

Transit Time Ultrasonic Flow Meters

TFX-5000 Meter





User Manual

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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

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

A WARNING 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

ACAUTION

- 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.

WARNING

AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.

INTRODUCTION

AWARNING

THIS EQUIPMENT INCLUDES SOME EXTERNAL NON-METALLIC PARTS. THE USER SHALL THEREFORE ENSURE THAT THE EQUIPMENT IS NOT INSTALLED IN A LOCATION WHERE IT MAY BE SUBJECTED TO EXTERNAL CONDITIONS (SUCH AS HIGH-PRESSURE STEAM) WHICH MIGHT CAUSE A BUILD-UP OF ELECTROSTATIC CHARGES ON NON-CONDUCTING SURFACES. ADDITIONALLY, CLEANING OF THE EQUIPMENT SHOULD BE DONE ONLY WITH A DAMP CLOTH.

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.



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





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).



- 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*.





- 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.



- **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).



- 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*.



- 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 18: Lift cover from base



Figure 19: Open cover to the left

6. 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.
- 7. Install the wires through the gland nuts and connect the wires to the removable terminal blocks. See *"Wiring the Transmitter" on page 14*.
- 8. Set up the meter. See "Initial Meter Setup" on page 21 for instructions.
- 9. Install the *adjustable* transducers according to instructions in the transducer user manual.
- 10. Wire the transducers to the transmitter.
- 11. Plug the wired terminal blocks into the main board.
- 12. Reassemble the cover. Torque the cover screws to 45 in-lb.

Installing a Panel-Mount Meter

- 1. Measure and cut a mounting hole into the customer-supplied panel to the dimensions shown in Figure 21.
- 2. Remove the 4 screws and 4 O-rings holding the front of the unit to the frame.
- 3. Verify that the gasket is secure in the mounting bezel.
- 4. Guide the front of the unit through the panel cutout.
- 5. Insert the 4 screws through the front of the unit and the panel.
- 6. Apply one O-ring to each screw from the back of the panel.
- 7. Align the front of the unit to the frame.
- 8. 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.

Torque Requirements

The tightening torque requirements for the screw connections of the plug-in terminals are 4.4 lb-in. (0.5 Nm) minimum to 5.3 lb-in. (0.6 Nm) maximum.

Electrical Symbols



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...12 AWG UL AWM 1007 Type 1007
- 9...28V DC, 20...26V AC
 Wire 20 AWG UL AWM 1007 Type 1007
- Transducer Cables
 Badger Meter supplied cable
- Digital Outputs/Inputs, Current Output, RS485, RTD or Encoder Interface
- Wire 28...12 AWG UL AWM 1007 Type 1007

Wiring the Transducer



Figure 24: Wiring connections

- **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 25*.



Figure 25: 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.

ACAUTION

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 to 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 26.
- **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.





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 27*.

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 27: 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.

AWARNING

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 28: AC/DC power connections

4...20 mA Output Wiring

Set up the current range and scaling in the Setup > Input/Output > Current #1 (or Current #2) menu. See "Setup > Input/Output > Current #1 (or Current #2)" on page 32 for details.

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.





Figure 30: Typical 4... 20 mA interface using external isolated 24V DC source

Digital Outputs Wiring



Figure 31: Typical control out 1, 2 and 3 interface with internal pullups active



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.





Digital Input Wiring



AquaCUE/BEACON Endpoint Wiring



Figure 35: AquaCUE/BEACON wiring

Figure 34: Digital input—reset totalizer

RTD1 Ex +

RTD1 Ex

RTD2 Ex +

RTD2 Sense +

RTD1 Sense + RTD1 Sense -

RTD Interface Wiring (Energy Models Only)



Temp #2



2 3

4

5

6 7



Auxiliary Output Card Wiring



Figure 38: Auxiliary output interface

Installing the MicroSD Card

AWARNING

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.



- 4. Insert the MicroSD card.
- 5. Slide the cover up to close.
- 6. 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:

- a. Enter the pipe characteristics, transducer, mounting and fluid.
- b. Record the calculated spacing as needed.
- c. Install transducer. See the transducer user manual for instructions.
- 2. Check calibration:

In the SETUP > METER > CALIBRATION menu, select **Field** for the Factor Mode if firmware version is prior to 02.02.480. 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.

d. 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.

e. 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.

 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



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.

Units Submenus	Options/Descriptions					
	Select the flow rate units/interval displayed on the <i>Home Screen</i> . FLOW UNITS are automatically converted into the selected option.					
	Option	Units/Interval		Option	Units/Interval	
	Fluid BBL/D	Fluid Barrels/Day (31.5 Gal)		GAL/S	US Gallons/Second	
	IBBL/D	Imperial Fluid Barrels/Day (36 IG)		GAL/MIN	US Gallons/Minute	
	L/S	Liters/Second		GAL/H	US Gallons/Hour	
	L/MIN	Liters/Minute		MG/D	Million US Gallons/Day	
	L/H	Liters/Hour		IG/S	Imperial Gallons/Second	
	M³/S	Cubic Meters/Second		IG/MIN	Imperial Gallons/Minute	
	M³/MIN	Cubic Meters/Minute		IG/H	Imperial Gallons/Hour	
	M³/H	Cubic Meters/Hour		MIG/D	Million Imperial Gallons/Day	
	FT³/S	Cubic Feet/Minute		OIL BBL/D	Oil Barrels/Day (42 Gal)	
	FT ³ /MIN	Cubic Feet/Minute		AC-FT/D	Acre Feet/Day	
	FT ³ /H	Cubic Feet/Hour				
	Custom	This selection in 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 numer	This is a numeric entry for the number of decimal places to display. Default is 2. Options are 07				
FLOW TOTAL MODE	*GROSS FLOW FORWARD FLO REVERSE FLOW	DW Any flow in forward and reverse direction. FLOW				
	NET FLOW	Forward flow minus reverse flov forward flow.	Forward flow minus reverse flow. A negative total results when reverse flow is gre forward flow.			

