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SCOPE OF THIS MANUAL

This manual is intended to help you get the TFX-5000 meter up and running quickly.

Read this manual carefully before attempting any installation or operation. Keep the manual accessible for future reference.

Typographic Conventions

- In step-by-step instructions, **bold** text indicates items on the screen you need to select or act upon.
Example: Click the **Setup** menu.
- Names of parameters, options, boxes, columns and fields are *italicized*.
Example: The value displays in the *Status* field.
- Messages and special markings are shown in quotation marks.
Example: "Error" displays in the title bar.
- In most cases, software screen text appears in the manual as it does on the screen. For example, if a word is capitalized on the screen, it is capitalized when referred to in the manual.

UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

SAFETY

Terminology and Symbols



Indicates a hazardous situation, which, if not avoided, *will* result in death or serious personal injury.



Indicates a hazardous situation, which, if not avoided, *could* result in death or serious personal injury.



Indicates a hazardous situation, which, if not avoided, *could* result in minor or moderate personal injury or damage to property.

Considerations

- The installation of the TFX-5000 meter must comply with all applicable federal, state, and local rules, regulations, and codes.
- Do not use sharp objects when operating the device (such as using a pen to press buttons on the keypad).
- When the TFX-5000 meter is a part of a system, it is configured in a fail-safe operation so that if the transmitter signal is compromised, the TFX-5000 meter will not cause harm to the system.

IMPORTANT

Not following instructions properly may impair safety of equipment and/or personnel.

INTRODUCTION

⚠ WARNING

POTENTIAL ELECTROSTATIC CHARGING HAZARD. THE NONMETALLIC PART OF THE ENCLOSURE MUST BE CLEANED WITH A DAMP CLOTH TO ELIMINATE THE RISK OF STATIC ELECTRICITY.

The TFX-5000 transit time meter measures volumetric flow and heating/cooling energy rates in clean liquids as well as those with small amounts of suspended solids or aeration, such as surface water or sewage. TFX-5000 ultrasonic flow and energy meters clamp onto the outside of pipes and do not contact the internal liquid.

The TFX-5000 meter is available in two versions:

- A flow meter for water delivery, sewage, cooling water, alcohols, chemical
- A heating/cooling energy flow meter used in conjunction with dual clamp-on RTDs for temperature measurement—ideal for hydronic process and HVAC applications

Transit time flow meters measure the time difference between the travel time of an ultrasound wave going *with* the fluid flow and *against* the fluid flow. The time difference is used to calculate the velocity of the fluid traveling in a closed-pipe system. The transducers used in transit time measurements operate alternately as transmitters and receivers. Transit time measurements are bi-directional and are most effective for fluids that have low concentrations of suspended solids and are sonically conductive.

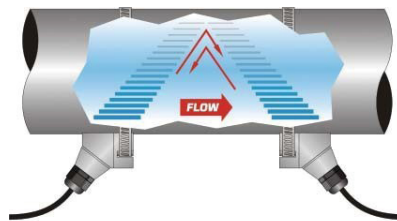


Figure 1: Meter operation

An ultrasonic meter equipped with heat flow capabilities measures the rate and quantity of heat delivered or removed from devices such as heat exchangers. By measuring the volumetric flow rate of the heat exchanger liquid, the temperature at the inlet pipe and the temperature at the outlet pipe, the energy usage can be calculated.

By applying a scaling factor, this heat flow measurement can be expressed in various units (Btu, Watts, Joules, Kilowatts and others).

DIMENSIONS

NOTE: Installation instructions begin on *page 10*.

Remote Enclosure

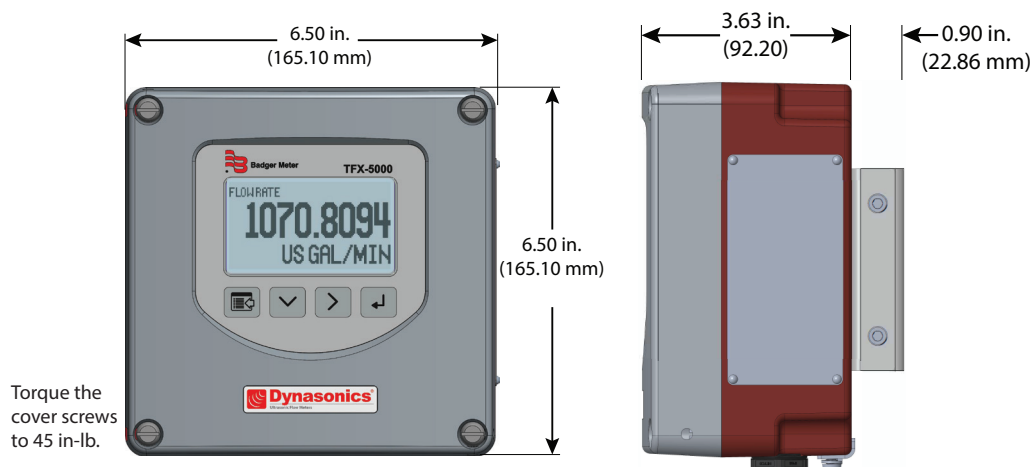


Figure 2: Remote mount enclosure dimensions

Wall Mount Bracket

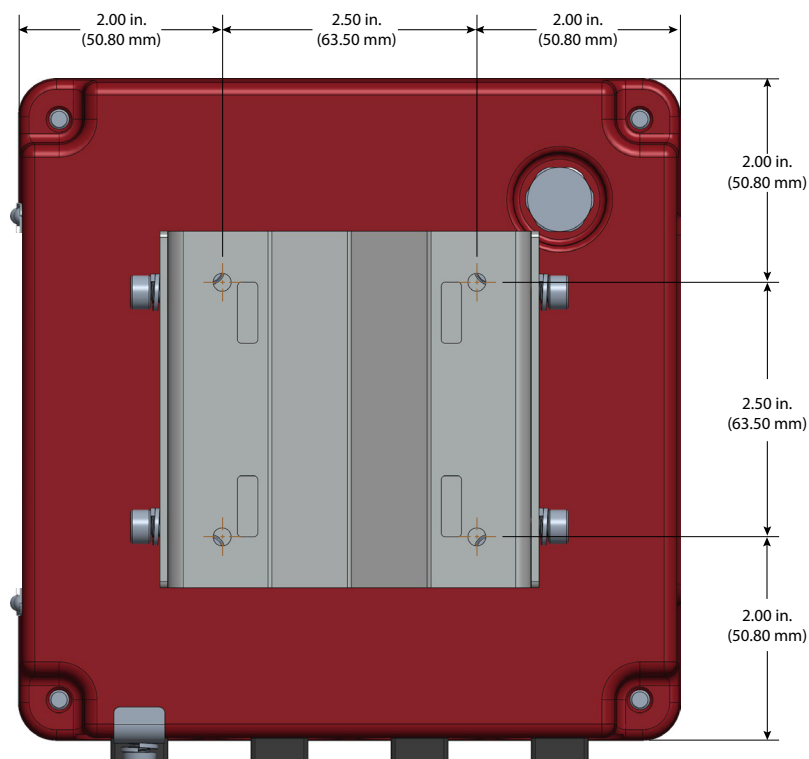


Figure 3: Wall mount enclosure dimensions

Panel Mount Enclosure

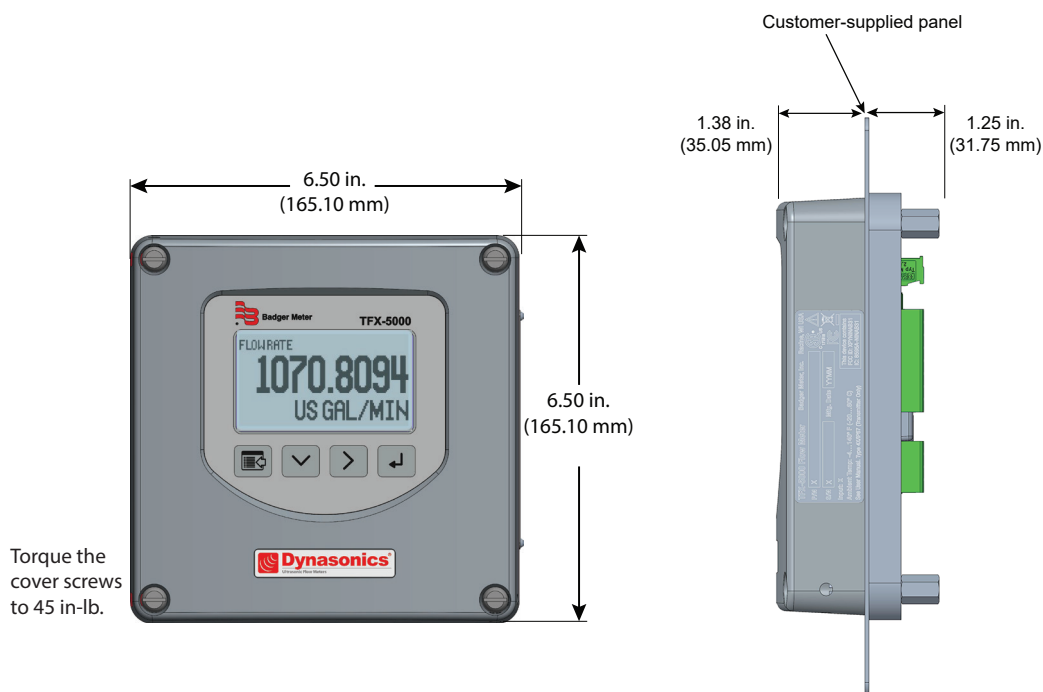






Figure 4: Panel mount enclosure dimensions

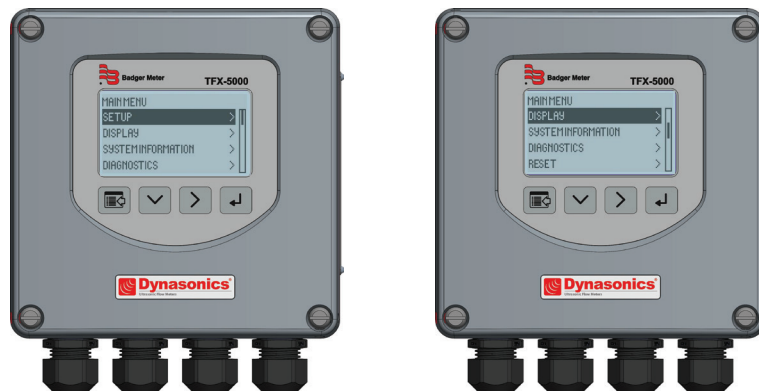
OPERATION

Keypad Operation on the Home Screen



-  The *MENU/BACK* key enters menu structure.
-  The *DOWN ARROW* key toggles between flow rate, flow total, velocity and flow rate with flow total.
-  The *RIGHT ARROW* key has no function.
-  The *ENTER* key has no function.

Keypad Operation in the Menu Structure



The cursor bar highlights the submenu or parameter that will be viewed or edited. The scroll bar on the right indicates the relative position the cursor bar is at on the list when there are more than 4 items.

- *MENU/BACK* returns to parent menu (up a level). If at the *Main* (top level) menu, returns to the *Home Screen*.
- *DOWN ARROW* scrolls the list.
- *RIGHT ARROW* and *ENTER* have the same function in the menu structure and advance to the submenu or to read/edit a parameter.

Selecting an Option in a Parameter Selection List



The active option in the parameter list has a filled-in box on the left side. The scroll bar on the right indicates the relative position the cursor bar is at on the list when there are more than 4 items.

- *DOWN ARROW* scrolls the list.
- *ENTER* selects the option and the box on the left side fills in to show the item is selected.
- *MENU/BACK* exits parameter editing and returns to the parent menu (up a level).

Entering a Number



The parameter name and current value is displayed in the top portion of the screen. Edit the number on the bottom right of the screen.

- *MENU/BACK* exits parameter editing and returns to parent menu (up a level). The parameter remains at the value displayed in the top portion of the screen.
- *DOWN ARROW* cycles through the numbers and other options.
- *RIGHT ARROW* moves the cursor to the right. Once it reaches the rightmost digit or a space, the cursor moves to the leftmost digit.
- *ENTER* accepts the value.

INSTALLATION

Overview

Each of the installation steps that follow is explained in detail on *page 11* through *page 12*. The actual installation procedures differ slightly, depending on whether the transducers are *fixed* or *adjustable*.

If the transducers are *fixed*, you will:

1. Install the transducers.
2. Install the transmitter.
3. Wire the transmitter.
4. Program the meter.

If the transducers are *adjustable*, you will:

1. Install the transmitter.
2. Wire the transmitter.
3. Set up the meter (select the optimum transmission mode, enter the site information, and enter the fluid and pipe properties).
4. Install the transducers.
5. Complete the meter programming.

Installation Considerations

Mount the transmitter in a location:

- Where little vibration exists.
- That is protected from corrosive fluids.
- That is within the transmitters ambient temperature limits:
–4...140° F (–20...60° C); relative humidity 0...85%, non-condensing; altitude 2000 m max.
- That is out of direct sunlight. Direct sunlight may increase transmitter temperature above the maximum limit.
- That protects the oleophobic vent from materials that may plug or seal the vent.

Equipment Required

- Screwdrivers, wide blade and tiny blade (for securing wires to the terminal blocks)
- User manual for the transducers
- Four #8 or M4 screws, if mounting the transmitter on a wall
- Stainless steel banding straps, if mounting the transmitter on a pipe

Installing the Transducers

See the user manual for your particular transducer for installation instructions.

Installing a Meter with a Remote Transmitter and Fixed Transducers

- Locate the transmitter within the length of the transducer cables supplied or exchange the cable for one of proper length.
- See *Figure 2 on page 6* for enclosure and mounting dimension details. Allow enough room for door swing, maintenance and conduit entrances.

IMPORTANT

When routing wires to the transmitter, make sure the cables are not twisted, pinched or hanging loosely.

1. Install the *fixed* transducers according to instructions in the transducer user manual.
2. Attach the mounting bracket to a wall (with 4 customer-supplied #8 or M4 screws, see “Wall Mount Bracket” on page 7 for dimensions) or to a pipe (with mounting straps).

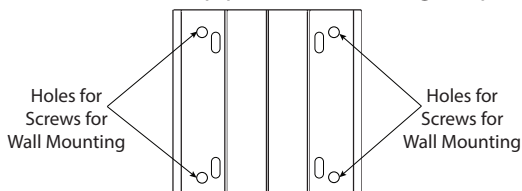


Figure 5: Wall mount

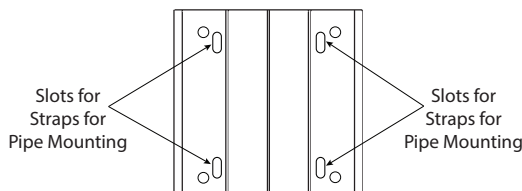


Figure 6: Pipe Mount

3. Align the transmitter's bracket with the mounted bracket. Use a 4 mm hex tool to secure the 4 provided screws from the sides through the mating holes. See *Figure 8*.
4. If necessary, you can rotate the mounting bracket in 90° increments to accommodate the final orientation of the transmitter. From inside the enclosure, remove the 4 screws holding the bracket. Rotate the bracket and replace the screws. See *Figure 7*.

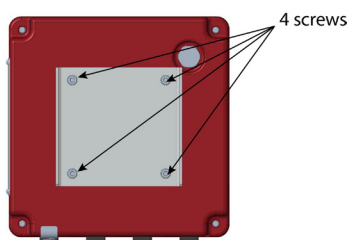


Figure 7: Rotatable adapter plate

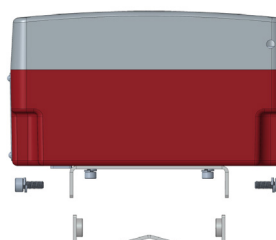


Figure 8: Secure the bracket

5. Insert a wire for earth ground under the grounding bracket (see *Figure 10*) and screw it down tight.
6. Partially loosen the 2 enclosure captive screws on the left side of the transmitter cover. Completely loosen the 2 screws on the right side. Grasp and lift the cover and open it to the left. The cover remains attached and the left screws act as a hinge.

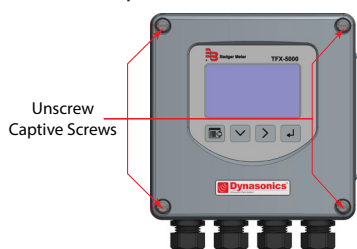


Figure 9: Captive cover screws

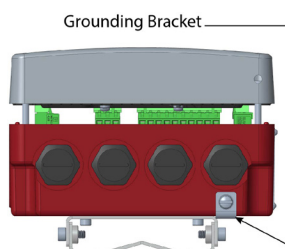


Figure 10: Lift cover from base

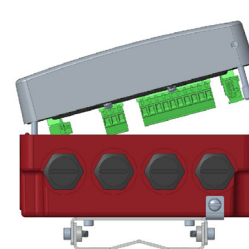


Figure 11: Open cover to the left

7. Use conduit holes where cables enter the enclosure from the bottom. Use suitably certified plugs to seal any holes that are not used for cable entry. A cable gland kit is included for inserting the transducer and power cables.



Figure 12: Conduit holes

NOTE: Use suitably certified fittings/plugs to maintain the watertight integrity of the enclosure. Generally, the right conduit hole (viewed from front) is used for power, the left conduit hole for transducer connections, and the center holes are used for I/O wiring.

8. Install the wires through the gland nuts and connect the wires to the removable terminal blocks. See *"Wiring the Transmitter"* on page 14.
9. Wire the transducers to the transmitter.
10. Plug the wired terminal blocks into the main board.
11. Reassemble the cover. Torque the cover screws to 45 in-lb.
12. Set up the meter. See *"Initial Meter Setup"* on page 21 for instructions.

Installing a Meter with a Remote Transmitter and Adjustable Transducers

- Locate the transmitter within the length of the transducer cables supplied or exchange the cable for one of proper length.
- Install the transducers after entering the pipe settings into the transmitter and determining the spacing and mounting method.
- See *Figure 2 on page 6* for enclosure and mounting dimension details. Allow enough room for door swing, maintenance and conduit entrances.

IMPORTANT

When routing wires to the transmitter, make sure the cables are not twisted, pinched or hanging loosely.

1. Attach the mounting bracket to a wall (with 4 customer-supplied #8 or M4 screws, see *"Wall Mount Bracket"* on page 7 for dimensions) or to a pipe (with mounting straps).

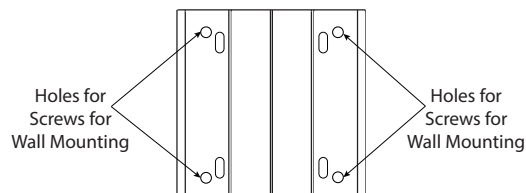


Figure 13: Wall mount

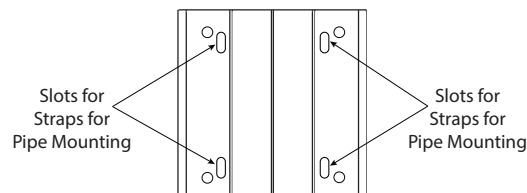


Figure 14: Pipe Mount

2. Align the transmitter's bracket with the mounted bracket. Use a 4 mm hex tool to secure the 4 provided screws from the sides through the mating holes. See *Figure 16*.
3. If necessary, you can rotate the mounting bracket in 90° increments to accommodate the final orientation of the transmitter. From inside the enclosure, remove the 4 screws holding the bracket. Rotate the bracket and replace the screws. See *Figure 15*.

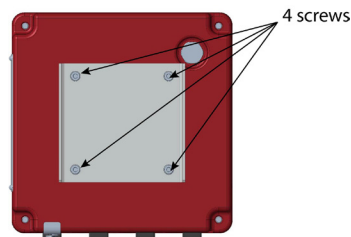


Figure 15: Rotatable adapter plate

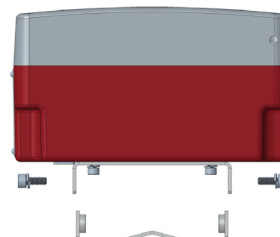


Figure 16: Secure the bracket

4. Insert a wire for earth ground under the grounding bracket (see *Figure 18*) and screw it down tight.
5. Partially loosen the 2 enclosure captive screws on the left side of the transmitter cover. Completely loosen the 2 screws on the right side. Grasp and lift the cover and open it to the left. The cover remains attached and the left screws act as a hinge.

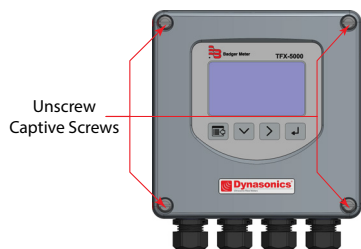


Figure 17: Captive cover screws

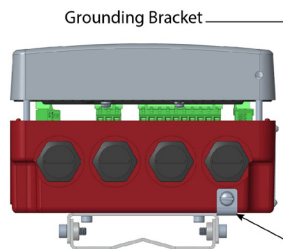


Figure 18: Lift cover from base

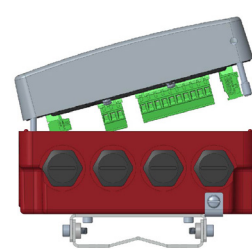


Figure 19: Open cover to the left

- Use conduit holes where cables enter the enclosure from the bottom. Use suitably certified plugs to seal any holes that are not used for cable entry. A cable gland kit is included for inserting the transducer and power cables.

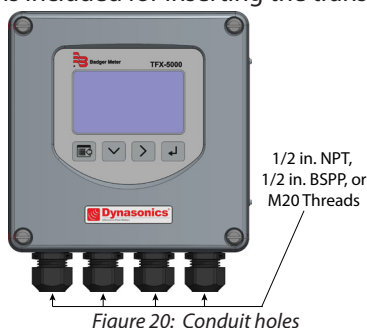


Figure 20: Conduit holes

NOTE: Use suitably certified fittings/plugs to maintain the watertight integrity of the enclosure. Generally, the right conduit hole (viewed from front) is used for power, the left conduit hole for transducer connections, and the center holes are used for I/O wiring.

- Install the wires through the gland nuts and connect the wires to the removable terminal blocks. See *“Wiring the Transmitter”* on page 14.
- Set up the meter. See *“Initial Meter Setup”* on page 21 for instructions.
- Install the *adjustable* transducers according to instructions in the transducer user manual.
- Wire the transducers to the transmitter.
- Plug the wired terminal blocks into the main board.
- Reassemble the cover. Torque the cover screws to 45 in-lb.

Installing a Panel-Mount Meter

- Measure and cut a mounting hole into the customer-supplied panel to the dimensions shown in *Figure 21*.
- Remove the 4 screws and 4 O-rings holding the front of the unit to the frame.
- Verify that the gasket is secure in the mounting bezel.
- Guide the front of the unit through the panel cutout.
- Insert the 4 screws through the front of the unit and the panel.
- Apply one O-ring to each screw from the back of the panel.
- Align the front of the unit to the frame.
- Tighten the 4 screws and torque them to 45 in-lb.

