TEKTROL
Technology Solutions

TEK-LCD 7801C

NEMA 4X Panel Mount Multi-Channel Controller

Instruction Manual

Document Number: IM-7801C

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NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

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1 Safety Instructions

1.1 Intended Use

Tek-LCD 7801C NEMA 4X Panel Mount Multi-Channel Controller is easy to use and satisfies a wide variety of process display, alarm, and control applications.

1.2 Certifications

CE Approvals.

1.3 Safety Instructions from the Manufacturer

1.3.1 Disclaimer

The manufacturer will not be held accountable for any damage that happens by using its product, including, but not limited to direct, indirect, or incidental and consequential damages.
Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.
The manufacturer has the right to modify the content of this document, including the disclaimer, at any time for any reason without prior notice, and will not be answerable in any way for the possible consequence of such changes.

1.3.2 Product Liability and Warranty

The operator shall bear authority for the suitability of the device for the specific application. The manufacturer accepts no liability for the consequences of misuse by the operator. Wrong installation or operation of the devices (systems) will cause the warranty to be void. The respective Terms and Conditions of Sale, which forms the basis for the sales contract shall also apply.

1.3.3 Information Concerning the Documentation

To prevent any injury to the operator or damage to the device it is essential to read the information in this document and the applicable national standard safety instructions. This operating manual contain all the information that is required in various stages, such as product identification, incoming acceptance and storage, mounting, connection, operation and commissioning, troubleshooting, maintenance, and disposal.

1.4 Safety Precautions

You must read these instructions carefully prior to installing and commissioning the device. These instructions are an important part of the product and must be kept for future reference. Only by observing these instructions, optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device can be ensured.
For additional information that are not discussed in this manual, contact the manufacturer.

Warnings and Symbols Used

The following safety symbol marks are used in this operation manual and on the instrument.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

1.5 Packaging, Transportation and Storage

1.5.1 Packaging

The original package consists of

- Tek-LCD 7801C NEMA 4X Panel Mount Multi-Channel Controller
- Documentation

NOTE

Unpack and Check the contents for damages or sign of rough handling. Report damage to the manufacturer immediately. Check the contents against the packing list provided.

1.5.2 Transportation

- Avoid impact shocks to the device and prevent it from getting wet during transportation.
- Verify local safety regulations, directives, and company procedures with respect to hoisting, rigging, and transportation of heavy equipment.
- Transport the product to the installation site using the original manufacturer's packing whenever possible.

1.5.3 Storage

If this product is to be stored for a long period of time before installation, take the following precautions:

- Store your product in the manufacturer's original packing used for shipping.
- Storage location should conform to the following requirements:
  1. Free from rain and water
  2. Free from vibration and impact shock
  3. At room temperature with minimal temperature and humidity variation
- Properties of the instrument can change when stored outdoors.

1.5.4 Nameplate

The nameplate lists the important information, such as design details and technical data.

NOTE

Check the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

2 Product Description

2.1 Introduction

Tek-LCD 7801C NEMA 4X Panel Mount Multi-Channel Controller 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 bar graph 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.

Tek-LCD 7801C NEMA 4X Panel Mount Multi-Channel Controller takes full advantage of its color display by allowing the user to customize screen colors for bar graphs, 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.

Fig 1: Tek-LCD 7801C NEMA 4X Panel Mount Multi-Channel Controller

2.2 Specifications

Note: All specifications apply to operation at 77°F (25°C)	
Display	Color; QVGA (320x240 px), 5.7" (145 mm) diagonally, white backlight; Bar Graph: Twenty divisions; Numerical: Up to 15 digits (±999,999,999,999,999); Feet & Inches Format: 99,999' 11.9"
Screen Bar Graph	Enable/disable: Channels, totals, timers; Bar Graph scale: 0 – 100%, independent of channel scale; Twenty Divisions: 5% each; Screen: Select to show bar graph or not
Color Selection	65 colors selection, customize bar graph, 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
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
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
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
Internal Buzzer	60 dBA @ 24 inches (61 cm)
External Horn	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
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

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
Manual Control	Analog outputs and relays can be controlled manually from the View menu or from a function key
Non-Volatile Memory	Settings stored for a minimum of 10 years
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
Operating Temperature	-40°F to 140°F (-40°C to 60°C)
Storage Temperature	-40°F to 140°F (-40°C to 60°C)
Relative Humidity	0 to 90% non-condensing
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" x 10" ±1/16" (250mm x 250mm ±1.3 mm) (H x W); Panel thickness: 1/16" – 1/4" (1.8 mm to 8.9 mm); Clearance behind panel: 6" (150mm)
Dimensions	10 ¾" x 10 ¾" x 4 ¾" (276mm x 276mm x 124mm) (H x W x D)
Weight	7.4lb (3.4kg) approx.
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

Non-Resettable 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
Roll-Over	Enter the value for total to roll-over to 0
Negative Total	Allow total value to count below 0 for bi-directional flow based on rate channel
Total Bar Graph	Bar graph can be scaled to represent the expected maximum total
Date Format	Month, day, year
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
Analog Inputs	(4) Analog inputs/card; (4) Pulse inputs/card; (28) Analog inputs max; 28) Pulse inputs max; (5) Relays/card; (30) Relays max with (4) analog or (4) pulse inputs; no other I/O; 199 Modbus RTU;
Digital Inputs	5 Inputs, non-isolated, 30 VDC max • Low: 0 to 1.2 V • High: 2.8 to 30.0 V • Internal pull-up: 5 kΩ 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
Typical Input	4-20mA
Input Range	0-24mA
Analog Outputs	(5) Analog outputs/card; (35) Analog outputs max with no other I/O cards (Seven I/O slots)
Digital Outputs	4 Outputs • 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

Output	4 to 20mA
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
Accuracy	±0.03% of full scale ±1 count
4-20 mA Display Value	Up to six full digits recommended ±999,999
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 bar graph; 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 50/60Hz
Common Mode Rejection	90 dB at 50/60 Hz

2.3 Dimensional Drawings

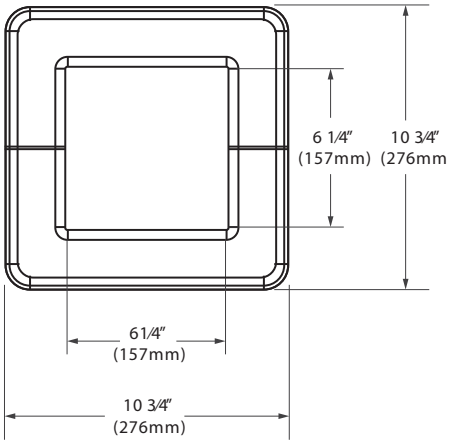


Fig 2: Front Panel Mount

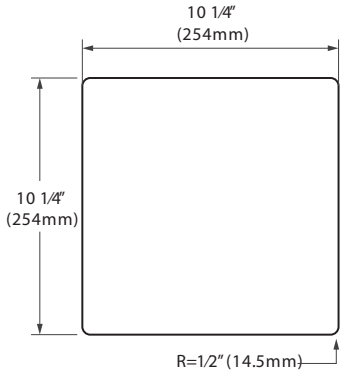


Fig 3: Panel Cutout

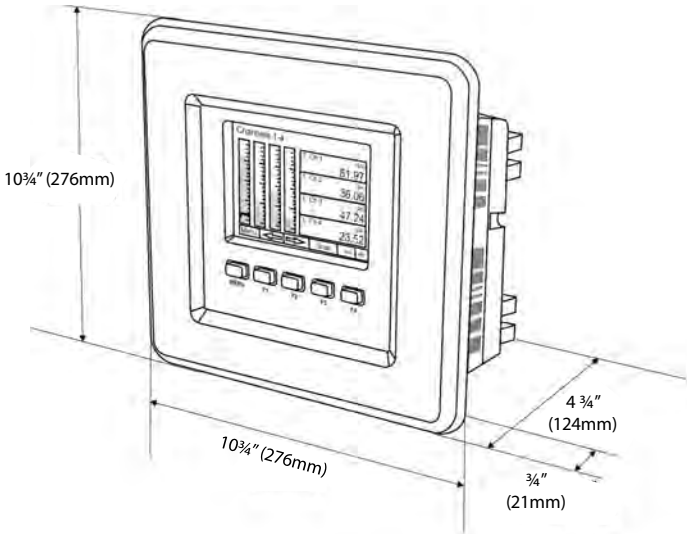


Fig 4: Mounting Panel

2.4 Popular Models

General Purpose Panel-Mount Models				
Model	**Pulse Inputs**	**4-20 mA Inputs**	**4-20 mA Outputs**	**Relays**
7801C-GP	0	0	0	0
7801C-GP-4AI	0	4	0	0
7801C-GP-4AI-10RY	0	4	0	10
7801C-GP-4AI-5AO-10RY	0	4	5	10
7801C-GP-4AI-20RY	0	4	0	20
7801C-GP-4AI-5AO-20RY	0	4	5	20
7801C-GP-8AI	0	8	0	0
7801C-GP-8AI-10RY	0	8	0	10
7801C-GP-8AI-10AO-10RY	0	8	10	10
7801C-GP-8AI-20RY	0	8	0	20
7801C-GP-8AI-25RY	0	8	0	25
7801C-GP-12AI	0	12	0	0
7801C-GP-12AI-20RY	0	12	0	20
7801C-GP-12AI-10AO-10RY	0	12	10	10
7801C-GP-16AI	0	16	0	0
7801C-GP-16AI-15RY	0	16	0	15
7801C-GP-16AI-15AO	0	16	15	0
7801C-GP-20AI	0	20	0	0
7801C-GP-20AI-10RY	0	20	0	10
7801C-GP-20AI-10AO	0	20	10	0
7801C-GP-24AI	0	24	0	0
7801C-GP-24AI-5RY	0	24	0	5
7801C-GP-24AI-5AO	0	24	5	0
7801C-GP-28AI	0	28	0	0
7801C-GP-4PI	4	0	0	0
7801C-GP-4PI-5AO	4	0	5	0
7801C-GP-4PI-5AO-10RY	4	0	5	10
7801C-GP-4PI-4AI-5AO	4	4	5	0
7801C-GP-4PI-4AI-5AO-10R	4	4	5	10
7801C-GP-4PI-8AI-10AO-10RY	4	8	10	10
7801C-GP-8PI	8	0	0	0
7801C-GP-8PI-10AO	8	0	10	0
7801C-GP-8PI-10AO-10RY	8	0	10	10
7801C-GP-8PI-8AI-10AO-5RY	8	8	10	5

Where,

G = General Purpose
P = Panel-Mount
AI = Analog Input
PI = Pulse Input
AO = Analog Output
RY = Relay
E = Ethernet

Model	Description
7801C-M1	Add-On Feature: NEMA 4X Panel Mount Multi-Channel Controller + Modbus Client/Snooper/Spoofer
7801C-C4AI	(4) Isolated 4-20 mA Inputs Card for NEMA 4X Panel Mount Multi-Channel Controller
7801C-C4PI	(4) Pulse Inputs Card for NEMA 4X Panel Mount Multi-Channel Controller
7801C-C5AO	(5) Isolated 4-20 mA Outputs Card for NEMA 4X Panel Mount Multi-Channel Controller
7801C-C5RY	(5) Relays Card for NEMA 4X Panel Mount Multi-Channel Controller
7801C-C4AI	(4) Isolated 4-20 mA Inputs Card for NEMA 4X Panel Mount Multi-Channel Controller
7801C-12	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate for up to 12 Inputs and Outputs
7801C-24	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate for up to 24 Inputs and Outputs
7801C-36	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate for up to 36 Inputs and Outputs
7801C-12-DATA	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate with data for up to 12 Inputs and Outputs
7801C-24-DATA	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate with data for up to 24 Inputs and Outputs
7801C-DATA	NEMA 4X Panel Mount Multi-Channel Controller Calibration and Certificate with data for up to 36 Inputs and Outputs
7801C	Custom Setup for NEMA 4X Panel Mount Multi-Channel Controller
7801C-1909	NEMA 4X Plastic Enclosure; Dimensions: 12”x 12" x 6" (300mm x 300mm x 150mm) (H x W x D)
7801C-1939	NEMA 4X Plastic Enclosure; Dimensions: 18" x 14" x 8" (450 mm x 350 mm x 200 mm) (H x W x D)
7801C-2909	NEMA 4 Steel Enclosure; Dimensions: 12" x 12" x 6" (300mm x 300mm x 150mm) (H x W x D)
7801C-2919	NEMA 4 Steel Enclosure; Dimensions: 14" x 12" x 8" (350mm x 300mm x 200mm) (H x W x D)
7801C-2929	NEMA 4 Steel Enclosure; Dimensions: 16" x 14" x 10" (400mm x 350mm x 250mm) (H x W x D)
7801C-3939	NEMA 4X Plastic Enclosure with Clear Cover; Dimensions: 17.7" x 13.8" x 7.9" (450 mm x 350 mm x 200 mm) (H x W x D)

2.5 Accessories

2.5.1 Light or Horn Accessories

Model	Description
7801C-LHRB1	Red Light / Horn and Button with Holes Drilled in Enclosure(1)
7801C-LHGB1	Green Light / Horn and Button with Holes Drilled in Enclosure(1)
7801C-LHYB1	Yellow Light / Horn and Button with Holes Drilled in Enclosure(1)
7801C-LHBB1	Blue Light / Horn and Button with Holes Drilled in Enclosure(1)
7801C-LHWB1	White Light / Horn and Button with Holes Drilled in Enclosure(1)
7801C-LH5CB1	Light / Horn with User Choice of Red, Green, Yellow, Blue or White Light, Button, and Holes Drilled in Enclosure(1)
7801C-LH3LCB1-RYG	Light / Horn with Red, Yellow, Green Light Layers, Button, and Holes Drilled in Enclosure(1)
7801C-LHR	Red Light / Horn
7801C-LHG	Green Light / Horn
7801C-LHY	Yellow Light / Horn
7801C-LHB	Blue Light / Horn
7801C-LHW	White Light / Horn
7801C-LH5C	Light / Horn with User Choice of Red, Green, Yellow, Blue or White Light
7801C-LH3LC-RYG	Light / Horn with Red, Yellow, Green Light Layers

2.5.2 PDA-BUTTON Momentary Pushbutton

Model	Description
7801C-BUTTON1B	NEMA 4X Black Button
7801C-BUTTON1G	NEMA 4X Green Button
7801C-BUTTON1R	NEMA 4X Red Button

2.5.3 7801C-SH Sun Hood

Model	Description
7801C-SH	7801C Sun Hood

2.5.4 7801C-2360 Control Stations

Model	Description
7801C2360-E	Emergency Stop Button
7801C2361-A	1 Black Ack Button
7801C2361-Q	1 Black Silence Button

2.5.5 Signal Splitter & Conditioner Accessories

Model	Description
7801C-1MA-1MA	Signal Isolator with One 4-20 mA Input and One 4-20 mA Output
7801C-1MA-2MA	Signal Splitter with One 4-20 mA Input and Two 4-20 mA Outputs
7801C-1V-1MA	Signal Conditioner with One 0-10 VDC Input and One 4-20 mA Output
7801C-1MA-1V	Signal Conditioner with One 4-20 mA Input and One 0-10 VDC Output

2.5.6 Split Core AC Current Transducer

Model	Description
7801C-6420	Split Core AC Current Transducer. Input: 30/60/120 AAC; Output 4-20 mA

2.5.7 Panel Mount Buzzer and Light

Model	Description
7801C-1000	Panel Mount Buzzer and Light

2.5.8 Snubber 0.01µF/470Ω Flexible Leads

Model	Description
7801C-6901	Snubber 0.01µF/470Ω Flexible Leads

2.5.9 Low-Cost Signal Generator

Model	Description
7801C-9502	4-20 mA or 0-10 VDC, Low-Cost Signal Generator

2.5.10 7801C-ENC NEMA 4X Plastic and NEMA 4 Steel Enclosures

The 7801C-ENC enclosures provide a convenient way to mount the Tek-LCD 7801C 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 Tek-LCD 7801C. The enclosures are available in various sizes, with the larger enclosures capable of housing other pieces of equipment, such as the 7801C-01 power supply.

*Note: The enclosure and Tek-LCD 7801C are ordered and packaged separately.

- **NEMA 4X Plastic Enclosures**

7801-1909

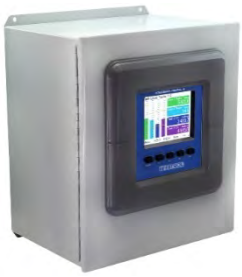
7801-1939

7801-3939

- **NEMA 4 Steel Enclosures**

7801-2909

7801-2919



7801-2929

3 Installation

This section covers instructions on installation and commissioning. Installation of the device must be carried out by qualified trained, specialists authorized to perform such works.

CAUTION

- When removing the instrument from hazardous processes, avoid direct contact with the fluid and the meter.
- All installation must comply with local installation requirements and local electrical code.

NOTE

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

3.1 Panel Mounting

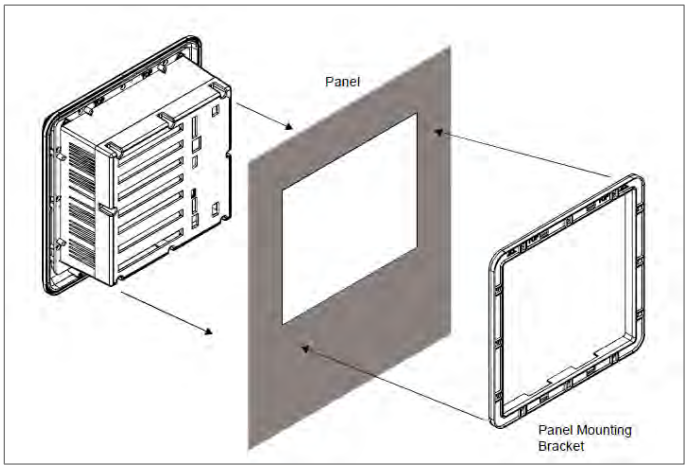


Fig 5: Panel Mount Installation

- Prepare panel cutout as 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.

*Note:

1. Panel cutout: 10" x 10" ±0.05" (250mm x 250mm ±1.3mm)
2. Panel thickness: 1/16" to ¼" (1.8mm to 8.9 mm)
3. Clearance: Allow 6" (150mm) behind panel

4 Electrical Connections

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 meter and ensure personnel safety.

4.1 Terminal Connections

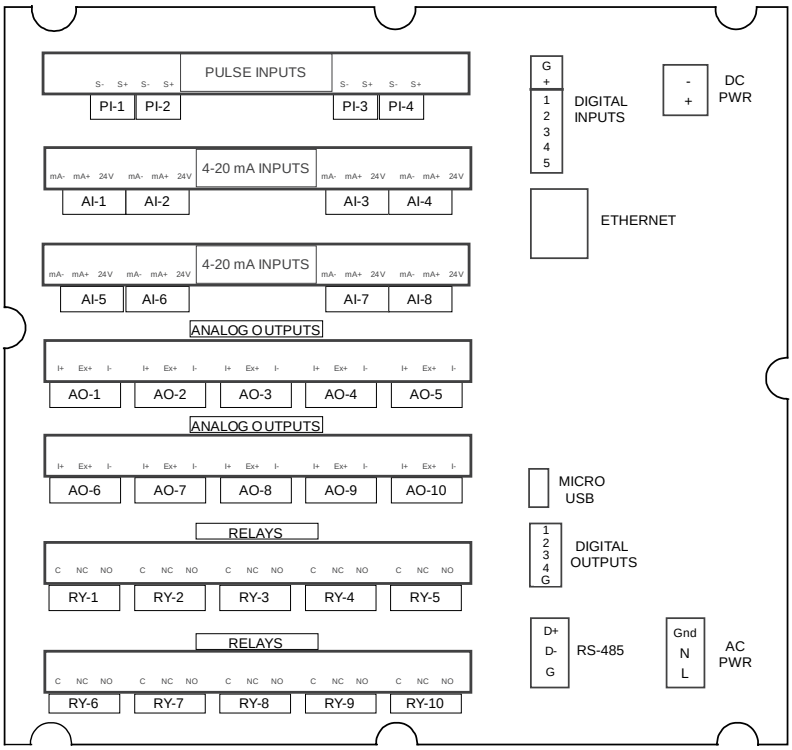


Fig 6: Terminal Connection for Tek-LCD 7801C

- The back panel is labelled with the I/O boards that were installed at the factory.
- The removable connectors are labelled with the connection signal for each terminal.
- Figure 6 shows terminal connections of Tek-LCD 7801C.
- This model accepts (4) pulse and (8) analog inputs, and (10) 4-20 mA outputs and (10) relays. (5) digital inputs, (4) digital outputs, RS-485 serial capability and USB connections are standard on Tek-LCD 7801C NEMA 4X Multi-Channel Controller.
- Ethernet is an option.
- If all Input or Output slots are used exclusively for one function, the Tek-LCD 7801C NEMA 4X Multi-Channel Controller 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 24V or less, otherwise the controller will run on DC power.