Units Submenus	Options/Descriptions						
	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 Bar	rel (31.5 Gal)	
	MGAL	Million US Gallons		L		Liter	
FLOW TOTAL UNITS	IGAL	Imperial Gallons		HL	He	ctoliter	
	AC-FT	Acre Foot		M ³	Cubi	c Meters	
	MIGAL	Million Imperial Gallons FT ³		Cul	pic Feet		
	Oil BBL	Oil Barrels (42 Gal)					
	Custom	Custom This selection in 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 numer	ic entry for the number of decima	I places to d	isplay. Default	is 0. Options are	7.	
	Select the unit	s for the velocity displayed on the	Home Screer	า.			
VELOCITY UNITS	*FT/S Feet/ M/S Mete	Second rs/Second					
	Select the unit converted into	s for the energy rate displayed on the selected option:	the Home Sc	reen. ENERGY	RATE UNITS are a	utomatically	
	Option	Units		Optio	n	Units	
	BTU/H	Btu/hour		kJ/H	Kile	ojoules/hour	
ENERGY RATE UNITS	kBTU/H	Thousand Btu/hour		MJ/H	Meg	ja joules/hour	
(Energy Units Only)	MMBTU/H	Million Btu/hour	kCAL/H		ł Kilo	calories/hour	
	W	Watts	MCAL/H		H Mega	a calories/hour	
	*kW	Kilowatts				(Refrigeration)	
	MW	Megawatts) 1 Ton	= 12,000 Btu/h	
ENERGY RATE DECIMAL (Energy Units Only)	This is a nume	This is a numeric entry for the number of decimal places to display. Default is 2. Options are 07.					
ENERGY TOTAL MODE (Energy Units Only)	FORWARD FLOW REVERSE FLOW NET FLOW Forward flow minus reverse flow. A negative total results when reverse flow is greater than the forward flow. *GROSS FLOW						
	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		Optio	n	Units	
ENERGY TOTAL UNITS	BTU	British Thermal Unit		kWH	Ki	lowatt Hour	
(Energy Units Only)	kBTU	Thousand Btu		MWh	Me	gawatt Hour	
	MMBTU	Million Btu		kJ		Kilo Joules	
	KCAL	Kilo Calories		MJ	N	1ega Joules	
	MCAL	Mega Calories		TON-F	Ton-ho	ur (Refrigeration)	
ENERGY TOTAL DECIMALS (Energy Units Only)	This is a nume	ic entry for the number of decima	Il places to d	isplay. Default	is 2. Options are	e 07.	
TEMPERATURE UNITS (Energy Units Only)	°F °C K						
	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						
DISPLAY MODE	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				
	Select the transducer type:				
TRANSDUCER	UZ 2 MHZ	Option UZ when ordered with the TFX-5000 meter; universal small pipe transducers integrated in a rail			
	CX 2 MHZ	Options CACT when ordered with the TFX-5000 meter; fixed size small pipe transducers			
	JZ / KZ 1 MHZ	Options JZ and KZ when ordered with the TFX-5000 meter; medium size pipe transducers integrated in a rail			
	NZ / RZ / WZ 1 MHZ	Options NZ, WZ and RZ when ordered with the TFX-5000 meter; medium size pipe transducers, including submersible			
	HZ 1 MHZ	Option HZ when ordered with the TFX-5000 meter; high temperature medium pipe transducers			
	LZ / YZ 0.5 MHZ	Option LZ and YZ when ordered with the TFX-5000 meter; large pipe transducers, including submersible			
	For mounting options, see the transducer user manual.				
MOUNTING	Z PATH				
MOUNTING	*V PATH				
	W PATH				
	Cx TYPE is substituted for MOUNTING when CX 2 MHZ is selected as the transducer type.				
	CA: 1/2 IN ANSI CJ: 1-1/4 I	N 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				
CX ITFE	CE: 1-1/2 IN ANSI CN: 3/4 IN	I SS TUBE			
	CF: 2 IN ANSI CP: 1 IN S	STUBE			
	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	NTUBE			