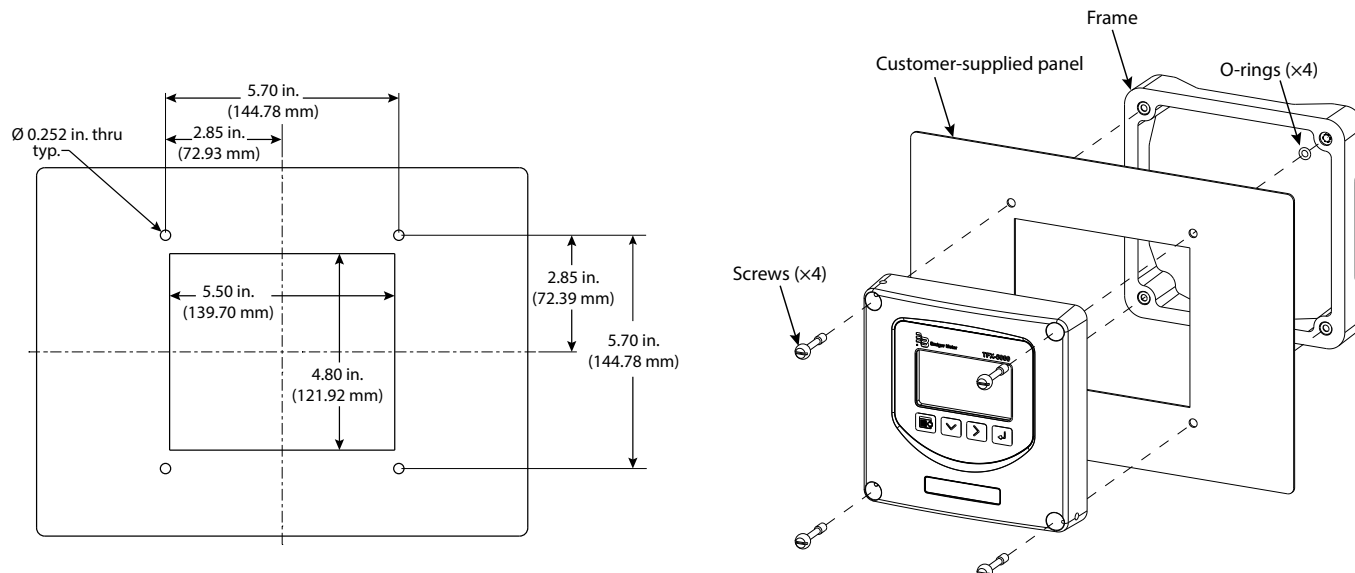


Figure 21: Panel cutout dimensions and installation exploded view

WIRING THE TRANSMITTER

IMPORTANT: Select field wiring means rated for 5° C above the maximum area temperature when it is possible that the temperature will exceed 55° C.

To access terminal strips for wiring, loosen the 4 enclosure captive screws. Grasp and lift the cover and open it to the left. The cover remains attached and the left screws act as a hinge.

Electrical Symbols

| Function | Direct Current | Alternating Current | Earth (Ground) | Protective Ground | Chassis Ground |
|----------|----------------|---------------------|----------------|-------------------|----------------|
| Symbol | | | | | |

Figure 22: Electrical symbols

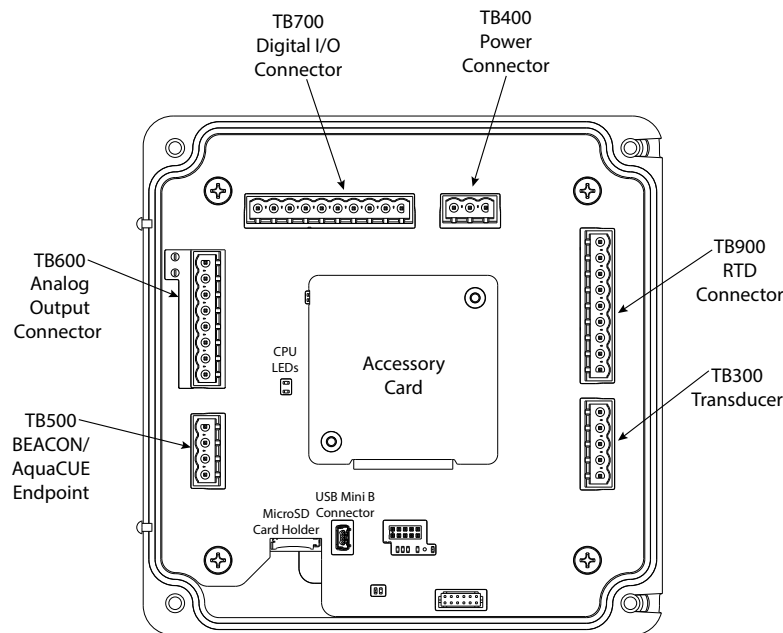


Figure 23: Wiring connectors

Connection Data

| Description | Minimum | Maximum |
|---|----------------------|---------------------|
| Conductor cross section solid | 0.2 mm ² | 2.5 mm ² |
| Conductor cross section flexible | 0.2 mm ² | 2.5 mm ² |
| Conductor cross section flexible, with ferrule without plastic sleeve | 0.25 mm ² | 2.5 mm ² |
| Conductor cross section flexible, with ferrule with plastic sleeve | 0.25 mm ² | 2.5 mm ² |
| Conductor cross section AWG | 24 | 12 |
| 2 conductors with same cross section, solid | 0.2 mm ² | 1 mm ² |
| 2 conductors with same cross section, stranded | 0.2 mm ² | 1.5 mm ² |
| 2 conductors with same cross section, stranded, ferrules without plastic sleeve | 0.25 mm ² | 1 mm ² |
| 2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve | 0.5 mm ² | 1.5 mm ² |
| AWG according to UL/CUL | 30 | 12 |

Rated Conditions of Terminals

- Mains AC 85...264V AC
Wire 18-12AWG UL AWM 1007 Type 1007
- 9...28V DC, 20...26VAC
Wire 20AWG UL AWM 1007 Type 1007
- Transducer Cables
Badger Meter supplied cable
- Digital Outputs/Inputs, Current Output, RS-485, RTD or Encoder Interface
- Wire 28...12 AWG UL AWM 1007 Type 1007

Wiring the Transducer

NOTE: Submersible transducer cables are larger diameter. Each cable requires a separate conduit hole. The standard yellow cable and high temperature cables are small enough to use a single cable gland with a 2-hole grommet.

NOTE: Transducer cables have two wire-color combinations. For the blue and white combination, the blue wire is positive (+) and the white wire is negative (-). For the red and black combination, the red wire is positive (+) and the black wire is negative (-). The transducer wires are labeled to indicate which pair is upstream or downstream.

1. Guide the transducer terminations through a conduit hole in the bottom of the enclosure.
2. Secure the transducer cable with the supplied conduit nut (if flexible conduit was ordered with the transducer).
3. Install the ferrite to the cable:
 - a. To open the ferrite, pull the fastener away from the body of the ferrite.
 - b. Wrap the cable tightly around half of the ferrite and place the cable into the groove.
 - c. Snap the ferrite shut.
4. The terminals within the transmitter are screw-down barrier terminals. Connect the wires at the corresponding screw terminals in the transmitter. Observe upstream and downstream orientation and wire polarity. See *Figure 24*.

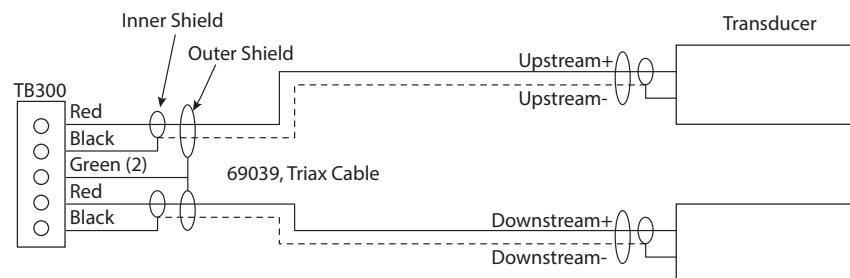


Figure 24: Upstream/downstream transducer

Power

Connect power to the screw terminal block in the transmitter.

- Low voltage power can use any available conduit hole in the enclosure.
- Line voltage AC power must use the right conduit hole, which is aligned with the terminal block on the AC power board.
- Use wiring practices that conform to local and national codes such as The National Electrical Code Handbook in the U.S.

⚠ CAUTION

ANY OTHER WIRING METHOD MAY BE UNSAFE OR CAUSE IMPROPER OPERATION OF THE TRANSMITTER.

NOTE: This transmitter requires clean electrical line power. Do not operate this transmitter on circuits with noisy components (such as fluorescent lights, relays, compressors, or variable frequency drives). Do not use step-down transformers from high voltage, high amperage sources. Do not run signal wires with line power within the same wiring tray or conduit.

9...28V DC Power

The transmitter may be operated from a 9...28V DC source, as long as the source supplies a maximum of 8 Watts of power. Connect the DC power to 9...28V DC In, power return, and chassis ground, as in *Figure 25*.

NOTE: DC-powered transmitters are protected from major catastrophe with an internal 2.0 Amp slow-blow fuse. If this fuse is blown, replace the transmitter or return it to the factory for repair.

IMPORTANT: A Class II DC power supply is required.

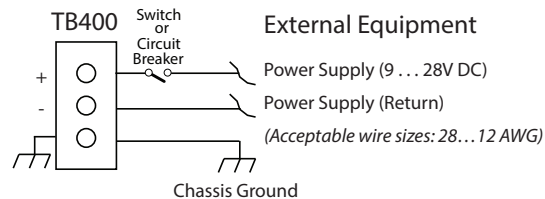


Figure 25: Power supply 9...28V DC

20...26V AC Power

The transmitter may be operated from a 20...26V AC source, as long as the source supplies a maximum of 8 Watts of power. Connect the AC power to 20...26V AC In, power return, and chassis ground, as in *Figure 26*.

NOTE: 24V AC powered transmitters are protected from major catastrophe with an internal 2.0 Amp slow-blow fuse. If this fuse is blown, replace the transmitter or return it to the factory for repair.

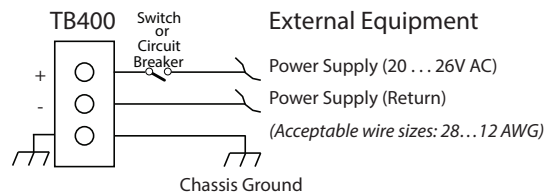


Figure 26: Power supply 20...28V AC

Mains Power

IMPORTANT: The measuring device does not have an internal circuit breaker. For compliance with IEC 61010-1, a switch in close proximity to the transmitter is required so that the power supply line can be easily disconnected from the mains.

The transmitter may be operated from 90...250V AC, 47...63 Hz, 24VA maximum power source.

NOTE: Mains AC-powered transmitters are protected with 1A, 250V AC, 5×20 mm, slow-blow, field-replaceable fuse.

⚠ WARNING

TO PREVENT SHORTING OUT THE MAINS AC POWER, YOU MUST REPLACE THE TERMINAL BLOCK COVER ON THE AC MODULE AFTER WIRING THE POWER.

Remove the terminal block covers before wiring and replace them after wiring:

1. Grasp the sides of the cover and gently pull it up.
2. Insert wires into the slots on the cover and screw them down to secure.
3. Align the cover in its original orientation over the terminal block and push down to connect.

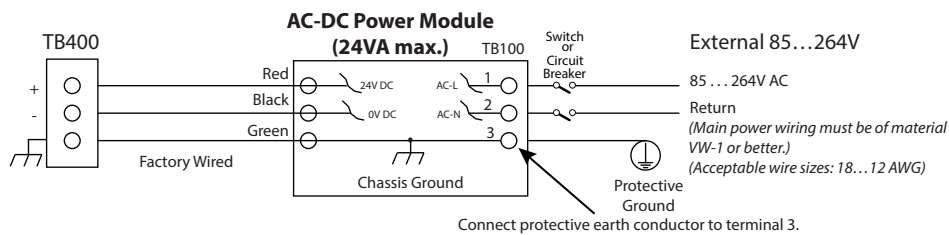


Figure 27: AC/DC power connections

4...20 mA Output Wiring

The 4...20 mA output transmits an analog current signal that is proportional to system flow rate. The 4...20 mA output can be internally or externally powered and can span negative to positive flow rates.

Both current loops are ISOLATED from DC GND or Power.

NOTE: 4...20 OUT 2 available with Energy model only.

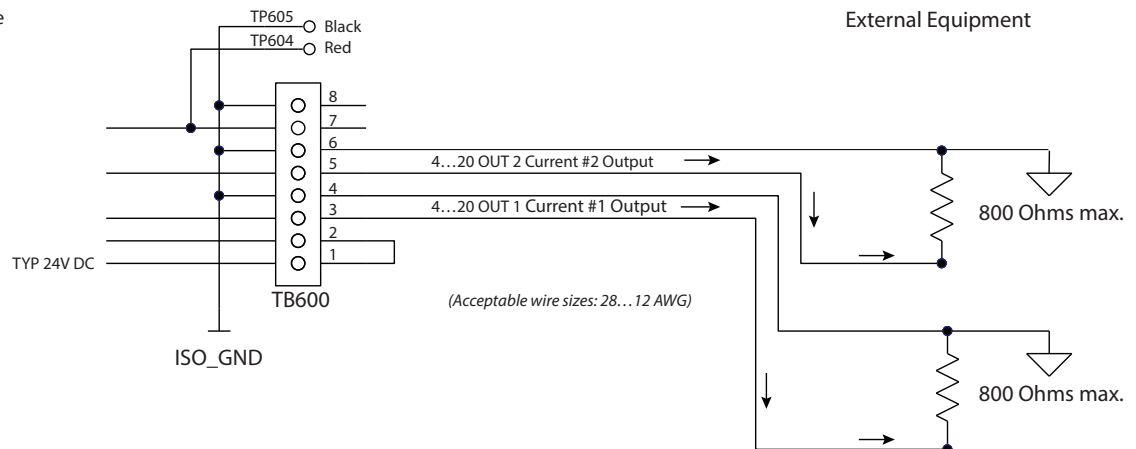


Figure 28: Typical 4...20 mA interface using internal isolated 24V DC source

NOTE: 4...20 OUT 2 available with Energy model only.

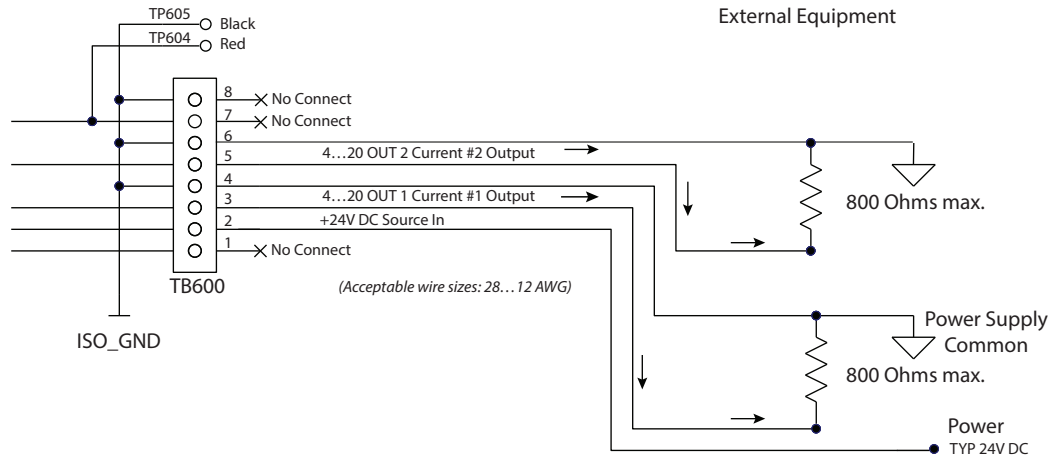


Figure 29: Typical 4...20 mA interface using external isolated 24V DC source

Digital Outputs Wiring

NOTE: Control Output 3 available with Energy model only.

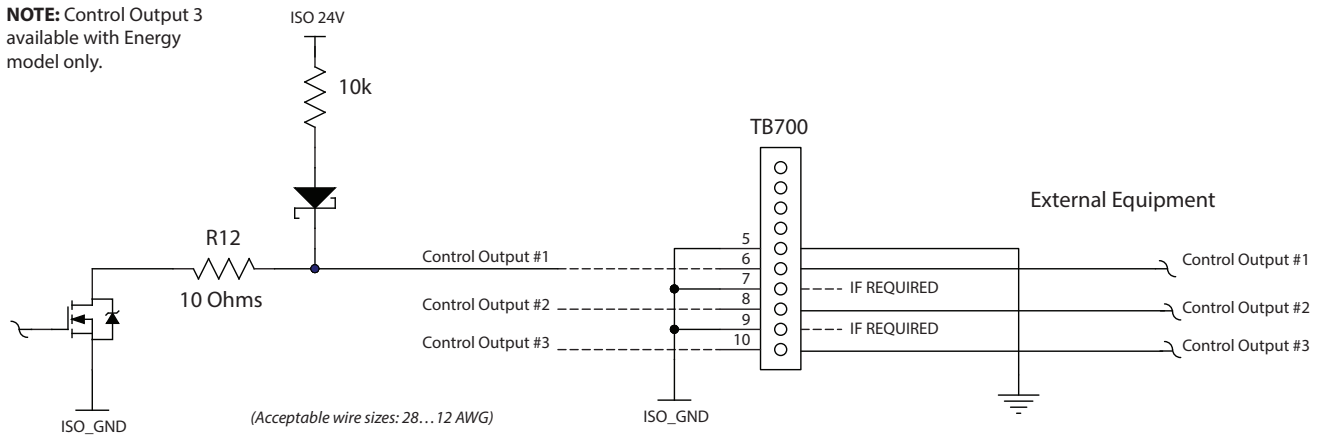


Figure 30: Typical control out 1, 2 and 3 interface with internal pullups active

NOTE: Control Output 3 available with Energy model only.

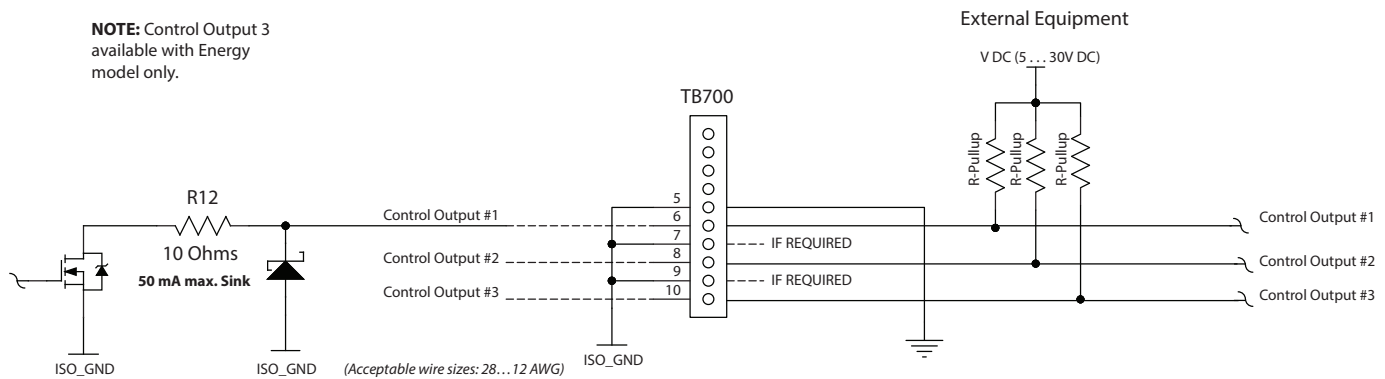


Figure 31: Typical control out 1, 2 and 3 interface with external pullups passive

RS485 Output

The RS485 feature allows up to 126 transmitters to be placed on a single three-wire cable up to 4000 feet. All transmitters are assigned a unique numeric address that allows all of the transmitters on the cable network to be independently accessed. Either Modbus RTU or BACnet MS/TP protocol is used to interrogate the transmitters.

Flow rate and total can be monitored over the digital communications bus.

When a USB programming cable is connected, the RS485 and frequency outputs are disabled.