*Note:

1. Each 4-20mA input has its own isolated 24VDC power supply to power the transmitter.
2. Each 4-20mA output has its own isolated 24VDC power supply to power the output loop.
3. Each relay is Form C and rated at 10 A.
4. Input / output connections are made to removable screw connectors.
5. Every Tek-LCD 7801C has five digital inputs (additional digital inputs can be obtained by using the Pulse Inputs), four digital outputs, RS-485 with Modbus.
6. All Tek-LCD 7801C models can be powered from either AC or DC Power.
7. Ethernet with Modbus TCP is an option.
8. Micro USB is used for programming the Tek-LCD 7801C.

4.2 Power Connection

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.

4.2.1 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.

4.2.2 24 VDC Power ± 10%

- Use two-terminal power connector as shown in Figure 7.
- Unit is protected internally with 3.7 A auto-resettable fuse. 4 A max, slow blow, 50 V min, UL Recognized external fuse recommended.

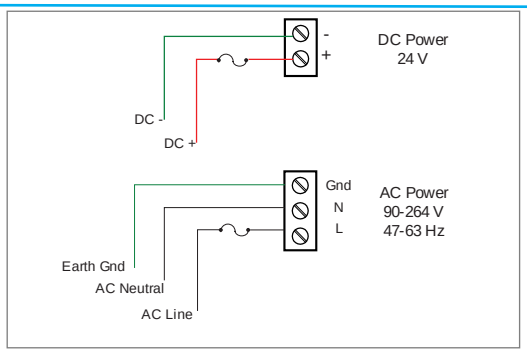


Fig 7: Power Connection

4.2.3 Isolated Input Signal Connections

- Isolated input signal connections are made to removable screw terminal connectors, which are labelled 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.

4.2.4 4-20 mA Analog Input Connections

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

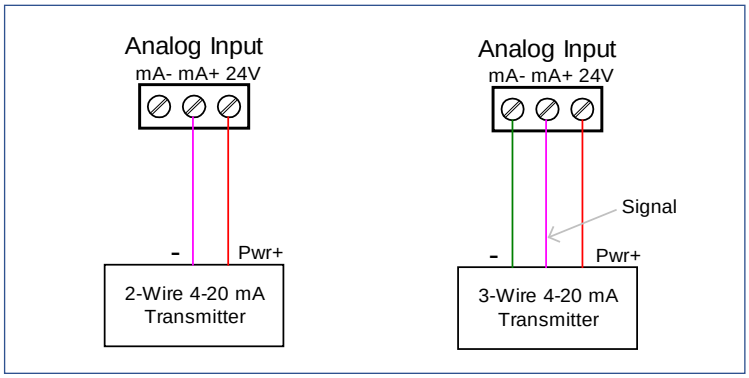


Fig 8: Transmitters Powered by Tek-LCD 7801C Isolated 24 VDC Power Supply

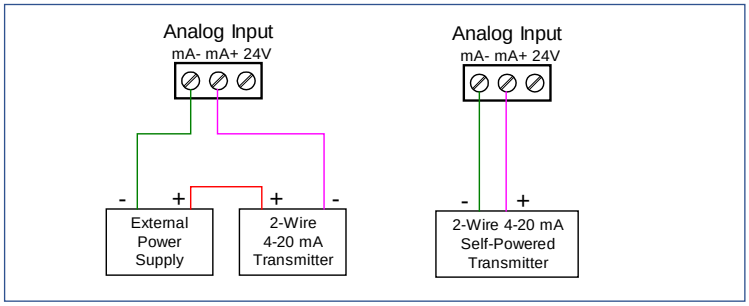


Fig 9: Transmitter Powered by Ext. Supply or Self-Powered

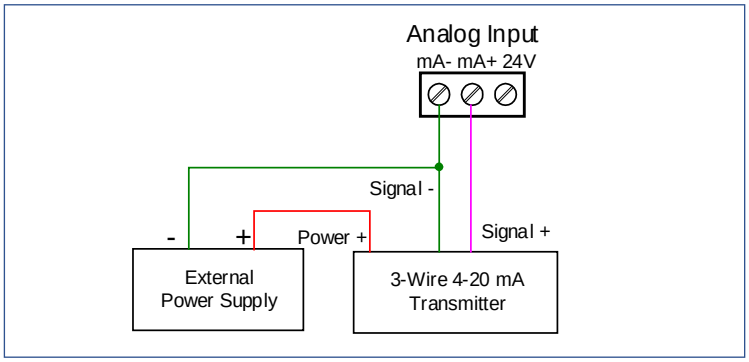


Fig 10: 3-Wire Transmitters Powered Externally

4.2.5 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.

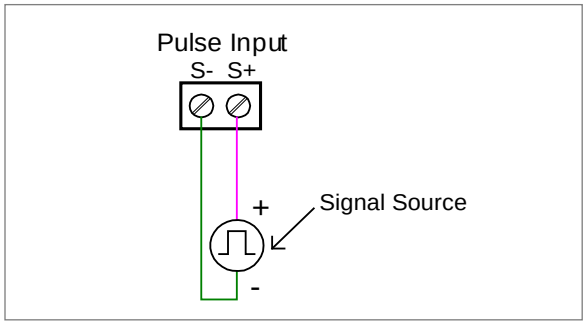


Fig 11: Flow Meter Pulse Input Connections

4.2.6 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 12. 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 12) 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.

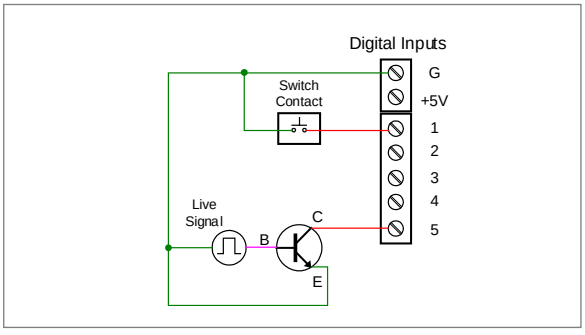


Fig 12: Digital Input from Switch Closure and Live Signal

4.2.7 Analog Output Connections

- Figure 13 shows examples for isolated 4-20 mA transmitter output connections. Terminal connectors are labelled 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.

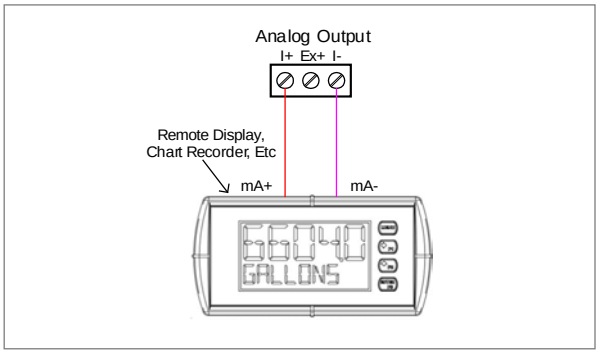


Fig 13: Active 4-20 mA Output Powered by Controller

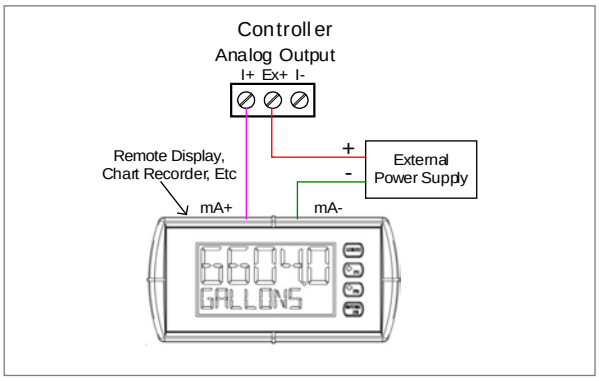


Fig 14: Passive 4-20 mA Output Powered by External Supply

4.2.8 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.

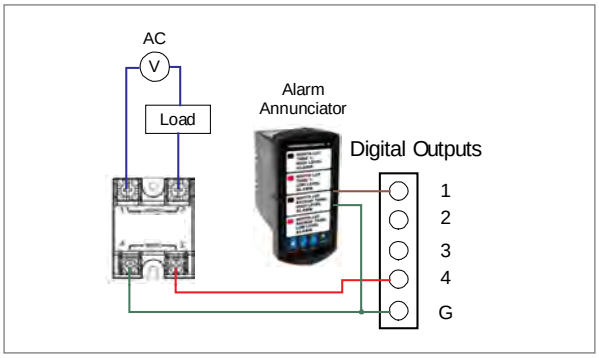


Fig 15: Digital Outputs Driving 5 V Solid State Relay

4.2.9 Connections to Power Gas Detector

Some sensors requiring more than 200mA of excitation current can be powered by the Tek-LCD 7801C by connecting two or more power supplies in parallel as shown in the following diagrams.

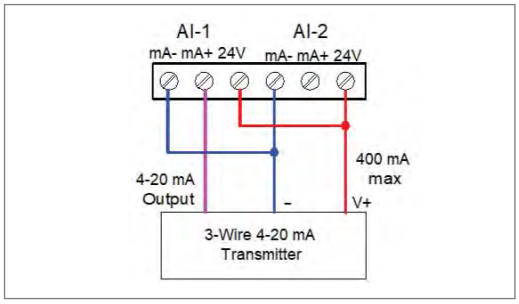


Fig 16: Two Supplies in Parallel Powering 3-Wire Transmitter

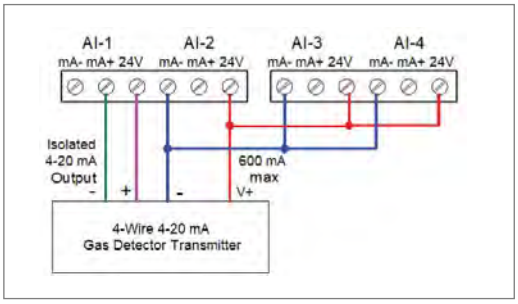


Fig 17: Powering 4-Wire Gas Detector & Isolated 4-20 mA Output

4.2.10 Relay Connections

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

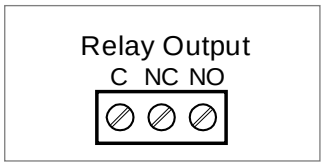


Fig 18: Relay Connections

4.2.11 Switching Inductive Loads

- The Tek-LCD 7801C 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 figure 19 circuits for RC network assembly and installation.

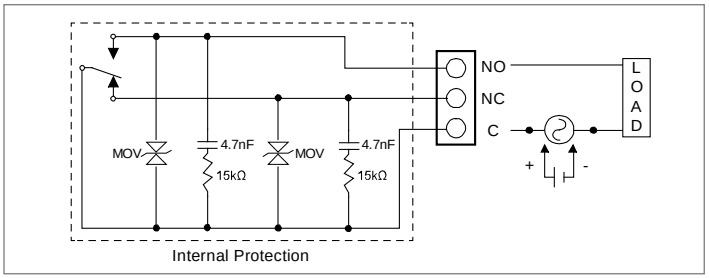


Fig 19: AC and DC Internal Inductive Loads Protection

- 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

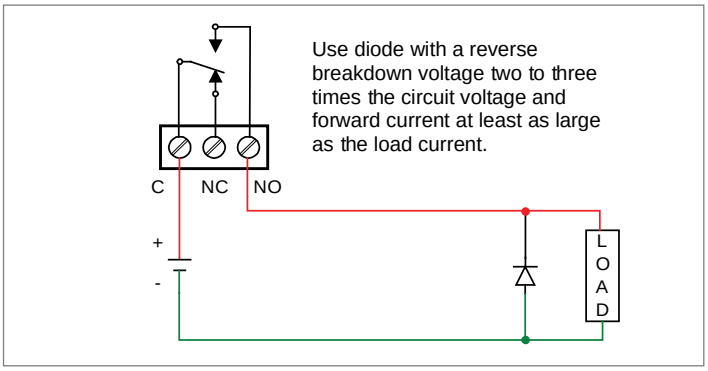


Fig 20: Low Voltage DC Loads Protection

4.2.12 RC Networks Available from Tek-Trol

RC networks are available from Tek-Trol and should be applied to each relay contact switching an inductive load.

4.2.13 Serial Communication Connections

- The RS-485 port for serial communication (using Modbus protocol) has three terminals labelled 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.

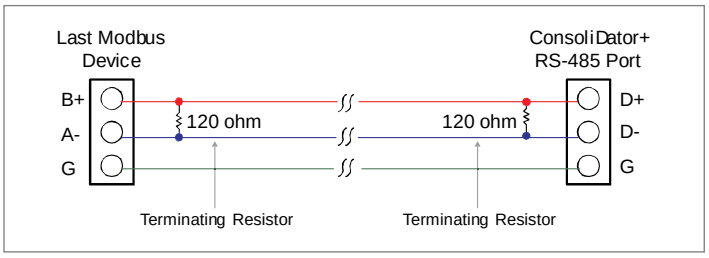


Fig 21: Serial Connections

4.2.14 Ethernet Option

The Ethernet port is available on the RJ45 connector. This allows the Tek-LCD 7801C to connect to a local area network.

4.2.15 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.

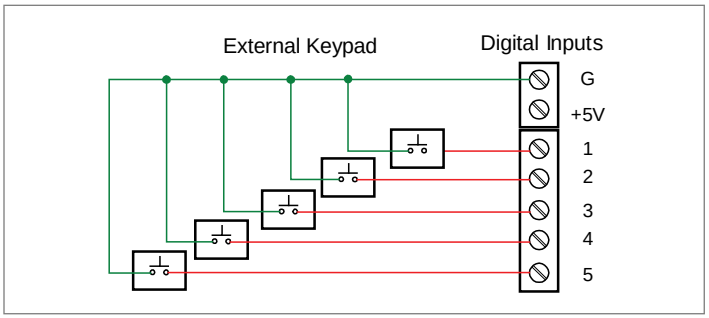


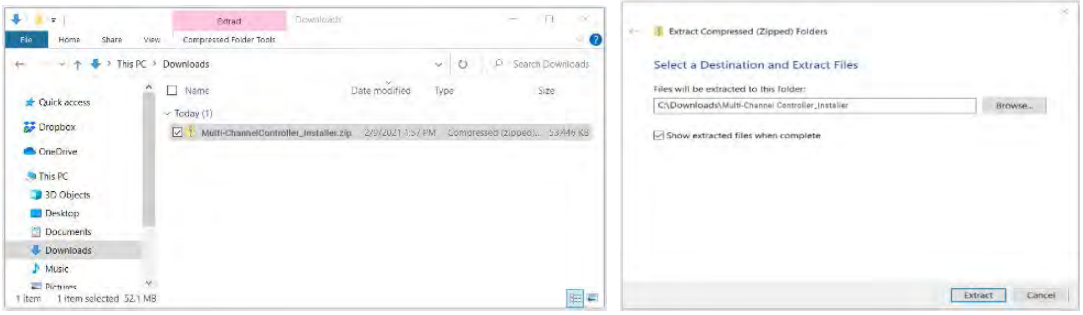
Fig 22: External Keypad Connections

5 Configuration

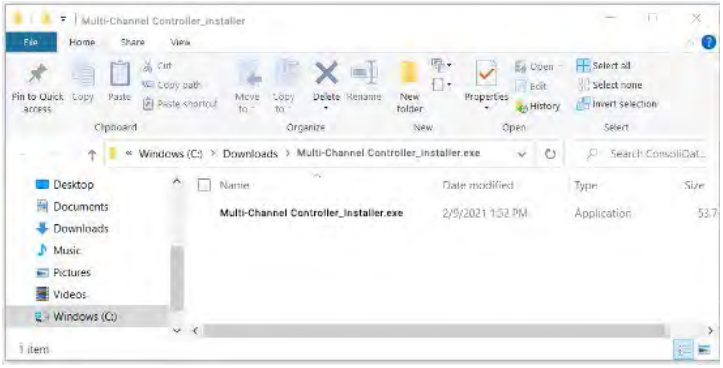
5.1 Software Installation

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

1. Download the latest version of the Tek-LCD 7801C configuration software from our website predig.com/software or from the included CD.
2. Extract the contents of the Tek-LCD 7801C_Installer.zip file into a folder in your computer.

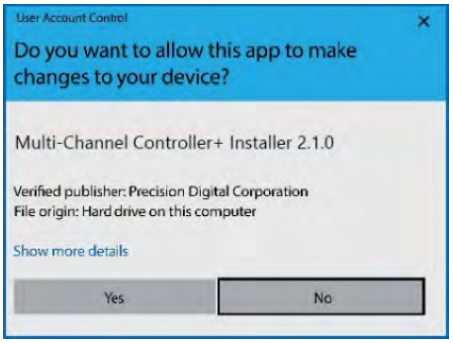


3. Double-click on the executable file Tek-LCD 7801C_Installer.exe and follow the on-screen instructions.

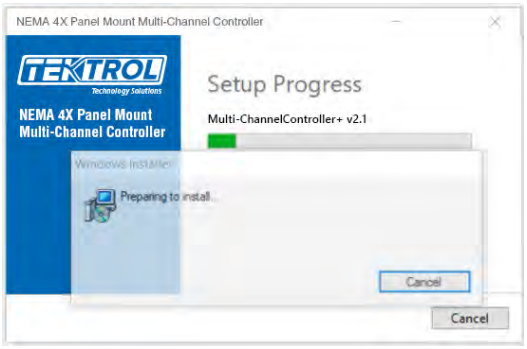


4. This message is displayed. Click on Install to start the software installation process.

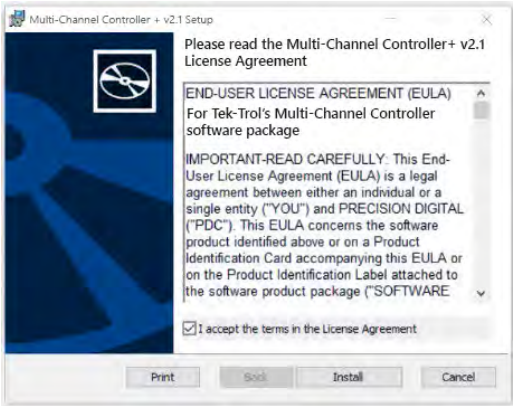
5. The User Account Control message is displayed. Click Yes to proceed with the installation.



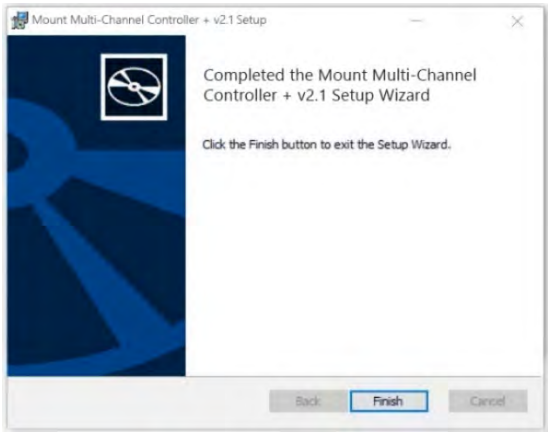
6. The installation progress is displayed.



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.



9. After the installation is complete, the following message is displayed. Click Close to finish. A Tek-LCD 7801C icon will be placed on your desktop.

10. You are now ready to start using the software to configure your TEK-LCD 7801C Controller.

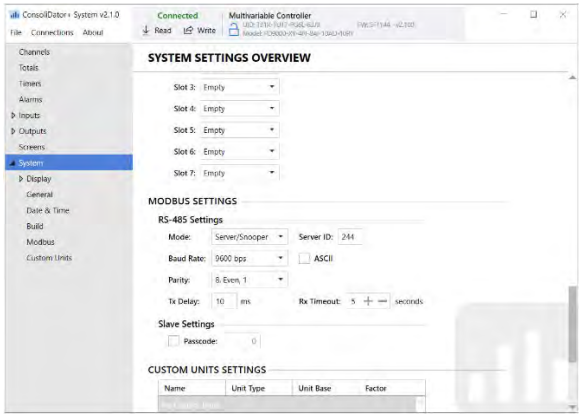
WARNING

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

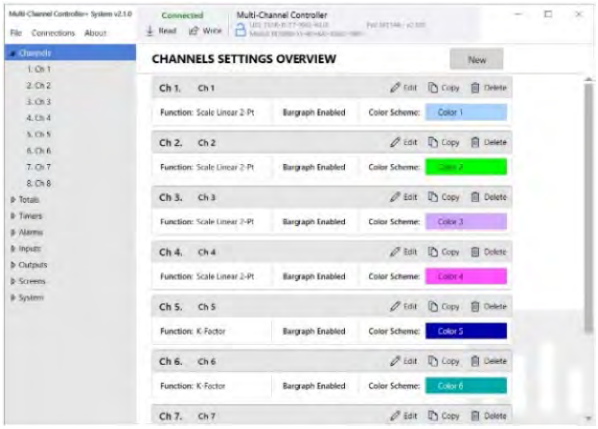
5.2 Tek-LCD 7801C Software

1. Connect one end of the provided USB cable to the controller and the other end to the computer.
2. Double-click on the Tek-LCD 7801C icon.

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



4. 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.



5. You can now begin to configure the Tek-LCD 7801C for your application, either by editing the existing settings or by starting fresh creating a new configuration.
6. Click on File to save files, open existing files, or to create a new configuration even without a controller connected.