Setup > Meter > Pipe

Pipe Submenus	Options/Description	S				
	STAINLESS 302/303	STAINLESS 430	IRON - DUCTILE	POLYPROPYLENE		
	STAINLESS 304	ALUMINUM	HD POLYETHYLENE			
	STAINLESS 304L	BRASS NAVAL	LD POLYETHYLENE			
PIPE MATERIAL	*STAINLESS 316	CARBON STEEL	PFA TEFLON			
	STAINLESS 347	COPPER	PVC CPVC			
	STAINLESS 410	IRON - CAST	PVDF			
	For the best accuracy, or <i>MANUAL MM</i> . If you do not have a g	measure the outer di auge, you can select a	ameter and wall thickr In ASME/ANSI or ASTN	ness with a gauge and select <i>MANUAL INCHES</i> 1 definition. Schedule, copper tubing and cast		
	iron class are filtered	pased on pipe materia	l selection.			
	as applicable:	carbon steel, cvc, pcvo	c material is selected, t	the following pipe schedules are also available		
	SCHEDULE STD S	CHEDULE 80				
	SCHEDULE 5 S	CHEDULE 100				
	*SCHEDULE 10 S	CHEDULE 120				
	SCHEDULE 20 S	CHEDULE 140				
	SCHEDULE 30 S	CHEDULE 160				
	SCHEDULE 40 S	CHEDULE 180				
	SCHEDULE 60 S	CHEDULE STG				
	If copper material is s	elected, the following	types are also availabl	e:		
PIPE TYPE	ТҮРЕК ТҮРЕМ					
	TYPE L PIPE SIZE	E				
	If cast iron pipe material is selected, the following classes are also available:					
	CLASS A CLASS E					
	CLASS B CLASS F					
	CLASS C CLASS G					
CLASS D CLASS H						
	If ductile iron nine material is selected, the following classes are also available:					
	CLASS 52 CLASS 56					
	CLASS 53	, ,				
	IT aluminum or brass naval material is selected, the following is also available:					
DIDE SIZE	Available only when 6	DIDE TVDE is MANIIAI · N	lumeric entry: min 05	5 in (15 mm) may 300 in (7500 mm)		
	PIPE SIZE NOMINAL is	substituted for PIPE SI	7F when a schedule/tu	bing/class is selected.		
PIPE SIZE NOMINAL	Enumeration based o	n schedule; min. 0.5 ir	n. (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. WALL THICKNESS is on tubing and classes	0.00, max. 5 in. (125 m ly useful for <i>MANUAL</i> ,	m); METRIC and MANUAL II	NCHES; It can be skipped for pipe schedule,		
LINER MATERIAL	NONE	HD POLYETHYLEN	E TAR EPOXY			
	ACRYLIC	LD POLYETHYLEN	E PFE TEFLON			
	ASBESTOS CEMENT	POLYPROPYLENE	GLASS PYREX			
	EBONITE	POLYSTYRENE	FIBERGLASS EP	ΟΧΥ		
	MORTAR	RUBBER				
LINER THICKNESS	Numeric entry min 0	.00, max. 5 in. (125 mr	m)			
I.D. SIZE	Numeric display in inc	ches or millimeters. ba	ised on PIPE TYPE			

Setup > Meter > Fluid

Fluid Submenus	Options/Descriptions							
	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%			
FLOID	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%	Hyrdrofluoric Acid 49%			
	Brine - 10%	Ethylene Glycol 50%	Jet Fuel B/JP4	Propylene Glycol 50%	Custom			
	SOUND SPEED	Numeric entry; Units	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.						
CUSTOM FLUID	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	F or C					
	SPECIFIC HEAT	Numeric entry; Units capacity per unit ma	: joule/gram °C; min. 0 ss of a material.	.01, max. 65.0; Specific he	eat capacity is the heat			

Setup > Meter > Spacing

An asterisk (*) indicates the parameter default.

Spacing Submenus	Options/Descriptions
	*Numeric display 0300 units in inches or millimeters, based PIPE settings.
CALIBRATED SPACING	The spacing required between two transducers based on the pipe parameters. Take this measurement between the lines scribed into the side of the transducers or use the scale on the rails, if used. See the transducer user manual. For Cx transducers with fixed spacing, the parameter will not be shown.

Setup > Meter > Flow Setup

Flow Setup Submenus	Options/Descriptions
DIRECTION	*FORWARD
	REVERSE
RIDIRECTIONAL	*ENABLED
BIDIRECTIONAL	DISABLED
LOW FLOW CUTOFF	Numeric entry. Units and decimals are based on FLOW RATE UNITS. Zero and positive values. *0.0
SIGNAL CUTOFF	*30 The low threshold when the meter will stop reading flow and display a F10 Low Signal message
	(see <i>noubleshoung on page</i> 40 for causes of a low signal).
SIGNAL HIGH	*90% The high threshold when the meter will stop reading flow and display a F11 High Signal message (see
	<i>"Troubleshooting" on page 46</i> for causes of a high signal).
MINIMUM FLOW	-10000 (default); min2,000,000. 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 = C Where Q = Volumetric Tin = Temperatu Tout = Temperatu C = Heat capac	$Q \times (Tin - Tout) \times C \times \rho$: flow rate ire at the inlet ire at the outlet :ity fluid	2	
DAMPING	*10 seconds			
SENSITIVITY	*60%			
HYSTERESIS	*5%	For detailed information on these parameters, see the paragraphs following this table.		
BAD DATA REJECTION	*3			
FILTER METHOD	*Adaptive			
WAVE	*AUTO automatically selects waveform ba SIN CARROT TOP is best for low speed flow BEST BARKER is best for high speed flow		sed on flow speed and signal quality. <i>ı</i> .	
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	
MANUAL REF TEMP	Numeric entry -4035	50° F (–40…176° C)	number compensation and the fluid speed of sound.	
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 39: 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 41 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 40: 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 41: New valid flow data

Setup > Meter > Calibration

An asterisk (*) indicates the parameter default.

Calibration Submenus	Options/Descriptions	
FACTOR MODE	FACTORY *FIELD	Select <i>FIELD</i> to set the zero and use the sensor and scale factors of the transducers. Only selectable in firmware versions prior to 02.02.480.
	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
FACTORY SETTINGS	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 #.###
ZERO MODE	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.
SET ZERO - NO FLOW	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.
SET ZERO - FLOW	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 510 seconds and will indicate if the meter was successful or not in determining the flow.
MANUAL ZERO	Numeric entry ## ### ns	Allows for manual entry of the zero value when ZERO MODE is MANUAL.
ZERO VALUE	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.
SENSOR FACTOR	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.
SCALE FACTOR	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. (Skip this step if firmware is 02.02.480 or higher.) 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) or (actual total)/(meter total)
- 5. Enter the SCALE FACTOR.

Setup > Input/Output > Current #1 (or Current #2)

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.