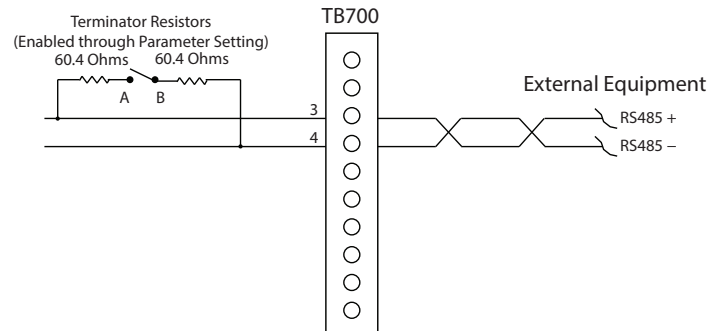


Figure 32: Typical RS485 interface

Digital Input Wiring

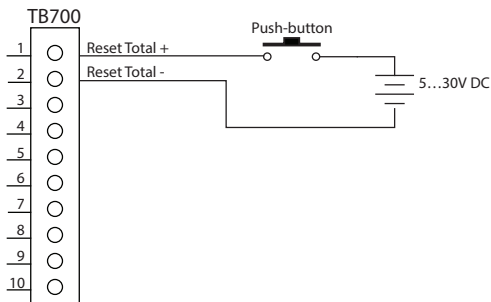


Figure 33: Digital input—reset totalizer

AquaCUE/BEACON Endpoint Wiring

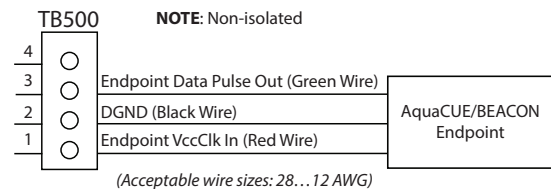


Figure 34: AquaCUE/BEACON wiring

RTD Interface Wiring (Energy Models Only)

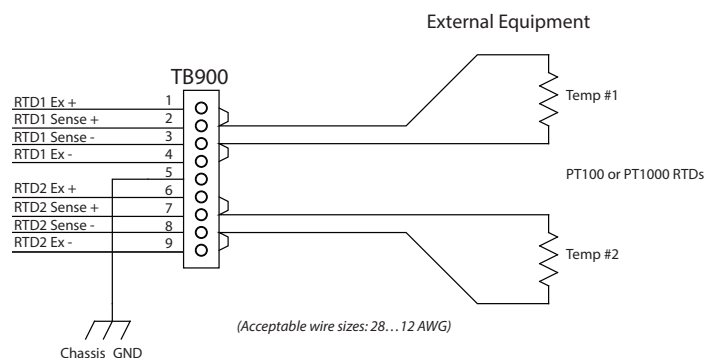


Figure 35: Two-wire RTD interface

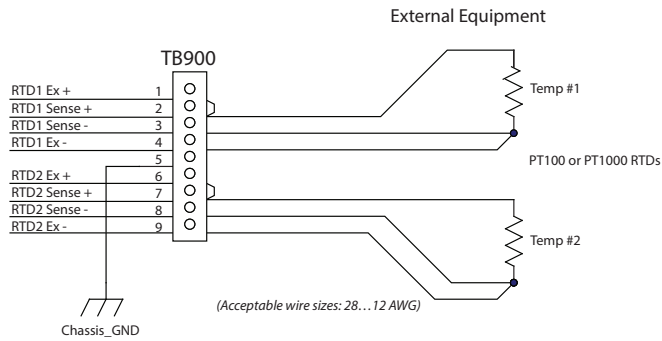


Figure 30: Three-wire RTD interface

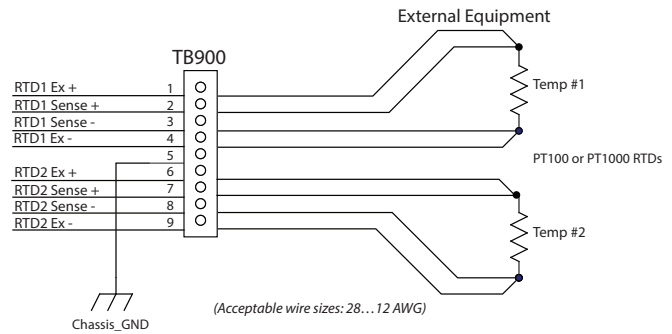


Figure 36: Four-wire RTD interface

Auxiliary Output Card Wiring

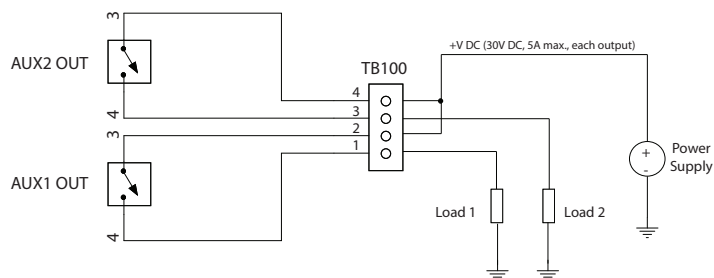


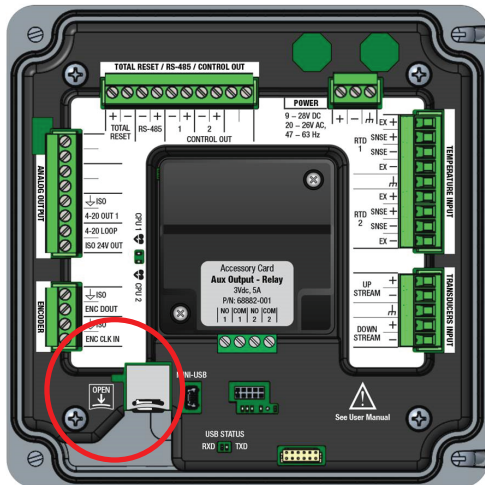
Figure 37: Auxiliary output interface

Installing the MicroSD Card

⚠ WARNING

IN A HAZARDOUS LOCATION WHERE EXPLOSIVE GAS OR DUST IS PRESENT, DISCONNECT THE POWER BEFORE OPENING THE ENCLOSURE AND INSERTING OR REMOVING THE MICROSD CARD. AFTER THE CARD IS INSERTED OR REMOVED, CLOSE THE ENCLOSURE BEFORE REAPPLYING POWER.

1. In all locations, turn off power to the unit.
2. Remove the enclosure cover.
3. Put your finger in the groove of the tray and slide the tray downward. The tray springs open.



5. Insert the MicroSD card.
6. Slide the cover up to close.
7. Replace the enclosure cover.

Connecting the USB Cable

Use a USB cable when connecting a TFX-5000 meter to a computer with SoloCUE Flow Device Manager software.

WARNING

**DO NOT USE THE MINI USB PORT IN A HAZARDOUS LOCATION WHERE EXPLOSIVE GAS OR DUST IS PRESENT.
DO NOT OPEN THE TRANSMITTER WHILE POWERED IF WATER OR SPRAY COULD CONTACT ELECTRONICS OR INTERIOR.**

1. Open the enclosure cover.
2. Connect the USB cable to the mini USB port, aligning the pins in the cable with the holes in the port.
3. Program the transmitter.
4. Remove the USB cable and close the enclosure cover.

Initial Meter Setup

You can set up the meter using the TFX-5000 keypad or the SoloCUE Flow Device Manager software. This document addresses procedures using the TFX-5000 keypad. To use SoloCUE, see the *"SoloCUE Flow Device Manager Installation Guide"* available at www.badgermeter.com.

For in-depth parameter programming, see *"Parameter Descriptions by Menu"* on page 23.

1. Program the meter settings:
When using the keypad to set up the TFX-5000 meter to measure flow, press MENU/BACK to enter the main menu. In the **SETUP > METER** menu, enter the pipe characteristics, transducer, mounting and fluid, and record the calculated spacing as needed. Install transducer. See the transducer user manual for instructions.
2. Check calibration:
In the **SETUP > METER > CALIBRATION** menu, select **Field** for the *Factor Mode*. Enter the calibration and sensor factors from the transducers into the scale factor and sensor factor value..
3. Zero the meter:
Due to different pipe characteristics, the meter must be zeroed in order to maintain accuracy. The recommended method is to stop flow and make sure there is no flow before zeroing the meter. In situations in which that is not feasible, you may zero the meter while the flow is steady or enter the zero manually. Based on *ZERO MODE*, the **SET ZERO** option will be selectable.
 - a. If *ZERO MODE* is set to *NO FLOW*:
Check that the pipe is full of liquid and not flowing. Flow must be absolutely zero.
Securely close any valves and allow time for settling to occur.
Select **SET ZERO-NO FLOW** and click **OK** to set the new zero.
 - b. If *ZERO MODE* is set to *STEADY FLOW*:
Check that the pipe is full of liquid and flowing at a steady rate.
Select **SET ZERO-FLOW** and click **OK** to set the new zero.
4. Select temperature sensor (energy models only):
In the **SETUP > INPUTS/OUTPUT > RTD** menu, select the temperature sensor type, range and order for positive and negative energy calculations.
5. Select units:
In the **SETUP > UNITS** menu, select the units and format of flow rate, total and velocity, and for energy meters the energy rate, energy total and temperature.
6. Set up the flow settings:
In the **SETUP > METER > FLOW SETUP** menu, select flow direction, low and maximum flow cutoff, and minimum and maximum signal strength.

MENU MAP

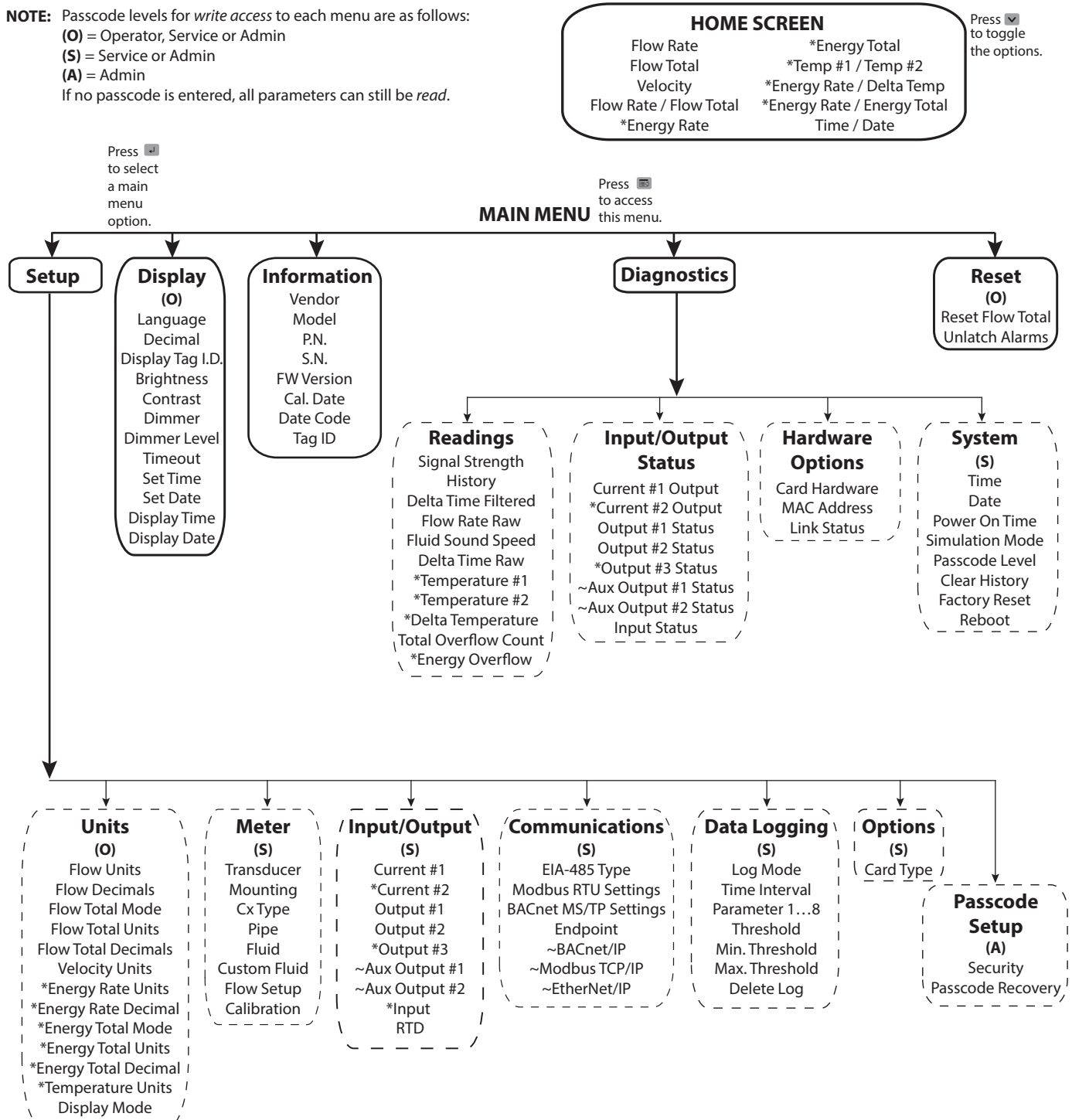
NOTE: Passcode levels for *write access* to each menu are as follows:

(O) = Operator, Service or Admin

(S) = Service or Admin

(A) = Admin

If no passcode is entered, all parameters can still be *read*.



* Energy units only.

~ Optional card installed.

PARAMETER DESCRIPTIONS BY MENU

Main Menu Structure

The transmitter's firmware has a hierarchical menu structure. See "*Menu Map*" on page 22 for a visual path to the parameters. The five *Main Menus* used in the transmitter firmware are as follows:

| Menu | Function |
|-------------|---|
| SETUP | Contains all of the configuration parameters for initially programming the transmitter to measure flow |
| DISPLAY | Configures transmitter display functions |
| INFORMATION | Displays system information, such as the model number and firmware version |
| DIAGNOSTICS | Displays system status and allows you to clear the history, reset to factory defaults and reboot the system |
| RESET | Resets the flow total or unlatches alarms |

The following pages define the configuration parameters located in each of the menus.

Setup > Units

Use *SETUP > UNITS* to define the measurement standards for the transmitter. Contains all of the configuration parameters for setting the units and decimals for the readings and the totalizer mode. Requires operator level passcode or higher if security is enabled.

An asterisk (*) indicates the parameter default.

| Units Submenus | Options/Descriptions | |
|-----------------|---|---|
| FLOW UNITS | Select the flow rate units/interval displayed on the <i>Home Screen</i> . <i>FLOW UNITS</i> are automatically converted into the selected option. | |
| | Option | Units/Interval |
| | Fluid BBL/D | Fluid Barrels/Day (31.5 Gal) |
| | IBBL/D | Imperial Fluid Barrels/Day (36 IG) |
| | L/S | Liters/Second |
| | L/MIN | Liters/Minute |
| | L/H | Liters/Hour |
| | M ³ /S | Cubic Meters/Second |
| | M ³ /MIN | Cubic Meters/Minute |
| | M ³ /H | Cubic Meters/Hour |
| | FT ³ /S | Cubic Feet/Minute |
| | FT ³ /MIN | Cubic Feet/Minute |
| | FT ³ /H | Cubic Feet/Hour |
| | Custom | This selection is only available if <i>Custom Units</i> is enabled through SoloCUE Flow Device Manager. Use SoloCUE to change the <i>Custom Units</i> . |
| | | |
| FLOW DECIMALS | This is a numeric entry for the number of decimal places to display. Default is 2. Options are 0...7 | |
| FLOW TOTAL MODE | *GROSS FLOW | Any flow in forward and reverse direction. |
| | FORWARD FLOW | |
| | REVERSE FLOW NET FLOW | Forward flow minus reverse flow. A negative total results when reverse flow is greater than forward flow. |

| Units Submenus | Options/Descriptions | | | |
|--|--|---|---------------|---|
| FLOW TOTAL UNITS | Select the units for the flow total displayed on the <i>Home Screen</i> . <i>FLOW TOTAL UNITS</i> are automatically converted into the selected option: | | | |
| | Option | Units | Option | Units |
| | GAL | US Gallons | Fluid BBL | Fluid Barrel (31.5 Gal) |
| | MGAL | Million US Gallons | L | Liter |
| | IGAL | Imperial Gallons | HL | Hectoliter |
| | AC-FT | Acre Foot | M³ | Cubic Meters |
| | MIGAL | Million Imperial Gallons | FT³ | Cubic Feet |
| | Oil BBL | Oil Barrels (42 Gal) | | |
| | Custom | This selection is only available if <i>Custom Units</i> is enabled through SoloCUE Flow Device Manager. Use SoloCUE to change the <i>Custom Units</i> . | | |
| FLOW TOTAL DECIMALS | This is a numeric entry for the number of decimal places to display. Default is 0. Options are 0...7. | | | |
| VELOCITY UNITS | Select the units for the velocity displayed on the <i>Home Screen</i> . *FT/S Feet/Second M/S Meters/Second | | | |
| ENERGY RATE UNITS (Energy Units Only) | Select the units for the energy rate displayed on the <i>Home Screen</i> . <i>ENERGY RATE UNITS</i> are automatically converted into the selected option: | | | |
| | Option | Units | Option | Units |
| | BTU/H | Btu/hour | kJ/H | Kilojoules/hour |
| | kBTU/H | Thousand Btu/hour | MJ/H | Mega joules/hour |
| | MMBTU/H | Million Btu/hour | kCAL/H | Kilocalories/hour |
| | W | Watts | MCAL/H | Mega calories/hour |
| | *kW | Kilowatts | TON (RT) | Ton (Refrigeration) 1 Ton = 12,000 Btu/h |
| | MW | Megawatts | | |
| ENERGY RATE DECIMAL (Energy Units Only) | This is a numeric entry for the number of decimal places to display. Default is 2. Options are 0...7. | | | |
| ENERGY TOTAL MODE (Energy Units Only) | FORWARD FLOW | | | |
| | REVERSE FLOW | Forward flow minus reverse flow. A negative total results when reverse flow is greater than the forward flow. | | |
| | NET FLOW | Forward flow minus reverse flow. A negative total results when reverse flow is greater than the forward flow. | | |
| | *GROSS FLOW | Any flow in forward and reverse direction. | | |
| ENERGY TOTAL UNITS (Energy Units Only) | Select the units for the energy total displayed on the <i>Home Screen</i> . <i>ENERGY TOTAL UNITS</i> are automatically converted into the selected option: | | | |
| | Option | Units | Option | Units |
| | BTU | British Thermal Unit | kWH | Kilowatt Hour |
| | kBTU | Thousand Btu | MWh | Megawatt Hour |
| | MMBTU | Million Btu | kJ | Kilo Joules |
| | KCAL | Kilo Calories | MJ | Mega Joules |
| | MCAL | Mega Calories | TON-H | Ton-hour (Refrigeration) |
| ENERGY TOTAL DECIMALS (Energy Units Only) | This is a numeric entry for the number of decimal places to display. Default is 2. Options are 0...7. | | | |
| TEMPERATURE UNITS (Energy Units Only) | °F °C K | | | |
| DISPLAY MODE | Select the parameters to display on the <i>Home Screen</i> . Alternatively, you can change the display from the <i>Home Screen</i> by pressing the <i>DOWN</i> button. | | | |
| | *FLOW RATE | ENERGY TOTAL | | |
| | FLOW TOTAL | TEMP #1 / TEMP #2 | | |
| | VELOCITY | ENERGY RATE / DELTA TEMPERATURE | | |
| | RATE/TOTAL | ENERGY RATE / ENERGY TOTAL | | |
| | ENERGY RATE | TIME / DATE | | |

Setup > Meter

Contains all of the configuration parameters for setting the meter. Requires service level passcode or higher if security is enabled. An asterisk (*) indicates the parameter default.

| Meter Submenus | Options/Descriptions |
|----------------|--|
| TRANSDUCER | Select the transducer type: |
| | UZ 2 MHZ Option UZ when ordered with the TFX-5000 meter |
| | CX 2 MHZ Options CA...CS and CZ when ordered with the TFX-5000 meter |
| | JZ / KZ EASYRAIL 1 MHZ Options JZ and KZ when ordered with the TFX-5000 meter |
| | NZ / RZ / WZ 1 MHZ Options NZ, WZ and RZ when ordered with the TFX-5000 meter |
| | HZ 1 MHZ Option HZ when ordered with the TFX-5000 meter |
| | LZ / YZ 0.5 MHZ Option LZ when ordered with the TFX-5000 meter |
| MOUNTING | For mounting options, see the transducer user manual. |
| | Z PATH |
| | *V PATH |
| | W PATH |
| Cx TYPE | DTTC TYPE is substituted for MOUNTING when TRANSDUCER DTTC is selected as the transducer type. |
| | CA: 1/2 IN ANSI CJ: 1-1/4 IN COPPER |
| | CB: 3/4 IN ANSI CK: 1-1/2 IN COPPER |
| | CC: 1 IN ANSI CL: 2 IN COPPER |
| | CD: 1-1/4 IN ANSI CM: 1/2 IN SS TUBE |
| | CE: 1-1/2 IN ANSI CN: 3/4 IN SS TUBE |
| | CF: 2 IN ANSI CP: 1 IN SS TUBE |
| | CG: 1/2 IN COPPER CQ: 1-1/4 IN SS TUBE |
| | CH: 3/4 IN COPPER CR: 1-1/2 IN SS TUBE |
| | CT: 1 IN COPPER CS: 2 SS IN TUBE |

Setup > Meter > Pipe

An asterisk (*) indicates the parameter default.

| Pipe Submenus | Options/Descriptions |
|-------------------|--|
| PIPE MATERIAL | STAINLESS 302/303 STAINLESS 430 IRON - DUCTILE POLYPROPYLENE STAINLESS 304 ALUMINUM HD POLYETHYLENE STAINLESS 304L BRASS NAVAL LD POLYETHYLENE *STAINLESS 316 CARBON STEEL PFA TEFLON STAINLESS 347 COPPER PVC CPVC STAINLESS 410 IRON - CAST PVDF |
| PIPE TYPE | <p>For the best accuracy, measure the outer diameter and wall thickness with a gauge and select <i>MANUAL INCHES</i> or <i>MANUAL MM</i>.</p> <p>If you do not have a gauge, you can select an ASME/ANSI or ASTM definition. Schedule, copper tubing and cast iron class are filtered based on pipe material selection.</p> <p>If stainless steel pipe, carbon steel, cvc, pcvc material is selected, the following pipe schedules are also available as applicable:</p> <p>SCHEDULE STD SCHEDULE 80 SCHEDULE 5 SCHEDULE 100 *SCHEDULE 10 SCHEDULE 120 SCHEDULE 20 SCHEDULE 140 SCHEDULE 30 SCHEDULE 160 SCHEDULE 40 SCHEDULE 180 SCHEDULE 60 SCHEDULE STG</p> <p>If copper material is selected, the following types are also available:</p> <p>TYPE K TYPE M TYPE L PIPE SIZE</p> <p>If cast iron pipe material is selected, the following classes are also available:</p> <p>CLASS A CLASS E CLASS B CLASS F CLASS C CLASS G CLASS D CLASS H</p> <p>If ductile iron pipe material is selected, the following classes are also available:</p> <p>CLASS 50 CLASS 54 CLASS 51 CLASS 55 CLASS 52 CLASS 56 CLASS 53</p> <p>If aluminum or brass naval material is selected, the following is also available:</p> <p>PIPE SIZE (in inches)</p> |
| PIPE SIZE | Available only when <i>PIPE TYPE</i> is <i>MANUAL</i> ; Numeric entry; min. 0.5 in (15 mm), max. 300 in (7500 mm) |
| PIPE SIZE NOMINAL | <i>PIPE SIZE NOMINAL</i> is substituted for <i>PIPE SIZE</i> when a schedule/tubing/class is selected. Enumeration based on schedule; min. 0.5 in. (15 mm), max. 24 in. (610 mm) 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, 3-1/2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24 |
| WALL THICKNESS | Numeric entry; *min. 0.00, max. 5 in. (125 mm); <i>WALL THICKNESS</i> is only useful for <i>MANUAL METRIC</i> and <i>MANUAL INCHES</i> ; It can be skipped for pipe schedule, tubing and classes |
| LINER MATERIAL | NONE HD POLYETHYLENE TAR EPOXY ACRYLIC LD POLYETHYLENE PFE TEFLON ASBESTOS CEMENT POLYPROPYLENE GLASS PYREX EBONITE POLYSTYRENE FIBERGLASS EPOXY MORTAR RUBBER |
| LINER THICKNESS | Numeric entry; min. 0.00, max. 5 in. (125 mm) |
| I.D. SIZE | Numeric display in inches or millimeters, based on <i>PIPE TYPE</i> |

Setup > Meter > Fluid

| Fluid Submenus | Options/Descriptions | | | | | |
|----------------|----------------------|---|---------------------|-----------------------|-----------------------|--|
| FLUID | Water - Tap | Acetone | Ethylene Glycol 30% | Kerosene | Propylene Glycol 30% | |
| | Raw Sewage | Ammonia | Gasoline | Methanol | Stoddard Solvent | |
| | Water - Distilled | Benzene | Glycerin | Oil Diesel #1 | Sulfuric Acid 96% | |
| | Water - Sea 3.5% | Ethanol | Isopropanol | Oil Diesel #2 | Hydrochloric Acid 36% | |
| | Brine - 3.5% | Ethylene Glycol 100% | Jet Fuel A1/JP8 | Propylene Glycol 100% | Hydrofluoric Acid 49% | |
| | Brine - 10% | Ethylene Glycol 50% | Jet Fuel B/JP4 | Propylene Glycol 50% | Custom | |
| CUSTOM FLUID | SOUND SPEED | Numeric entry; Units ft/s or m/s based on velocity units. | | | | |
| | SPEED UNITS | Ft/s or m/s | | | | |
| | SPECIFIC GRAVITY | Numeric entry; Specific gravity (density relative to water), pipe size and viscosity are used to calculate the Reynolds number. The Reynolds number indicates whether the fluid is in turbulent, transition or laminar flow and the flow profile. | | | | |
| | VISCOSITY | Numeric entry; Units centipoise (cP) or mPa-s. Dynamic viscosity of the fluid. | | | | |
| | VISCOSITY UNITS | Units centipoise (cP) or mPa-s | | | | |
| | REFERENCE TEMP | Numeric entry, F or C. Default 15° C. Reference temperature of viscosity and specific gravity. | | | | |
| | REF TEMP UNITS | F or C | | | | |
| | SPECIFIC HEAT | Numeric entry; Units: joule/gram °C; min. 0.01, max. 65.0; Specific heat capacity is the heat capacity per unit mass of a material. | | | | |