6 Setup and Programming

6.1 Navigation 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.

6.1.1 Keys and Buttons

- The unit is equipped with five buttons located below the display.
- The function of each button corresponds to its 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 shown in table 1 are used to navigate through menus and edit settings.
- Other special keys appear throughout the programming process.

Table 1: Key and its Description

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

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

6.2 Basic Instructions

NOTE

- 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.

- Setup and programming are done through the front panel buttons or with the Tek-LCD 7801C 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.
- Figure 23 and 24 are shown 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 keys and button functions, refer 6.1.1 section.

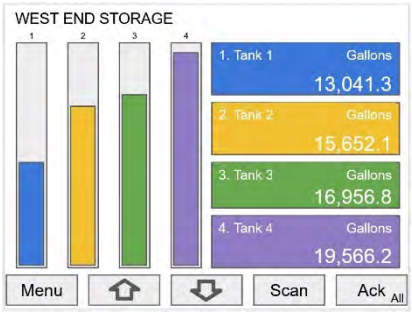


Fig 23: Typical screen view displaying 4 channels and 4 bar graphs representing the values of each channel.

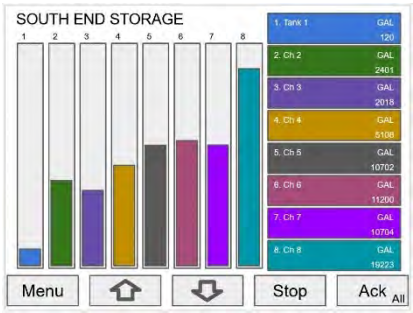
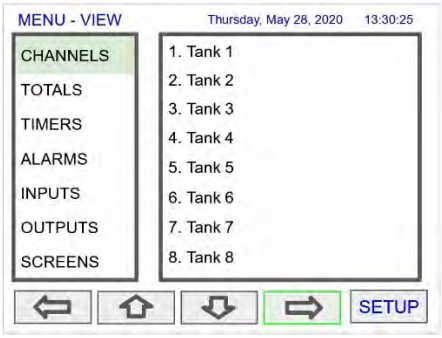


Fig 24: Typical screen view displaying 8 channels and 8 bar graphs representing the values of each channel.

- Press the Menu key to begin setup and programming.



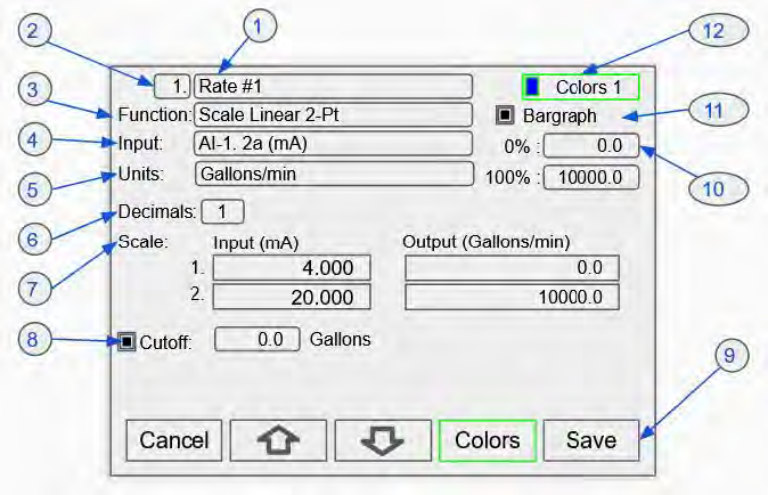
- The View screen view all the settings and values for Channels, Totals, Timers, etc.
- Press the Setup key to program the instrument.

6.3 Setup Menu

- The Setup menu is the starting point during the programming process.
- Setup menu 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.

6.4 Channel Parameter



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
- **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

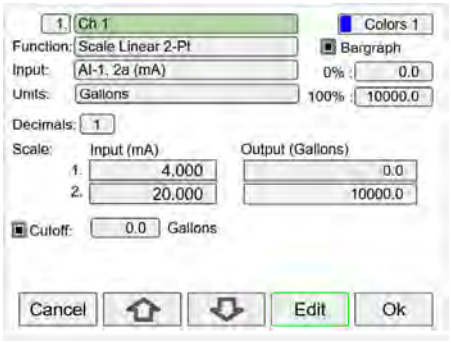
See Channel & Math Functions on page *15* for details.

- **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)

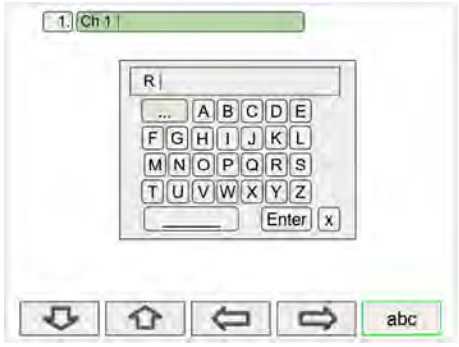
4. **Input**: Source for the channel (PV)
   - mA Input (4-20 mA)
   - Pulse Input
   - Digital Input
   - Modbus Input
   - Channel
   - Total
   - Timer
   - Alarm
   - mA Output
   - Relay Output
   - Digital Output
   - Modbus Output
5. **Units**: Engineering units / time or none
   - None
   - Time
   - 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**: This 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

6.5 Data Entry Keypad

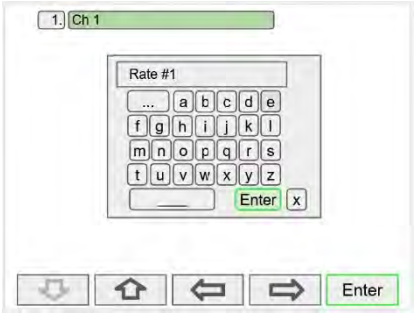
The system provides a keypad for entering values and tags, which contains numbers, characters, and symbols.



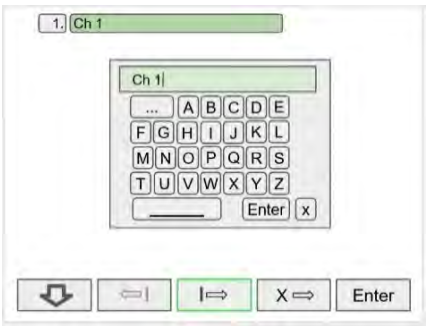
- Press Edit key to start editing the channel configuration.
- The green background indicates the field to be edited.
- Press Edit key again to change the channel's tag, this opens the data entry keypad.



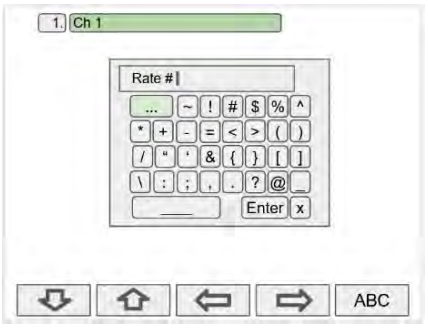
- Use the Down Arrow key to navigate to the keypad. Use the |→ and ←| keys to move the cursor and use the **X**→key to delete characters.
- To enter characters in the selected text field, use the arrow keys to navigate through the popup keypad.



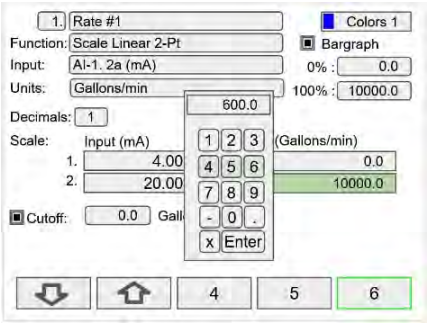
- To change the character set, navigate to the three dots and press the key indicating the next set of characters.



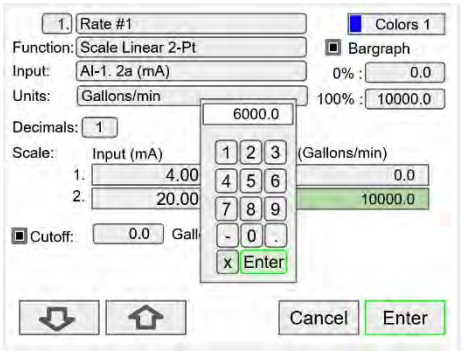
- To enter symbols, press the three dots and select the desired symbol.



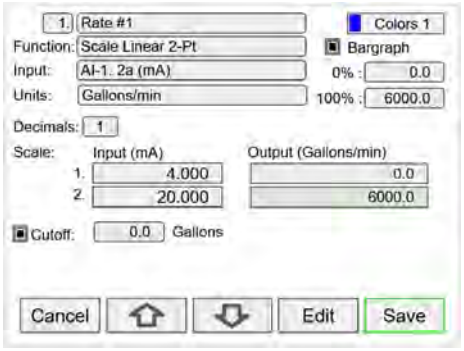
- When done typing the characters in the selected field, press the Enter key.



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



- Press Enter to accept the changes.



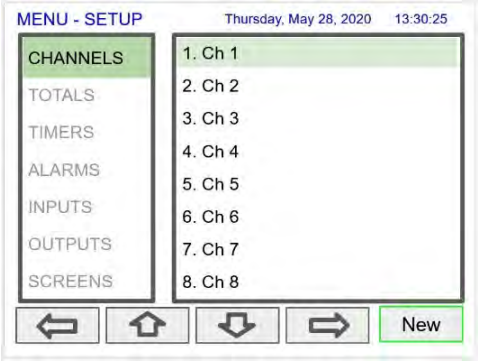
- Press the Save key to save the changes. The bar graph is automatically adjusted to reflect the scale entered.
- The bar graph scaling can be changed without affecting the input scaling.

6.6 Setup Channel

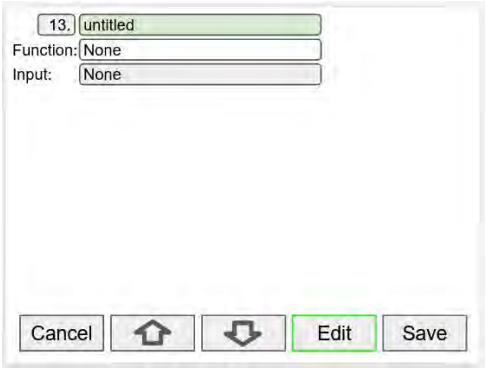
- The Setup Channels menu is used to configure each channel, enter a tag, select the input source, scale the input, and program other settings that will determine the channel's processing capabilities.
- Use the Arrow keys to navigate through the existing channels.
- Press the New key to create a new 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.

6.7 Create New Channel

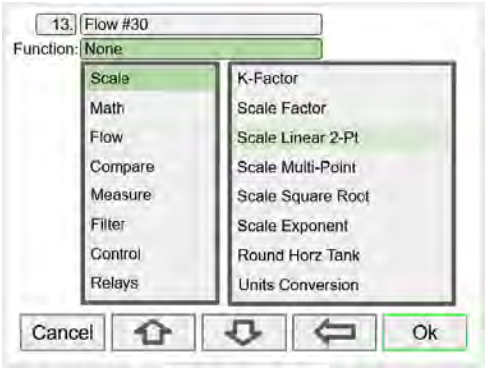
- Press the New key to create a new channel.



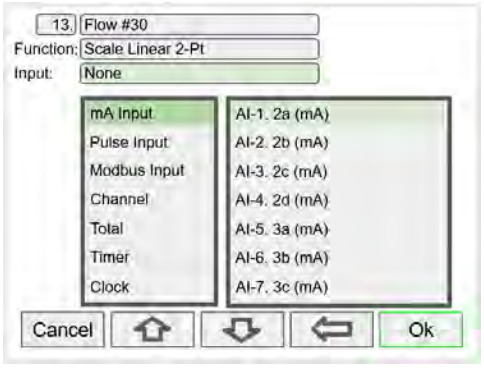
- Press the Edit key to edit the channel tag and other settings.
- Press the Up and Down arrow keys to select setting to be edited.



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

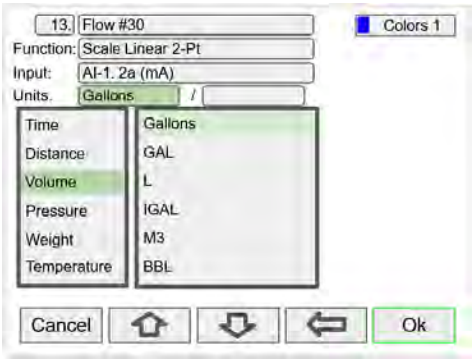


- Select the input source for the channel.

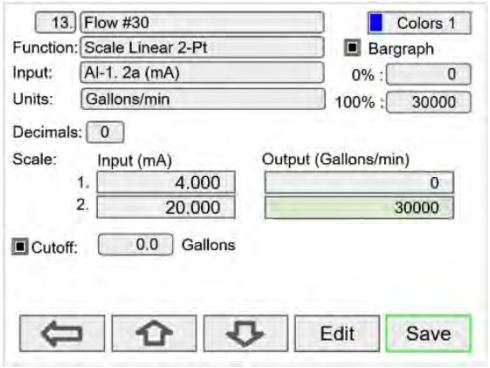


*Note: The inputs shown depend on the installed hardware and the configuration.

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

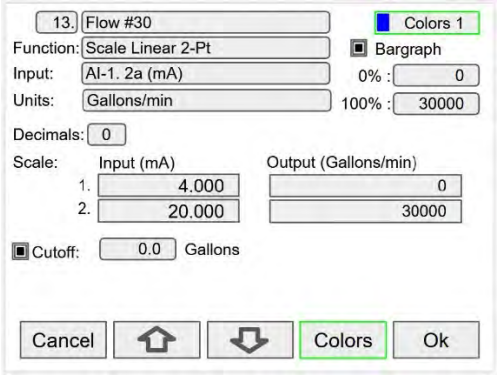


- Select number of decimals, scale the input, enter the cut-off value, select colours for bar graph and text, confirm the bar graph's scale, and press Save.



6.8 Bar Graph, Background and Text Colours

- To select a channel color pattern, navigate to the colours setting and press the colours key.

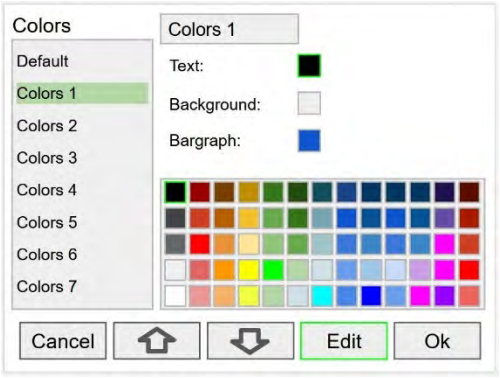


- Select a color pattern or press the Edit key to make changes to the colours' tag, text, background, and bar graph.

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

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

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

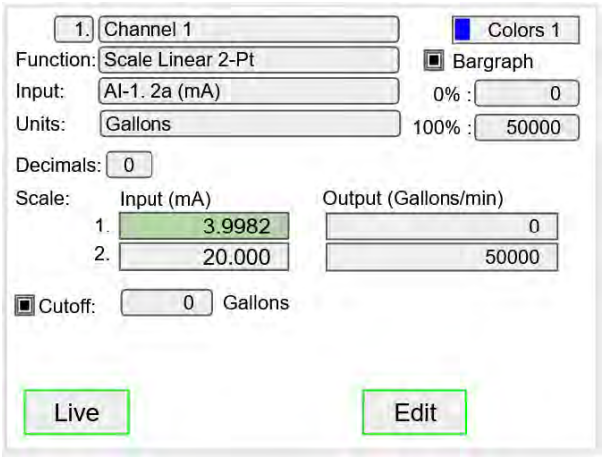


- Press Save to save the colour changes.
- Press Select to apply the colour pattern to the channel. The Manage button is used to move or delete colours.

6.9 Live Calibration

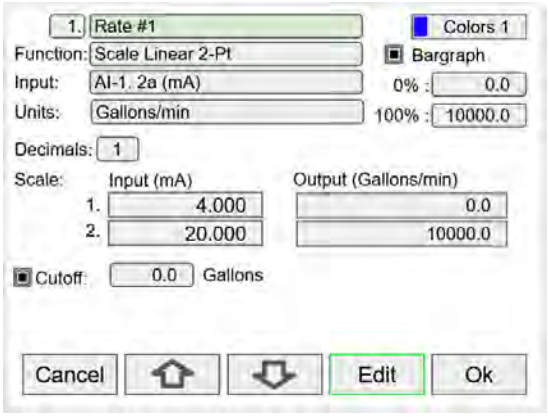
- The Live Calibration feature is used to calibrate a channel by applying a live calibration signal.
- From the Setup menu, navigate to the channel to be calibrated.
- Go to Input 1 entry box.
- Apply Input 1 signal from sensor or calibrator.
- Press & hold the Edit key and press the Live key a few time until a stable reading is displayed.
- Release the Edit key; the input 1 value has been captured.

- Repeat the steps above for the additional inputs to be calibrated.
- Adjust the output values according to the calibrated inputs.
- Press Save.

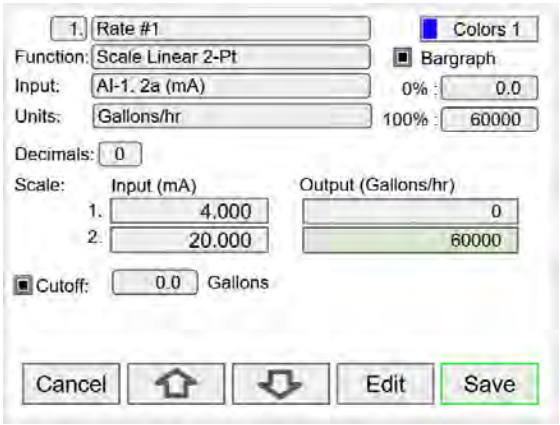


6.10 Edit Channel

- 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.

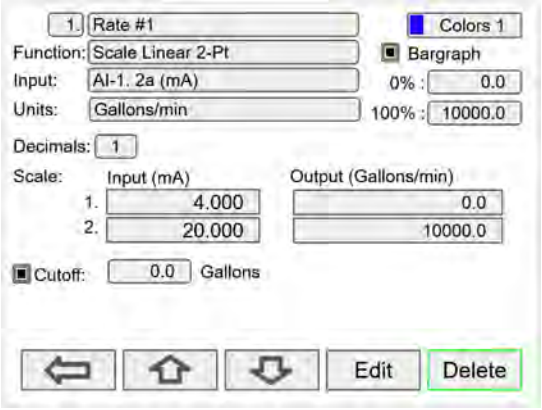


- After making all the changes, press the Save key.

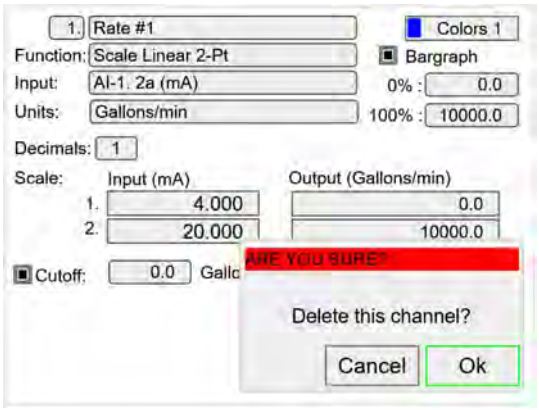


6.11 Delete Channel

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



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



6.12 2-Point Linear Scaling

- Linear mode refers to basic 2-point scaling of a 4-20mA signal in engineering units.
- The graph in figure 25 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.

Process		Scaling Parameters			
Input (mA)	Output (%)	*mA Input:*	4.000	*Low Value:*	0.00
4.00	0.00	*mA Input:*	20.000	*High Value:*	100.00
5.00	6.25				
6.00	12.50				
7.00	18.75				
8.00	25.00				
9.00	31.25				
10.00	37.50				
11.00	43.75				
12.00	50.00				
13.00	56.25				
14.00	62.50				
15.00	68.75				
16.00	75.00				
17.00	81.25				
18.00	87.50				
19.00	93.75				
20.00	100.00				

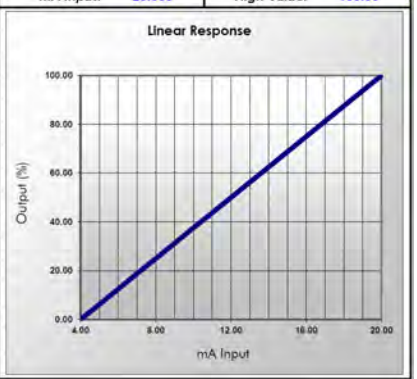


Fig 25: Linear Response Graph

6.13 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 26 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 cut-off which can be used to suppress readings below a programmed value. Below the cut-off value, the controller will display “0”.