Current #1 Submenus	Options/Descriptions		
OUTPUT SOURCE	*FLOW RATE TEMPERATURE #1 TEMPERATURE #2 ENERGY FLOW VELOCITY SIGNAL STRENGTH TEST MODE DISABLED	Select the reading to be assigned to the 420 mA output. Temperature and energy options only available with energy meter.	
RANGE	*4-20 mA 4-20 mA NAMUR Current limit at 0-20 mA	range is NAMUR 43 compliant with lower measuring limit at 3.8 mA and upper 20.5 mA and minimum alarm 3.5 mA and maximum alarm 22.6 mA.	
MIN VALUE	Enter the value of the reading at 4 mA. Can also be the setting for the 0 mA setpoint when 4-20 mA RANGE is selected. Units and decimal places based on parameter selected. Negative numbers accepted.		
MAX VALUE	Enter the value of the reading at 20 mA. Units and decimal places based on parameter selected. Negative numbers accepted.		
FAILURE MODE	*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.	
FIXED VALUE	Enter the value for the current output when there is a failure mode. This parameter is only displayed with FAILURE MODE is set to FIXED VALUE.		
TEST CURRENT	Available only when OUTPUT SOURCE is in TEST MODE. 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. 022 mA.		
TRIM 4 mA	Available only when OUTPU the current range selected.	JT SOURCE is in TEST MODE. Set the test current to 4 mA or 0 mA, depending on Adjusts output until PLC/ DCS/BAS reads the desired value.	
TRIM 20 mA	Available only when OUTPU PLC/DCS/BAS reads 20 mA	<i>JT SOURCE</i> is in <i>TEST MODE</i> . Set the test current to 20 mA. Adjusts output until	

Setup > Inputs/Output > Output #1 (or Output #2 or Output #3)

Output #1, Output #2 or Output #3 can operate independently as a frequency, totalizer pulse, direction status or alarm status output. In the *SETUP* > *INPUT/OUTPUTS* > *OUTPUT #1 (OR OUTPUT #2 OR OUTPUT #3)* > *MODE* menu, select the *MODE* of operation. Then go to the *PARAMETERS* menu to set up the operation for that *MODE*.

Output #3 is available on the energy unit only.

Output #1 Submenus	Options/Descriptions					
MODE	*FREQUENCY PULSE TOTAL FLOW DIRECTIO ALARM DISABLED	FREQUENCY and PULSE TOTAL m contact output. N	nodes are not available wit	h AUX OUTPUT #1 a	nd #2 dry	
	OUTPUT SOURCE	*FLOW RATE VELOCITY ENERGY FLOW (Energy meter only) TEST FREQUENCY				
	VALUE AT 0 HZ	Numeric entry. Units and decimal place based on parameter selected. Negative numbers accepted. Default -5000.	Enter the maximum flow corresponds to maximum Can be negative to indica <i>Maximum</i> match the unit	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		
	MAX VALUE	Numeric entry. Units and decimal place based on source selected. Negative numbers accepted. Default 5000.	SETUP > MEASUREMENTS Example 1: For a system that only ha maximum flow rate is 100	> FLOW UNITS. s flow in one direction gal/min, and the co	on, the orresponding	
PARAMETERS (Frequency Mode)	MAX FREQUENCY	Numeric entry. Units in Hz. Default 1 kHz.	maximum frequency is 20 Parameter Output Source Minimum Maximum Maximum Frequency Example 2: For a system that flow is b from -100 gal/min to 100 gal/min is 2000 Hz, set up Parameter Output Source Minimum Maximum Maximum Frequency With this setup at <i>no flow</i>	000 Hz, set up the particular Value Flow Rate 0 gal/min 100 gal/min 2000 Hz bidirectional, the flow gal/min and the free to the parameters to: Value Flow Rate -100 gal/min 100 gal/min 2000 Hz	w rate ranges quency at 100	
	TEST	Available when TEST MODE is selecte	d for OUTPUT SOURCE. To c	heck the wiring to t	he control	
	FREQUENCY	system or device, you can override th	<u>ne frequency output</u> with a	a fixed frequency.		

Output #1 Submenus	Options/Descri	Options/Descriptions			
PARAMETERS (Pulse Total Mode)	OUTPUT SOURCE	*POSITIVE FLOW NEGATIVE FLOW BIDIRECTIONAL FLOW Also available for energy meters:		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	
		POSITIVE ENERGY NEGATIVE ENERGY BIDIRECTIONAL ENERGY		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 pu Enter the number of totalizer units per pulse. The totalizer unit is in the SETUP > MEASUREME menu. For example, if the totalizer unit is gallons, setting the PULSES/UNIT to 10 transmits 1 every 10 gallons. Setting the SCALING FACTOR to 0.1 transmits 1 pulse every 0.1 gallons.		e based on flow rate selection. Default is 1 unit per pulse. pulse. The totalizer unit is in the SETUP > MEASUREMENTS t is gallons, setting the PULSES/UNIT to 10 transmits 1 pulse FACTOR to 0.1 transmits 1 pulse every 0.1 gallons.	
	PULSE WIDTH	Numeric entry 1…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 option.	s to be at the high voltage level, use the <i>PULSE HIGH</i>	
	OUTPUT SOURCE	*FLOW RATE ENERGY FLOW			
		FORWARD ON *REVERSE ON			
PARAMETERS (Flow Direction Mode)	DIRECTION 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 not be active.			
	OUTPUT STATE OUTPUT LOW	OUTPUT LOW	The output remain voltage level. Wh voltage level.	ins in the off state and the voltage floats at the source en the output turns on, the voltage drops to the low	
		OUTPUT HIGH	Use if the output detected.	needs to be at the high voltage when the direction is	