Setup > Meter > Flow Setup

An asterisk (*) indicates the parameter default.

| Flow Setup Submenus | Options/Descriptions |
|---------------------|--|
| DIRECTION | *FORWARD REVERSE |
| BIDIRECTIONAL | *ENABLED DISABLED |
| LOW FLOW CUTOFF | Numeric entry. Units and decimals are based on FLOW RATE UNITS. Zero and positive values. *0.0 |
| SIGNAL CUTOFF | *30% |
| SIGNAL HIGH | *90% |
| MINIMUM FLOW | -10000 (default); min. -2,000,000. Number of decimals points depends on Home Screen settings. |
| MAXIMUM FLOW | 10000 (default); max. 2,000,000 |

Setup > Meter > Advanced

An asterisk (*) indicates the parameter default.

| | | |
|---|--|--|
| HEAT CALCULATION (Energy meter only) | Dynasonics Calculation EN1434 TYPE $Rate\ of\ Heat\ Delivery = Q \times (T_{in} - T_{out}) \times C \times \rho$ Where <div><div>Q =</div><div>Volumetric flow rate</div></div> <div><div>T_{in} =</div><div>Temperature at the inlet</div></div> <div><div>T_{out} =</div><div>Temperature at the outlet</div></div> <div><div>C =</div><div>Heat capacity</div></div> <div><div>ρ =</div><div>Density of fluid</div></div> | |
| DAMPING | *40 seconds | For detailed information on these parameters, see the paragraphs following this table. |
| SENSITIVITY | *60% | |
| HYSTERESIS | *5% | |
| BAD DATA REJECTION | *3 | |
| FILTER METHOD | *Adaptive | |
| WAVE | <div><div>•</div><div>*AUTO automatically selects waveform based on flow speed and signal quality.</div></div> <div><div>•</div><div>SIN CARROT TOP is best for low speed flow.</div></div> <div><div>•</div><div>BEST BARKER is best for high speed flow.</div></div> | |
| TEMP COMPENSATION | *MANUAL TEMP #1 TEMP #2 | Selection is only available for Energy meter. For the Flow meter, manual temperature compensation is always on. Temperature compensation adjusts the viscosity of the fluid used in Reynolds number compensation and the fluid speed of sound. |
| MANUAL REF TEMP | Numeric entry -40...350° F (–40...176° C) | |
| REF TEMP UNITS | ° F ° C K | Select the units for the manual reference temperature. |
| REYNOLDS | *ENABLED DISABLED | Flow rate compensation based on fluid Reynolds number as the fluid changes from laminar to transitional to turbulent flow. |

Filter Parameters

Filter Method (Default: Adaptive)

The TFX-5000 flow meter offers three levels of signal filtering:

- *None* imposes no filtering on the signal from the transducers.
- *Simple with Rejection* uses *Damping* and *Bad Data Rejection* to filter the flow data.
- **Adaptive* filtering allows the meter's software routines to alter the filtering, depending on the variability of the transducer's signal. The *Adaptive* filter uses a combination of *Damping*, *Bad Data Rejection*, *Sensitivity* and *Hysteresis* to modify the flow input data.

Damping (Range 0...100 Seconds; Default: 40 Seconds)

Damping is the approximate amount of time the filtering routines use to attain a 99% stable rate value. Generally, the higher the damping value, the more stable the rate readings are—but at the expense of response time.

Sensitivity (Range 0...100%; Default: 60%)

Sensitivity determines how fast the adaptive filtering responds to a change in rate. Increasing the sensitivity decreases the filtering, which allows the display to respond to rate changes more rapidly.

Hysteresis (Range 0...25%; Default: 5%)

Hysteresis creates a window around the average flow measurement reading, defining the limits at which the automatic damping increases occur. If the rate varies within the hysteresis window, greater damping occurs up to the maximum values set by the flow filter *Damping* entry. The filter also establishes a flow rate window where measurements outside of the window are captured by the *Bad Data Rejection* window. Enter the value as a percentage of actual flow rate.

For instance, a *Hysteresis* setting of 5% allows the flow to vary $\pm 5\%$ from the currently established flow rate without automatically decreasing the value of the *Damping*.

For example, if the average flow rate is 100 gpm and the *Hysteresis* is set to 10%, a filter window of 90...110 gpm is established. Successive flow measurements that reside within that window are recorded and averaged in accordance with the *Damping* setting. Flow readings outside of the window are rejected or accepted in accordance with the *Bad Data Rejection* setting.

Filter settings for this example:

| | |
|---------------------------|------------|
| Filter Method | Adaptive |
| Damping | 40 seconds |
| Sensitivity | 60% |
| Hysteresis | 10% |
| Bad Data Rejection | 3 |

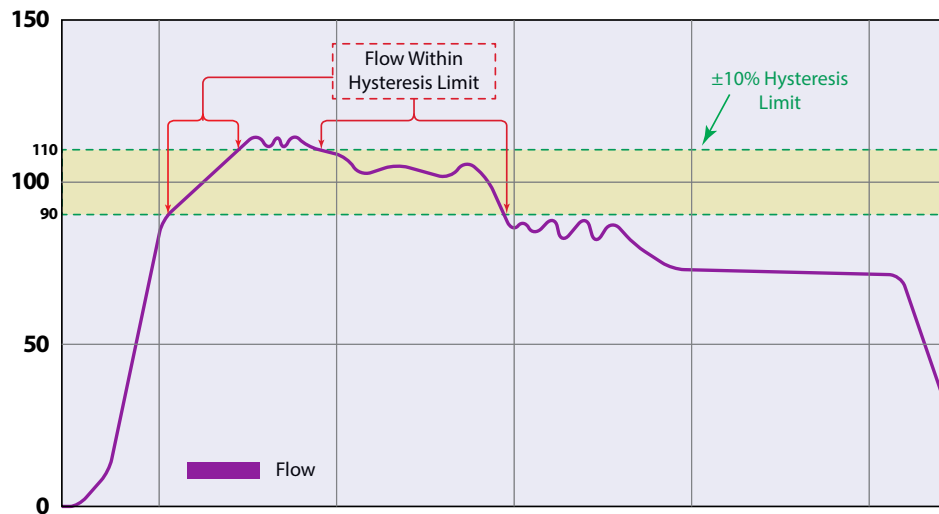


Figure 38: Hysteresis window

Bad Data Rejection (Range 0...10 Samples; Default: 3)

The *Bad Data Rejection* setting is related to the number of successive **readings** that must be measured outside of a the *Hysteresis* value before the flow meter considers the new flow value valid. In this example, a *Hysteresis* setting of 10% produces a $\pm 10\%$ band centered on the current valid flow rate of 100 gpm.

The *Bad Data Rejection* setting is the number of successive **samples** that must be outside of the *Hysteresis* window before the flow meter considers the change in flow as real. Larger values are entered into the *Bad Data Rejection* window when measuring liquids that contain gas bubbles, as the gas bubbles tend to disturb the ultrasonic signals and cause more extraneous flow readings to occur. Larger *Bad Data Rejection* values tend to make the flow meter less responsive to rapid changes in actual flow rate.

In Figure 40 on page 30, flow data falls outside the flow *Hysteresis* window but does not reach the minimum time specified in the *Bad Data Rejection* window. When data appears that is outside the *Hysteresis* band and shorter than the *Bad Data Rejection* window time, the data is rejected.

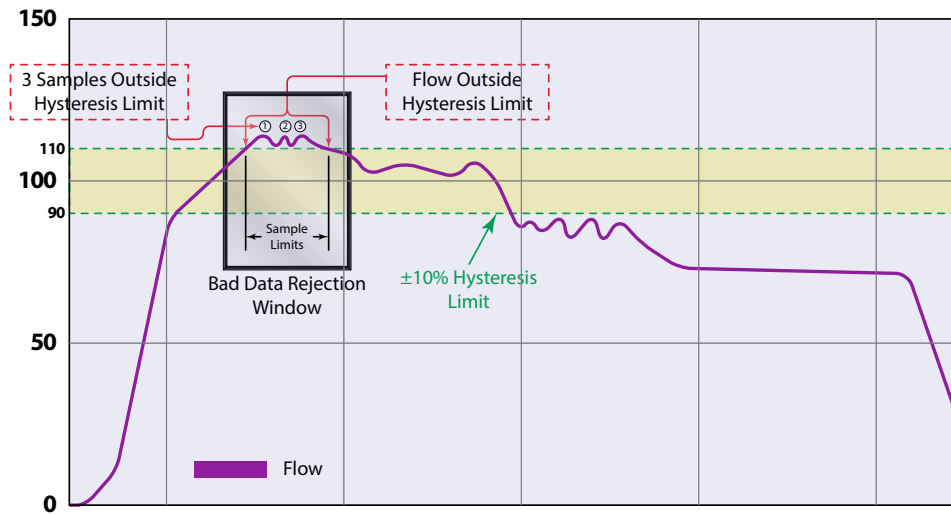


Figure 39: Bad data (rejection)

The flow rate is again outside the original $\pm 10\%$ Hysteresis window, but the data exists for a time period greater than the *Bad Data Rejection* window. In this instance, the meter interprets the data as a new valid flow rate and moves the *Hysteresis* window to correspond with the new established flow rate.

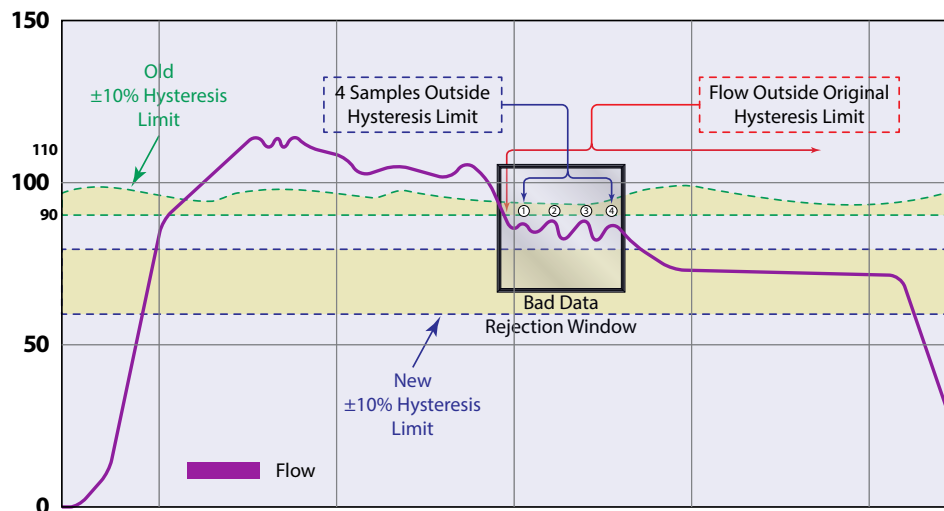


Figure 40: New valid flow data

Setup > Meter > Calibration

An asterisk (*) indicates the parameter default.

| Calibration Submenus | Options/Descriptions | |
|---------------------------|--|---|
| <i>FACTOR MODE</i> | FACTORY *FIELD | Select <i>FIELD</i> to set the zero and use the sensor and scale factors of the transducers. |
| <i>FACTORY SETTINGS</i> | ZERO | The zero offset entered during factory calibration. <i>ZERO</i> is for reference only and most likely the <i>ZERO VALUE</i> for your installation will be different from the factory <i>ZERO</i> . Numeric display; *0.000 ns |
| | CAL FACTOR | One of two calibration factors unique to each transducer pair if the transmitter was used during factory calibration. Numeric display #.### |
| | SENSOR FACTOR | One of two calibration factors unique to each transducer pair if the transmitter was used during factory calibration. Numeric display #.### |
| <i>ZERO MODE</i> | MANUAL *NO FLOW STEADY FLOW | Due to different pipe characteristics, the meter must be zeroed in order to maintain accuracy. The recommended method is to stop flow and make sure there is no flow before zeroing the meter. In situations in which that is not feasible, you may zero the meter while the flow is steady or enter the zero manually. Select the method to zero the meter. |
| <i>SET ZERO - NO FLOW</i> | SET ZERO AT NO FLOW in process and confirmation screen | Check that the pipe is full of liquid and not flowing. Flow must be absolutely zero. Securely close any valves and allow time for settling to occur. |
| <i>SET ZERO - FLOW</i> | SET ZERO AT FLOW in process and confirmation screen | Stabilize the flow to a steady level before zeroing the meter. In situations where it is not possible to stop flow, use this method to zero the meter. When selected, the meter will calculate the zero typically in 5...10 seconds and will indicate if the meter was successful or not in determining the flow. |
| <i>MANUAL ZERO</i> | Numeric entry ## ### ns | Allows for manual entry of the zero value when <i>ZERO MODE</i> is <i>MANUAL</i> . |
| <i>ZERO VALUE</i> | Numeric display ## ### ns | The zero offset used to calculate the flow rate. If the meter is not zeroed after installation, this value will match the factory <i>ZERO</i> setting. |
| <i>SENSOR FACTOR</i> | Numeric entry ## ### ns | The value used in calculating the zero value when zeroing the meter at steady flow. This value can be found on the transducer label. |
| <i>SCALE FACTOR</i> | Numeric entry | The factor used for linearizing the flow rate calculation when <i>FIELD</i> is selected for <i>FACTOR MODE</i> . Enter the <i>CAL FACTOR</i> from the transducer. |

Factory Calibrated Procedure

Each transducer pair has a *CAL FACTOR* and *SENSOR FACTOR* on the label. Verify *FACTOR MODE* is set to *FIELD* and enter the factors from the transducer into the *CAL FACTOR* and *SENSOR FACTOR* settings.

Zero the meter after entering the *CAL FACTOR* and *SENSOR FACTOR*.

Field Calibration Procedure

To calibrate the TFX-5000 flow meter, use a master meter or gravimetric test stand.

1. Verify that *FACTOR MODE* is set to **FIELD** and the transducer sensor factor is entered into the *SENSOR FACTOR* setting.
2. Set *SCALE FACTOR* set to **1**.
3. Run calibration test.
4. Calculate the *SCALE FACTOR*.

$$SCALE FACTOR = (actual\ flow) / (meter\ flow\ rate) \text{ or } (actual\ total) / (meter\ total)$$
5. Enter the *SCALE FACTOR*.

Setup > Input/Output > Current #1

Requires service level passcode or higher if security is enabled. The current output, reset input and frequency/pulse/status output can be set up through the *SETUP > INPUT/OUTPUT* menus.

An asterisk (*) indicates the parameter default.

| Current #1 Submenus | Options/Descriptions | |
|----------------------|--|---|
| <i>OUTPUT SOURCE</i> | *FLOW RATE TEMPERATURE #1 TEMPERATURE #2 ENERGY FLOW VELOCITY SIGNAL STRENGTH TEST MODE DISABLED | Select the reading to be assigned to the 4...20 mA output. Temperature and energy options only available with energy meter. |
| <i>RANGE</i> | *4-20 mA 4-20 mA NAMUR 0-20 mA | Current range is NAMUR 43 compliant with lower measuring limit at 3.8 mA and upper limit at 20.5 mA and minimum alarm 3.5 mA and maximum alarm 22.6 mA. |
| <i>MIN VALUE</i> | Enter the value of the reading at 4 mA. Can also be the setting for the 0 mA setpoint when 4-20 mA <i>RANGE</i> is selected. Units and decimal places based on parameter selected. Negative numbers accepted. | |
| <i>MAX VALUE</i> | Enter the value of the reading at 20 mA. Units and decimal places based on parameter selected. Negative numbers accepted. | |
| <i>FAILURE MODE</i> | *MIN CURRENT MAX CURRENT LAST VALUE TEST CURRENT | When an Fxx error occurs, such as low signal strength, the transmitter will set the current output the selected value. |
| <i>FIXED VALUE</i> | Enter the value for the current output when there is a failure mode. This parameter is only displayed with <i>FAILURE MODE</i> is set to <i>FIXED VALUE</i> . | |
| <i>TEST CURRENT</i> | Available only when <i>OUTPUT SOURCE</i> is in <i>TEST MODE</i> . Default 12.00 mA. To check the wiring to the control system or gauge, you can override the current output with a fixed current. Numeric entry mA. 0...22 mA. | |
| <i>TRIM 4 mA</i> | Available only when <i>OUTPUT SOURCE</i> is in <i>TEST MODE</i> . Set the test current to 4 mA or 0 mA, depending on the current range selected. Adjusts output until PLC/ DCS/BAS reads the desired value. | |
| <i>TRIM 20 mA</i> | Available only when <i>OUTPUT SOURCE</i> is in <i>TEST MODE</i> . Set the test current to 20 mA. Adjusts output until PLC/DCS/BAS reads 20 mA. | |

Setup > Inputs/Output > Output #1 (or Output #2)

Output #1 and output #2 can operate independently as a frequency, totalizer pulse, direction status or alarm status output. In the *SETUP > INPUT/OUTPUTS > OUTPUT #1 (OR OUTPUT #2) > MODE* menu, select the *MODE* of operation. Then go to the *PARAMETERS* menu to set up the operation for that *MODE*.

An asterisk (*) indicates the parameter default.

| Output #1 Submenus | Options/Descriptions | | | | | | | | | | | | |
|--------------------------------|--|--|---|-----------|---------------|---------------|-----------|--------------|-----------|-------------|-------------------|-------------------|---------|
| MODE | *FREQUENCY FREQUENCY and PULSE TOTAL modes are not available with AUX OUTPUT #1 and #2 dry PULSE TOTAL contact output. FLOW DIRECTION ALARM DISABLED | | | | | | | | | | | | |
| PARAMETERS (Frequency Mode) | OUTPUT SOURCE | *FLOW RATE VELOCITY ENERGY FLOW (Energy meter only) TEST FREQUENCY | Select the reading to assign to the frequency output. | | | | | | | | | | |
| | VALUE AT 0 HZ | Numeric entry. Units and decimal place based on parameter selected. Negative numbers accepted. Default -5000. | Enter the maximum flow rate or velocity frequency that corresponds to maximum frequency flow rate or velocity. Can be negative to indicate reverse flow. The units of <i>Maximum</i> match the units in <i>SETUP > MEASUREMENTS > FLOW UNITS</i> . Example 1: For a system that only has flow in one direction, the maximum flow rate is 100 gal/min, and the corresponding maximum frequency is 2000 Hz, set up the parameters to: | | | | | | | | | | |
| | MAX VALUE | Numeric entry. Units and decimal place based on source selected. Negative numbers accepted. Default 5000. | | | | | | | | | | | |
| | MAX FREQUENCY | | <table><tr><th>Parameter</th><th>Value</th></tr><tr><td>Output Source</td><td>Flow Rate</td></tr><tr><td>Minimum</td><td>0 gal/min</td></tr><tr><td>Maximum</td><td>100 gal/min</td></tr><tr><td>Maximum Frequency</td><td>2000 Hz</td></tr></table> Example 2: For a system that flow is bidirectional, the flow rate ranges from -100 gal/min to 100 gal/min and the frequency at 100 gal/min is 2000 Hz, set up the parameters to: | Parameter | Value | Output Source | Flow Rate | Minimum | 0 gal/min | Maximum | 100 gal/min | Maximum Frequency | 2000 Hz |
| | Parameter | Value | | | | | | | | | | | |
| Output Source | Flow Rate | | | | | | | | | | | | |
| Minimum | 0 gal/min | | | | | | | | | | | | |
| Maximum | 100 gal/min | | | | | | | | | | | | |
| Maximum Frequency | 2000 Hz | | | | | | | | | | | | |
| | | <table><tr><th>Parameter</th><th>Value</th></tr><tr><td>Output Source</td><td>Flow Rate</td></tr><tr><td>Minimum</td><td>-100 gal/min</td></tr><tr><td>Maximum</td><td>100 gal/min</td></tr><tr><td>Maximum Frequency</td><td>2000 Hz</td></tr></table> With this setup at <i>no flow</i> , the frequency output is 1000 Hz.. | Parameter | Value | Output Source | Flow Rate | Minimum | -100 gal/min | Maximum | 100 gal/min | Maximum Frequency | 2000 Hz | |
| Parameter | Value | | | | | | | | | | | | |
| Output Source | Flow Rate | | | | | | | | | | | | |
| Minimum | -100 gal/min | | | | | | | | | | | | |
| Maximum | 100 gal/min | | | | | | | | | | | | |
| Maximum Frequency | 2000 Hz | | | | | | | | | | | | |
| | TEST FREQUENCY | Available when <i>TEST MODE</i> is selected for <i>OUTPUT SOURCE</i> . To check the wiring to the control system or device, you can override the frequency output with a fixed frequency. | | | | | | | | | | | |

| Output #1 Submenus | Options/Descriptions | | |
|-------------------------------------|----------------------|--|---|
| PARAMETERS (Pulse Total Mode) | OUTPUT SOURCE | *POSITIVE FLOW NEGATIVE FLOW BIDIRECTIONAL FLOW Also available for energy meters: POSITIVE ENERGY NEGATIVE ENERGY BIDIRECTIONAL ENERGY | Select whether the pulse output accumulates only on positive (forward) flow, only on negative (reverse) flow or anytime flow occurs regardless of the flow direction (bidirectional). For bidirectional, assign the direction status to the other output, if desired. |
| | SCALING FACTOR | Numeric entry. Units and decimal place based on flow rate selection. Default is 1 unit per pulse. Enter the number of totalizer units per pulse. The totalizer unit is in the <i>SETUP > MEASUREMENTS</i> menu. For example, if the totalizer unit is gallons, setting the <i>PULSES/UNIT</i> to 10 transmits 1 pulse every 10 gallons. Setting the <i>SCALING FACTOR</i> to 0.1 transmits 1 pulse every 0.1 gallons. | |
| | PULSE WIDTH | Numeric entry 5...2000 ms. Default 50 ms. Enter the pulse width in milliseconds. | |
| | PULSE STATE | *PULSE LOW PULSE HIGH | <i>PULSE LOW</i> , the pulse totalizer output remains in the off state and the voltage floats at the source voltage level. When the pulse is triggered, the output turns on and the voltage drops to the low voltage level. This setup uses the least power. If the pulse needs to be at the high voltage level, use the <i>PULSE HIGH</i> option. |
| PARAMETERS (Flow Direction Mode) | OUTPUT SOURCE | *FLOW RATE ENERGY FLOW | |
| | DIRECTION | FORWARD ON *REVERSE ON For energy meters only: ENERGY FORWARD ENERGY REVERSE | Select whether the output is active when the flow is forward or reverse. When the absolute value of the flow rate is below the cutoff, the output will not be active. |
| PARAMETERS (Alarm Mode) | ALARM | *ERRORS ONLY HIGH FLOW LOW FLOW HI/LO FLOW For energy meters only: HIGH ENERGY LOW ENERGY HI/LO ENERGY HIGH TEMP1 HIGH TEMP2 LOW TEMP1 LOW TEMP2 | Select the flow condition or meter condition to trigger the alarm and turn on the output. |
| | SET HIGH | Numeric entry. Units and decimal place based on FLOW RATE selected. Negative numbers accepted. Default is 10000. | Enter the value that the flow rate must be greater than in order to trigger an alarm. <i>SET HIGH</i> is only visible/settable when <i>ALARM</i> is set to <i>HIGH FLOW</i> , <i>OUT OF RANGE</i> or <i>ALL</i> . |
| | SET LOW | Numeric entry. Units and decimal place based on FLOW RATE selected. Negative numbers accepted. Default is 0. | Enter the value that the flow rate must be less than in order to trigger an alarm. <i>SET LOW</i> is only visible/settable when <i>ALARM</i> is set to <i>LOW FLOW</i> , <i>OUT OF RANGE</i> or <i>ALL</i> . |
| | LATCHING | *DISABLED ENABLED | When <i>ENABLED</i> , the output remains on after the alarm condition clears. Resetting alarm latch turns off the output. |
| | ANTI-CHATTER | SET DELAY | Enter how long the alarm condition must occur before activating the output to prevent nuisance trips. Numeric entry. Units: Milliseconds. Default is 100 ms. |
| | | HYSTERESIS | Enter how long the alarm condition is cleared before resetting the output to prevent the output from chattering. The parameter is only valid if <i>LATCHING</i> is <i>DISABLED</i> . Numeric entry. Default is 100 ms. |
| PULL UP RESISTOR | INTERNAL | See "Digital Outputs Wiring" on page 18. | |
| | *EXTERNAL | | |