Process		Scaling Parameters			
Input (mA)	Display (%)	*mA Input:*	4.000	*Low Value:*	0.00
4.00	0.00	*mA Input:*	20.000	*High Value:*	100.00
5.00	25.00				
6.00	35.36				
7.00	43.30				
8.00	50.00				
9.00	55.90				
10.00	61.24				
11.00	66.14				
12.00	70.71				
13.00	75.00				
14.00	79.06				
15.00	82.92				
16.00	86.60				
17.00	90.14				
18.00	93.54				
19.00	96.82				
20.00	100.00				

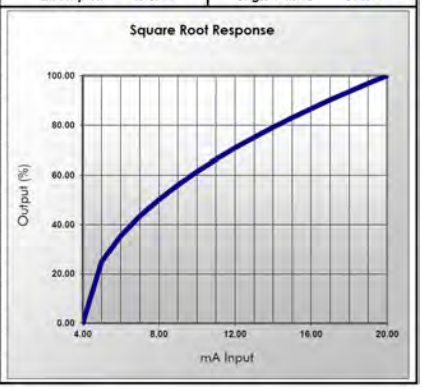


Fig 26: Square Root Response Graph

6.14 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 27 shows the display response based on example parameters and exponent of 1 ½”. For this mode select [Scale Exponent] from Function options.
- The exponent mode supports low-flow cut-off which can be used to suppress readings below a programmed value. Below the cut-off value, the controller will display “0”.

Process		Scaling Parameters				Exponent
Input (mA)	Output (%)	*mA Input:*	4.000	*Low Value:*	0.00	1.500
4.00	0.00	*mA Input:*	20.000	*High Value:*	100.00	
5.00	1.56					
6.00	4.42					
7.00	8.12					
8.00	12.50					
9.00	17.47					
10.00	22.96					
11.00	28.94					
12.00	35.36					
13.00	42.19					
14.00	49.41					
15.00	57.00					
16.00	64.95					
17.00	73.24					
18.00	81.85					
19.00	90.77					
20.00	100.00					

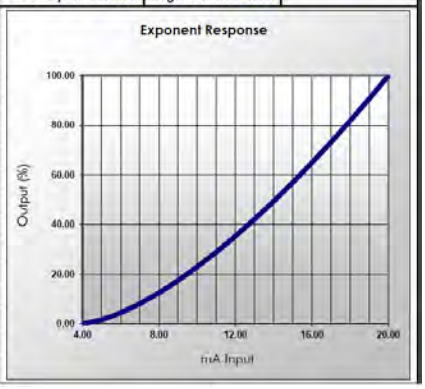


Fig 27: Exponent Response Graph

6.15 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 28 shows the display response based on tank example:
- Diameter = 48”; Length = 120”
- For this mode select [Round Horz Tank] from Function options.

Process		Parameters		Tank Dimensions
Input (Inch)	Output (US GAL)	Level Input 1: 0.00	Low Value: 0.00	Diameter: 48.0 Inch
0.00	0.00	Level Input 2: 48.00	High Value: 940.03	Length: 120.0 Inch
6.00	67.82			
12.00	183.78			
24.00	470.01			
30.00	618.05			
36.00	756.25			
42.00	872.21			
48.00	940.03			

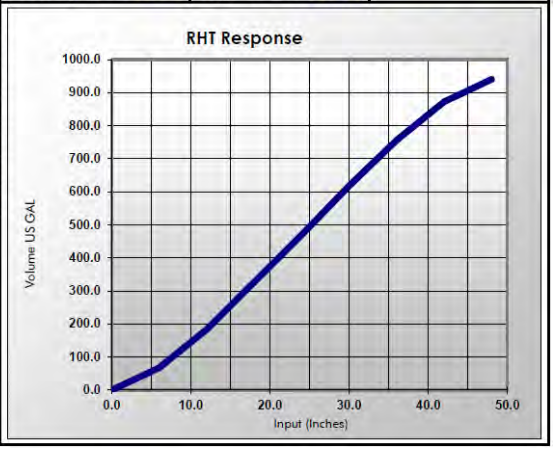


Fig 28: Round Horizontal Tank Volume Graph

6.16 Open Channel Flow Application

The Tek-LCD 7801C, 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 Tek-LCD 7801C for open channel flow applications:

6.16.1 Programmable Exponent

- In this method, all the user needs to do is enter the exponent for the weir or flume into the Tek-LCD 7801C and the controller automatically raises the input signal to that power.
- For instance, to display open channel flow rate and total from a 3” Parshall flume and take a one pint sample every 100,000 gallons, the user would program the Tek-LCD 7801C as shown in the table 2.

Table 2: 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.

6.16.2 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 Tek-LCD 7801C: Parshall Flumes, V-Notch Weirs, Cipolletti 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.

Table 3: 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; 4mA = 0 ft; 20mA = 3ft
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.

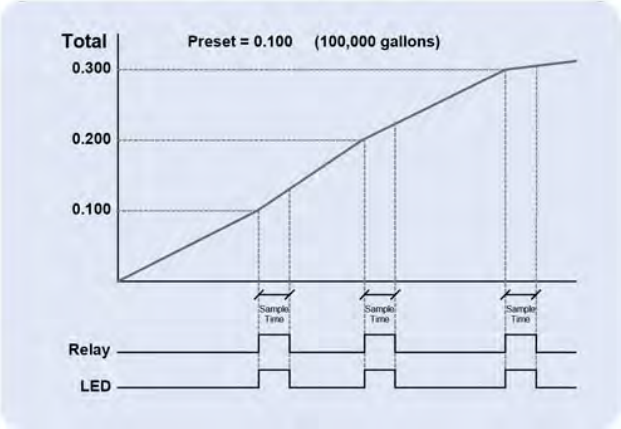
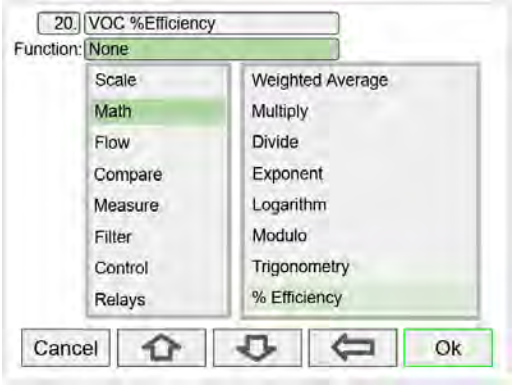


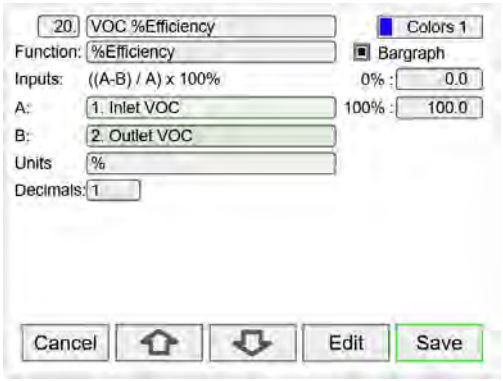
Fig 29: Total Relay Sampling Operation

6.17 Setup Math Function

- 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 as follows:
  - Constant
  - Summation
  - Difference
  - Absolute Difference
  - Absolute Value
  - Average*
  - Weighted Average
  - Multiply
  - Divide
  - Exponent
  - Logarithm
  - Modulo
  - Trigonometry
  - % Efficiency
- For Example: % Efficiency
- Select math function for % Efficiency and press Ok.



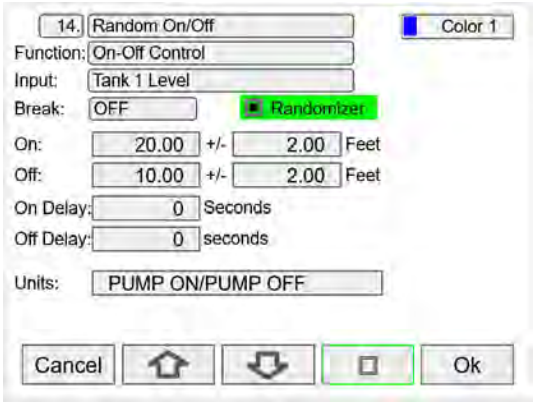
- Enter the input sources for the math function, select the units and number of decimals, and press Ok and Save.



- Additional Functions: Scale, Open Channel Flow, Compare, Measure, Filter, Control, Relays and Modbus.

6.18 Random Varying On-Off Control

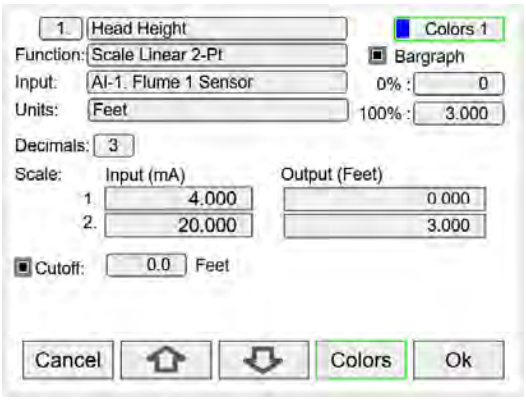
- The On-Off Control with the Randomizer function is used to prevent grease build-up in tank level control applications.
- The controller randomly varies the On and Off points within the user-selected range.
  - Create a channel.
  - Function: On-Off Control
  - Input: Level or volume channel
  - Enter On / Off points
  - Enter the allowed +/- deviations.



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

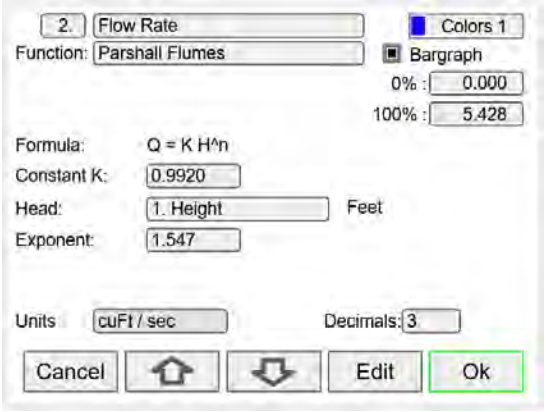
6.19 Open Channel Flow

- The built-in math formulas in the Tek-LCD 7801C 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 3ft.
- Scale the 4-20mA input.

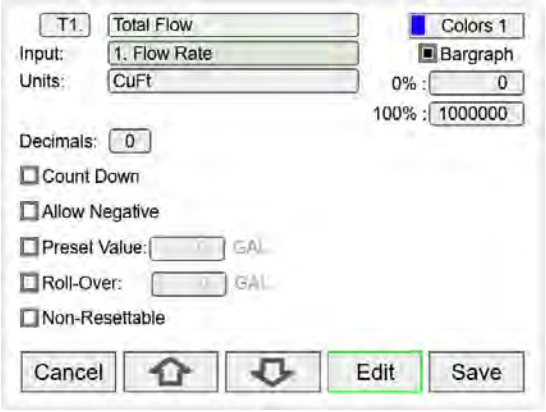


- Select the type of weir or flume installed.

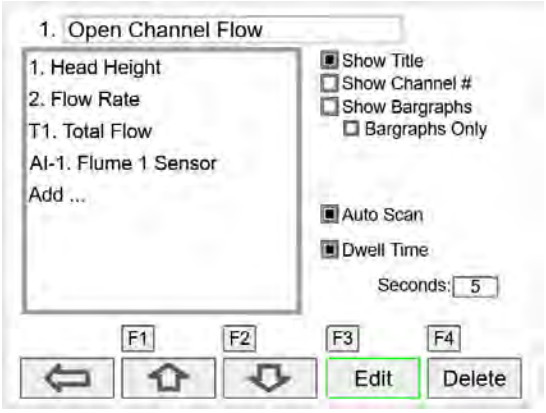
- Enter the constant K, the channel used for measuring the head height and the specified exponent.
- Select the flow rate units.
- The Controller calculates the flow rate in the specified engineering units.
- The units can be changed at any time without making any other changes.



6.20 Setup Totalizer Based on Flow Rate



6.21 Setup Screen to Monitor Open Channel Flow



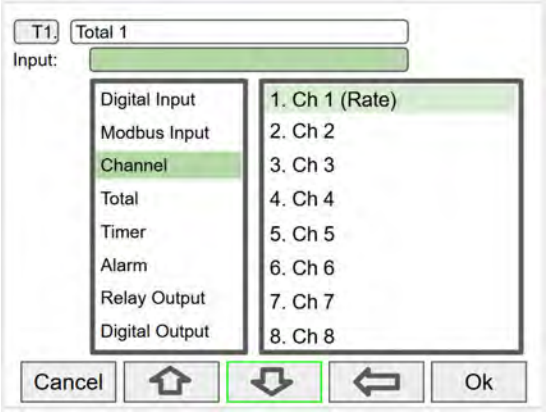
6.22 Setup Totalizer

- 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 totalized based on the pulse count and K-Factor value; this is the most accurate method because every pulse is counted.

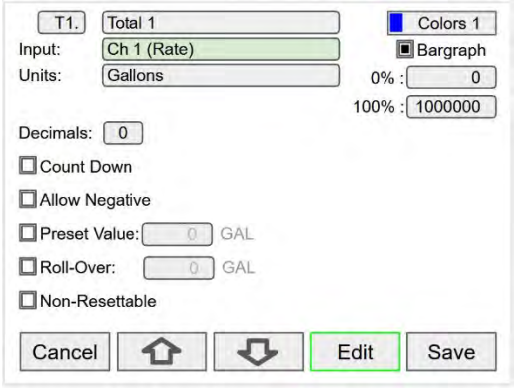
*Note: The non-resettable function can be disabled by the user at any time, after unlocking a password-protected controller.

6.23 Setup Total with Rate Source

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

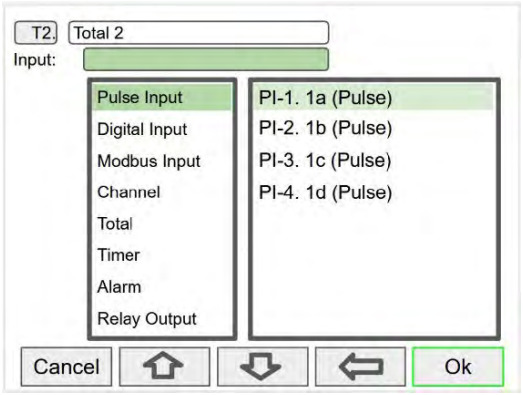


- Select total units, count up or down, enter preset and roll-over values, and select non-resettable if required.
- After pressing Save, press Yes to reset the total to the preset value.

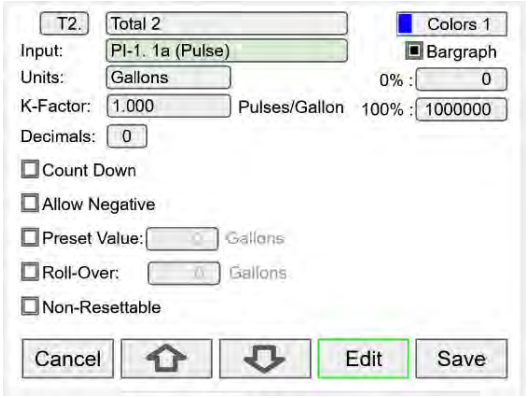


6.24 Setup Total with Pulse Input Source

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

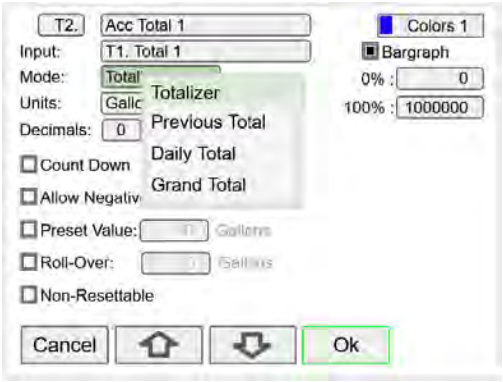


- Select the units and enter the K-Factor provided by the flow meter manufacturer.

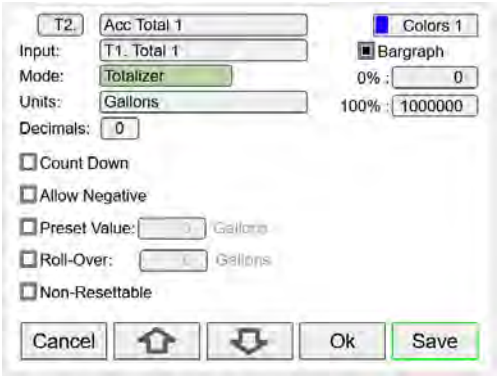


6.25 Setup Accumulated Total (Triggered)

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

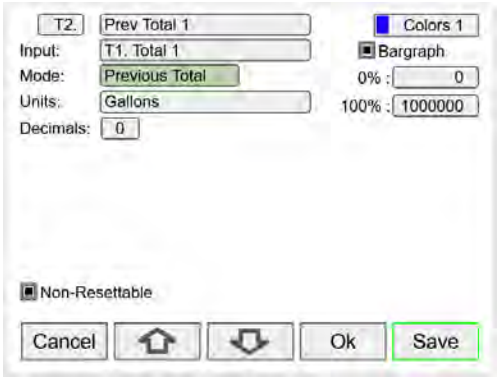


- The Totalizer mode can be used to add the input total to the new total when a trigger is activated. The trigger can be a digital input, a Modbus input, or any event selected.

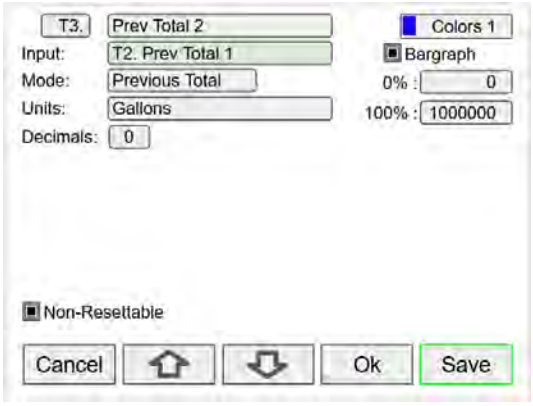


6.26 Setup Previous Total

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

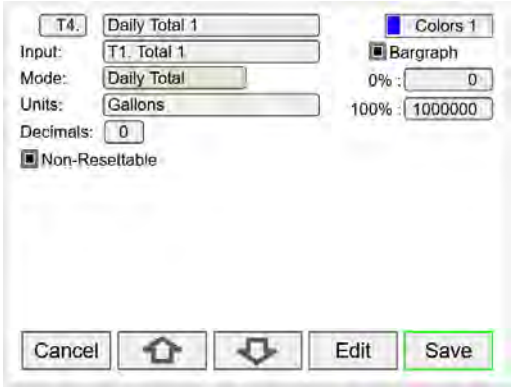


- Multiple previous totals can be saved by using a previous total as the input for a new total. Link previous totals to maintain a history of total resets.

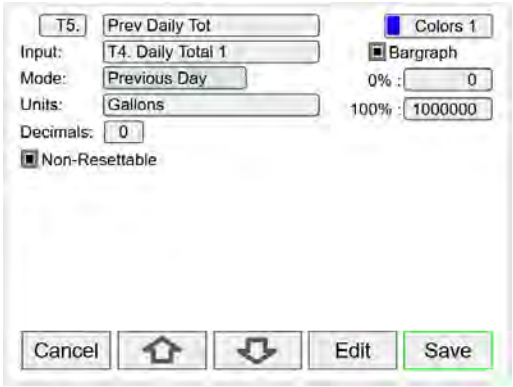


6.27 Setup Daily Total

- The daily total is automatically reset every day at midnight.

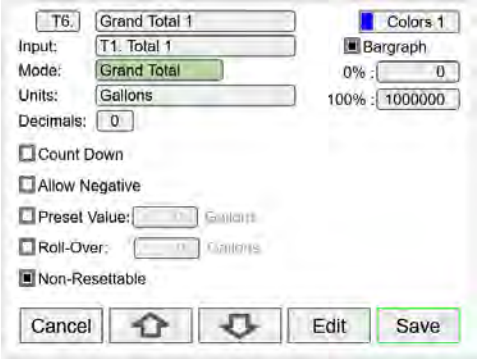


- The daily total can be the input to a previous total to save the previous day total. Link previous daily totals to maintain a history of daily totals.



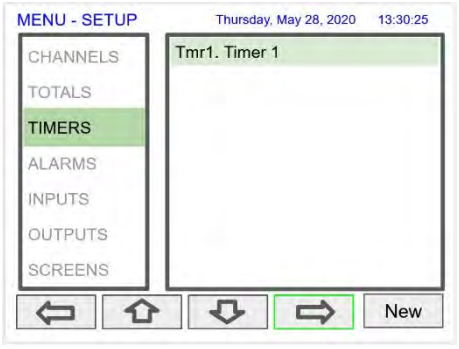
6.28 Setup Grand Total

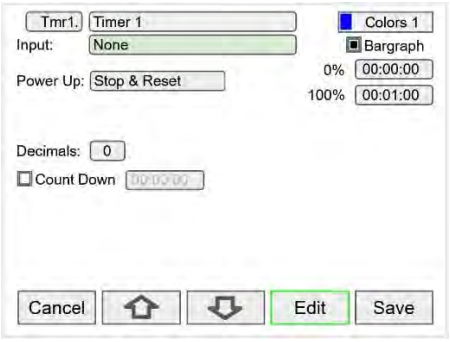
- The grand total takes the input from another total, and it is not affected by resets of the input total. It is normally set up as non-resettable.