Output #1 Submenus	Options/Descri	ptions			
DADAMETERS		*ERRORS ONLY HIGH FLOW LOW FLOW HI/LO FLOW	Y		
	ALARM	For energy meta only: HIGH ENERGY LOW ENERGY HI/LO ENERGY HIGH TEMP1 HIGH TEMP2 LOW TEMP1 LOW TEMP2	ers	Select the flow condition or meter condition to trigger the alarm and turr on the output.	
	SET HIGH	Numeric entry. Units and decimal place based on FLOW RATE selecte Negative numbers accepted. Default is 10000.		and decimal W RATE selected. ccepted.	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, OUT OF RANGE</i> or <i>ALL</i> .
(Alarm Mode)	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, OUT OF RANGE</i> or <i>ALL</i> .
	LATCHING	*DISABLED ENABLED	When ENABLED, the output remains on after the alarm condition clears. Resetting alarm latch turns off the output.		
		SET DELAY Enter		ter how long the alarm condition must occur before activating the output to event nuisance trips. Numeric entry. Units: Milliseconds. Default is 100 ms.	
	ANTI-CHATTER	HYSTERESIS	Enter how long the alarm condition is cleared before resetting the output prevent the output from chattering. The parameter is only valid if <i>LATCHIN DISABLED</i> . Numeric entry. Default is 100 ms.		
		MIN ON-TIME	Nur	neric entry. Units:	Milliseconds. Default is 200 ms.
	OUTPUT STATE	OUTPUT LOW		The output remains in the off state and the voltage floats at the source voltage level. When the output turns on, the voltage drops to the low voltage level.	
		OUTPUT HIGH		Use if the output detected.	needs to be at the high voltage when the direction is
PULL UP RESISTOR	INTERNAL *EXTERNAL	See "Digital Out	puts	Wiring" on page 18	3.

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

This menu shows only with card installed for AUTODETECT or CARD TYPE is set to AUX OUTPUT.

Output #1 Submenus	Options/Des	Options/Descriptions				
	FLOW DIRECT	FION FREQUEN	CY and PULSE TOTAL	modes are not available with AUX OUTPUT card.		
MODE	ALARM					
	DISABLED					
	OUTPUT	*FLOW RATE				
	SOURCE	ENERGY FLOW				
		FORWARD ON				
PARAMETERS		*REVERSE ON	Select whether t	he output is active when the flow is forward or reverse. When		
(Flow Direction Mode)	DIRECTION	For energy mete	rs the absolute valu	ie of the flow rate is below the cutoff, the output will not		
		only:	be active.	·····		
			RD			
			<u>-</u>			
		HIGH FLOW				
		LOW FLOW				
		HI/LO FLOW				
	ALARM	For energy meter	rs			
		only:	Select the flow o	andition or meter condition to trigger the alarm and turn on		
		HIGH ENERGY	the output.	shallon of meter condition to trigger the damana tamon		
		LOW ENERGY				
		HI/LO ENERGY				
		HIGH TEMP				
		LOW TEMP1				
		LOW TEMP2				
		Numeric entry. U	nits and decimal	Enter the value that the flow rate must be greater than in		
(Alarm Mode)	SET HIGH	place based on FLOW RATE selected.		order to trigger an alarm. SET HIGH is only visible/settable when ALARM is set to HIGH FLOW, OUT OF RANGE or ALL.		
(manninouc)		Negative numbers accepted.				
		Numeric entry I	nits and decimal			
		place based on F	LOW RATE selected.	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, OUT OF RANGE</i> or <i>ALL</i> .		
	SETLOW	Negative numbe	rs accepted.			
		Default is 0.	· · · · · · · · · · · · · · · · · · ·			
		*DISABLED	hen ENABLED, the output remains on after the alarm condition clears. Resetting			
		ENABLED	alarm latch turns off the output.			
		SET DELAY	Enter how long the a	er how long the alarm condition must occur before activating the output to		
	ANTI- CHATTER	SET DEE/	prevent nuisance trip	event nuisance trips. Numeric entry. Units: Milliseconds. Default is 100 ms.		
			Enter how long the a	ter how long the alarm condition is cleared before resetting the output to		
		ITTSTERESIS	Disage FD Numeric e	om challering. The parameter is only valid if LATCHING IS		
		MIN ON-TIME	Numeric entry. Units: Milliseconds. Default is 200 ms.			

Setup > Inputs/Output > Input

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

An asterisk (*) indicates the parameter default.

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

An asterisk (*) indicates the parameter default.

RTD Submenus	Options/Descriptions		
	Pt1000 2-WIRE		
	Pt1000 3-WIRE		
TEMD SENSOD TVDE	Pt1000 4-WIRE	Solact the temperature concerture	
TEIVIF SEINSON TTPE	Pt100 2-WIRE		
	Pt100 3-WIRE		
	Pt100 4-WIRE		
	32122° F (050° C)		
DANCE	32212° F (0100° C)	Solact the temperature range	
NANGE	-40392° F (-40200° C)		
	486° F (-2030° 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 "Traublachestics" on page 46 before adjusting the DTD input	
TRIM RTD #2	Adjust the offset for the temperature reading for RTD #2.	see <i>moubleshooting on page 40</i> before adjusting the RTD input.	

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.

Dynasonics	Setup > Inputs
p Data Logging Communication Calibratic	Diagnostics
ansmitter Transducer Inputs Outputs-Curre	nt Outputs-Digital Advanced
Digital Input	Temperature Input
Mode Reset Totalizer	Temp Sensor Type PT1000 3-wire
State Active High	Range -40 TO 200°C (-40 TC
	Delta Temp T1 - T2
	Trim RTD 1 0.0
	Trim RTD 2 0.0

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*.