Setup > Inputs/Output > Input

An asterisk (*) indicates the parameter default.

| Input Submenus | Options/Descriptions | |
|----------------|----------------------|--|
| MODE | DISABLED | Select the action to take when the input is active (based on the state). |
| | *RESET TOTAL | |
| | UNLATCH ALARM | |
| STATE | *ACTIVE ON HIGH | Select the voltage level to make the input active. |
| | ACTIVE ON LOW | |

Setup > Inputs/Output > RTD (Energy Models Only)

An asterisk (*) indicates the parameter default.

| Input Submenus | Options/Descriptions | |
|------------------|---|--|
| TEMP SENSOR TYPE | Pt1000 2-WIRE | Select the temperature sensor type. |
| | Pt1000 3-WIRE | |
| | Pt1000 4-WIRE | |
| | Pt100 2-WIRE | |
| | Pt100 3-WIRE | |
| | Pt100 4-WIRE | |
| RANGE | 32...122° F (0...50° C) | Select the temperature range. |
| | 32...212° F (0...100° C) | |
| | -40...392° F (-40...200° C) | |
| | 4...86° F (-20...30° C) | |
| DELTA TEMP | TEMP #1-TEMP #2 TEMP #2-TEMP #1 | Select the order for positive and negative energy calculations. |
| TRIM RTD #1 | Adjust the offset for the temperature reading for RTD #1. | See "Troubleshooting" on page 44 before adjusting the RTD input. |
| TRIM RTD #2 | Adjust the offset for the temperature reading for RTD #2. | |

Trimming the RTDs

1. Change the *Home Screen* on the transmitter to read the temperature of the RTDs.
2. Connect a computer with SoloCUE Flow Device Manager software to the TFX-5000 transmitter. In the *Setup > Input* tab, check the *Temp Sensor Type* and *Range*.
3. With a constant temperature controlled heat source at the midpoint of the operating range, heat RTD 1. Allow time for the RTD to heat thoroughly.
4. Compare the temperature of the heat source with the temperature reading of *Temp 1* on the display. In SoloCUE, adjust the *Trim RTD 1* until *Temp 1* matches the heat source temperature.
5. Repeat steps #3 and #4 for RTD 2.

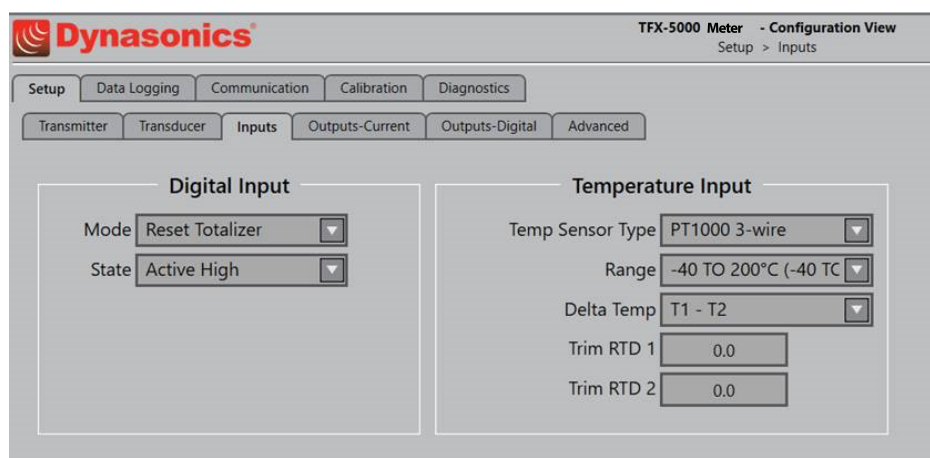


Figure 41: Trimming the RTDs

Setup > Communications

Requires service level passcode or higher if security is enabled. For addressing information, see the "TFX-5000 Meter Modbus RTU Protocol" user manual or the "TFX-5000 Meter BACnet MS/TP Protocol" user manual, available at www.badgermeter.com.

An asterisk (*) indicates the parameter default.

| Communication Submenus | Options/Descriptions | |
|--|--|--|
| EIA-485 TYPE | DISABLE | Either disable this feature or select a network type. |
| | *MODBUS RTU | |
| | BACNET MS/TP | |
| MODBUS RTU SETTINGS (Displayed when MODBUS RTU is selected as the option for EIA-485 TYPE.) | ADDRESS | Numeric entry 1...254 |
| | BAUD RATE | *AUTO, 9600, 19200, 38400, 57600, 76800, 115200 |
| | ACCESS | WRITE/READ allows full access. RESET/READ allows you to read any, but only write to <i>Flow Total Reset</i> (cannot set up meter). READ ONLY allows read only. |
| | PARITY | *NONE ODD PARITY EVEN PARITY |
| | STOP BIT | *1 STOP BIT 2 STOP BITS |
| | RESISTOR | *DISABLED ENABLED |
| | WORD ORDER | BIG ENDIAN *LITTLE ENDIAN |
| | TIMEOUT | Numeric entry 0...10000 ms |
| BACNET MS/TP SETTINGS | MAC ADDRESS | Numeric entry 0...127 |
| | BACNET ID | Numeric entry 0...4194303 |
| | BAUD RATE | *9600, 19200, 38400, 57600, 76800, 115200 |
| | ACCESS | WRITE/READ allows full access. RESET/READ allows you to read any, but only write to <i>Flow Total Reset</i> (cannot set up meter). READ ONLY allows read only. |
| | MAX MASTER | Numeric entry 1...127 |
| | PARITY | *NONE ODD PARITY EVEN PARITY |
| | STOP BIT | *1 STOP BIT 2 STOP BITS |
| | RESISTOR | DISABLED *ENABLED |
| ENDPOINT | Select the settings to match the BEACON/AquaCUE settings. Only the flow total selected for the <i>Home Screen</i> will be sent. Energy totals are not supported. | |
| | DIAL COUNT | 7, *8, 9, 10 |
| | RESOLUTION | *OFF, 1, 10, 100, 1000, 10000, 0.1, 0.01, 0.001, 0.0001 |
| | PROTOCOL | *DISABLED V1 V2 V3 |
| | When an ORION endpoint is connected to the transmitter, select the settings to match the BEACON/AquaCUE settings. Only the flow total selected for the <i>Home</i> screen will be sent. V1 protocol does not support dial counts above 7. | |

| Communication Submenus | Options/Descriptions | |
|--|----------------------|--|
| BACNET/IP (Shows only with card installed for AUTODETECT or CARD TYPE is set to BACNET/IP.) | WEBSERVER | Note: WEBSERVER is READ ONLY. *ENABLED DISABLED |
| | CLIENT TIMEOUT | 0...65,535 ms |
| | DEVICE INSTANCE | BACnet ID range: 0...99,999,999 |
| | DHCP | *DISABLED ENABLED |
| | IP ADDRESS | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0-255 for the remaining values. Option not available if DHCP is enabled. |
| | SUBNET MASK | Numeric entry ###.###.###.###. Enter each value from 0...255. Option not available if DHCP is enabled. |
| | GATEWAY | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | DNS PRIMARY | ###.###.###.### Enter a value from 1...255 for the first value and 0-255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | DNS SECONDARY | ###.###.###.### Enter a value from 1...255 for the first value and 0...255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | PORT | Use SoloCUE if you need to change the UDP port from the default setting: *AUTO NEGOTIATION 10 Mbit HALF DUPLEX 10 Mbit FULL DUPLEX 100 Mbit HALF DUPLEX 100 Mbit FULL DUPLEX |
| | ACCESS | WRITE/READ allows full access RESET/READ allows you to read any, but only write to <i>Flow Total Reset</i> (cannot set up meter) *READ ONLY allows read only |
| MODBUS TCP/IP | WEBSERVER | Note: WEBSERVER is READ ONLY. *ENABLED DISABLED |
| | CLIENT TIMEOUT | 0...65,535 ms |
| | WORD ORDER | BIG ENDIAN *LITTLE ENDIAN |
| | DHCP | *DISABLED ENABLED |
| | IP ADDRESS | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | SUBNET MASK | Numeric entry ###.###.###.###. Enter each value from 0...255. Option not available if DHCP is enabled. |
| | GATEWAY | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | DNS PRIMARY | ###.###.###.### Enter a value from 1...255 for the first value and 0...255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | DNS SECONDARY | ###.###.###.### Enter a value from 1...255 for the first value and 0...255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | PORT | *AUTO NEGOTIATION 10 Mbit HALF DUPLEX 10 Mbit FULL DUPLEX 100 Mbit HALF DUPLEX 100 Mbit FULL DUPLEX |
| | ACCESS | WRITE/READ allows full access RESET/READ allows you to read any, but only write to <i>Flow Total Reset</i> (cannot set up meter) *READ ONLY allows read only |

| Communication Submenus | Options/Descriptions | |
|--|----------------------|--|
| ETHERNET/IP (Shows only with card installed for AUTODETECT or CARD TYPE is set to ETHERNET/IP.) | WEBSERVER | Note: WEBSERVER is READ ONLY. *DISABLED ENABLED |
| | DHCP | *DISABLED ENABLED |
| | IP ADDRESS | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | IP ADDRESS | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | SUBNET MASK | Numeric entry ###.###.###.###. Enter each value from 0...255. Option not available if DHCP is enabled. |
| | GATEWAY | Numeric entry ###.###.###.###. Enter a value from 1...255 for the first value and 0...255 for the remaining values. Option not available if DHCP is enabled. |
| | DNS PRIMARY | ###.###.###.### Enter a value from 1...255 for the first value and 0...255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | DNS SECONDARY | ###.###.###.### Enter a value from 1...255 for the first value and 0...255 for the remaining values. It is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 because clients may not be able to locate the DNS server. |
| | PORT | Use SoloCUE if you need to change the TCP or UDP port from the default setting: *AUTO NEGOTIATION 10 Mbit HALF DUPLEX 10 Mbit FULL DUPLEX 100 Mbit HALF DUPLEX 100 Mbit FULL DUPLEX |
| | ACCESS | WRITE/READ allows full access RESET/READ allows you to read any, but only write to <i>Flow Total Reset</i> (cannot set up meter) *READ ONLY allows read only |

Setup > Data Logging (Service Level Access)

Requires service level passcode or higher if security is enabled.

Due to FAT32 limitation on the microSD card, if the file size exceeds 4 GB, the log file will be closed and a new file started. Both files will be accessible. The name of the files are FILE0001.txt, FILE0002.txt, and so on. Log files are automatically saved as .txt files to the microSD card. Before removing the microSD card, change the LOG MODE to DISABLED. With an 8 GB microSD card installed, the card will have enough memory to last about 1-1/2 years when logging 8 parameters at a 1 second time interval.

| Data Logging Submenus | Options/Descriptions | | |
|--------------------------------------|--|---|----------------------|
| LOG MODE | Log files can be transferred to a computer by using SoloCUE. Data logging will pause during the file transfer. | | |
| | New log file created when parameters are added or removed from data log. | | |
| | *DISABLED | | |
| | CONTINUOUS | Logs when transmitter is on and operating. | |
| TIME INTERVAL | THRESHOLD | Logs when the threshold value is between the minimum and maximum values. For example, only log when process equipment is operational and flow is above cutoff. | |
| | 1 SECOND | 1 MINUTE | 1 HOUR |
| | 2 SECONDS | 2 MINUTES | 2 HOURS |
| | 5 SECONDS | 5 MINUTES | 4 HOURS |
| | 10 SECONDS | 10 MINUTES | 6 HOURS |
| | 20 SECONDS | 30 MINUTES | 12 HOURS |
| PARAMETER #1 PARAMETER #8 | 30 SECONDS | 24 HOURS | |
| | NOTE: For error/alarm codes, the last 10 codes in the history are logged with commas separating the values. | | |
| | FLOW RATE | DELTA TRANSIT TIME | ENERGY TOTAL FORWARD |
| | FLOW TOTAL GROSS | TEMPERATURE #1 | ENERGY TOTAL REVERSE |
| | FLOW TOTAL FORWARD | TEMPERATURE #2 | ENERGY TOTAL NET |
| | FLOW TOTAL REVERSE | TEMP#1 - TEMP#2 | SIGNAL STRENGTH |
| | FLOW TOTAL NET | TEMP#2 - TEMP#1 | SOUND SPEED |
| | VELOCITY | ENERGY RATE | ERROR/ALARM CODE |
| THRESHOLD | REYNOLDS | ENERGY TOTAL GROSS | NONE |
| | If THRESHOLD control is selected, this setting will be active. | | |
| | FLOW RATE | | |
| | FLOW TOTAL | | |
| | TEMPERATURE #1 | | |
| | TEMPERATURE #2 | | |
| | DELTA TEMPERATURE | | |
| | ENERGY RATE | | |
| MIN THRESHOLD | ENERGY TOTAL | | |
| MAX THRESHOLD | VELOCITY | | |
| DELETE LOG | Will stop recording and delete all records. Prompt with a confirmation screen. | | |

Setup > Options

| Options Submenu | Options/Descriptions | | |
|-----------------|---|--|--|
| CARD TYPE | If CARD TYPE is set to AUTODETECT, the transmitter will automatically detect when a new card is installed and display menu for the card settings. If CARD TYPE is set to a specific communication/contact card, the card settings will remain for that card type even if it is not installed. If a different card is installed or no card is installed, a warning will be displayed on the home screen and the card will be inactive. | | |
| | If CARD TYPE is set to DISABLED, then the card connection will be disabled and the Ethernet and contact menus will not be displayed. | | |
| | DISABLED | | |
| | AUTODETECT | | |
| | BACNET/IP | | |
| | MODBUS TCP/IP | | |
| | ETHERNET/IP | | |
| | AUX OUTPUT | | |

Setup > Passcode Setup > Security

If *SECURITY* is enabled and you exit the *MAIN MENU*, you must re-enter your passcode to access the *MAIN MENU* again.

Passcode Setup offers three levels of access. Read-Only access does not require a passcode:

- **ADMIN**—You must enter the fault *ADMIN* passcode 000000 to change security from *DISABLE* to *ENABLE*
- **OPERATOR**
- **SERVICE**

| Security Submenus | Options/Descriptions | |
|-------------------|--|---|
| SET ADMIN | 6-digit passcode | Numeric entry |
| SET OPERATOR | 6-digit passcode | Numeric entry |
| SET SERVICE | 6-digit passcode | Numeric entry |
| LOGOUT TIMEOUT | 1 MINUTE 5 MINUTES *10 MINUTES 20 MINUTES 30 MINUTES 60 MINUTES | When logout occurs, the display returns to the <i>Home Screen</i> . |

Setup > Passcode Setup > Passcode Recovery

An asterisk (*) indicates the parameter default.

| Passcode Setup Submenus | Options/Descriptions | |
|-------------------------|--------------------------|---|
| PASSCODE RECOVERY | Passcode recovery screen | |
| TEMPORARY PASSCODE | Numeric entry | After 20 attempts to enter the temporary passcode, you will be prompted to generate a new <i>RECOVERY CODE</i> . |
| SECURITY | *DISABLED ENABLED | When <i>SECURITY</i> is enabled, you are prompted to set the service and operator passwords. If you do not, the defaults remain in place. |

Only the *ADMIN* level can reset passcodes. If the *ADMIN* passcode is lost and the passcodes need to be reset, you can contact Badger Meter, provide a recovery code to the representative and request a temporary passcode.

To generate a recovery code:

1. Select **PASSCODE RECOVERY**.
2. The next screen prompts you to generate a recovery code or cancel the request. When you request the code, it displays on the screen. Write the number in a safe place.
3. Press **MENU/BACK** and continue to operate the meter in read-only mode.

You will not be prompted to enter a passcode when you navigate the menus. You have the option of canceling the recovery process and continue to use the existing passcodes by entering the *ADMIN* passcode. The *PASSCODE LEVEL* in the *DIAGNOSTIC* menu will be set to *RECOVERY* until you successfully enter a new *ADMIN* passcode or cancel the recovery.

When you receive your temporary passcode, select **SETUP > PASSCODE SETUP > TEMPORARY PASSCODE** and enter your temporary passcode. You will automatically be prompted to enter a new *ADMIN* passcode (prompt will be either in the SoloCUE® software utility or the front panel, depending on where the temporary passcode was entered). If you do not enter a new *ADMIN* passcode within 15 minutes, the recovery mode is canceled and you must request a new recovery code to reset the passcodes. *TEMPORARY PASSCODE* can be entered from the SoloCUE software utility or the front panel, regardless of what was used to start it.

Display Menu

Requires operator level passcode or higher if security is enabled. An asterisk (*) indicates the parameter default.

| Display Submenus | Options/Descriptions | | | | | |
|------------------|--|---|--|---|---------------------------------------|--|
| LANGUAGE | *ENGLISH | English | | | | |
| | DEUTSCHE | German | | | | |
| | ESPAÑOL | Spanish | | | | |
| | FRANÇAIS | French | | | | |
| | ITALIANO | Italian | | | | |
| DECIMAL | ## #,# | Select whether the decimal indicator is a period or a comma. | | | | |
| DISPLAY TAG ID | *DISABLED ENABLED | Displays the <i>TAG ID</i> on the <i>Home Screen</i> . Default is TFX-5000. Use SoloCUE to change the <i>TAG ID</i> . | | | | |
| BRIGHTNESS | Select the display brightness 10...100% in increments of 10. Default is 70%. | | | | | |
| CONTRAST | Adjust the screen contrast 12...37. Default is 24. | | | | | |
| DIMMER | *ENABLED DISABLED | Enable the <i>DIMMER</i> to reduce the display <i>BRIGHTNESS</i> after the buttons are not pressed for the <i>TIMEOUT</i> period. Select the <i>BRIGHTNESS</i> level. Default is 10%. Press any button to awaken the transmitter and return to normal <i>BRIGHTNESS</i> . The buttons pressed will not be active for one second after the transmitter is awakened. | | | | |
| DIMMER LEVEL | OFF 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% | | | | | |
| | TIMEOUT | | 5 MINUTES *10 MINUTES 20 MINUTES 30 MINUTES 60 MINUTES | | | |
| | | | SET TIME | | Numeric entry for 24 hour clock HH:MM | |
| | | | SET DATE | | Numeric entry for date YYYY-MM-DD | |
| | | DISPLAY TIME | 24 HOUR AM / PM | Select format of the time to display on the home screen and on SoloCUE dashboard. | | |
| DISPLAY DATE | YYYY-MM-DD MM-DD-YYYY DD-MM-YYYY | Select format of the date to display on the home screen and on SoloCUE dashboard. | | | | |

Information Menu

An asterisk (*) indicates the parameter default.

| Information Submenus | Options/Descriptions |
|----------------------|-----------------------------|
| VENDOR | BADGER METER |
| MODEL | TFX-5000 |
| P.N.: | Badger Meter part number |
| S.N. | Serial Number |
| FW VERSION | Firmware Version xx.xx.xxx |
| CAL. DATE | Calibration Date YYYY-MM-DD |
| DATE CODE | Manufacture Date YYYY-MM-DD |
| TAG ID | 16 characters |

Diagnostics Menu

The *DIAGNOSTICS* menu displays system status and allows you to clear the history, reset to factory defaults and reboot the system. An asterisk (*) indicates the parameter default.