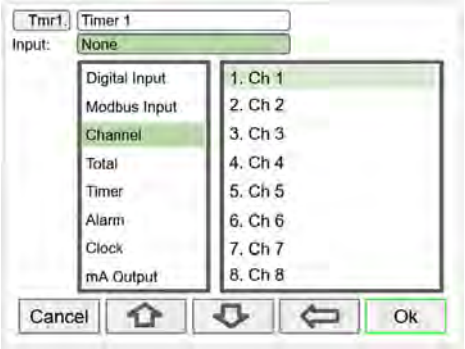
6.29 Setup Timers

- 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.





- Additional Inputs to control the timer: mA Input, Relay Output, Pulse Input, Digital Output Modbus Output



6.30 Timer Automatic Actions

The automatic timer actions are:

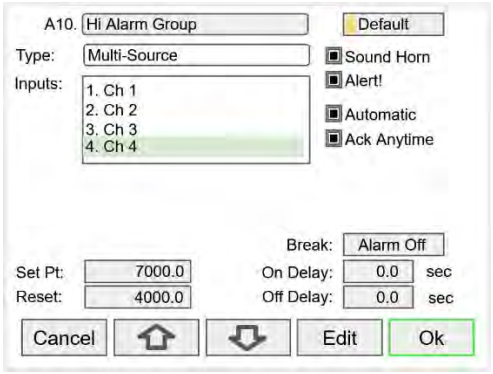
- Power Up: Timer action on power up
- Error: Timer action when an error is detected
- Reset: Event that causes the timer to reset
- Start: Event that triggers the timer to start
- Stop: Event that causes the timer to stop

- **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 Bar Graph**
  The bar graph scaling follows the time format selected based on decimal point.
- **Timer Colours**
  Select the colours 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.

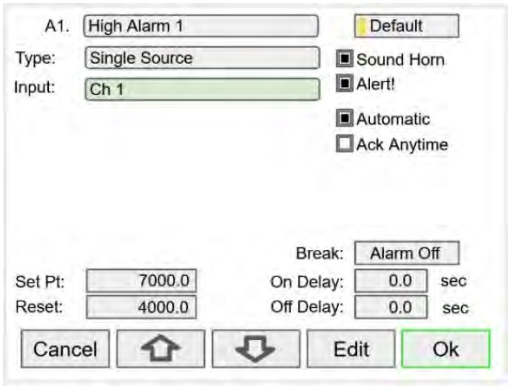
6.31 Setup Alarms

- 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. Colours: 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.

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



- Automatic only: Alarm resets automatically at the reset point.



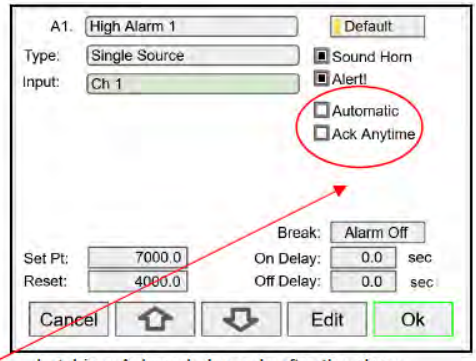
Multi-Source Alarm
This alarm type behaves as a logic OR; if any of the sources crosses the set point, the alarm goes on.

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

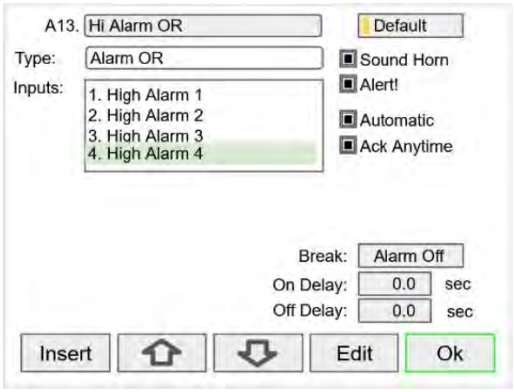


Latching: Acknowledge only after the alarm condition has cleared

Manual Ack (Latching): Select Ack Anytime only

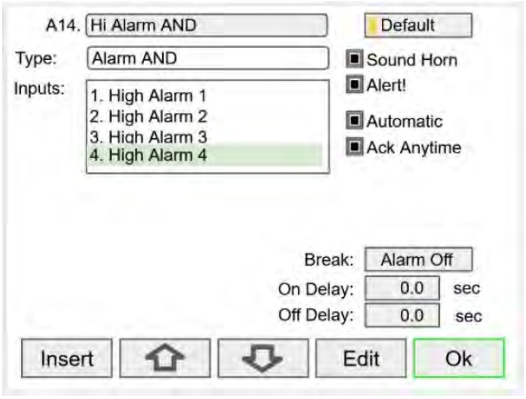
6.32 Logic OR Alarm

- 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.



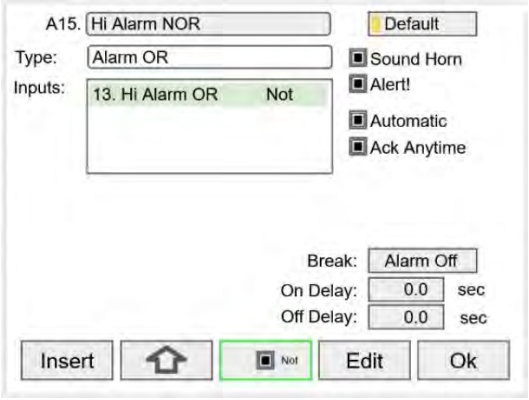
6.33 Logic AND Alarm

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.



6.34 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 inversed (Not) to create a specialized alarm logic.

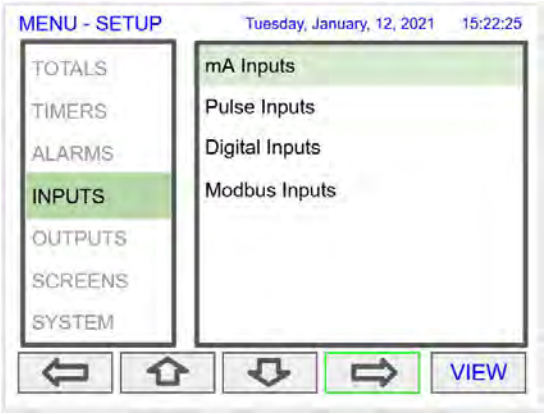


6.35 Day & Time Alarms

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.

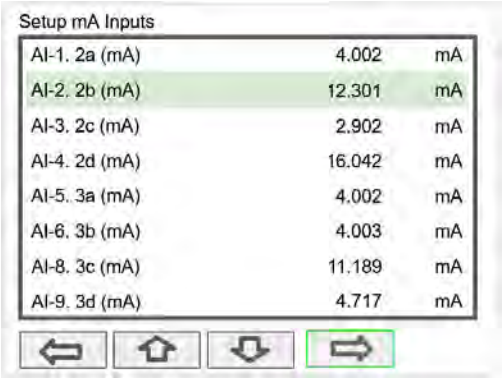
6.36 Setup Inputs

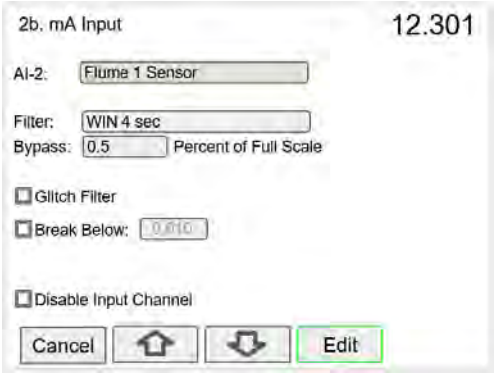
The Setup Inputs screen is used to configure the hardware inputs, assigning a user-defined tag, and setting the filter values.



6.37 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.



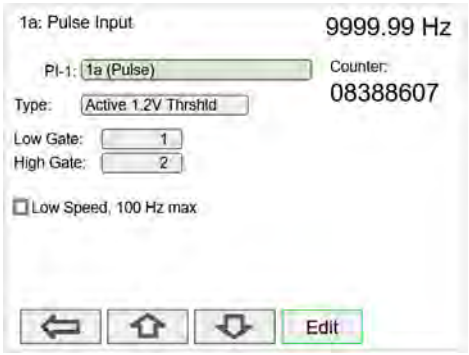


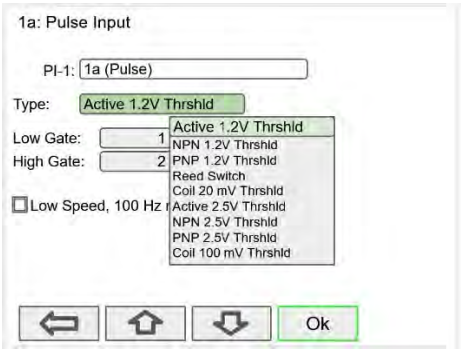
- The top line, for each input, shows the slot # and input location (2b = slot #2, second input from the left). It also shows the actual current input.
- The next line shows the input type and # (AI-2) with the default tag, which can be changed at any time.
    - Filter*: Select filter time.
    - Bypass: 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.

*Note: For more filtering: If you need a more stable reading, select IIR 16 sec or IIR32 sec setting.

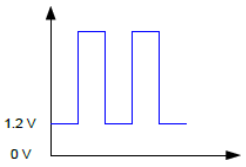
6.38 Setup Pulse Inputs

- 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.



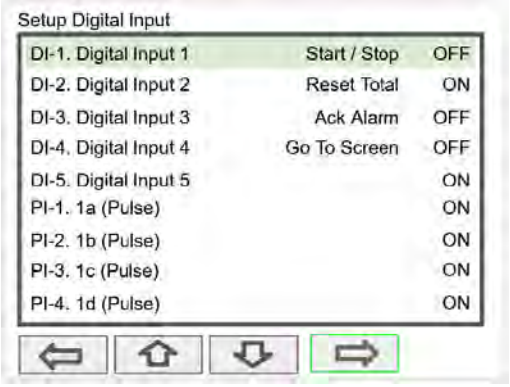


*Note: Threshold is the voltage level at which a transition from high to low is detected. For example, the "Active 1.2V Thrshld" setting will detect a square wave signal when it falls below 1.2 V.



6.39 Setup Digital Inputs

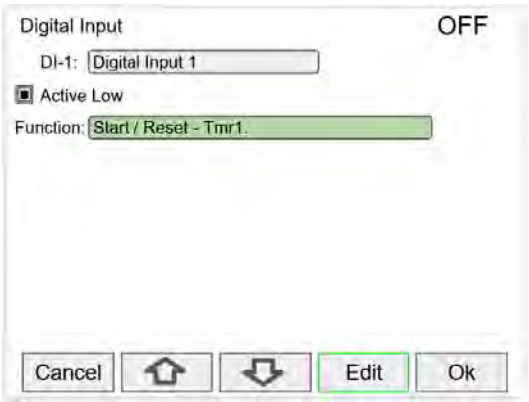
- The digital inputs can be assigned to perform various user functions, such as trigger alarm, acknowledge alarms, reset total, etc.
- Pulse inputs can be used as digital inputs by setting them up according to the type of input they are intended to accept. For example, to accept a contact closure the pulse input must be setup for Reed Switch type input.



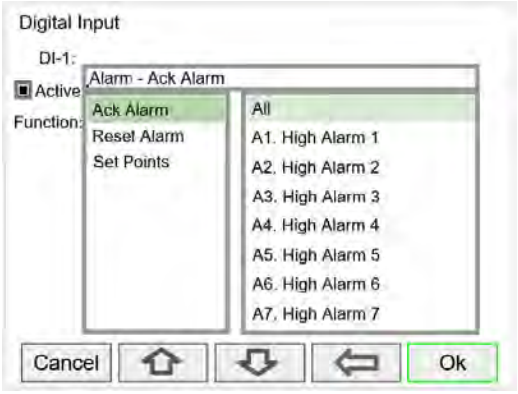
6.39.1 Digital Input Functions

- 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



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



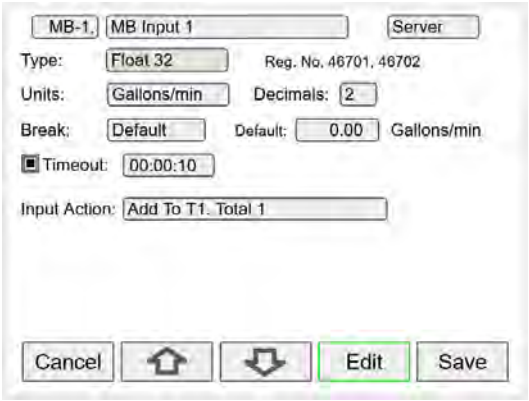
6.40 Modbus Functionality

- The Tek-LCD 7801C supports Modbus RTU, Modbus ASCII, Enron Modbus, and Ethernet Modbus TCP/IP. The Server mode is a standard Tek-LCD 7801C 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 Spoofer 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.

6.41 Setup Modbus Inputs (Server)

The Modbus Server mode is a standard 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)

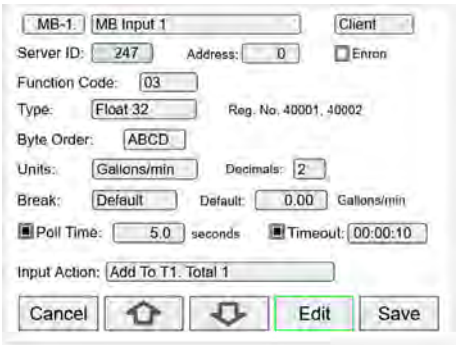


- **Data Types**
  - Bit – Logic (Coil)
  - Signed/Unsigned 16 (Short), 32 (Long), 64 (Long Long)
  - Float 32, Float 64 (Double)

6.42 Setup Modbus Inputs (Client)

The Modbus Client mode is an option in the Tek-LCD 7801C. 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)



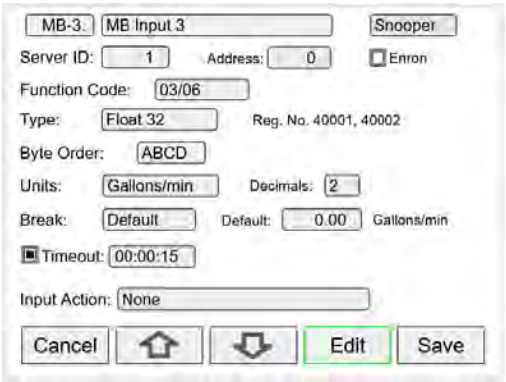
- **Data Types**
  - Bit – Logic (Coil)
  - Signed/Unsigned 16 (Short)
  - 32 (Long), 64 (Long Long)
  - Float 32, Float 64 (Double)

*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.

6.43 Setup Modbus Inputs (Snooper)

The Modbus Snooper mode is part of the Modbus Client Add-On Features option in the Tek-LCD 7801C. 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)



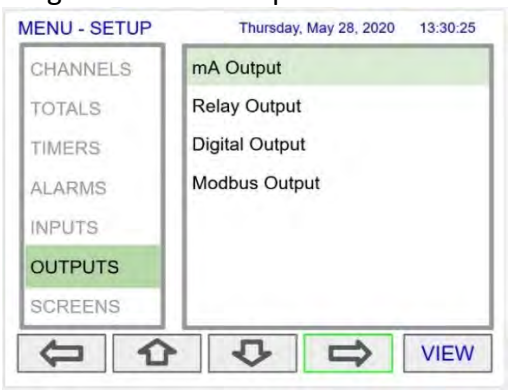
- **Data Types**
  - Bit – Logic (Coil)
  - Signed/Unsigned 16 (Short)
  - 32 (Long), 64 (Long Long)
  - Float 32, Float 64 (Double)

*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.

6.44 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

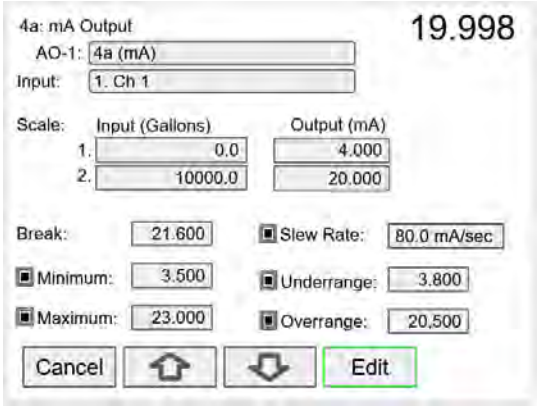


6.45 Setup 4-20 mA Outputs

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.

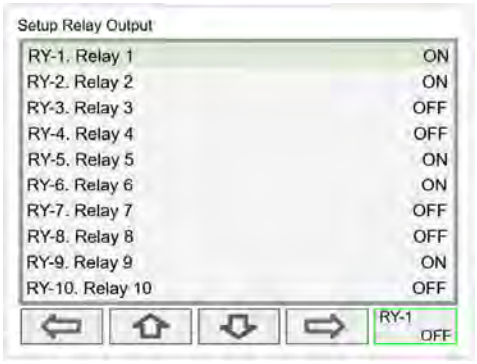
The top line indicates the slot # and position of the analog output (4a = slot #4, first position from the left). It also displays the actual mA output.

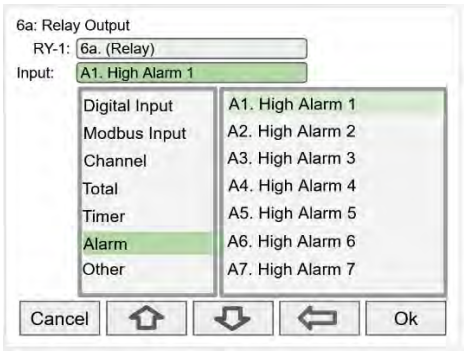
- AO-1: Analog output 1
- Input: Select source for the mA output
- Scale: Enter input and output values
- Break: mA output when sensor or communications break is detected
- Minimum: The minimum output allowed
- Maximum: The maximum output allowed
- Slew Rate: Rate of change in mA/sec
- Underrange: mA 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%.



6.46 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
- 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.

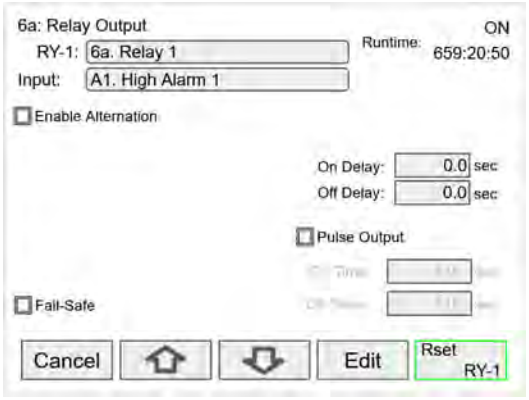




*Note: Function: Select Other to set relay to always on, always off, drive a relay-horn, or to alternate with another relay.

6.47 Relay Assigned to Alarm

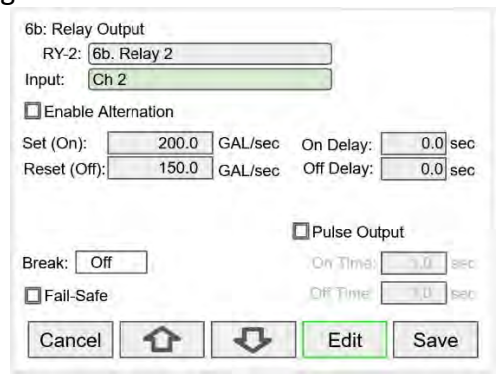
The relay runtime & cycle count can be reset (cleared) from the relay setup screen.



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

6.48 Relay Assigned to Channel

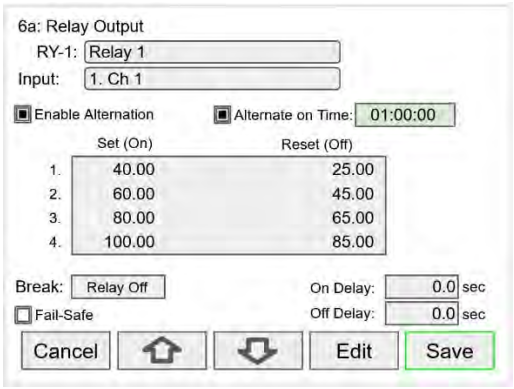
Relays not assigned to alarms are used for automatic on/off control based on set & reset point; they cannot be acknowledged.



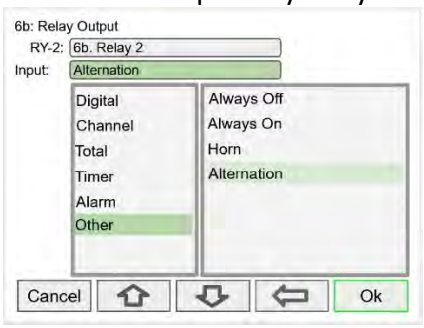
6.49 Pump Alternation Relays

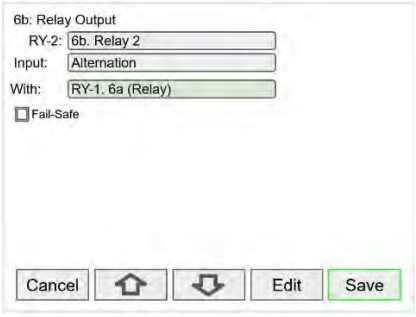
To setup a group of relays for pump alternation control, follow these steps.

