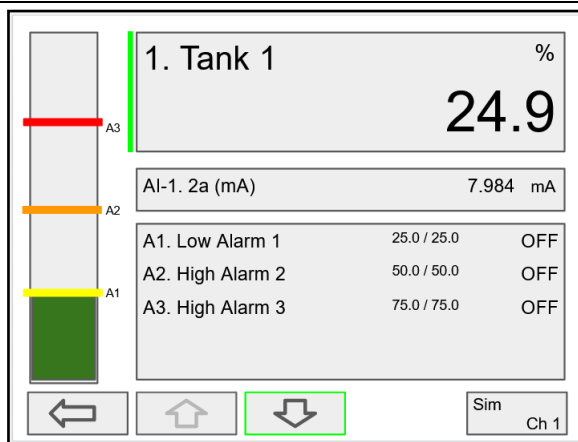
The bargraph can be configured to show different colors depending on the value of the process variable. The following example illustrates the use of colors:

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

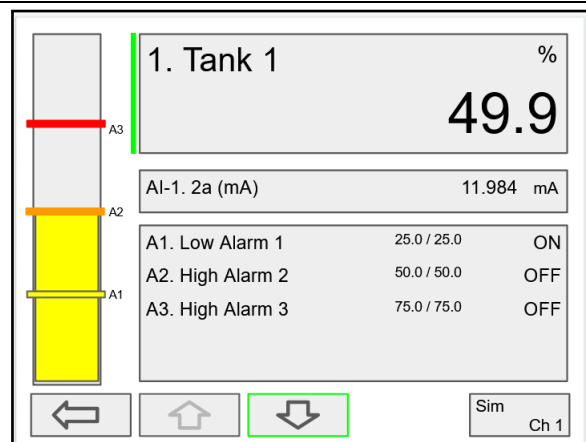
Note: The bargraph color changes, as shown in the graphics below.



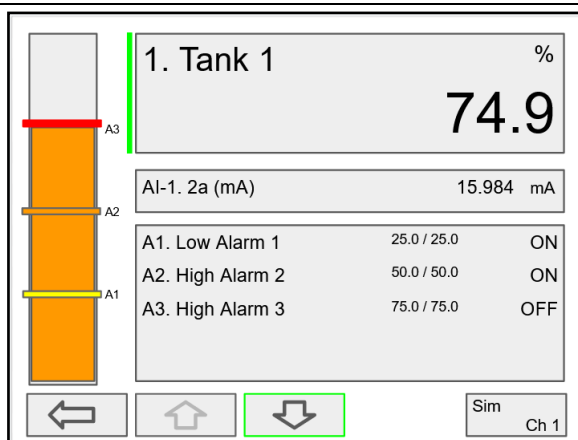
Color changes above the set point for each alarm



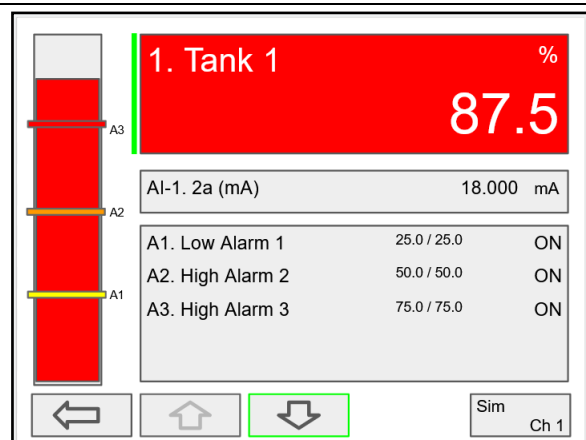
The bargraph shows green below the the first set point



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 & ASCII Serial Communication

The controller is equipped with serial communication capability as a standard feature. Baud Rate, Parity, Server 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 Server ID must be unique, so it will not interfere with other devices. Modbus Enron is supported by the Client/Snooper add-on feature.

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 & Time, Firmware Information

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 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. Program parameters can be written either before or with the Program Id. See <i>Table 4.</i> for details.
40082 - 40099	81 - 98	Program Parameters (x18)	Various	06, 16	W	

PVs Register Numbers & Addresses

The process variables (PVs) 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 Input* menu and the Modbus output registers can be mapped under the *Setup – Outputs – Modbus Output* menu; this allows assigning any parameter to the Modbus output registers and selecting the data type for input and output registers.

The Modbus input and output register numbers are displayed on the controller as they are created; they are listed in this table as reference, if you are away from the controller and need to access the information.