| Diagnostics Submenus | Options/Descriptions | | |
|----------------------|----------------------|--|--|
| READINGS | SIGNAL STRENGTH | Read-only numeric with message to indicate the quality of the ultrasonic signal. | |
| | HISTORY | Chronological list of 120 past errors, alarms and warning messages. | |
| | DELTA TIME FILTERED | Read-only ##.## ns | |
| | FLOW RATE RAW | Read-only unfiltered flow rate | |
| | FLUID SOUND SPEED | Read-only; Units are the same as <i>VELOCITY</i> ; Measured ultrasound speed of the fluid. | |
| | DELTA TIME RAW | Read-only ns | |
| | REYNOLDS NUMBER | Read-only; unitless | |
| | REYNOLDS FACTOR | Read-only; unitless | |
| | TEMPERATURE #1 | Read-only; Energy meters only; Units are the same as the <i>Home Screen</i> . | |
| | TEMPERATURE #2 | Read-only; Energy meters only; Units are the same as the <i>Home Screen</i> . | |
| | DELTA TEMPERATURE | The temperature difference between the two RTDs, either T1 - T2 or T2 - T1, according to the setting in <i>INPUT/OUTPUT > RTD > DELTA TEMP</i> . | |
| | TOTAL OVERFLOW COUNT | Numeric integer | The <i>TOTAL OVERFLOW COUNT</i> increments each time the flow total exceeds the digits in the display. |
| INPUT/OUTPUT STATUS | ENERGY OVERFLOW | Numeric integer | The <i>ENERGY OVERFLOW</i> is a counter that increments each time the energy total exceeds the digits in the display |
| | CURRENT #1 OUTPUT | Read-only mA | |
| | CURRENT #2 OUTPUT | Read-only mA; Energy meters only | |
| | OUTPUT #1 STATUS | *ON | Status of digital output. If the output mode is <i>ALARM</i> or <i>FLOW DIRECTION</i> , then the output status <i>ON</i> or <i>OFF</i> is indicated. Frequency and Pulse modes can operate too fast to view the <i>ON</i> and <i>OFF</i> state, so the mode is shown for the status. |
| | | OFF | |
| | | FREQUENCY | |
| | | PULSE | |
| | OUTPUT #2 STATUS | DISABLED | |
| | | ON | |
| | | OFF | |
| | | FREQUENCY | |
| | OUTPUT #3 STATUS | PULSE | Energy meters only |
| | | DISABLED | |
| | | ON | |
| | | OFF | |
| | AUX OUTPUT #1 STATUS | FREQUENCY | Only with auxiliary contact output option. |
| | | PULSE | |
| | | DISABLED | |
| | | ON | |
| | AUX OUTPUT #2 STATUS | OFF | Only with auxiliary contact output option. |
| | | PULSE | |
| | | DISABLED | |
| | | ON | |
| | INPUT STATUS | OFF | Status of digital input to reset totalizer or unlatch alarm. |
| | | ON | |
| HARDWARE OPTIONS | CARD HARDWARE | NONE BACNET/IP MODBUS TCP/IP ETHERNET/IP DRY CONTACTS | Identifies the hardware type of communication card or contact card installed regardless of the settings |
| | MAC ADDRESS | xx:xx:xx:xx:xx:xx Read only. Ethernet card must be installed and cable must be connected for the <i>MAC Address</i> to display. | |
| | LINK STATUS | CONNECTED DISCONNECTED | Read only. Ethernet link status if Ethernet card is installed and enabled. |

| Diagnostics Submenus | Options/Descriptions | | |
|--|----------------------|--|---|
| SYSTEM (Requires service level passcode or higher if security is enabled.) | TIME | HH:MM:SS (24 hour clock) | Displays the time. |
| | DATE | YYYY-MM-DD | Displays the date. |
| | POWER ON TIME | In seconds | |
| | SIMULATION MODE | OFF 100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0% | <i>Flow Simulation</i> provides output and display simulation based on a percentage of the full scale flow. Simulation will not accumulate the totalizers. The range of simulation includes 0...100% of the full scale flow. Use the <i>Flow Simulation</i> parameter to set the range of simulation in 10% increments. To change the <i>Flow Simulation</i> , from the <i>INPUTS/OUTPUTS</i> menu: 1. Select FLOW SIMULATION to view the <i>Flow Simulation</i> display. 2. Click RIGHT ARROW to increment the percentage by 10, or click DOWN ARROW to decrement the percentage by 10. |
| | PASSCODE LEVEL | READ ONLY OPERATOR SERVICE ADMIN RECOVERY | Defines the parameters, screens and actions available to a user. |
| | CLEAR HISTORY | CLEAR HISTORY confirmation screen | Clears all alarms, warnings, errors and informational messages from the <i>ALARM HISTORY</i> buffer. This is typically done after startup or maintenance on the flow system is successfully completed. |
| | FACTORY RESET | FACTORY RESET confirmation screen | Resets all parameters to the values on the device when it was shipped from the factory. Any settings made will be reset. |
| | REBOOT | REBOOT confirmation screen | Reboots the device. The TFX-5000 meter does not require this manual <i>REBOOT</i> for any procedure, but it may be useful for system troubleshooting. |

Reset Menu

| Reset Submenus | Options/Descriptions |
|------------------|--|
| RESET FLOW TOTAL | Reset the <i>FLOW TOTAL</i> . See the "Reset Flow Totalizer Procedure" below. |
| UNLATCH ALARMS | Only available if alarm latch is enabled. Unlatches output if alarm condition occurred and cleared. See "Setup > Inputs/Output > Output #1 (or Output #2)" on page 33. |

Reset Flow Totalizer Procedure

The flow meter accumulates the amount of flow passing through the meter into a flow totalizer. To reset the flow total:

1. Press **MENU/BACK**.
2. Select **RESET** from the *Main Menu*.
(Press **DOWN** to scroll through the list of options. When *RESET* is the top item, press **ENTER**.)
3. Select **RESET FLOW TOTAL** from the *Reset menu*.
(With *RESET FLOW TOTAL* as the top item, press **ENTER**.)
4. Select **OK** to confirm reset.

After selecting *RESET FLOW TOTAL*, you are prompted to confirm the reset of the flow total. Press **ENTER** to confirm or press **MENU/BACK** to cancel.

TROUBLESHOOTING

Warning and alarm messages are classified according to NAMUR 107 standards.

Out of Specification Messages

Warning and alarm messages occur when the flow meter is operational, but the readings might be out of specification or an operator might need to take action. If a warning or alarm condition occurs, a warning/alarm icon with code will appear in the at the bottom of the *Home Screen*. The flow rate and flow total will continue to be displayed.

Error Messages

An error condition occurs when the flow rate cannot be determined, such as when the signal strength is too low. If an error condition occurs, the flow rate will be replaced with the "failed" icon, code and description.

If conditions cause multiple messages to occur, all messages will be saved to the history, but some messages may not be displayed. If an error condition occurs, warning and alarm messages will not be displayed. If multiple errors occur, each error message will cycle through and be viewable for 5 seconds. Similarly, if multiple warning or alarm conditions occur (but no error conditions), each message will cycle through and be viewable for 5 seconds.

Warning, Alarm and Error Messages automatically clear when the issue clears.

Check Function Codes

When the meter or outputs are in a test mode, a check function message appears at the bottom of the *Home Screen*.

View Alarm and Message Buffer

Up to 30 alarm or warning message codes are buffered on a first-in-first-out basis. To view the buffer, go to *DIAGNOSTICS > HISTORY*.

Warning and Alarm Message Codes

Failure Codes

| Code | Description | Correction |
|----------------------|--|--|
| F02 ELECTRONIC ERROR | Multiple watchdog timeouts occurred. | Contact factory |
| F03 ELECTRONIC ERROR | Voltage levels are out of specification. | Reboot transmitter; If error repeats, repair or replace transmitter. |
| F10 LOW SIGNAL | Signal strength is below cutoff. | Check for empty pipe, transducer spacing and parameter settings. |
| F11 HIGH SIGNAL | Signal strength is oversaturated. | Change transducer mounting for more paths or enable shunt resistor. |
| F20 RTD #1 ERROR | Unable to detect RTD #1. | Check wiring to RTD #1 connector. |
| F21 RTD #2 ERROR | Unable to detect RTD #2. | Check wiring to RTD #2 connector. |

Check Function Codes

| Code | Description | Correction |
|------------------------------|--------------------------------------|---------------------------------------|
| C01 CURRENT TEST | Current output is in test mode. | Change Current Output from Test Mode. |
| C10 OUTPUT #1 FREQUENCY TEST | Output #1 is in frequency test mode. | Change Output #1 from Test Mode. |
| C11 OUTPUT #1 PULSE TEST | Output #1 is in pulse test mode. | Change Output #1 from Test Mode. |
| C12 OUTPUT #1 SWITCH TEST | Output #1 is forced on or off. | Change Output #1 from Test Mode. |
| C20 OUTPUT #2 FREQUENCY TEST | Output #2 is in frequency test mode. | Change Output #2 from Test Mode. |
| C21 OUTPUT #2 PULSE TEST | Output #2 is in pulse test mode. | Change Output #2 from Test Mode. |
| C22 OUTPUT #2 SWITCH TEST | Output #2 is forced on or off. | Change Output #2 from Test Mode. |
| C30 OUTPUT #3 FREQUENCY TEST | Output #3 is in frequency test mode. | Change Output #3 from Test Mode. |
| C31 OUTPUT #3 PULSE TEST | Output #3 is in pulse test mode. | Change Output #3 from Test Mode. |
| C32 OUTPUT #3 SWITCH TEST | Output #3 is forced on or off. | Change Output #3 from Test Mode. |
| C41 AUX #1 PULSE TEST | Aux Output #1 is in pulse test mode. | Change Aux Output #1 from Test Mode. |
| C42 AUX #1 SWITCH TEST | Aux Output #1 is forced on or off. | Change Aux Output #1 from Test Mode. |
| C51 AUX #2 PULSE TEST | Aux Output #2 is in pulse test mode. | Change Aux Output #2 from Test Mode. |
| C52 AUX #2 SWITCH TEST | Aux Output #2 is forced on or off. | Change Aux Output #2 from Test Mode. |
| C60 SIMULATION MODE | Meter is running flow simulation. | Deactivate Simulation Mode. |

Out-of-Specification Codes

| Code | Description | Correction |
|---------------------------|--|--|
| S01 ELECTRONIC WARNING | Fault detected and meter rebooted. | Contact factory, update firmware, or repair or replace transmitter. |
| S02 DEFAULT FAILED | Reset to factory defaults failed. | Check calibration. If it does not match the calibration settings on the transducer serial tag, enter field calibration settings. Return to the <i>Home Screen</i> and continue to operate (if the reset to factory defaults is through the transmitter). |
| S03 LANGUAGE FILE CORRUPT | English only. | Update firmware. |
| S10 mA TOO HIGH | Flow or energy rate higher than flow rate at 20 mA output. | Check the scaling of the Current #1 output. |
| S11 mA TOO HIGH | Flow or energy rate higher than 20 mA. | Check the scaling of the Current #2 output. |
| S19 mA SUPPLY VOLTAGE ERR | Supply voltage out of range for 4-20 mA outputs. | Check wiring. |
| S20 FREQ HIGH | Value higher than max. frequency output. | Check the scaling of the frequency on Output #1. |
| S21 FREQ HIGH | Value higher than max. frequency output. | Check the scaling of the frequency on Output #2. |
| S22 FREQ HIGH | Value higher than max. frequency output. | Check the scaling of the frequency on Output #3. |
| S30 PULSE HIGH | Pulse output is too fast for the pulse width. | Check the scaling factor, units and pulse width of the pulse on Output #1. |
| S31 PULSE HIGH | Pulse output is too fast for the pulse width. | Check the scaling factor, units and pulse width of the pulse on Output #2. |
| S32 PULSE HIGH | Pulse output is too fast for the pulse width. | Check the scaling factor, units and pulse width of the pulse on Output #3. |
| S33 PULSE HIGH | Pulse output is too fast for the pulse width. | Check the scaling factor, units and pulse width of the pulse on Aux Output #1 dry contact. |
| S34 PULSE HIGH | Pulse output is too fast for the pulse width. | Check the scaling factor, units and pulse width of the pulse on Aux Output #2 dry contact. |
| S40 HIGH FLOW | Flow rate is above high flow alarm setting. | Check flow rate and Set High setting for Output #1. |
| S41 HIGH FLOW | Flow rate is above high flow alarm setting. | Check flow rate and Set High setting for Output #2. |
| S42 HIGH FLOW | Flow rate is above high flow alarm setting. | Check flow rate and Set High setting for Output #3. |
| S43 HIGH FLOW | Flow rate is above high flow alarm setting. | Check flow rate and Set High setting for Aux Output #1. |
| S44 HIGH FLOW | Flow rate is above high flow alarm setting. | Check flow rate and Set High setting for Aux Output #2. |
| S45 LOW FLOW | Flow rate is below low flow alarm setting. | Check flow rate and Set Low setting for Output #1. |
| S46 LOW FLOW | Flow rate is below low flow alarm setting. | Check flow rate and Set Low setting for Output #2. |
| S47 LOW FLOW | Flow rate is below low flow alarm setting. | Check flow rate and Set Low setting for Output #3. |
| S48 LOW FLOW | Flow rate is below low flow alarm setting. | Check flow rate and Set Low setting for Aux Output #1. |
| S49 LOW FLOW | Flow rate is below low flow alarm setting. | Check flow rate and Set Low setting for Aux Output #2. |
| S50 TOTAL OVERFLOW | Accumulated flow total is greater than viewable digits. | Check the totalizer units or reset the flow total to clear the overflow counter. |
| S60 COMM TIMEOUT | Modbus master or BACnet device communication packet. | Check master device poll rate and offline status. Check wiring and termination resistor setting. |
| S61 MODULE TIMEOUT | Network timeout. | Check communication settings and wiring. |
| S62 DISCONNECTED | Bluetooth connection timed out. | — |
| S63 BLUETOOTH FAIL | Unable to initialize Bluetooth. | Update firmware. If error repeats, repair or replace transmitter. |
| S64 MODULE FAILED | Unable to initialize module. | Reseat module and reboot transmitter. If error repeats, replace module. |
| S65 MODULE MISMATCH | Module installed does not match settings. | Replace module with correct module. Check card type settings. |
| S67 DATA LOG ERROR | microSD card is missing or full. | Check microSD card. If data logging is not required, disable data logging. |
| S70 TEMP #1 LOW | Temp. #1 is below low alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #1. |
| S71 TEMP #1 LOW | Temp. #1 is below low alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #2. |
| S72 TEMP #1 LOW | Temp. #1 is below low alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #3. |
| S73 TEMP #2 LOW | Temp. #1 is below low alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Aux Output #1. |
| S74 TEMP #2 LOW | Temp. #1 is below low alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Aux Output #2. |
| S75 TEMP #1 HIGH | Temp. #1 is above high alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #1. |
| S76 TEMP #1 HIGH | Temp. #1 is above high alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #2. |
| S77 TEMP #1 HIGH | Temp. #1 is above high alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Output #3. |
| S78 TEMP #1 HIGH | Temp. #1 is above high alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Aux Output #1. |
| S79 TEMP #1 HIGH | Temp. #1 is above high alarm setting. | Check fluid temperature and RTD #1. Check alarm settings for Aux Output #2. |
| S80 HIGH ENERGY RATE | Flow rate is above high flow alarm setting. | Check energy flow rate and Set High setting for Output #1. |
| S81 HIGH ENERGY RATE | Flow rate is above high flow alarm setting. | Check energy flow rate and Set High setting for Output #2. |
| S82 HIGH ENERGY RATE | Flow rate is above high flow alarm setting. | Check energy flow rate and Set High setting for Output #3. |
| S83 HIGH ENERGY RATE | Flow rate is above high flow alarm setting. | Check energy flow rate and Set High setting for Aux Output #1. |
| S84 HIGH ENERGY RATE | Flow rate is above high flow alarm setting. | Check energy flow rate and Set High setting for Aux Output #2. |
| S85 LOW ENERGY RATE | Flow rate is above low flow alarm setting. | Check energy flow rate and Set Low setting for Output #1. |
| S86 LOW ENERGY RATE | Flow rate is above low flow alarm setting. | Check energy flow rate and Set Low setting for Output #2. |
| S87 LOW ENERGY RATE | Flow rate is above low flow alarm setting. | Check energy flow rate and Set Low setting for Output #3. |
| S88 LOW ENERGY RATE | Flow rate is above low flow alarm setting. | Check energy flow rate and Set Low setting for Aux Output #1. |
| S89 LOW ENERGY RATE | Flow rate is above low flow alarm setting. | Check energy flow rate and Set Low setting for Aux Output #2. |
| S90 TEMP #2 LOW | Temp. #2 is below low alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #1. |
| S91 TEMP #2 LOW | Temp. #2 is below low alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #2. |
| S92 TEMP #2 LOW | Temp. #2 is below low alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #3. |
| S93 TEMP #2 LOW | Temp. #2 is below low alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Aux Output #1. |
| S94 TEMP #2 LOW | Temp. #2 is below low alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Aux Output #2. |

| Code | Description | Correction |
|------------------|---------------------------------------|---|
| S95 TEMP #2 HIGH | Temp. #2 is above high alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #1. |
| S96 TEMP #2 HIGH | Temp. #2 is above high alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #2. |
| S97 TEMP #2 HIGH | Temp. #2 is above high alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Output #3. |
| S98 TEMP #2 HIGH | Temp. #2 is above high alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Aux Output #1. |
| S99 TEMP #2 HIGH | Temp. #2 is above high alarm setting. | Check fluid temperature and RTD #2. Check alarm settings for Aux Output #2. |

Informational Events Codes

Information events are only displayed in the ALARM HISTORY and not on the *Home Screen*.

| Code | Description |
|-------------------------|--|
| I01 POWER ON | Power on or rebooted. |
| I11 ZERO | Meter zeroed. |
| I12 FACTORY CALIBRATION | Calibration changed from Field to Factory. |
| I13 FIELD CALIBRATION | Calibration changed from Factory to Field. |
| I21 FIRMWARE CHANGED | Firmware updated. |
| I31 FLOW TOTAL RESET | Flow total reset to zero. |
| I41 NO SD CARD | Micro SD card not installed. |

Symptoms

Symptom: Transmitter does not power up.

| Possible Causes | Recommended Action |
|--|--|
| <ul style="list-style-type: none"> No power or inadequate power Blown fuse (AC Model only) Display ribbon cable not seated properly | <ul style="list-style-type: none"> Measure voltage at the power terminals and check that the voltage matches the labels by the power terminals. Check the fuse near the power terminals. If fuse is blown, verify the voltage and polarity is correct and reset the fuse. Inspect ribbon cable connections. LED's on power board will light up with no LCD display. Replace the transmitter if the above actions do not resolve the issue. |

Symptom: Flow reading appears to be incorrect.

| Possible Causes | Recommended Action |
|---|--|
| <ul style="list-style-type: none"> Incorrect positioning of transducers Poor contact between transducers and pipe Poor placement of transducers Low signal strength Process loop issues Incorrect pipe settings Meter not calibrated Display not set up correctly | <p>Refer to the Transducer Mounting Configuration section for details on proper installation.</p> <p>At the transducer:</p> <ul style="list-style-type: none"> Verify that the spacing of the transducers is set correctly. On most transducers, a scribe mark on the side of the transducers indicates the point of measurement—NOT from the end points of the transducers. Verify that the transducers are aligned correctly. For Z-Mount, verify the transducers are 180° from each other. Make sure there is a good contact between the transducers and pipe and a thin coat of acoustic coupling is applied. For integral mount, check for over-tightening of the transducers. <p>Process loop and general location:</p> <ul style="list-style-type: none"> Make sure the transducers are on the sides of the pipe and NOT on the top of the pipe. Check that the transducers are NOT located at the highest point in the loop where air may accumulate. Check that the transducers are NOT on a downward flowing pipe unless adequate downstream head pressure is present to overcome partial filling or cavitation. Check that the transducers have adequate straight pipe upstream and downstream. Check process loop for entrained air or particulates which will impact the flow readings. Pipes may develop scale, product build-up or corrosion over time. As a result, the effective wall thickness may be different than a new pipe and wall thickness or liner parameters may need to be adjusted. <p>At the transmitter:</p> <ul style="list-style-type: none"> Verify that pipe parameters match the installation. |

Symptom: Unstable flow.

| Possible Causes | Recommended Action |
|--|--|
| <ul style="list-style-type: none"> • Installation issues • Flow instability • Transducers mounting is loose • Transducers are moved • Incorrect flow settings | <ul style="list-style-type: none"> • Check process loop for variations of entrained air which will impact the flow • Check for pump induced flow instability. • Check that the transducers are secure and are in area where the transducers will not be inadvertently bumped or disturbed. • Check low flow cutoff, minimum flow or maximum flow settings. |

Symptom: Flow readout is opposite of the flow direction.

| Possible Causes | Recommended Action |
|--|---|
| <ul style="list-style-type: none"> • Integral mount transmitter is mounted in reverse flow direction so display is properly oriented • Up and down transducers wiring reversed • Flow direction parameter is reversed | <ul style="list-style-type: none"> • Change the transducer flow direction parameter. • Rewire the up and down transducers to the transmitter. |

Symptoms: Current, frequency or pulse outputs do not match the readings.

| Possible Causes | Recommended Action |
|---|---|
| <ul style="list-style-type: none"> • Incorrect parameter settings • Wiring or control system configuration issues | Verify that the parameters for the output are set properly. |

REPLACEMENT PROCEDURES

⚠ WARNING

DISCONNECT POWER BEFORE OPENING THE ENCLOSURE.

Tools Required

- A Phillips #2 screwdriver
- A flat blade screwdriver
- Tweezers for electronics
- A workbench that prevents ESD damage to the electronics

⚠ CAUTION

CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). BEFORE PICKING UP AN ESD-SENSITIVE ELECTRONIC COMPONENT, DISCHARGE YOURSELF BY TOUCHING A GROUNDED BARE METAL SURFACE OR APPROVED ANTI-STATIC MAT.



OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC-SENSITIVE DEVICES.

Replacing an AC Module

1. Turn off the power.
2. Open the enclosure.
3. Unplug the DC power wire connector from the terminal block on the main board.
4. Remove (2) M3 pan head phillips screws that secure the cover over the AC power terminal block.
5. Unplug the wire connector from the terminal block on the AC module.
6. Remove the remaining (4) M3 pan head phillips screws and lock washers that secure the AC module to the enclosure base.
7. Remove the AC module.

Installation is in the reverse order.

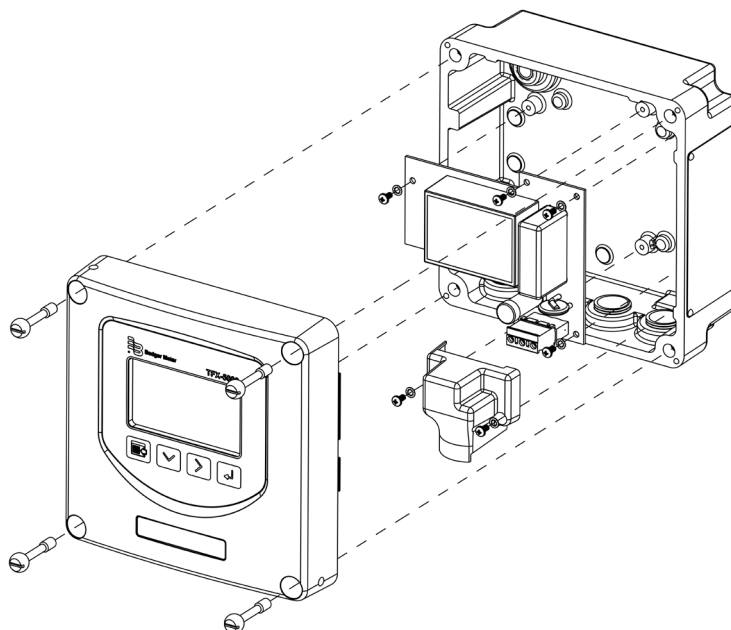


Figure 42: Replacing an AC module

Replacing the Communication or Dry Contact Board

1. Turn off the power.
2. Open the enclosure.
3. Disconnect the wires from the communication board.
4. Remove (2) M3 pan head phillips screws that secure the cover over the communication board.
5. Remove the cover.
6. Remove the remaining (2) M3 pan head phillips screws that secure the communications board.
7. Lift the communications board straight out to unplug from the main board.