1. Select the primary alternating relay



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





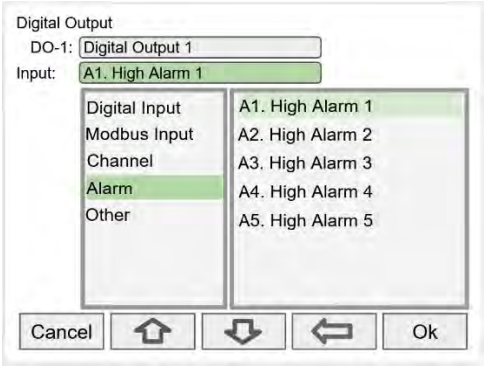
Setup the additional alternation relays. Select the primary relay to alternate with.

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

6.50 Setup Digital Output

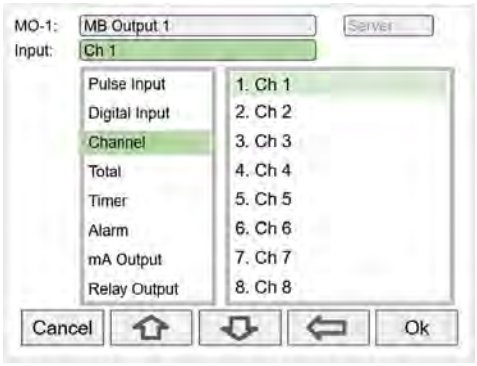
The Digital Output menu allows assigning the 4 outputs to various events generated by digital inputs, On/Off channels, alarms, and horn on state.

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

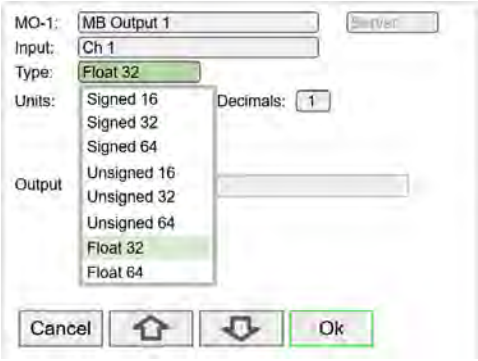


6.51 Setup Modbus Output (Server)

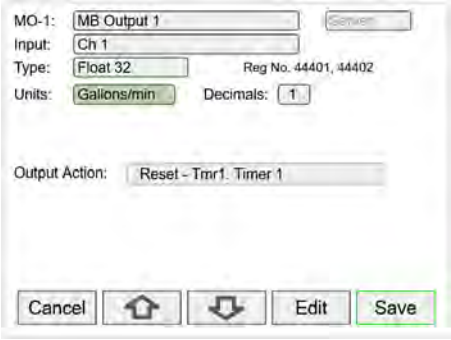
- The Modbus output is a standard Tek-LCD 7801C feature; this is additional to the predetermined Modbus table provided, see Modbus Register Tables.
- The Modbus Output menu allows assigning up to 99 Modbus register sets (1 to 4) to output any of the values available in the system (e.g. PV channels, Totals, 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 below: mA Input, Digital Output.



- Select the data type.

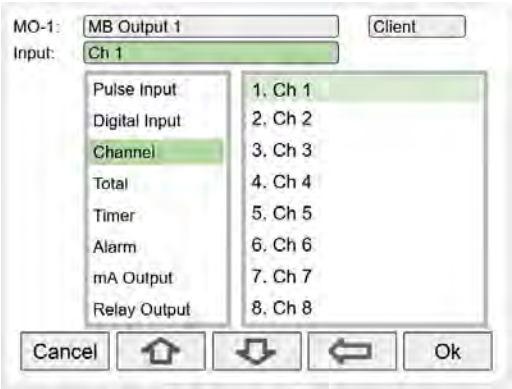


- The register number is provided for each data type.

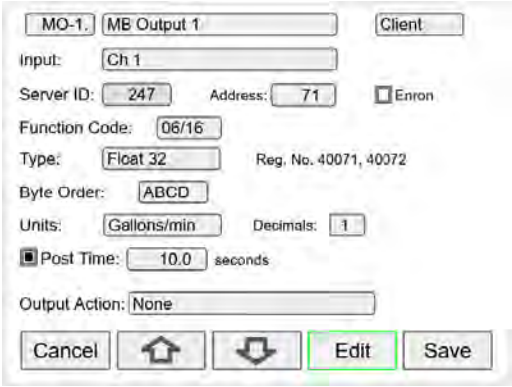


6.52 Setup Modbus Output (Client)

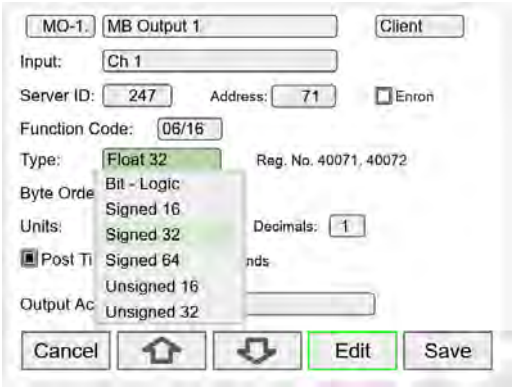
- The Modbus outputs from a Tek-LCD 7801C Client can be written to Modbus servers or they can be read using the Ethernet TCP/IP port. The outputs are posted periodically on a schedule or on demand by triggering a user function (e.g., F1 function: Output (Post) - MO-1).
- Process variables can be read by the Client, scaled, combined with other variables using the math functions, and the results can be written to another Tek-LCD 7801C 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



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



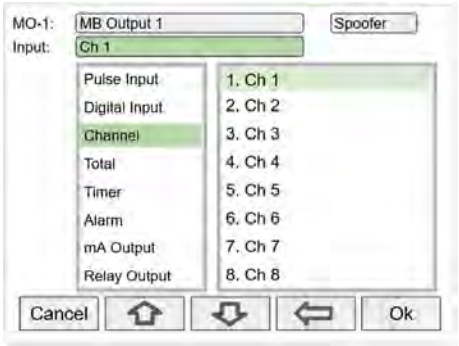
- The data type must match the type required by the server device; otherwise, the value will not be correct.



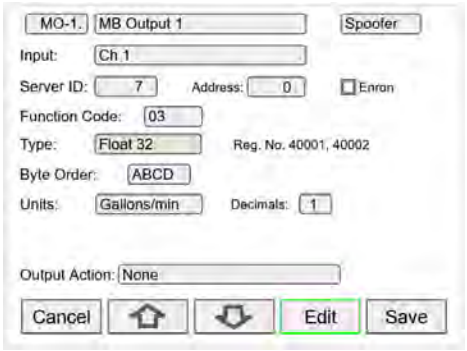
  - Server ID
  - Register Address (Base 0)
  - Select Enron, if applicable
  - Function Code
  - Data Type – Reg. No. displayed automatically
  - Byte Order
  - Engineering Units and decimals to be used
  - Post Time: How often to write to the server
  - Output Action: Select from many actions available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

6.53 Setup Modbus Output (Spoofer)

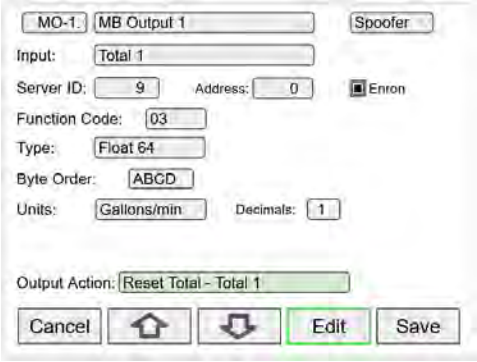
- The Modbus Spoofer feature is part of the Modbus Client/Snooper add-on feature. To enable this feature, you must purchase a Tek-LCD 7801C-M1 and enter the key in the System – General menu. The controller must be configured as a Modbus Server/Snooper in the System – Modbus menu. See page 67 for instructions on how to enable the Add-On Features.
- The Spoofer 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.



6.54 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.

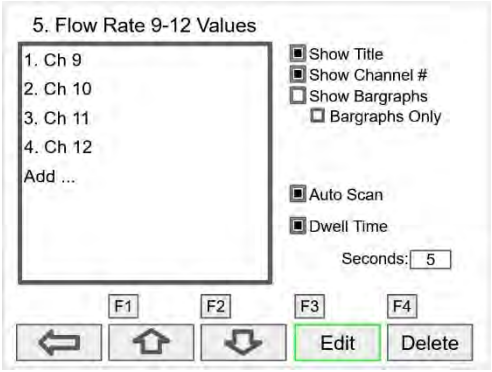
6.54.1 Screens Settings

Up to eight PVs and/or alarms can be displayed per screen. The screens can be setup to scan automatically, display bar graphs, 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

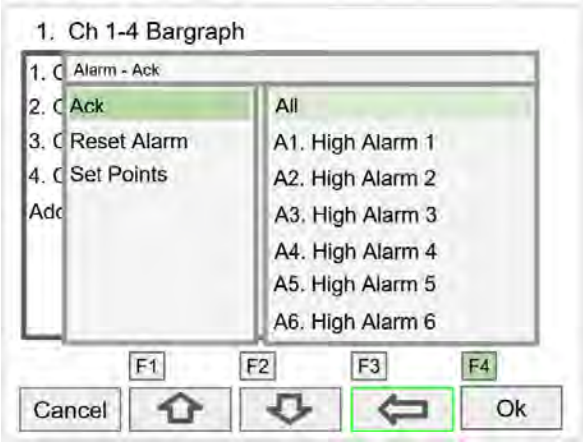
- Show Channel #: Select to display the channel #
- Show Bar Graphs: Select to display the bar graphs
- Bar Graph Only: Select to display only the bar graphs
- Auto Scan: Select to scan the screens automatically
- Dwell Time: Number of seconds the screen is displayed before moving to the next screen
- 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.

6.55 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.
- F4 Assigned to Acknowledge All Alarms



You can setup following functions keys:

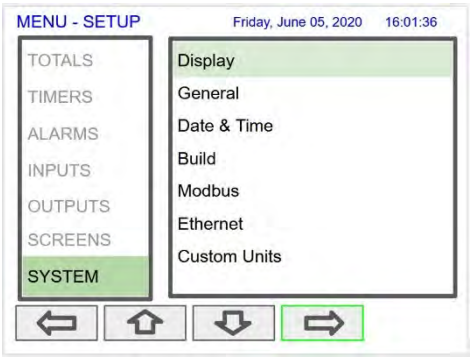
- Channel
- Total
- Timer
- Alarm
- Screens
- Simulate
- Horn
- mA Output
- Relay

6.56 Setup System

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

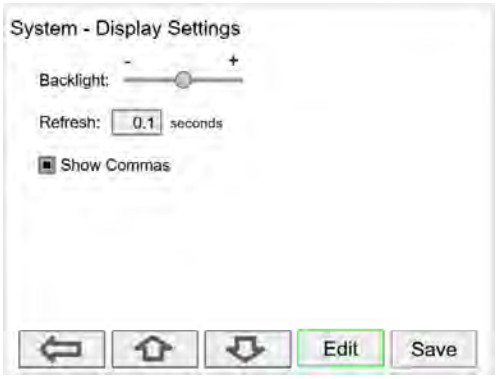
6.56.1 Setup Display

The System Display menu is used to adjust the display settings, setup colours for parameters, bar graphs, and alarms.



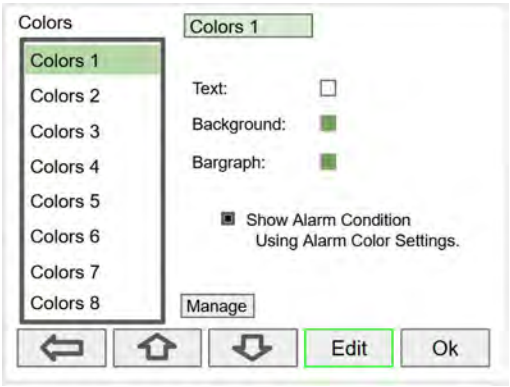
6.56.1.1 *Display Setting*

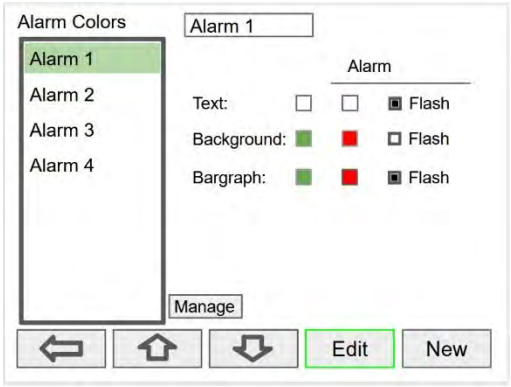
The Display Settings menu is used to adjust the backlight brightness, refresh rate and to enable or disable the display of commas for all numeric values.



6.56.2 Setup Colours

- The Colours menu is used to select the colours for text, values, and bar graphs associated with the parameter being displayed.
- The Alarm Colours menu is used to select the colours and behaviour of the alarms' text, alarm panel background, and the bar graph indicator for set and reset points.

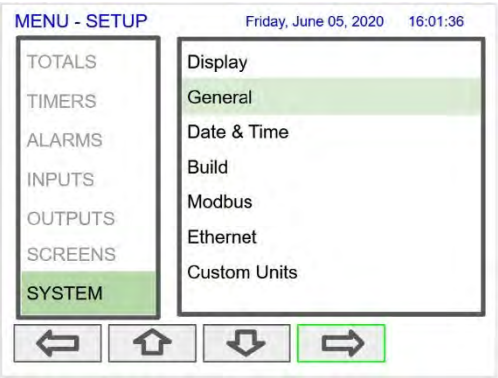




6.57 General Setting

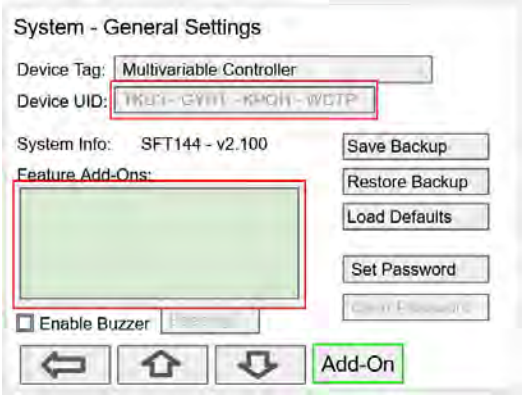
The General Settings menu contains the settings listed below.

- 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



6.57.1 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: 7801C-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 alpha-numeric key received
  7. The added feature will be displayed in this window. Press any arrow to move to other settings or exit.

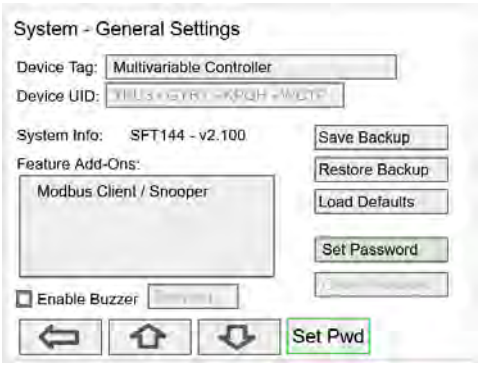


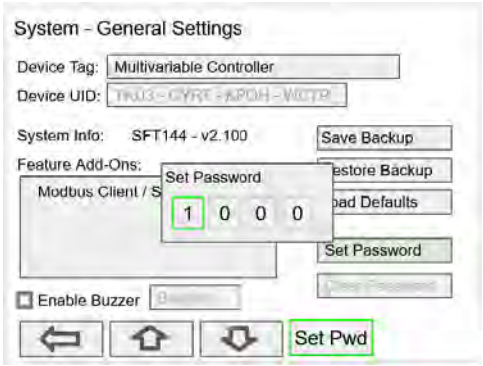
6.58 Set Password

CAUTION

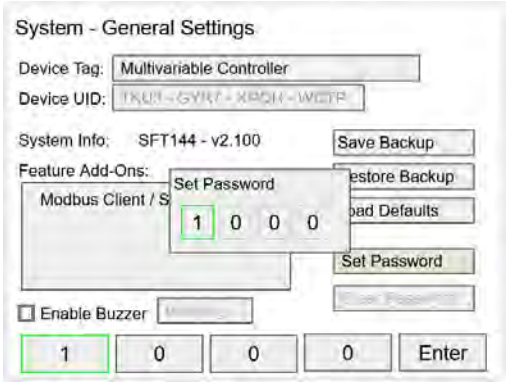
The function keys and the digital inputs are not password protected.

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





- **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:

  a. Enter the correct password
  b. Go to the System menu – General Settings
  c. Navigate to the Clear Password button
  d. Press the Clr Pwd key

6.59 System Date & Time

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

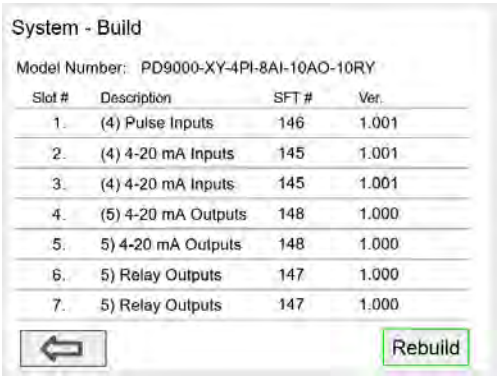
6.60 System Build

- 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:

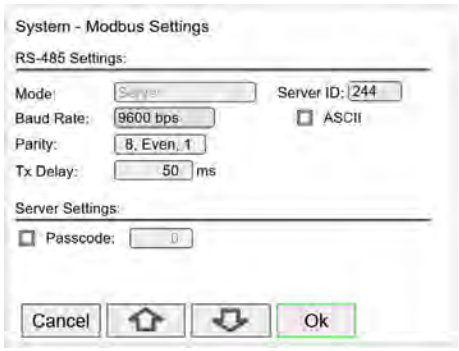
i. Save a backup copy of the configuration
ii. Remove the defective card
iii. Install the new card in the same slot where the defective card was.
iv. It is not necessary to press Rebuild.



6.61 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.

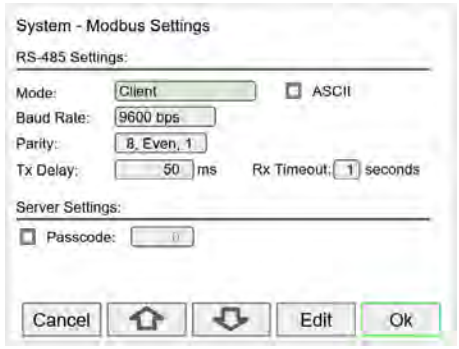


*Note: The Modbus passcode is different than the main password used to protect access to the Setup and View menus.

6.62 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.

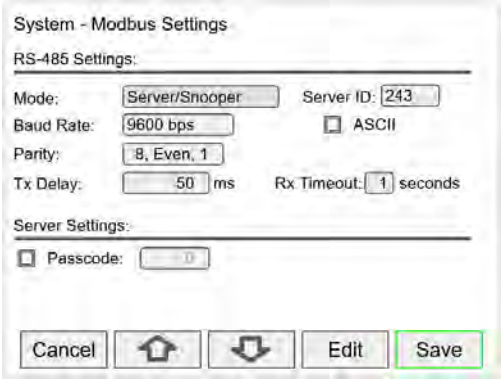


*Note: The Modbus passcode is different than the main password used to protect access to the Setup and View menus.

6.63 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.

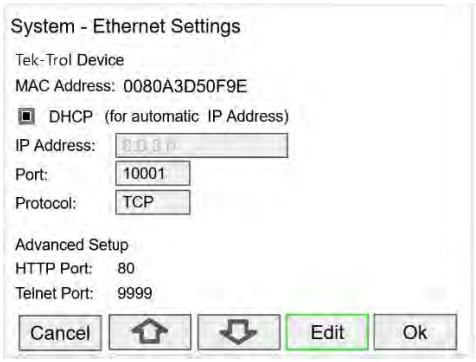
- Modbus Write Protection
  Select Passcode and enter a Modbus passcode between 0 and 9999 to prevent unauthorized writes to the controller.



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

6.64 Ethernet Settings

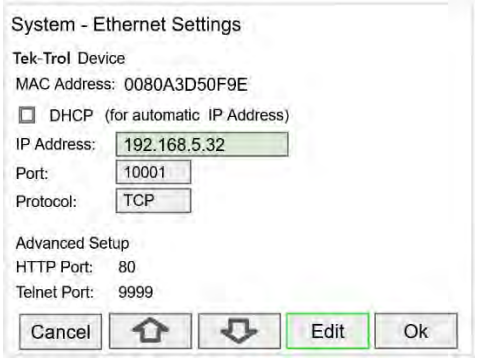
- The Ethernet menu provides basic information about the Ethernet port and allows the user to program a static IP Address, the port number, and the protocol to be used.
- The settings provided in the System menu are sufficient to establish Ethernet communications using the TCP or UDP protocols.
- For more advanced setup, refer to the instructions provided under Ethernet Port Setup.
- 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.