Communication Submenus	Options/Descriptions				
	DISABLE				
EIA-485 TYPE	*MODBUS RTU	Either disable this feature or select a network type.			
	BACNET MS/TP				
	ADDRESS	Numeric entry 1254			
	BAUD RATE	*AUTO, 9600, 19200, 38400, 57600, 76800, 115200			
MODBUS RTU SETTINGS	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			
(Displayed when MODBUS RTU is	STOP BIT	*1 STOP BIT 2 STOP BITS			
selected as the option for	RESISTOR	*DISABLED ENABLED			
EIA-485 TYPE.) V	WORD ORDER	BIG ENDIAN *LITTLE ENDIAN For 32-bit numbers or data types spanning over multiple registers, select the order of the 16-bit word or register to match the Modbus RTU master.			
	TIMEOUT	Numeric entry 010000 ms Enter 0 ms to disable the timeout option. For networks with a predictable poll rate by the master device, this parameter is an option to record and display an S60 code when the meter does not receive a message from the master device. Enter the time that the TFX-5000 meter should record and display a loss of communication timeout.			
	MAC ADDRESS	Numeric entry 0127			
	BACNET ID	Numeric entry 04194303			
	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.			
BACNET MS/TP	MAX MASTER	Numeric entry 1127			
SETTINGS	PARITY	*NONE ODD PARITY EVEN PARITY			
	STOP BIT	*1 STOP BIT 2 STOP BITS			
	RESISTOR	DISABLED *ENABLED			
	Select the setting sent. Energy total	is to match the BEACON/AquaCUE settings. Only the flow total selected for the <i>Home Screen</i> will be Is are not supported.			
	DIAL COUNT	7, *8, 9, 10			
	RESOLUTION	*OFF, 1, 10, 1000, 10000, 0.1, 0.01, 0.001, 0.0001			
ENDFOINT	PROTOCOL	*DISABLEDWhen an ORION endpoint is connected to the transmitter, select the settingsV1to match the BEACON/AquaCUE settings. Only the flow total selected for theV2Home Screen will be sent.V3V1 protocol does not support dial counts above 7			

Communication Submenus	Options/Descriptions				
	WEBSERVER	Note: WEBSERVER is READ ONLY. *ENABLED DISABLED			
	CLIENT TIMEOUT	065,535 ms			
	DEVICE INSTANCE	BACnet ID range: 099,999,999			
	DHCP	*DISABLED ENABLED			
	IP ADDRESS	Numeric entry ###.###.###.Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.			
BACNET/IP (Shows only with	SUBNET MASK	Numeric entry ###.###.###. Enter each value from 0255. Option not available if DHCP is enabled.			
card installed for	GATEWAY	Numeric entry ###.###.###. Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.			
CARD TYPE is set to BACNET/IP.)	DNS PRIMARY	###.###.### Enter a value from 1255 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 1255 for the first value and 0255 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			
	WEBSERVER	Note: WEBSERVER is READ ONLY. *ENABLED DISABLED			
	CLIENT TIMEOUT	065,535 ms			
	WORD ORDER	BIG ENDIAN *LITTLE ENDIAN			
	DHCP	*DISABLED ENABLED			
	IP ADDRESS	Numeric entry ###.###.###.Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.			
	SUBNET MASK	Numeric entry ###.###.###. Enter each value from 0255. Option not available if DHCP is enabled.			
MODBUS TCP/IP	GATEWAY	Numeric entry ###.###.###. Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.			
	DNS PRIMARY	###.###.### Enter a value from 1255 for the first value and 0255 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 1255 for the first value and 0255 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			
	WEBSERVER	Note: WEBSERVER is READ ONLY. *DISABLED ENABLED		
	DHCP	*DISABLED ENABLED		
	IP ADDRESS	Numeric entry ###.###.###.Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.		
	SUBNET MASK	Numeric entry ###.###.###. Enter each value from 0255. Option not available if DHCP is enabled.		
(Shows only with	GATEWAY	Numeric entry ###.###.###. Enter a value from 1255 for the first value and 0255 for the remaining values. Option not available if DHCP is enabled.		
AUTODETECT or CARD TYPE is set	DNS PRIMARY	###.###.### Enter a value from 1255 for the first value and 0255 for the remaining values is not recommended to use static IP address in the range of 169.254.0.0 to 169.254.255.255 becau clients may not be able to locate the DNS server.		
	DNS SECONDARY	###.###.### Enter a value from 1255 for the first value and 0255 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				
	New log file created when parameters are added or removed from data log. *DISABLED				
LOG MODE	CONTINUOUS Logs when	transmitter is on and operating.	ansmitter is on and operating.		
	THRESHOLD Logs when	the threshold value is between the minir	num and maximum values.		
	For examp	e, only log when process equipment is or	perational and flow is above cutoff.		
	1 SECOND 1 MINUTE	1 HOUR			
	2 SECONDS 2 MINUTES	2 HOURS			
	5 SECONDS 5 MINUTES	4 HOURS			
TIMEINTERVAL	10 SECONDS 10 MINUTE	S 6 HOURS			
	20 SECONDS 30 MINUTE	S 12 HOURS			
	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		
PARAMETER #1	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		
PARAMETER #8	FLOW TOTAL NET	TEMP#2 - TEMP#1	SOUND SPEED		
	VELOCITY	ENERGY RATE	ERROR/ALARM CODE		
	REYNOLDS	ENERGY TOTAL GROSS	NONE		
	If THRESHOLD control is select	ed, this setting will be active.			
	FLOW RATE				
	FLOW TOTAL				
	TEMPERATURE #1				
THRESHOLD	TEMPERATURE #2				
	DELTA TEMPERATURE				
	ENERGY RATE				
	ENERGY TOTAL				
	VELOCITY				
MIN IHRESHOLD	Numeric entry (plus or minus)	It IHRESHOLD log model is selected, the	his setting will be active.		
MAX THRESHOLD	Numeric entry (plus or minus)	If THRESHOLD log model is selected, tl	nis setting will be active.		
DELETE LOG	Will stop recording and delete all records. Prompt with a confirmation screen.				