Installation is in reverse order, noting the following. To install a new communications board, align the pins with the header on the main board and gently press straight down. Be careful not to misalign the pins. Do not use excessive force.

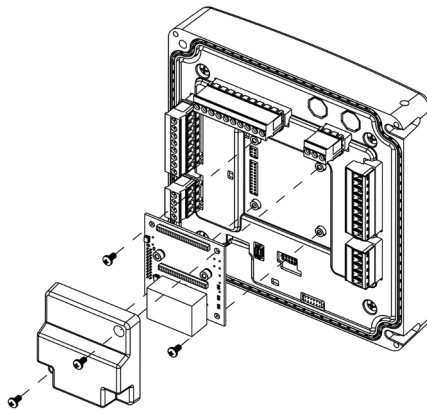


Figure 43: Replacing the Communication or Dry Contact Board

Replacing the Main Board

1. Turn off the power.
2. Open the enclosure.
3. Remove the terminal blocks from the header on the main board.
4. If a communications board is present, remove it.
5. Remove the (4) M4 pan head phillips screws that secure the main board and shield.
6. Lift the shield off the main board.
7. Gently pull the main board straight out to disengage it from the display header and remove it from the enclosure lid.

Installation is in reverse order, noting the following. To install a new main board, align the pins on the display header with the socket on the main board and gently press straight down. Be careful not to misalign the pins. Do not use excessive force.

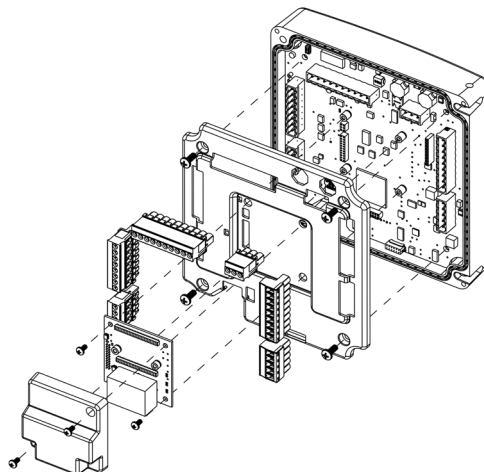


Figure 44: Replacing the Communication or Dry Contact Board

SPECIFICATIONS

System

| | | |
|-------------------------------------|--|---|
| Liquid Types | Most clean liquids or liquids containing small amounts of suspended solids or gas bubbles | |
| Flow Accuracy | Medium and Large Pipes (RZ, NZ, WZ, HZ, LZ, YZ, JZ, KZ) | $\pm 0.5\% \pm 0.0049 \text{ ft/s}$ (0.015 m/s) |
| | Small Pipes (CA-CT, UZ) | 1 in. (25 mm) and larger = $\pm 1\% \pm 0.03 \text{ ft/s}$ (0.009 m/s) 3/4 in. (19 mm) and smaller = $\pm 1\%$ of full scale |
| Repeatability | 0.2% above 1.5 ft/s | |
| Velocity | Medium and Large Pipes | Up to 40 ft/s, depending on pipe and fluid |
| | Small Pipes | Up to 20 ft/s, depending on pipe and fluid |
| Certification and Compliance | General Safety (all models): cCSAus, CE, Pollution Degree 2, CE compliance to Low Voltage Directive, 2014/35/EU Hazardous Location transmitter and transducers: CSA-c-us Class I Division 2 Groups ABCD T4 Requires flexible conduit Not available with UZ, HZ or JZ and KZ (Easy Rail) transducers, Auxiliary Dry Contact card or units with AquaCUE/BEACON endpoints | |

Transmitter

| | | |
|---------------------------------|--|---|
| Power Options | 24V DC/AC | 9...28V DC @ 8 W max. or 20...26 AC 47...63 Hz @ 0.5 A max., 2 Amp slow-blow fuse, not field replaceable |
| | Mains AC | 85...264V AC 47...63 Hz @ 24VA max. 1 Amp slow-blow fuse, manually field replaceable Over-Voltage Rating Category II (CAT II) |
| Display | Options | Display with keypad or no display/keypad |
| | Keypad | 4-button navigation, keypad with tactile feedback; polyester film |
| | Display | 128 × 64 pixel LED backlit graphical display; adjustable brightness and timeout; polycarbonate window |
| | Flow rate/total | 8-digit |
| Enclosure | NEMA Type 4, IP67 | |
| Construction | Aluminum construction; painted; wall, panel or pipe mounting; stainless steel fasteners and mounting hardware; EPDM gasket | |
| | Conduit Holes | (4) 1/2 in. NPT, M20 × 1.5 or 1/2 BSPP; cable glands available for NPT and M20 |
| Environmental Ratings | Pollution Degree | 2 |
| | Altitude Restriction | Up to 2000 m (6561 ft) |
| | Ambient Temperature Range | −4...140° F (−20...60° C) |
| | Storage Temperature Range | −40...176° F (−40...80° C) |
| | Humidity | 0...85%, non-condensing |
| Configuration | Via optional keypad or SoloCUE configuration software; SoloCUE available on DVD | |
| Units (Field-Selectable) | Velocity | feet/second, meters/second |
| | Volumetric total | US Gallons, Million Gallons, Imperial Gallons, Million Imperial Gallons, Acre-Feet, Liters, Hectoliters, Cubic Meters, Cubic Feet, Oil Barrels (42 gallons), Fluid Barrels (31.5 gallons), Imperial Fluid Barrels (36 imperial gallons), Pounds (Kilograms) and custom units |
| | Flow rate | Acre Feet/Day, Liters/Second, Liters/Minute, Liters/Hour, Cubic Meters/Second, Cubic Meters/Minute, Cubic Meters/Hour, Cubic Feet/Minute, Cubic Feet/Minute, Cubic Feet/Hour, Gallons/Second, Gallons/Minute, Gallons/Hour, Million Gallons/Day, Imperial Gallons/Second, Imperial Gallons/Minute, Imperial Gallons/Hour, Million Imperial Gallons/Day, Oil Barrels/Day, Fluid Barrels/Day, Imperial Fluid Barrels/Day and custom units |
| | Energy total (energy meters) | British Thermal Unit (Btu), Thousand Btu, Millions Btu, Kilocalories, Mega calories, Kilowatt-hour, Megawatt hour, Kilojoules, Mega joules, Ton-hour (Refrigeration) |
| | Heat/cooling rate (energy meters) | Btu/hour, Thousand Btu/hour, Millions Btu/hour, Ton (Refrigeration), Watts, Kilowatts, Megawatts, Kilojoules/hour, Mega joules/hour, Kilocalories/hour, Mega calories/hour |

| | | Flow Meter | Energy Meter |
|--------------------|--|--|---|
| Inputs and Outputs | 0/4...20 mA output | One 16-bit, isolated, max 800 Ohms, internal or external power | Two 16-bit, isolated, max 800 Ohms, internal or external power |
| | Digital input | One 5...30V DC, isolated, externally or internally sourced, reset totalizer or alarm output | |
| | Digital output | Two selectable pulse, alarm, flow direction, sink isolated open collector, 5...30V DC, max. 50 mA externally or internally sourced | Three selectable pulse, frequency, alarm, flow direction, isolated open collector, 5...30V DC, externally or internally sourced |
| | | Frequency output: 50% duty cycle, 63...10k Hz maximum frequency | |
| | | Pulse (totalizer) output: 5 kHz max. output, open collector, pulse width 5...500 ms programmable | |
| | | Optional: Two dry contact output for alarm or flow direction 30V DC max., 5A max. (Ethernet not available with this option) | |
| | RTD (energy only) | None | Two 2-wire, 3-wire or 4-wire Pt100/Pt1000 RTD inputs; Range of -40...200° C; Clamp-on resistor kits available |
| Ports | Programming | USB 2.0 mini B connector for connection to a device with SoloCUE configuration software | |
| | EIA-485 | Modbus RTU command set or BACnet MS/TP; Baud rates 9600, 14400,19200, 38400, 57600, 76800, 115k; terminating resistor selectable | |
| | Ethernet | Optional 10/100 Base T RJ45, communication via Modbus TCP/IP, EtherNet/IP, or BACnet/IP with webserver | |
| | AquaCUE/BEACON | Connectivity to AquaCUE/BEACON endpoint (LTE cellular) | |
| Data Logging | Number of points | Up to 8 parameters per record. Selectable 1 second to 1 day Transfer logs via memory card | |
| | Real Time Clock | Backed up with a super capacitor, minimum of 32 days of data retention without power; Requires no servicing | |
| | MicroSD card slot | 8 GB card, included with transmitter | |
| Alarms | Records 150 previous alarms, warnings or errors | | |
| Languages | English | | |
| Security | Four levels: Read-only, Operator, Service and Admin; 6-digit passcode number; selectable auto logout | | |

Transducers

| Model | Construction | Cable Length Max. | Pipe/Tubing Sizes | Flow Rate Max. GPM (LPM) | Pipe/Tubing Materials | Protection |
|--|--|-------------------|---|--------------------------|-----------------------|------------------|
| CA-CT fixed small pipe | CPVC, Ultem®, Nylon cord grip PVC cable jacket; -40...194° F (-40...90° C) | 100 ft (30 m) | 0.5...2 in. (12...50 mm) | 190 (720) | See ² | NEMA 6/IP67 |
| UZ ¹ adjustable small pipe | CPVC, Ultem, and anodized aluminum track system; Nickel-plated brass connector with Teflon insulation; PVC cable jacket -40...194° F (-40...90° C) | 100 ft (30 m) | 0.5...2 in. (12...50 mm) | 190 (720) | | NEMA 12 |
| NZ ¹ standard pipe | PVC, Ultem®, Nylon cord grip PVC cable jacket; -40...194° F (-40...90° C) | 300 ft (90 m) | 2.5...12 in. (DN65...DN300) | 4000 (15,000) | | NEMA 6/IP67 |
| RZ ¹ standard pipe | PBT glass filled, Ultem®, Nylon cord grip; PVC cable jacket; -40...250° F (-40...121° C) | 300 ft (90 m) | 2.5...12 in. (DN65...DN300) | 4000 (15,000) | | NEMA 6/IP67 |
| JZ, KZ ¹ standard pipe, integrated rail | PBT glass filled, Ultem, Nylon cord grip; PVC cable jacket; -40...250° F (-40...121° C) | 300 ft (90 m) | 2.5...6 in. (DN65...DN150) 2.5...12 in. (DN65...DN300) | 4000 (15,000) | | NEMA 6/IP67 |
| WZ ¹ standard pipe, submersible | CPVC, Ultem, Nylon cord grip Polyethylene cable jacket; -40...194° F (-40...90° C) | 300 ft (90 m) | 2.5...12 in. (DN65...DN300) | 4000 (15,000) | | NEMA 6P/ IP68 |
| HZ ¹ high temperature | PTFE, Vespel, Nickel-plated brass cord grip; FEP cable jacket; -40...350° F (-40...176° C) | 300 ft (90 m) | 2.5...12 in. (DN65...DN300) | 4000 (15,000) | | NEMA 6/IP67 |
| LZ ¹ large pipe | CPVC, Ultem, Nylon cord grip PVC cable jacket; -40...194° F (-40...90° C) | 300 ft (90 m) | 8...48 in. (DN200...DN1200) ^{3,4} | 33,000 (125,000) | | NEMA 6/IP67 |
| YZ ¹ large pipe, submersible | CPVC, Ultem, Nylon cord grip Polyethylene cable jacket; -40...194° F (-40...90° C) | 300 ft (90 m) | 8...48 in. (DN200...DN1200) ^{3,4} | 33,000 (125,000) | | NEMA 6/IP68 |

¹ Recommendations based on unlined, new pipes with water. Recommended pipe or tubing sizes vary with pipe conditions and fluid.

² PVC, CPVC, HDPE, PTFE, PDVF, stainless steel, ductile iron, aluminum, brass naval, carbon steel copper.

³ Large pipe transducers are recommended for 8...12 in. pipes if normal velocity is expected to be greater than 12 ft/s (3.6 m/s).

⁴ Consult factory for larger pipe sizes.

RTD Kits

| Part Number | Description | Installation | RTD Type | Construction | Temperature Range |
|-------------|---------------------------------------|------------------------------------|------------------|---|--------------------------------|
| 68996-001 | RTD matched pair; 15 ft (4.5 m) cable | Pipe clamp, surface mount, IP54 | Pt 1000, Class A | Aluminum body, silicone cable jacket | -58...356° F (-50...180° C) |
| 68996-002 | RTD matched pair; 50 ft (15 m) cable | | | | |
| 68996-003 | RTD matched pair; 100 ft (30 m) cable | | | | |

Data Logging Storage

| Part Number | Description |
|-------------|--------------------------------------|
| 69032-001 | MicroSD card, industrial grade, 8 GB |

Configuration Software

SoloCUE Flow Device Manager Software

The flow meter *may* be programmed through the keypad or with SoloCUE software. If the meter is ordered without a display/keypad, the flow meter *must* be programmed with SoloCUE software. The software is used to configure, calibrate and communicate with TFX-5000 meters. Additionally, it has numerous troubleshooting tools to make diagnosing and correcting installation problems easier.

| | | |
|------------------|--|---|
| SoloCUE | Used to configure, calibrate and troubleshoot flow meters and control valves; Software is compatible with Windows 7, 8, 10 | |
| USB Cable | RC820648 | USB 2.0 mini B connector to A connector, shielded |

PART NUMBER CONSTRUCTION

TFX-5000 Flow Meters for Pipes 2 in. and Smaller

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|--|---|--|---|--|---|--|---|----|---|--|---|--|---|--|
| | DQ | - | G | - | | - | | - | | - | | - | XX | - | | - | | - | |
| Model | TFX-5000 Ultrasonic Clamp-On Meter | | | | | | | | | | | | | | | | | | |
| Certification | General Area US/Canada, CE | | | | | | | | | | | | | | | | | | |
| Transducer Type¹ | 1/2 inch ANSI Pipe CA 3/4 inch ANSI Pipe CB 1 inch ANSI Pipe CC 1-1/4 inch ANSI Pipe CD 1-1/2 inch ANSI Pipe CE 2 inch ANSI Pipe CF 1/2 inch Copper Tube CG 3/4 inch Copper Tube CH 1 inch Copper Tube CT 1-1/4 inch Copper Tube CJ 1-1/2 inch Copper Tube CK 2 inch Copper Tube CL Small pipe, universal (not available with conduit) UZ | | | | | | | | | | | | | | | | | | |
| Transmitter Type | 110/220V AC Remote Mounted R 24V DC/AC Remote Mounted B | | | | | | | | | | | | | | | | | | |
| Display | Display and Keypad S No Display/Keypad W | | | | | | | | | | | | | | | | | | |
| Remote Cable Length | 15 feet (4.5 m) AC 30 feet (9 m) AF 50 feet (15 m) AK 75 feet (23 m) AR 100 feet (30 m) BW | | | | | | | | | | | | | | | | | | |
| Conduit Type and Length (Conduit length is less than or equal to cable length) | None WW 5 feet (1.5 m) AA 15 feet (4.5 m) AC 30 feet (9 m) AF 50 feet (15 m) AK 75 feet (23 m) AR 100 feet (30 m) BW | | | | | | | | | | | | | | | | | | |
| Hardware | 1/2 in. NPT Threads, Poly cable glands S 1/2 in. NPT Threads, Nickel Plated Brass cable glands T 1/2 in. NPT Threads, no cable glands N M20 Threads, Poly cable glands C M20 Threads, Nickel Plated Brass cable glands D M20 Threads, no cable glands A | | | | | | | | | | | | | | | | | | |
| Endpoint Wiring Method | None XX | | | | | | | | | | | | | | | | | | |
| Communication/Output | Standard Output (Modbus RTU or BACnet MS/TP field selectable) S Standard Output plus Modbus TCP Ethernet T Standard Output plus EtherNet/IP U Standard Output plus BACnet/IP Ethernet V Standard Output plus Aux Output 9 | | | | | | | | | | | | | | | | | | |
| Units of Measure Totalizer/Flow Rate | Gallons/gallons per minute (field selectable, additional options available) G | | | | | | | | | | | | | | | | | | |
| Testing & Tagging | Factory Calibrated F Factory Calibrated/Stainless Steel Tag S | | | | | | | | | | | | | | | | | | |

¹Stainless steel tube 1/2...2 in. options are available.

TFX-5000 Flow Meters for Pipes 2 in. and Smaller for Hazardous Locations

| | | | | | | | | | |
|---|----|----|--|--|--|--|--|--|--|
| <div style="display: flex; justify-content: space-between; align-items: center;"> [DQ] - [B] - [] - [] - [] - [] - [] - [] - [XX] - [] - [] - [] </div> | | | | | | | | | |
| Model | | | | | | | | | |
| TFX-5000 Ultrasonic Clamp-On Meter | | | | | | | | | |
| Certification | | | | | | | | | |
| Hazardous Location, Class I, Division 2 | | | | | | | | | |
| Transducer Type ¹ | | | | | | | | | |
| 1/2 inch ANSI Pipe | CA | | | | | | | | |
| 3/4 inch ANSI Pipe | CB | | | | | | | | |
| 1 inch ANSI Pipe | CC | | | | | | | | |
| 1-1/4 inch ANSI Pipe | CD | | | | | | | | |
| 1-1/2 inch ANSI Pipe | CE | | | | | | | | |
| 2 inch ANSI Pipe | CF | | | | | | | | |
| 1/2 inch Copper Tube | CG | | | | | | | | |
| 3/4 inch Copper Tube | CH | | | | | | | | |
| 1 inch Copper Tube | CT | | | | | | | | |
| 1-1/4 inch Copper Tube | CJ | | | | | | | | |
| 1-1/2 inch Copper Tube | CK | | | | | | | | |
| 2 inch Copper Tube | CL | | | | | | | | |
| Transmitter Type | | | | | | | | | |
| 110/220V AC Remote Mounted | R | | | | | | | | |
| 24V DC/AC Remote Mounted | B | | | | | | | | |
| Display | | | | | | | | | |
| Display and Keypad | S | | | | | | | | |
| No Display/Keypad | W | | | | | | | | |
| Remote Cable/Conduit Length ² | | | | | | | | | |
| 15 feet (4.5 m) | AC | AC | | | | | | | |
| 30 feet (9 m) | AF | AF | | | | | | | |
| 50 feet (15 m) | AK | AK | | | | | | | |
| 75 feet (23 m) | AR | AR | | | | | | | |
| 100 feet (30 m) | BW | BW | | | | | | | |
| Hardware | | | | | | | | | |
| 1/2 in. NPT Threads, Poly cable glands | S | | | | | | | | |
| 1/2 in. NPT Threads, Nickel Plated Brass cable glands | T | | | | | | | | |
| 1/2 in. NPT Threads, no cable glands | N | | | | | | | | |
| M20 Threads, Poly cable glands | C | | | | | | | | |
| M20 Threads, Nickel Plated Brass cable glands | D | | | | | | | | |
| M20 Threads, no cable glands | A | | | | | | | | |
| Endpoint Wiring Method | | | | | | | | | |
| None | XX | | | | | | | | |
| Communication/Output | | | | | | | | | |
| Standard Output (Modbus RTU or BACnet MS/TP field selectable) | S | | | | | | | | |
| Standard Output plus Modbus TCP Ethernet | T | | | | | | | | |
| Standard Output plus EtherNet/IP | U | | | | | | | | |
| Standard Output plus BACnet/IP Ethernet | V | | | | | | | | |
| Units of Measure Totalizer/Flow Rate | | | | | | | | | |
| Gallons/gallons per minute (field selectable, additional options available) | G | | | | | | | | |
| Testing & Tagging | | | | | | | | | |
| Factory Calibrated | F | | | | | | | | |
| Factory Calibrated/Stainless Steel Tag | S | | | | | | | | |

¹Stainless steel tube 1/2...2 in. options are available.² For hazardous location units, Remote Cable and Conduit Length codes must match.

TFX-5000 Flow Meters for Pipes 2.5 in. and Larger

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----|---|---|---|--|---|--|---|--|---|--|---|--|---|----|---|--|---|--|---|--|--|--|--|--|--|--|--|
| | DQ | - | G | - | | - | | - | | - | | - | | - | XX | - | | - | | - | | | | | | | | |
| Model | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TFX-5000 Ultrasonic Clamp-On Meter | | | | | | | | | | | | | | | DQ | | | | | | | | | | | | | |
| Certification | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| General Area US/Canada, CE | | | | | | | | | | | | | | | G | | | | | | | | | | | | | |
| Transducer Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Medium pipe, 2.5 in. (65 mm) or larger | | | | | | | | | | | | | | | RZ | | | | | | | | | | | | | |
| Medium pipe, submersible, 2.5 in. (65 mm) or larger ¹ | | | | | | | | | | | | | | | WZ | | | | | | | | | | | | | |
| 2.5...6 inches (65...150 mm) Easy Rail (not available with conduit) | | | | | | | | | | | | | | | JZ | | | | | | | | | | | | | |
| 2.5...12 inches (65...300 mm) Easy Rail (not available with conduit) | | | | | | | | | | | | | | | KZ | | | | | | | | | | | | | |
| Medium pipe, high temperature (not available with conduit) | | | | | | | | | | | | | | | HZ | | | | | | | | | | | | | |
| Large pipe, 8 in. (200 mm) or larger | | | | | | | | | | | | | | | LZ | | | | | | | | | | | | | |
| Large pipe, submersible, 8 in. (200 mm) or larger ¹ | | | | | | | | | | | | | | | YZ | | | | | | | | | | | | | |
| Transmitter Type | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 110/220V AC Remote Mounted | | | | | | | | | | | | | | | R | | | | | | | | | | | | | |
| 24V DC/AC Remote Mounted | | | | | | | | | | | | | | | B | | | | | | | | | | | | | |
| Display | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Display and Keypad | | | | | | | | | | | | | | | S | | | | | | | | | | | | | |
| No Display/Keypad | | | | | | | | | | | | | | | W | | | | | | | | | | | | | |
| Remote Cable Length | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 feet (4.5 m) | | | | | | | | | | | | | | | AC | | | | | | | | | | | | | |
| 30 feet (9 m) | | | | | | | | | | | | | | | AF | | | | | | | | | | | | | |
| 50 feet (15 m) | | | | | | | | | | | | | | | AK | | | | | | | | | | | | | |
| 75 feet (23 m) | | | | | | | | | | | | | | | AR | | | | | | | | | | | | | |
| 100 feet (30 m) | | | | | | | | | | | | | | | BW | | | | | | | | | | | | | |
| 150 feet (46 m) | | | | | | | | | | | | | | | BK | | | | | | | | | | | | | |
| 200 feet (61 m) | | | | | | | | | | | | | | | DW | | | | | | | | | | | | | |
| 250 feet (76 m) | | | | | | | | | | | | | | | DK | | | | | | | | | | | | | |
| 300 feet (90 m) | | | | | | | | | | | | | | | EW | | | | | | | | | | | | | |
| Conduit Type and Length (Conduit length is less than or equal to cable length.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| None | | | | | | | | | | | | | | | WW | | | | | | | | | | | | | |
| 5 feet (1.5 m) | | | | | | | | | | | | | | | AA | | | | | | | | | | | | | |
| 15 feet (4.5 m) | | | | | | | | | | | | | | | AC | | | | | | | | | | | | | |
| 30 feet (9 m) | | | | | | | | | | | | | | | AF | | | | | | | | | | | | | |
| 50 feet (15 m) | | | | | | | | | | | | | | | AK | | | | | | | | | | | | | |
| 75 feet (23 m) | | | | | | | | | | | | | | | AR | | | | | | | | | | | | | |
| 100 feet (30 m) | | | | | | | | | | | | | | | BW | | | | | | | | | | | | | |
| 150 feet (46 m) | | | | | | | | | | | | | | | BK | | | | | | | | | | | | | |
| 200 feet (61 m) | | | | | | | | | | | | | | | DW | | | | | | | | | | | | | |
| 250 feet (76 m) | | | | | | | | | | | | | | | DK | | | | | | | | | | | | | |
| 300 feet (90 m) | | | | | | | | | | | | | | | EW | | | | | | | | | | | | | |
| Hardware | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, Poly cable glands | | | | | | | | | | | | | | | S | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, Nickel Plated Brass cable glands | | | | | | | | | | | | | | | T | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, no cable glands | | | | | | | | | | | | | | | N | | | | | | | | | | | | | |
| M20 Threads, Poly cable glands | | | | | | | | | | | | | | | C | | | | | | | | | | | | | |
| M20 Threads, Nickel Plated Brass cable glands | | | | | | | | | | | | | | | D | | | | | | | | | | | | | |
| M20 Threads, no cable glands | | | | | | | | | | | | | | | A | | | | | | | | | | | | | |
| Endpoint Wiring Method | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| None | | | | | | | | | | | | | | | XX | | | | | | | | | | | | | |
| Communication/Output | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Standard Output (Modbus RTU or BACnet MS/TP field selectable) | | | | | | | | | | | | | | | S | | | | | | | | | | | | | |
| Standard Output plus Modbus TCP Ethernet | | | | | | | | | | | | | | | T | | | | | | | | | | | | | |
| Standard Output plus EtherNet/IP | | | | | | | | | | | | | | | U | | | | | | | | | | | | | |
| Standard Output plus BACnet/IP Ethernet | | | | | | | | | | | | | | | V | | | | | | | | | | | | | |
| Standard Output plus Aux Output | | | | | | | | | | | | | | | 9 | | | | | | | | | | | | | |
| Units of Measure Totalizer/Flow Rate | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gallons/gallons per minute (field selectable, additional options available) | | | | | | | | | | | | | | | G | | | | | | | | | | | | | |
| Testing & Tagging | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Factory Calibrated | | | | | | | | | | | | | | | F | | | | | | | | | | | | | |
| Factory Calibrated/Stainless Steel Tag | | | | | | | | | | | | | | | S | | | | | | | | | | | | | |

¹ Submersible transducer cables use two conduit openings.