*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.

6.65 Manually Assigned IP Address

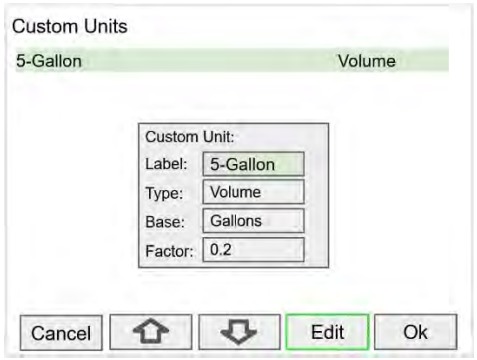
- To assign a static IP address, you must obtain it from your network administrator.
- Uncheck the DHCP box and enter the IP Address.
- Port: Do not change unless directed by IT administrator
- Protocol: Select TCP or UDP
- Advanced Setup settings is for information only.
- For complete setup of the Ethernet port, follow the instructions below.



6.66 Custom Units

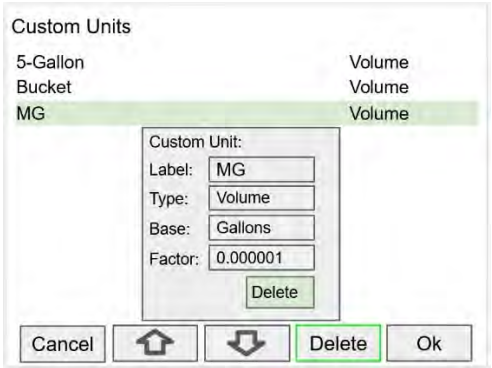
Custom units can be created either in the System menu or when a parameter is created in the Setup - Channels menu. Follow these steps to create a custom unit:

- 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



6.66.1 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.



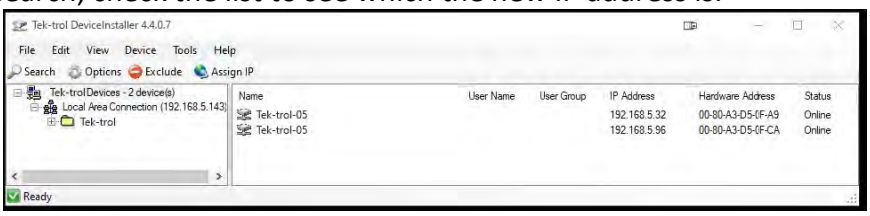
7 Ethernet Full Port Setup

CAUTION

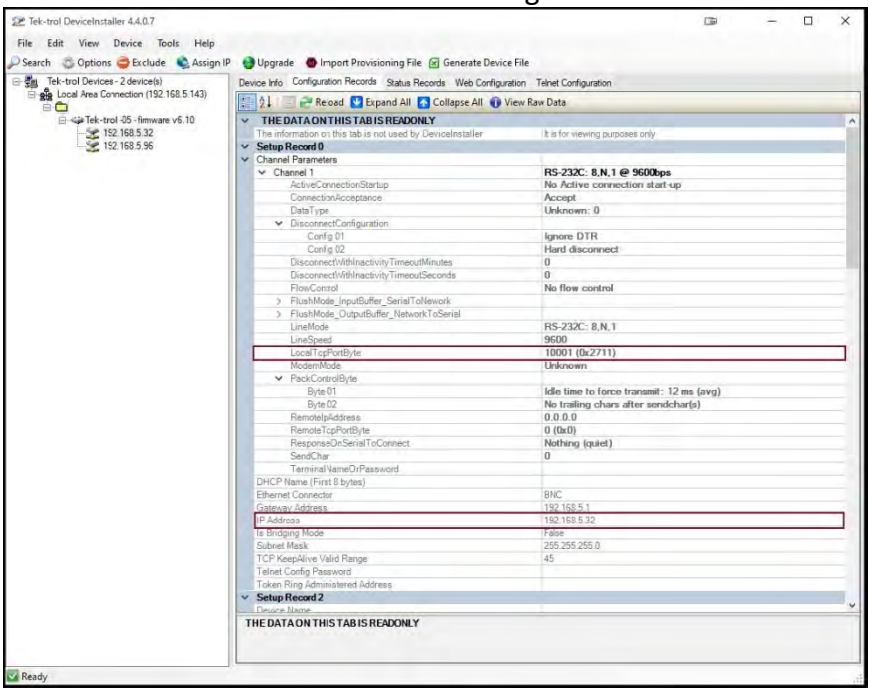
Consult with your IT department to configure the Ethernet port and maintain network security.

The Ethernet port option is fully configured using the Tek-Trol DeviceInstaller software, available for download from the Tek-Trol's Website. https://www.Tek-Trol.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 Tek-Trol DeviceInstaller; it will search for XPort devices on the Local Area Network (LAN) and display their status.
3. If no controller is found, click on Options, and select the type of connection being used (e.g. Wi-Fi).
4. If more than one controller is connected to the network, determine which is the new controller by the assigned IP address. If necessary, disconnect the new controller and click Device – Search, take note of the IP addresses listed. Next, connect the new controller to the LAN and repeat the search; check the list to see which the new IP address is.

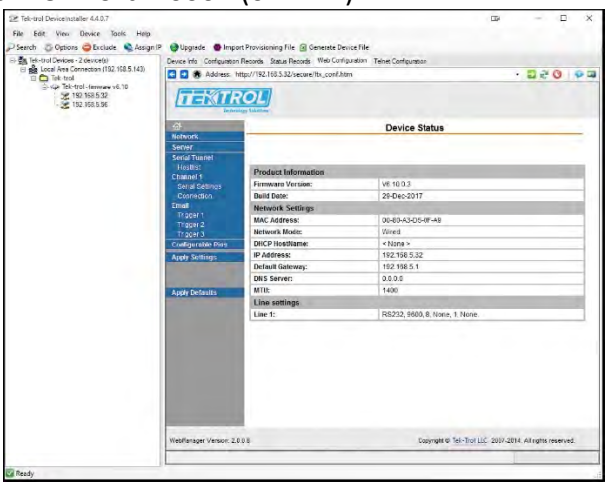


5. Double-click on the new device IP Address to be configured.

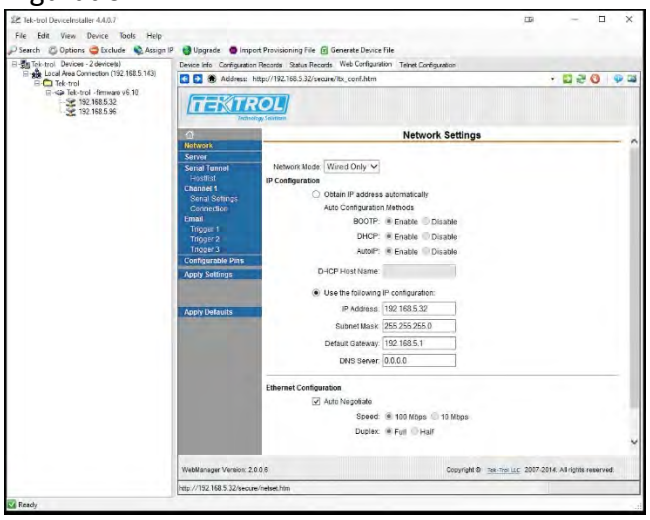


To communicate with a device connected over a LAN, you need the IP Address and the Local TCP Port.

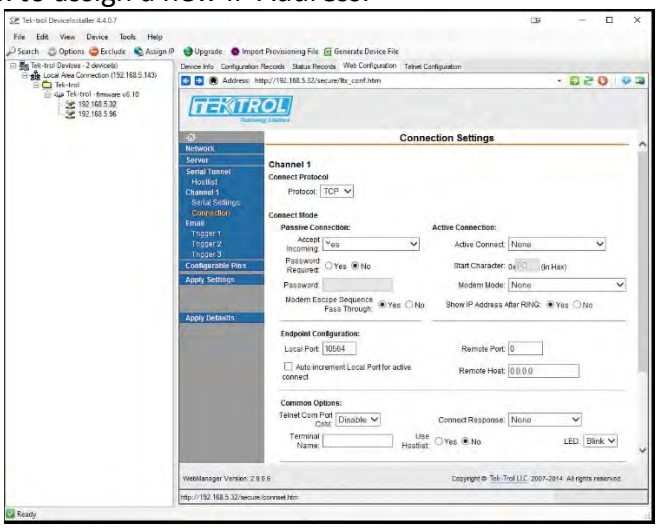
6. Click on Configuration Records to find these settings, see the example above. IP Address: 192.168.5.32; Local TCP Port: 10001 (0x2711).



7. Click on Web Configuration.



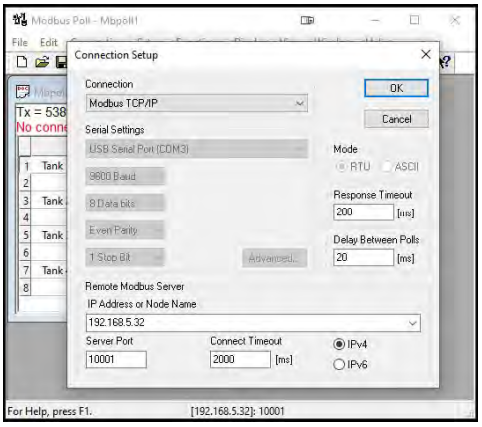
8. Click on Network to assign a new IP Address.

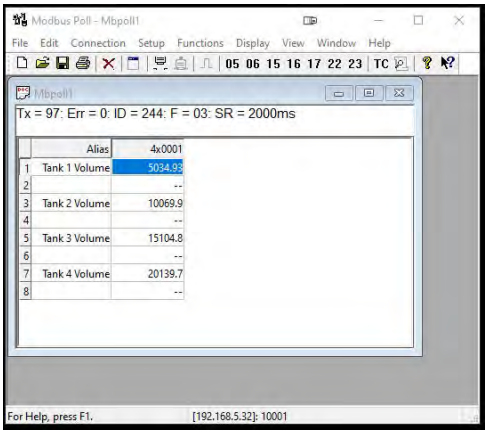


9. Click on Channel 1 – Connection to select the protocol: TCP or UDP. Note: For UDP protocol, select Datagram Type: 01
10. Under Endpoint Configuration, enter the Local Port to be used to access the controller locally or from a remote location. This should be provided by your company's IT department.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

7.1 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/

8 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.

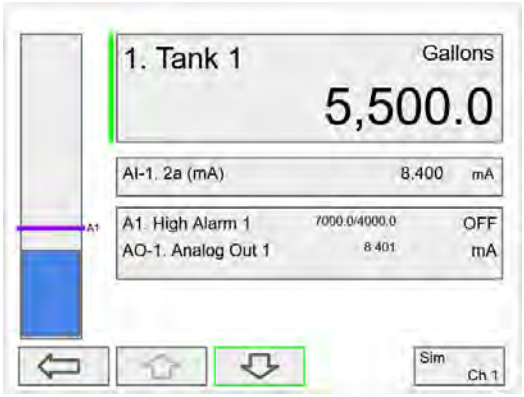
- Select any channel using the Up or Down Arrow keys

- Press the Right Arrow key again to step into viewing the channel details.

8.1 View Channel Details

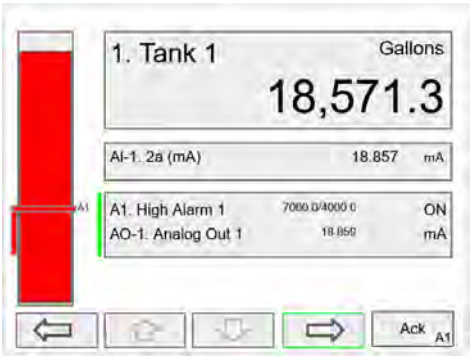
- Stepping into a channel allows the viewing of additional details for the inputs and outputs associated with that channel. It is also possible to simulate the selected parameter.
  - Channel number and tag
  - PV and units
  - View the channel input source
  - View alarms associated with channel
  - View analog outputs assigned to channel
  - Simulate the channel or analog input
  - Step into any associated parameter

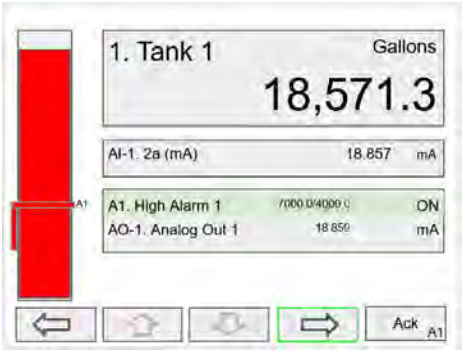
- Press the Down Arrow key to navigate to the channel input source and then down again to view alarms and analog outputs.



8.2 View Associated Parameters

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



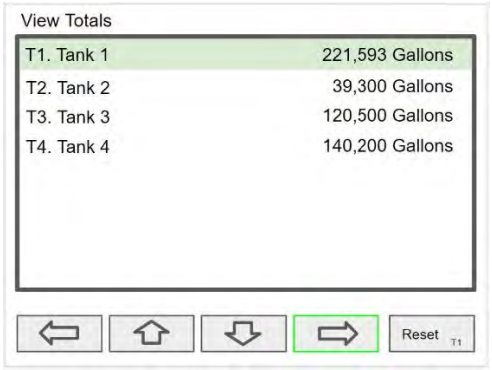


8.3 View Alarm Details

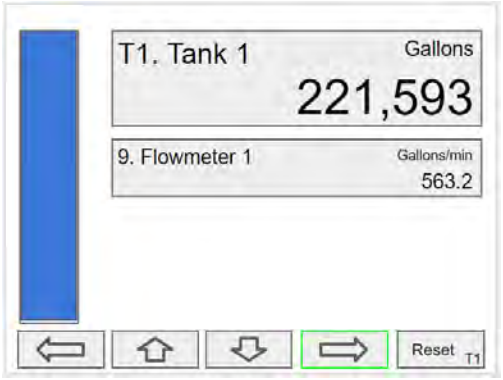
- Press the 3-Bar key to access the available options.
- Alarm view options: acknowledge alarm, reset alarm, change set/reset points, and simulate an alarm condition.

8.4 View Totals

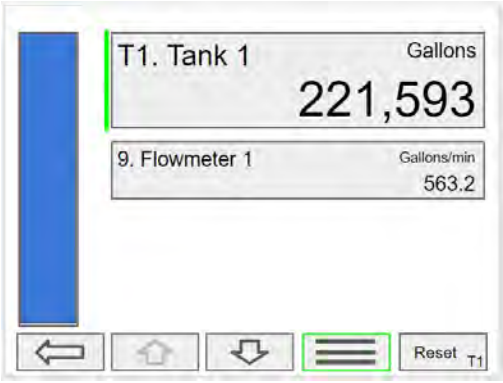
- The View Totals menu displays the value of all the totals and allows resetting each total individually.
  - Total number and tag
  - Accumulated total and units
  - Reset total key
  - View source for total
  - View alarms associated with total
  - View analog outputs assigned to total
- Press Right Arrow key to step into details of the selected total and view the source and associated outputs.



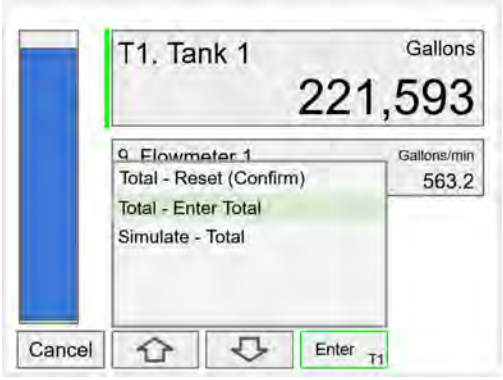
- Press the Right Arrow key to select Total 1.



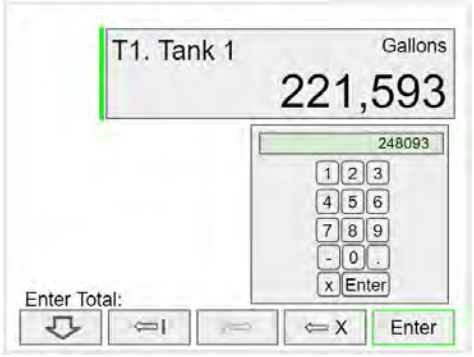
- Press the 3-Bar key to enter a new total, reset the total, or simulate a value for the total.
- Totals not associated with a rate channel have additional features: Add to or remove from the total.



- Press the Enter key to enter a new total.



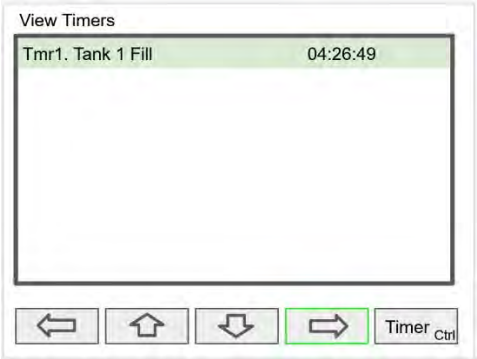
- Using the numbers keypad, enter a new total and then press the Enter key to save.



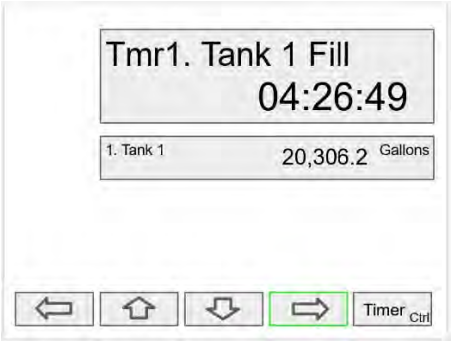
8.5 View Timers

- 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.

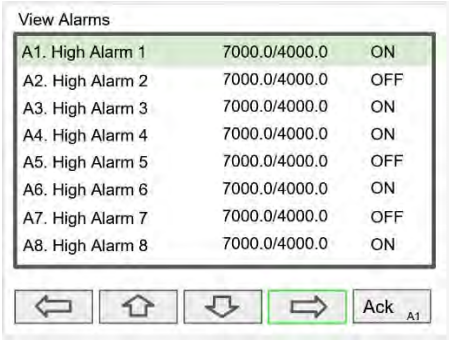
- Press the Reset key to reset the timer, select Timer Control for additional functions. Use the Simulate function to simulate the timer rising, falling, or jump to a specific value using the keypad.

- Press the Timer Control key (shown in the timer details screen) to access all timer control buttons.

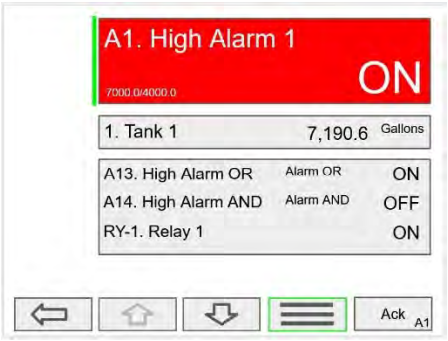
8.6 View Alarms

- 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

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

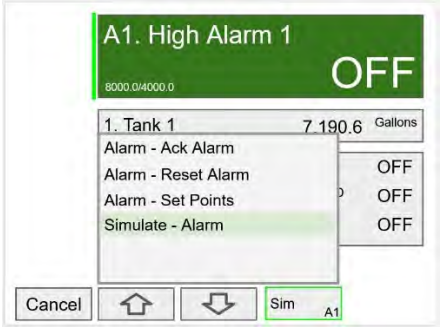


- Press the 3-Bar key to select Ack Alarm, Reset Alarm, change Set Points, or Simulate Alarm condition.



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

- Press the Simulate key to simulate an alarm condition.



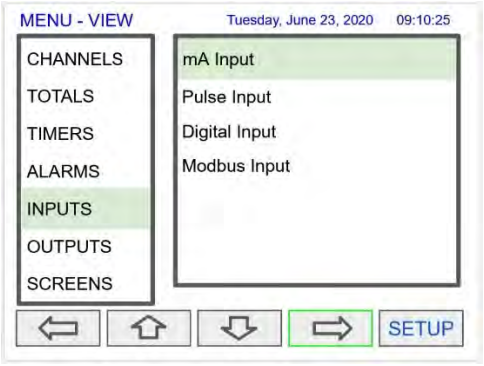
- Press the + key to turn on the alarm; note that alarm 13 and relay 1 also turned on. Press Ok key to maintain simulation or press Real to cancel simulation.