Table 3. PVs 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
		Total (N = 1 ... 32)					
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
		Timer (N = 1 ... 32)					
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
		Alarm (N = 1 ... 64)		64			
43601 + (N - 1)	3600 + (N - 1)	Alarm (N) Status	Short		03, 04	R	0: Off, 1: On, 2: On & Ack
		Modbus Output (N = 1 ... 64)					
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
		Modbus Input (N = 1 ... 199)					
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 70 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 can 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 Program Code plus parameters ending at Hour will set Minute and Second to zero.
40086	85	Minute	Short	06, 16	W		0..59 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 Program Code with parameters will ignore remaining parameters. 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 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

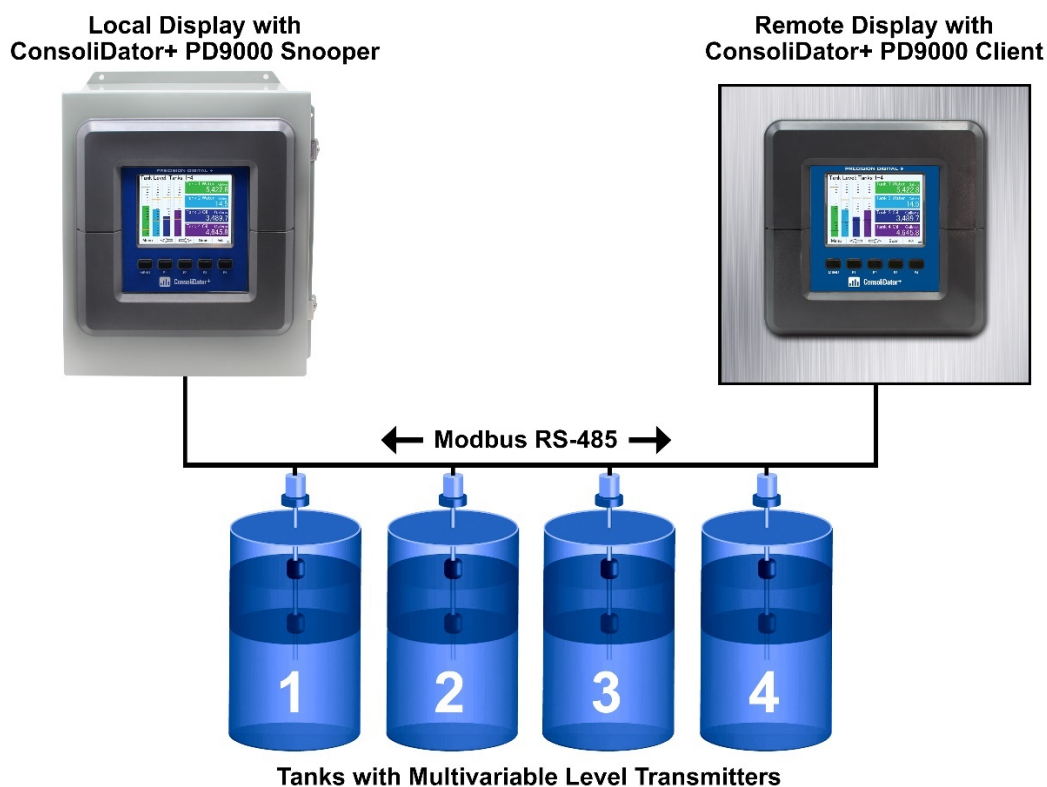
Reg. Number	Reg. Address	Description	Data Type	Function	R/W	Program Code	Comments
40081	80	Alarm - Stop	Short	06, 16	W	59	Interval alarms
40082	81	Alarm (N)	Short	06, 16	W		Program Code with only single parameter will ignore remaining parameters.
40083	82	Thru Alarm (N)	Short	06, 16	W		0 to ignore
40081	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

Modbus Applications

Snooper Mode

The *Snooper* mode can listen and read the process variables being transmitted on the RS-485 bus without causing any disruptions to the network. The controller can read up to 199 Modbus values, as inputs from other Modbus devices being polled by a Modbus Client. The inputs can be used as the source for channels, math functions, alarms, relay control, etc.



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 = PUMP 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

This controller is a highly sophisticated instrument with an extensive list of features and capabilities. If the front panel buttons are used to program the controller, it may be a difficult task to keep everything straight. That is why we strongly recommend the use of the free ConsoliDator+ configuration software for all programming activities. A cable is provided with the controller for programming with the software. If you have programmed the controller with the front panel buttons and it is not working as intended, try re-programming it with the ConsoliDator+ configuration software.

Symptom	Check/Action
No display or only backlight is visible, but outputs still function normally.	<ol style="list-style-type: none"> 1. Ambient temperature is below -40°C and affects LCD visibility. 2. Grounding is inadequate or not connected. Check earth ground continuity.
"BREAK" is displayed	<ol style="list-style-type: none"> 1. 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. 2. Modbus: Make sure all devices in the network have a unique server ID. 3. Modbus Inputs: Check the Timeout setting, increase the timeout if necessary.
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"> 1. Check signal source stability 2. Increase filter value 3. Decrease the display refresh rate (increase time)
mA input not responding to signal changes (value frozen)	<ol style="list-style-type: none"> 1. Cycle the power or 2. Go to setup mA input and disable input channel, then enable the input channel 3. Check that back cover is fully seated, and all I/O cards are tightly fixed in place.
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"> 1. Check if relays are in manual control mode. 2. Check Setup menu alarm set and reset points.
Writing to Modbus Input register failed	Check register number or register address being used <ol style="list-style-type: none"> 1. If using PLC address (Base 1) use register number (e.g. 46701) 2. If using Base 0 address, use register address (e.g. 6700)
The Modbus value being read is not correct	<ol style="list-style-type: none"> 1. Check the data type. 2. Check the byte order. 3. Confirm the units being sent by the server
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:	

Contact Precision Digital

Technical Support

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

Fax: (508) 655-8990

Email: support@predig.com

Sales Support

Call: (800) 343-1001 or (508) 655-7300

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