TFX-5000 Flow Meters for Pipes 2.5 in. and Larger for Hazardous Locations

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| <div style="display: flex; justify-content: space-between;"> [DQ] - [B] - [] - [] - [] - [] - [] - [] - [XX] - [] - [] </div> | | | | | | | | | |
| Model | | | | | | | | | |
| TFX-5000 Ultrasonic Clamp-On Meter | | | | | | | | | |
| Certification | | | | | | | | | |
| Hazardous Location, Class I, Division 2 | | | | | | | | | |
| Transducer Type | | | | | | | | | |
| Medium pipe, 2.5 in. (65 mm) or larger | | | | | | | | | |
| Medium pipe, submersible, 2.5 in. (65 mm) or larger ¹ | | | | | | | | | |
| Large pipe, 8 in. (200 mm) or larger | | | | | | | | | |
| Large pipe, submersible, 8 in. (200 mm) or larger ¹ | | | | | | | | | |
| Transmitter Type | | | | | | | | | |
| 110/220V AC Remote Mounted | | | | | | | | | |
| 24V DC/AC Remote Mounted | | | | | | | | | |
| Display | | | | | | | | | |
| Standard | | | | | | | | | |
| No Display/Keypad | | | | | | | | | |
| Remote Cable/Conduit Length ² | | | | | | | | | |
| 15 feet (4.5 m) | | | | | | | | | |
| 30 feet (9 m) | | | | | | | | | |
| 50 feet (15 m) | | | | | | | | | |
| 75 feet (23 m) | | | | | | | | | |
| 100 feet (30 m) | | | | | | | | | |
| 150 feet (46 m) | | | | | | | | | |
| 200 feet (61 m) | | | | | | | | | |
| 250 feet (76 m) | | | | | | | | | |
| 300 feet (90 m) | | | | | | | | | |
| Hardware | | | | | | | | | |
| 1/2 in. NPT Threads, Poly cable glands | | | | | | | | | |
| 1/2 in. NPT Threads, Nickel Plated Brass cable glands | | | | | | | | | |
| 1/2 in. NPT Threads, no cable glands | | | | | | | | | |
| M20 Threads, Poly cable glands | | | | | | | | | |
| M20 Threads, Nickel Plated Brass cable glands | | | | | | | | | |
| M20 Threads, no cable glands | | | | | | | | | |
| Endpoint Wiring Method | | | | | | | | | |
| None | | | | | | | | | |
| Communication/Output | | | | | | | | | |
| Standard Output (Modbus RTU or BACnet MS/TP field selectable) | | | | | | | | | |
| Standard Output plus Modbus TCP Ethernet | | | | | | | | | |
| Standard Output plus EtherNet/IP | | | | | | | | | |
| Standard Output plus BACnet/IP Ethernet | | | | | | | | | |
| Units of Measure Totalizer/Flow Rate | | | | | | | | | |
| Gallons/gallons per minute (field selectable, additional options available) | | | | | | | | | |
| Testing & Tagging | | | | | | | | | |
| Factory Calibrated | | | | | | | | | |
| Factory Calibrated/Stainless Steel Tag | | | | | | | | | |

¹ Submersible transducer cables use two conduit openings.² For hazardous location units, Remote Cable and Conduit Length codes must match.

TFX-5000 Energy Meters for Pipes 2 in. and Smaller

| | | | | | | | | | | | | | | | | | | |
|--|----|----|---|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|
| Model | | DR | G | | | | | | | | | | | XX | | | | |
| TFX-5000 Ultrasonic Clamp-On Meter | | DR | | | | | | | | | | | | | | | | |
| Certification | | | | | | | | | | | | | | | | | | |
| General Area US/Canada, CE | | | G | | | | | | | | | | | | | | | |
| Transducer Type ¹ | | | | | | | | | | | | | | | | | | |
| 1/2 inch ANSI Pipe | CA | | | | | | | | | | | | | | | | | |
| 3/4 inch ANSI Pipe | CB | | | | | | | | | | | | | | | | | |
| 1 inch ANSI Pipe | CC | | | | | | | | | | | | | | | | | |
| 1-1/4 inch ANSI Pipe | CD | | | | | | | | | | | | | | | | | |
| 1-1/2 inch ANSI Pipe | CE | | | | | | | | | | | | | | | | | |
| 2 inch ANSI Pipe | CF | | | | | | | | | | | | | | | | | |
| 1/2 inch Copper Tube | CG | | | | | | | | | | | | | | | | | |
| 3/4 inch Copper Tube | CH | | | | | | | | | | | | | | | | | |
| 1 inch Copper Tube | CT | | | | | | | | | | | | | | | | | |
| 1-1/4 inch Copper Tube | CJ | | | | | | | | | | | | | | | | | |
| 1-1/2 inch Copper Tube | CK | | | | | | | | | | | | | | | | | |
| 2 inch Copper Tube | CL | | | | | | | | | | | | | | | | | |
| Small pipe, universal, DTTSU (not available with conduit) | UZ | | | | | | | | | | | | | | | | | |
| Transmitter Type | | | | | | | | | | | | | | | | | | |
| 110/220V AC Remote Mounted | R | | | | | | | | | | | | | | | | | |
| 24V DC/AC Remote Mounted | B | | | | | | | | | | | | | | | | | |
| Display | | | | | | | | | | | | | | | | | | |
| Display and Keypad | S | | | | | | | | | | | | | | | | | |
| No Display/Keypad | W | | | | | | | | | | | | | | | | | |
| Remote Cable Length | | | | | | | | | | | | | | | | | | |
| 15 feet (4.5 m) | AC | | | | | | | | | | | | | | | | | |
| 30 feet (9 m) | AF | | | | | | | | | | | | | | | | | |
| 50 feet (15 m) | AK | | | | | | | | | | | | | | | | | |
| 75 feet (23 m) | AR | | | | | | | | | | | | | | | | | |
| 100 feet (30 m) | BW | | | | | | | | | | | | | | | | | |
| Conduit Type and Length (Conduit length is less than or equal to cable length) | | | | | | | | | | | | | | | | | | |
| None | WW | | | | | | | | | | | | | | | | | |
| 5 feet (1.5 m) | AA | | | | | | | | | | | | | | | | | |
| 15 feet (4.5 m) | AC | | | | | | | | | | | | | | | | | |
| 30 feet (9 m) | AF | | | | | | | | | | | | | | | | | |
| 50 feet (15 m) | AK | | | | | | | | | | | | | | | | | |
| 75 feet (23 m) | AR | | | | | | | | | | | | | | | | | |
| 100 feet (30 m) | BW | | | | | | | | | | | | | | | | | |
| RTD Type | | | | | | | | | | | | | | | | | | |
| Surface, Commercial | C | | | | | | | | | | | | | | | | | |
| None (user provided) | X | | | | | | | | | | | | | | | | | |
| RTD Length | | | | | | | | | | | | | | | | | | |
| 15 feet | AC | | | | | | | | | | | | | | | | | |
| 50 feet | AK | | | | | | | | | | | | | | | | | |
| 100 feet | BW | | | | | | | | | | | | | | | | | |
| None (user provided) | WW | | | | | | | | | | | | | | | | | |
| Hardware | | | | | | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, Poly cable glands | S | | | | | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, Nickel Plated Brass cable glands | T | | | | | | | | | | | | | | | | | |
| 1/2 in. NPT Threads, no cable glands | N | | | | | | | | | | | | | | | | | |
| Endpoint Wiring Method | | | | | | | | | | | | | | | | | | |
| None | XX | | | | | | | | | | | | | | | | | |
| Communication/Output | | | | | | | | | | | | | | | | | | |
| Standard Output (Modbus RTU or BACnet MS/TP field selectable) | S | | | | | | | | | | | | | | | | | |
| Standard Output plus Modbus TCP Ethernet | T | | | | | | | | | | | | | | | | | |
| Standard Output plus EtherNet/IP | U | | | | | | | | | | | | | | | | | |
| Standard Output plus BACnet/IP Ethernet | V | | | | | | | | | | | | | | | | | |
| Standard Output plus Auxilliary Dry Contact Output | 9 | | | | | | | | | | | | | | | | | |
| Units of Measure Totalizer/Flow Rate | | | | | | | | | | | | | | | | | | |
| Gallons/gallons per minute (field selectable, additional options available) | G | | | | | | | | | | | | | | | | | |
| Units of Measure Energy Totalizer/Rate | | | | | | | | | | | | | | | | | | |
| Kilowatt-hour/Watt (field selectable, additional options available) | R | | | | | | | | | | | | | | | | | |
| Testing & Tagging | | | | | | | | | | | | | | | | | | |
| Factory Calibrated | F | | | | | | | | | | | | | | | | | |
| Factory Calibrated/Stainless Steel Tag | S | | | | | | | | | | | | | | | | | |

¹ Stainless steel tube 1/2...2 in. options are available.

_____ DR - G - _____ - XX - _____

¹ Submersible transducer cables use two conduit openings.

NORTH AMERICAN PIPE SCHEDULES

Cast Iron Pipe, Standard Classes, 3...10 inch

| Size in. | | Class in. | | | | | | | |
|-------------|------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | | A | B | C | D | E | F | G | H |
| 3 | OD | 3.80 | 3.96 | 3.96 | 3.96 | — | — | — | — |
| | Wall | 0.39 | 0.42 | 0.45 | 0.48 | | | | |
| | ID | 3.02 | 3.12 | 3.06 | 3.00 | | | | |
| 4 | OD | 4.80 | 5.00 | 5.00 | 5.00 | — | — | — | — |
| | Wall | 0.42 | 0.45 | 0.48 | 0.52 | | | | |
| | ID | 3.96 | 4.10 | 4.04 | 3.96 | | | | |
| 6 | OD | 6.90 | 7.10 | 7.10 | 7.10 | 7.22 | 7.22 | 7.38 | 7.38 |
| | Wall | 0.44 | 0.48 | 0.51 | 0.55 | 0.58 | 0.61 | 0.65 | 0.69 |
| | ID | 6.02 | 6.14 | 6.08 | 6.00 | 6.06 | 6.00 | 6.08 | 6.00 |
| 8 | OD | 9.05 | 9.05 | 9.30 | 9.30 | 9.42 | 9.42 | 9.60 | 9.60 |
| | Wall | 0.46 | 0.51 | 0.56 | 0.60 | 0.66 | 0.66 | 0.75 | 0.80 |
| | ID | 8.13 | 8.03 | 8.18 | 8.10 | 8.10 | 8.10 | 8.10 | 8.00 |
| 10 | OD | 11.10 | 11.10 | 11.40 | 11.40 | 11.60 | 11.60 | 11.84 | 11.84 |
| | Wall | 0.50 | 0.57 | 0.62 | 0.68 | 0.74 | 0.80 | 0.86 | 0.92 |
| | ID | 10.10 | 9.96 | 10.16 | 10.04 | 10.12 | 10.00 | 10.12 | 10.00 |

Table 8: Cast iron pipe, standard classes, 3...10 inch

Steel, Stainless Steel, PVC Pipe, Standard Classes

| NPS in. | OD in. | SCH 60 | | X STG. | | SCH 80 | | SCH 100 | | SCH 120/140 | | SCH 180 | |
|------------|-----------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-------------|-------------|-----------|-------------|
| | | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. |
| 1 | 1.315 | — | | 0.957 | 0.179 | 0.957 | 0.179 | — | | — | | 0.815 | 0.250 |
| 1.25 | 1.660 | | | 1.278 | 0.191 | 1.278 | 0.191 | | | | | 1.160 | 0.250 |
| 1.5 | 1.900 | | | 1.500 | 0.200 | 1.500 | 0.200 | | | | | 1.338 | 0.281 |
| 2 | 2.375 | | | 1.939 | 0.218 | 1.939 | 0.218 | | | | | 1.687 | 0.344 |
| 2.5 | 2.875 | | | 2.323 | 0.276 | 2.323 | 0.276 | | | | | 2.125 | 0.375 |
| 3 | 3.500 | | | 2.900 | 0.300 | 2.900 | 0.300 | | | | | 2.624 | 0.438 |
| 3.5 | 4.000 | — | | 3.364 | 0.318 | 3.364 | 0.318 | — | | — | | — | |
| 4 | 4.500 | | | 3.826 | 0.337 | 3.826 | 0.337 | | | 3.624 | 0.438 | 3.438 | 0.531 |
| 5 | 5.563 | | | 4.813 | 0.375 | 4.813 | 0.375 | | | 4.563 | 0.500 | 4.313 | 0.625 |
| 6 | 6.625 | | | 5.761 | 0.432 | 5.761 | 0.432 | | | 5.501 | 0.562 | 5.187 | 0.719 |
| 8 | 8.625 | 7.813 | 0.406 | 7.625 | 0.500 | 7.625 | 0.500 | 7.437 | 0.594 | 7.178 | 0.719 | 6.183 | 1.221 |
| 10 | 10.75 | 9.750 | 0.500 | 9.75 | 0.500 | 9.562 | 0.594 | 9.312 | 0.719 | 9.062 | 0.844 | 8.500 | 1.125 |

Table 9: Steel, stainless steel, PVC pipe, standard classes

Steel, Stainless Steel, PVC Pipe, Standard Classes (continued)

| NPS in. | OD in. | SCH 5 | | SCH 10 (Lt Wall) | | SCH 20 | | SCH 30 | | STD | | SCH 40 | |
|------------|-----------|-----------|-------------|---------------------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| | | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. | ID in. | Wall in. |
| 1 | 1.315 | 1.185 | 0.065 | 1.097 | 0.109 | — | — | — | — | 1.049 | — | 1.049 | 0.133 |
| 1.25 | 1.660 | 1.53 | 0.065 | 1.442 | 0.109 | | | | | 1.380 | | 1.380 | 0.140 |
| 1.5 | 1.900 | 1.77 | 0.065 | 1.682 | 0.109 | | | | | 1.610 | | 1.610 | 0.145 |
| 2 | 2.375 | 2.245 | 0.065 | 2.157 | 0.109 | | | | | 2.067 | | 2.067 | 0.154 |
| 2.5 | 2.875 | 2.709 | 0.083 | 2.635 | 0.120 | | | | | 2.469 | | 2.469 | 0.203 |
| 3 | 3.500 | 3.334 | 0.083 | 3.260 | 0.120 | — | — | — | — | 3.068 | — | 3.068 | 0.216 |
| 3.5 | 4.000 | 3.834 | 0.083 | 3.760 | 0.120 | | | | | 3.548 | | 3.548 | 0.226 |
| 4 | 4.500 | 4.334 | 0.083 | 4.260 | 0.120 | | | | | 4.026 | | 4.026 | 0.237 |
| 5 | 5.563 | 5.345 | 0.109 | 5.295 | 0.134 | | | | | 5.047 | | 5.047 | 0.258 |
| 6 | 6.625 | 6.407 | 0.109 | 6.357 | 0.134 | | | | | 6.065 | | 6.065 | 0.280 |
| 8 | 8.625 | 8.407 | 0.109 | 8.329 | 0.148 | 8.125 | 0.250 | 8.071 | 0.277 | 7.981 | 0.322 | 7.981 | 0.322 |
| 10 | 10.75 | 10.482 | 0.134 | 10.42 | 0.165 | 10.25 | 0.250 | 10.13 | 0.310 | 10.02 | 0.365 | 10.02 | 0.365 |

Table 10: Steel, stainless steel, PVC pipe, standard classes (continued)

Copper Tubing, Copper and Brass Pipe, Aluminum

| Nominal Diameter in. | | Copper Tubing in. | | | Copper & Brass Pipe in. | Alum. in. | Nominal Diameter in. | Copper Tubing in. | | | Copper & Brass Pipe in. | Alum. in. | |
|----------------------------|------|----------------------|-------|-------|----------------------------------|--------------|----------------------------|----------------------|--------|--------|----------------------------------|--------------|-------|
| | | Type | | | | | | Type | | | | | |
| | | | | | | | | | | | | | |
| K | L | M | K | L | M | | | | | | | | |
| 0.5 | OD | 0.625 | 0.625 | 0.625 | 0.840 | — | 3-1/2 | OD | 3.625 | 3.625 | 3.625 | 4.000 | — |
| | Wall | 0.049 | 0.040 | 0.028 | 0.108 | | | Wall | 0.120 | 0.100 | 0.083 | 0.250 | |
| | ID | 0.527 | 0.545 | 0.569 | 0.625 | | | ID | 3.385 | 3.425 | 3.459 | 3.500 | |
| 0.6250 | OD | 0.750 | 0.750 | 0.750 | — | — | 4 | OD | 4.125 | 4.125 | 4.125 | 4.500 | 4.000 |
| | Wall | 0.049 | 0.042 | 0.030 | | | | Wall | 0.134 | 0.110 | 0.095 | 0.095 | 0.250 |
| | ID | 0.652 | 0.666 | 0.690 | | | | ID | 3.857 | 3.905 | 3.935 | 3.935 | 4.000 |
| 0.75 | OD | 0.875 | 0.875 | 0.875 | 1.050 | — | 4-1/2 | OD | — | — | — | — | 5.000 |
| | Wall | 0.065 | 0.045 | 0.032 | 0.114 | | | Wall | | | | | 0.250 |
| | ID | 0.745 | 0.785 | 0.811 | 0.822 | | | ID | | | | | 4.500 |
| 1 | OD | 1.125 | 1.125 | 1.125 | 1.315 | — | 5 | OD | 5.125 | 5.125 | 5.125 | 5.563 | 5.000 |
| | Wall | 0.065 | 0.050 | 0.035 | 0.127 | | | Wall | 0.160 | 0.125 | 0.109 | 0.250 | 0.063 |
| | ID | 0.995 | 1.025 | 1.055 | 1.062 | | | ID | 4.805 | 4.875 | 4.907 | 5.063 | 4.874 |
| 1.25 | OD | 1.375 | 1.375 | 1.375 | 1.660 | — | 6 | OD | 6.125 | 6.125 | 6.125 | 6.625 | 6.000 |
| | Wall | 0.065 | 0.055 | 0.042 | 0.146 | | | Wall | 0.192 | 0.140 | 0.122 | 0.250 | 0.063 |
| | ID | 1.245 | 1.265 | 1.291 | 1.368 | | | ID | 5.741 | 5.845 | 5.881 | 6.125 | 5.874 |
| 1.5 | OD | 1.625 | 1.625 | 1.625 | 1.900 | — | 7 | OD | — | — | — | 7.625 | 7.000 |
| | Wall | 0.072 | 0.060 | 0.049 | 0.150 | | | Wall | | | | 0.282 | 0.078 |
| | ID | 1.481 | 1.505 | 1.527 | 1.600 | | | ID | | | | 7.062 | 6.844 |
| 2 | OD | 2.125 | 2.125 | 2.125 | 2.375 | — | 8 | OD | 8.125 | 8.125 | 8.125 | 8.625 | 8.000 |
| | Wall | 0.083 | 0.070 | 0.058 | 0.157 | | | Wall | 0.271 | 0.200 | 0.170 | 0.313 | 0.094 |
| | ID | 1.959 | 1.985 | 2.009 | 2.062 | | | ID | 7.583 | 7.725 | 7.785 | 8.000 | 7.812 |
| 2.5 | OD | 2.625 | 2.625 | 2.625 | 2.875 | 2.500 | 10 | OD | 10.125 | 10.125 | 10.125 | 10.000 | — |
| | Wall | 0.095 | 0.080 | 0.065 | 0.188 | 0.050 | | Wall | 0.338 | 0.250 | 0.212 | 0.094 | — |
| | ID | 2.435 | 2.465 | 2.495 | 2.500 | 2.400 | | ID | 9.449 | 9.625 | 9.701 | 9.812 | — |
| 3 | OD | 3.125 | 3.125 | 3.125 | 3.500 | 3.000 | | | | | | | |
| | Wall | 0.109 | 0.090 | 0.072 | 0.219 | 0.050 | | | | | | | |
| | ID | 2.907 | 2.945 | 2.981 | 3.062 | 2.900 | | | | | | | |

Table 11: Copper tubing, copper and brass pipe, aluminum

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