8.7 View Inputs

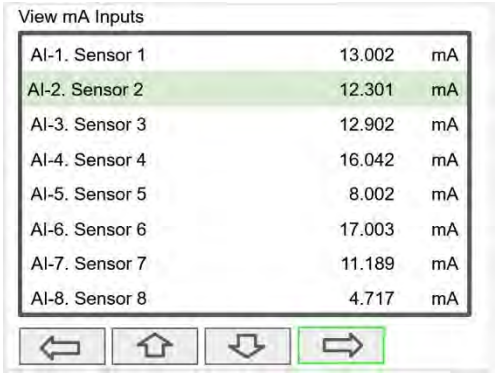
CAUTION

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

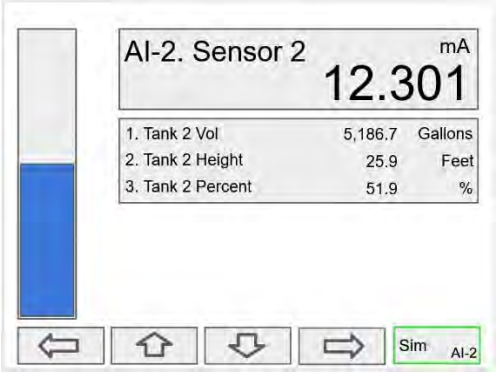
- The View Inputs menu displays the values and status of all the inputs and the details of the associated channels. Input simulation is also available in the input details.
  - Input # and tag
  - mA input value
  - Pulse input frequency
  - Digital input status
  - Modbus input value
  - Associated channel(s)
  - Input simulation
- Press the Right Arrow key to select the mA Input.



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

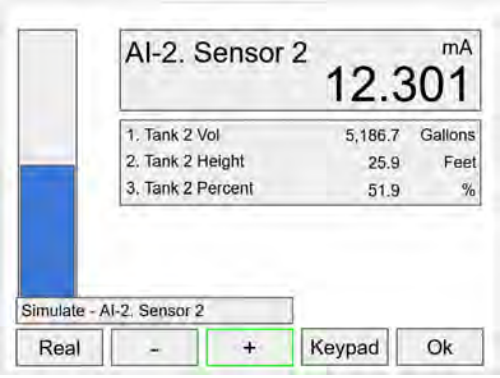


- The above screen shows the Analog Input 2 details and the associated channels.

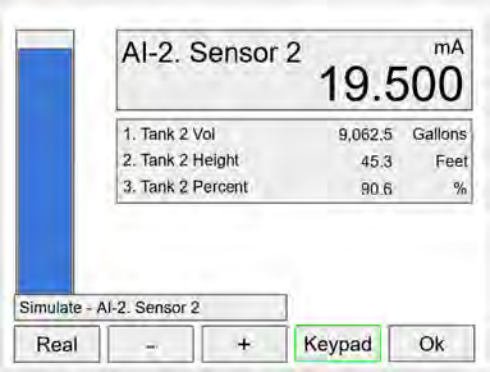


8.7.1 Simulate mA Input

- 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.

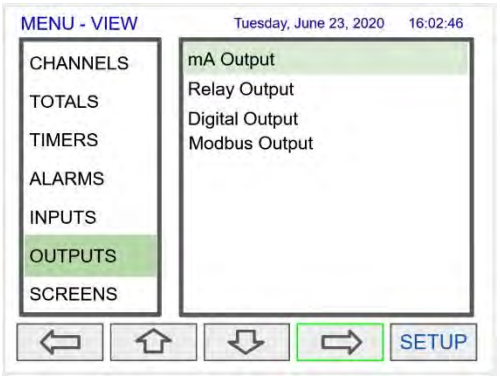


8.8 View Outputs

CAUTION

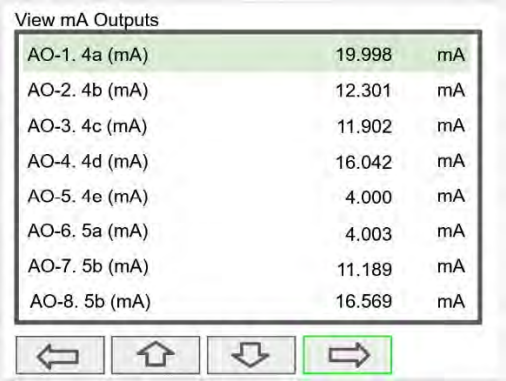
Manual control and simulation states are not saved on power cycle. On power up the controller initializes to the actual process conditions.

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

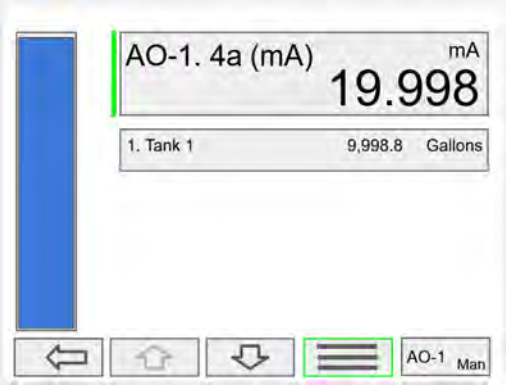


8.8.1 View mA Outputs

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

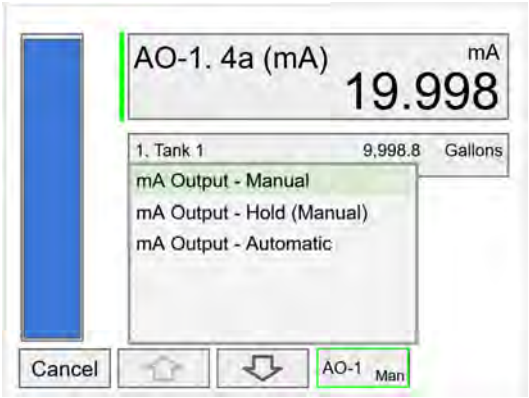


- Press the 3-Bar key to access Analog Output controls. Manual control, hold current value, return to automatic.

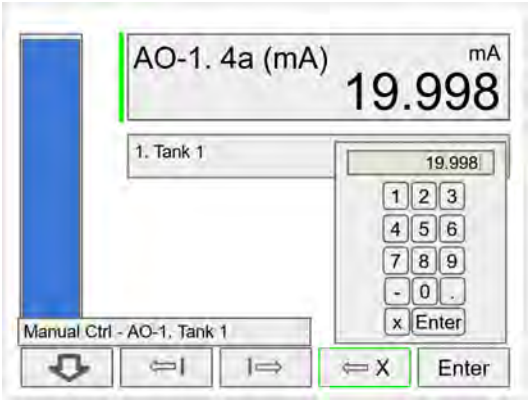


8.8.2 Manual Control of 4-20 mA Output

- 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 is small steps.

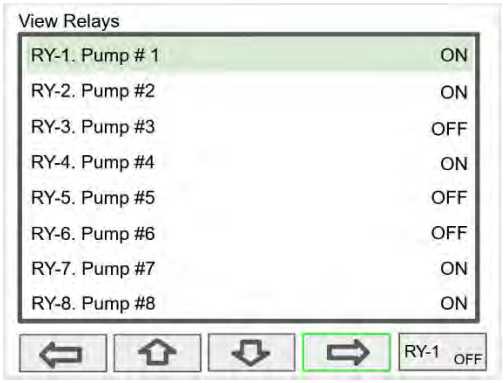


8.9 View Relays

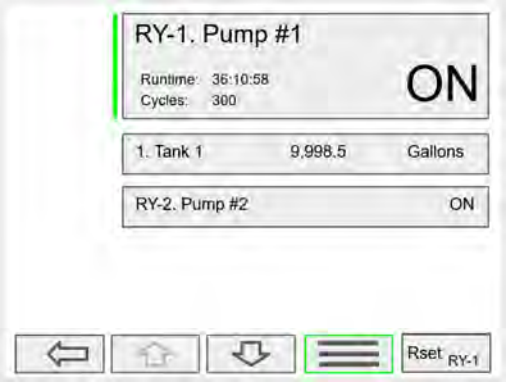
CAUTION

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

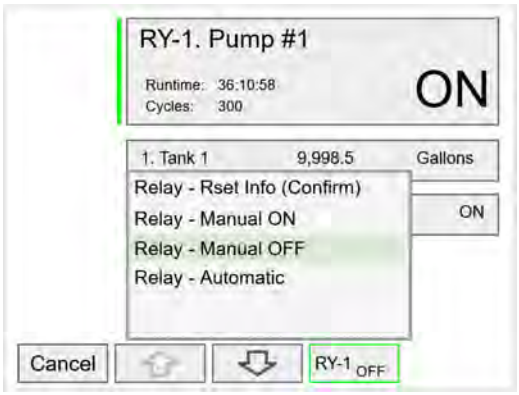
- The View Relays menu allows the user to view the details for all the relays. The F4 key can be used to turn on and off the selected relay (momentarily).
- Press the Right Arrow key to view the relay details.
  - Relay # and tag
  - Status
  - Runtime
  - Number of Cycles
  - Reset relay runtime & cycles count
  - Parameters associated with the relay
  - Other relays used in pump alternation
  - Manual control of relays



- 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.

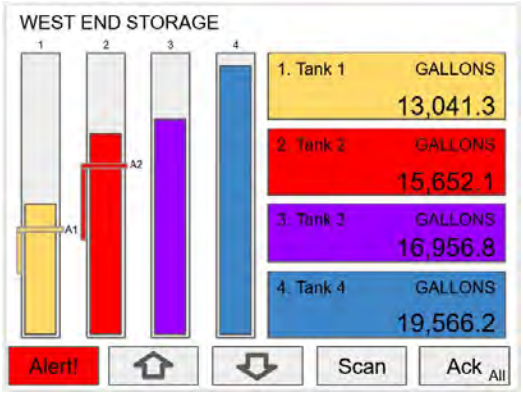


- An Alert! message is displayed in place of the Menu key anytime an item is in manual control or simulation mode.

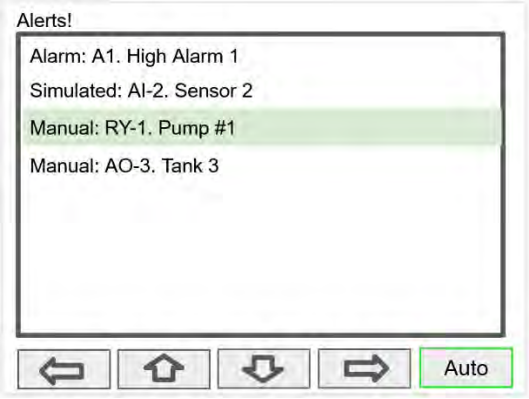


8.9.1 View Alert Messages

- If Alerts are enabled for alarms, the Menu key displays a flashing Alert! message on red background.
- Simulated parameters and manual control outputs, automatically generate alert messages displayed on a yellow background.

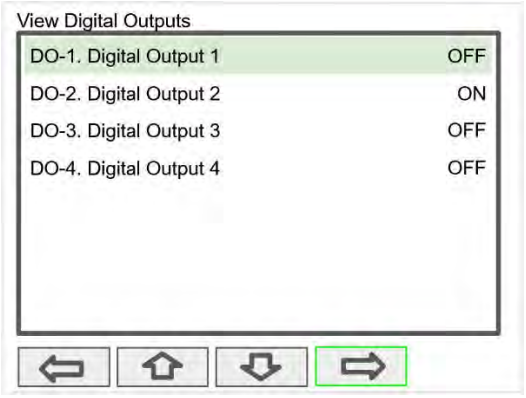


- The Alerts! Screen allows the user to acknowledge alarms, return outputs to automatic mode, and navigate to any of the listed items to view the details.



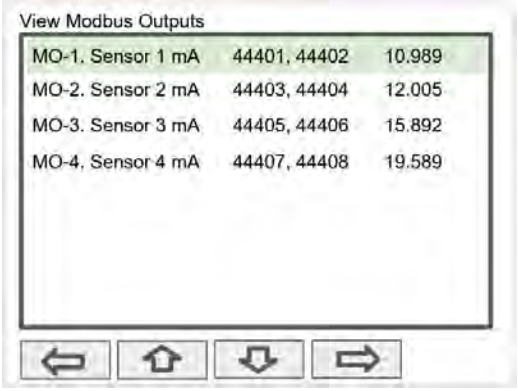
8.10 View Digital Outputs

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



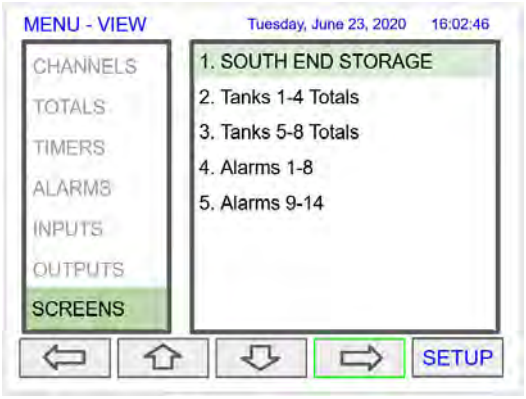
8.11 View Modbus Outputs

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.

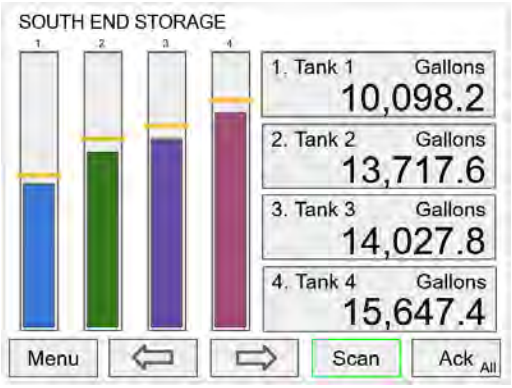


8.12 View Screens

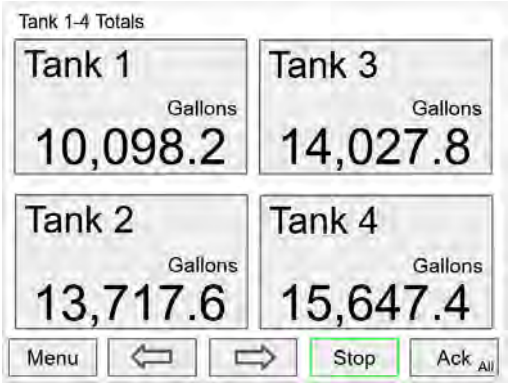
- With the View Screens menu, the user can go to any available screen and view the details. The screens can be scanned continuously or can be stopped to stay on a selected screen at any time.
- Press the Right Arrow key to view details of the selected view screen.



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



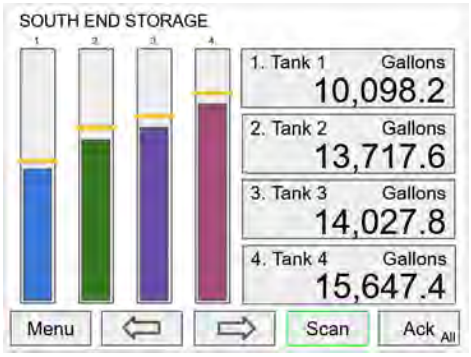
- Press the Stop key to have all available screens stop scanning and stay on the current screen.



9 Operation

9.1 Viewing Screens

The controller displays various screens with bar graphs, 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 bar graphs are optional, they are enabled or disabled during Screens setup. The scaling of the bar graph is done during the setup of each channel, and it can be different than the channel scaling values.

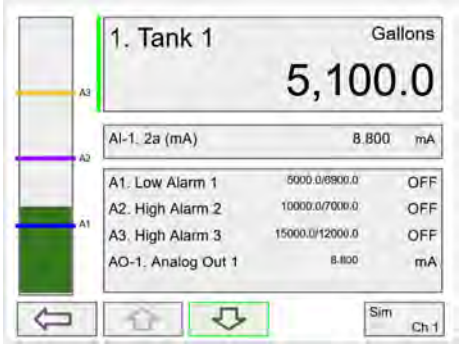


9.1.1 Individual Channel View

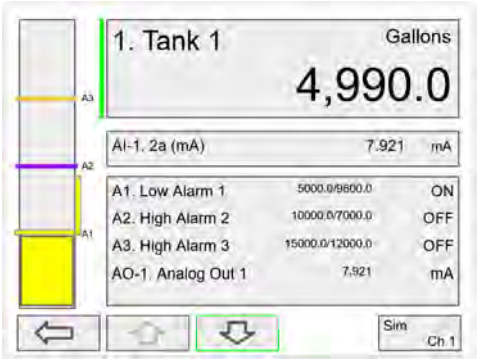
To view the details of any channel, press the Menu key and then press Right Arrow key to view the channels. Select the channel of interest. Navigate through the different items using the navigation keys. A green bar indicates the selected item, press the Right Arrow key to step into and see more details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

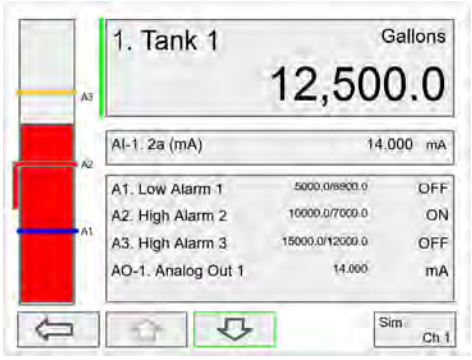
9.1.1.1 Low & High Alarm Indication

- The alarm set points are indicated by a line at the corresponding value on the bar graph. 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 bar graph.
- **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 bar graph.
- Alarm set points are indicated by horizontal lines.



- Low alarm indication.
- High alarm indication.





9.1.1.2 Multicolour Bar Graph Indication

- The bar graph can be configured to show different colours depending on the value of the process variable. The following example illustrates the use of colours:

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

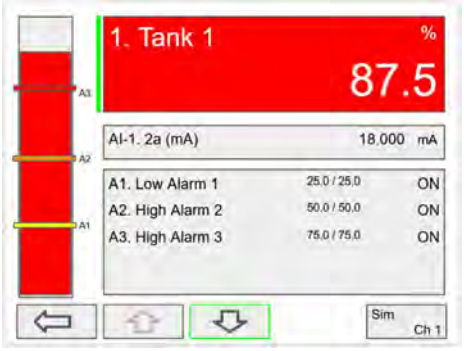
- Color changes above the set point for each alarm.

- The bar graph shows green below the first set point.

- The bar graph changes to yellow above set point 1.

- The bar graph changes to orange above set point 2.

- The bar graph changes to red above set point 3.
- The panel for the value can also be configured to change colours at the specified levels.



10 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:

Table 4: 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).

10.1 Modbus Register Tables

Table 5: 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

*Note: 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.

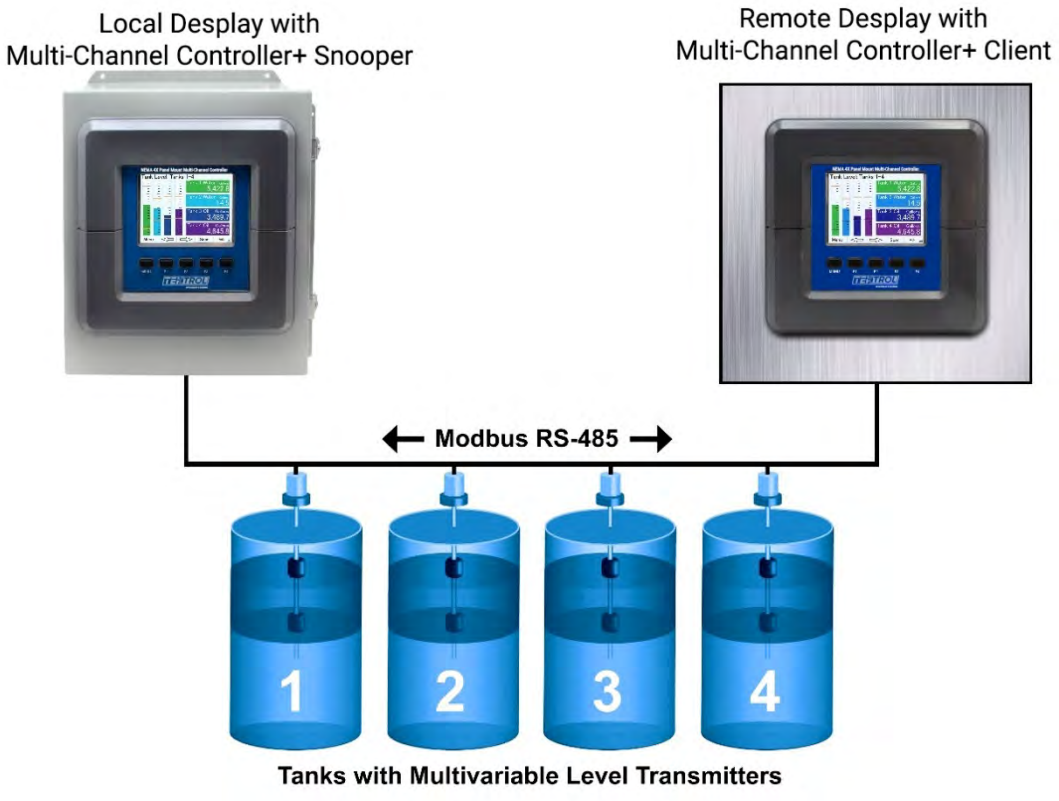
Table 6: Device Tag, Date & Time, Firmware Information

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.
40082 - 40099	81 - 98	Program Parameters (x18)	Various	06, 16	W	

10.2 Modbus Applications

10.2.1 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.



11 Troubleshooting

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 Tek-LCD 7801C 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 Tek-LCD 7801C configuration software.

11.1 Troubleshooting Tips

Table 7: Troubleshooting Tips

Symptom	Check/Action
No display or only backlight is visible, but outputs still function normally.	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	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	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)	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	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 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	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.

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Flow | Level | Temperature | Pressure | Valves | Analyzers | Accessories | TekValSys