Setup > Options

Options Submenu	Options/Descriptions
	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 <i>Home Screen</i> and the card will be inactive.
CARD TYPE	If CARD TYPE is set to DISABLED, then the card connection will be disabled and the Ethernet and contact menus will not be displayed.
CARDTHE	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.

The passcodes are the same for the display/keypad access and SoloCUE Flow Device Manager access, Each time the menus are accessed either through the display/keypad interface or through SoloCUE, a valid passcode must be entered to change parameters. The logged in security level of the display/keypad and SoloCUE are independent. For example, a person can log in at the Service level through the display/keypad, while another person logs in at the Admin level through SoloCUE.

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 between DISABLE and ENABLE or to set any passcode or the Logout Timeout.
- 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.
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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. No one will be able to view the recovery code if you exit the screen or reboot the meter.
- 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			
	*ENGLISH	English		
	DEUTSCHE	German		
LANGUAGE	ESPAÑOL	Spanish		
	FRANÇAIS	French		
	ITALIANO	Italian		
DECIMAL	#.# #,#	Select whether the decimal indicator is a period or a comma.		
	*DISABLED	Displays the TAG ID on the Home Screen. Default is TFX-5000.		
DISPLAY TAG ID	ENABLED	Use SoloCUE to change the TAG ID.		
BRIGHTNESS	Select the display brightr	ness 10100% in increments of 10. Default is 70%.		
CONTRAST	Adjust the screen contras	t 1237. Default is 24.		
DIMMER	*ENABLED DISABLED			
DIMMER LEVEL	OFF 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%	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.		
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 <i>Home Screen</i> and on the SoloCUE dashboard.		
DISPLAY DATE	YYYY-MM-DD MM-DD-YYYY DD-MM-YYYY	Select format of the date to display on the <i>Home Screen</i> and on the SoloCUE dashboard.		

Information Menu

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			
	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		
		Read-only: unitless: the Reynolds Number based on the fluid viscosity density		
	REYNOLDS NUMBER	velocity and pipe diameter		
READINGS	REYNOLDS FACTOR	Read-only; unitless; the factor applied to the measured flow rate based on the Reynolds Number.		
	TEMPERATURE #1	Read-only; Energy meters only; Units are the same as the Home Screen.		
	TEMPERATURE #2	Read-only; Energy meters only; Units are the same as the Home Screen.		
	DELTA TEMPERATURE	The temperature dif according to the set	ference between the two RTDs, either T1 - T2 or T2 - T1, ting in INPUT/OUTPUT > RTD > DELTA TEMP.	
	TOTAL OVERFLOW COUNT	Numeric integer	The <i>TOTAL OVERFLOW COUNT</i> increments each time the flow total exceeds the digits in the display.	
	ENERGY OVERFLOW	Numeric integer	The ENERGY OVERFLOW 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; Ener	gy meters only	
		*ON	· · · · · · · · · · · · · · · · · · ·	
		OFF		
	OUTPUT #1 STATUS	FREQUENCY		
		PULSE	Status of digital output. If the output mode is ALARM or	
		DISABLED	FLOW DIRECTION, then the output status ON or OFF is	
		ON	indicated. Frequency and Pulse modes can operate too fast to	
			view the ON and OFF state, so the mode is shown for	
			the status.	
	0011 01 #2 517105			
INPUT/OUTPUT STATUS			-	
	OUTPUT #3 STATUS		Energy meters only	
		PULSE		
		DISABLED		
	ΔΗΥ ΟΠΤΡΗΤ #1 STATUS	ON	-	
		OFF	Only with auxiliary contact output option	
		PULSE		
		DISABLED		
		ON		
		OFF	Only with auxiliary contact output option	
	AUX OUTPUT #2 STATUS	PULSE	Only with auxiliary contact output option.	
		DISABLED		
		ON		
	INPUT STATUS	OFF	Status of digital input to reset totalizer or unlatch alarm.	
	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	
		xx:xx:xx:xx:xx Rea	d only. Ethernet card must be installed and cable must be	
	MAC ADDRESS	connected for the N	IAC Address to display.	
		CONNECTED	Read only. Ethernet link status if Ethernet card is installed	
	LINK STATUS	DISCONNECTED	and enabled.	

Diagnostics Submenus	Options/Descriptions		
	TIME	HH:MM:SS (24 hour clock)	Displays the time.
	DATE	YYYY-MM-DD	Displays the date.
	POWER ON TIME	In seconds	
SYSTEM (Requires service level passcode or higher if security is enabled.)	SIMULATION MODE	OFF 100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%	 Flow Simulation provides output and display simulation based on a percentage of the full scale flow. Simulation will not accumulate the totalizers and any digital outputs set to pulse totalizer will not be active. The range of simulation includes 0100% of the full scale flow. Use the Flow Simulation parameter to set the range of simulation in 10% increments. To change the Flow Simulation, from the INPUTS/OUTPUTS menu: Select FLOW SIMULATION to view the Flow Simulation display. Click RIGHT ARROW to increment the percentage by 10, or click DOWN ARROW to decrement the percentage
	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 ALARM HISTORY 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 FLOW TOTAL. 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 or Output #3)" 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.
- 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.
		Check for empty pipe, transducer spacing and parameter settings.
F10 LOW SIGNAL	Signal strength is below cutoff.	Check for flow disturbances such as gas/air bubbles, foaming or debris in the liquid.
		Check for significant scale build in the pipe or detached pipe liners.
F11 HIGH SIGNAL	Signal strength is oversaturated.	Change transducer mounting for more paths.
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.
C20 OUTPUT #2 FREQUENCY TEST	Output #2 is in frequency test mode.	Change Output #2 from Test Mode.
C30 OUTPUT #3 FREQUENCY TEST	Output #3 is in frequency test mode.	Change Output #3 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.

Code	Description	Correction
	Flow or energy rate higher than flow rate at	Chack the scaling of the Current #1 output
	20 mA 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.	output, check that the ISO 24V OUT is jumpered to 4-20 LOOP (TB600 pins 1 & 2).
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.	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 aram setting.	Check flow rate and Set Low setting for Output #2.
S481 OW FLOW	Flow rate is below low flow aram setting.	Check flow rate and Set Low setting for Output #3.
S49 LOW FLOW	Flow rate is below low flow aram setting.	Check flow rate and Set Low setting for Aux Output #1.
S50 TOTAL OVERELOW	Accumulated flow total is greater than	Check the totalizer units or reset the flow total to clear the overflow counter
	viewable digits. Modbus master or BACnet device	Check master device poll rate and offline status. Check wiring and termination
	communication packet.	BACnet MS/TP Config) > Timeout parameter setting
S61 MODULE TIMEOUT	Network timeout.	Check communication settings and wiring of the Ethernet card.
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. Check card type detection matches the installed card or is set to autodetect. 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 #1 LOW	Temp. #1 is below low alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #1.
S74 TEMP #1 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 RID #1. Check alarm settings for Output #1.
	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Output #2.
S78 TEMP #1 HIGH	Temp. #1 is above high alarm setting.	Check fluid temperature and RTD #1. Check alarm settings for Aux Output #3.
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.
SOUTEMD #21 OW	Town rate is above low flow alarm setting.	Check fluid temporature and PTD #2. Check alarm cettings for Output #2.
S90 TEIVIP #2 LOW	Temp #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #1.
S92 TEMP #2 LOW	Temp #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #2.
S93 TEMP #21 OW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Output #3.
S94 TEMP #2 LOW	Temp. #2 is below low alarm setting.	Check fluid temperature and RTD #2. Check alarm settings for Aux Output #1.
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.
113 FIELD CALIBRATION	Calibration changed from Factory to Field.
I21 FIRMWARE CHANGED	Firmware updated or parameters set to factory defaults.
131 FLOW TOTAL RESET	Flow total reset to zero.
I41 NO SD CARD	MicroSD card not installed.

Symptoms

Symptom: Transmitter does not power up.

	Possible Causes		Recommended Action
•	No power or inadequate power	•	Measure voltage at the power terminals and check that the voltage matches the labels by the
	Blown fuse (AC Model only)		power terminals.
•	Display ribbon cable not seated properly	•	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. LEDs 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
•	Incorrect positioning of	Refer to the Transducer Mounting Configuration section for details on proper installation.
	transducers	At the transducer:
•	Poor contact between transducers and pipe	• 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
•	Poor placement of transducers	the transducers.
•	Low signal strength	Verify that the transducers are aligned correctly. For Z-Mount, verify the transducers are 180°
	Process loop issues	from each other.
•	Incorrect pipe settings	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.
•	Meter not calibrated	Process loop and general location:
•	Display not set up correctly	 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.
		At the transmitter:
		Verify that pipe parameters match the installation.

Symptom: Unstable flow.

	Possible Causes		Recommended Action
•	Installation issues	•	Check process loop for variations of entrained air which will impact the flow
•	Flow instability	•	Check for pump induced flow instability.
•	Transducer mounting is loose	•	Check that the transducers are secure and are in area where the transducers will not be
	Transducers are moved		inadvertently bumped or disturbed.
•	Incorrect flow settings	•	Check low flow cutoff, minimum flow or maximum flow settings.

Symptom: Flow readout is opposite of the flow direction.

	Possible Causes	Recommended Action
•	Integral mount transmitter is mounted in reverse flow direction so display is properly oriented	 Change the transducer flow direction parameter. Rewire the up and down transducers to the transmitter.
	Up and down transducers wiring is reversed	
•	Flow direction parameter is reversed	

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

	Possible Causes	Recommended Action
•	Incorrect parameter settings	Verify that the parameters for the output are set properly.
•	Wiring or control system	
	configuration issues	

REPLACEMENT PROCEDURES

AWARNING

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

ACAUTION

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.

And Serve 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 43: 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. Do not misalign the pins. Do not use excessive force.



Figure 44: 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 45: Replacing the Communication or Dry Contact Board

Firmware Update

Firmware can be updated using SoloCUE Flow Device Manager software. Parameter and calibration settings will not be overwritten unless there is a conflict with the new parameters. Back up the device configuration prior to updating the firmware. See "*TFX-5000 Firmware Update*" (available at *www.badgermeter.com*) for more information.

SPECIFICATIONS

System

Liquid Types	Most clean liquids or liquids c	ontaining small amounts of suspended solids or gas bubbles
	Medium Pipes (JZ, KZ, NZ, RZ, WZ, HZ)	\pm 0.5% \pm 0.025 ft/s (0.008 m/s) of reading
Flow Accuracy	Large Pipes (LZ, YZ)	\pm 0.5% \pm 0 0.049 ft/s (0.015 m/s) of reading
	Small Pipes (CA-CT, UZ)	1 in. (25 mm) and larger = $\pm 1\% \pm 0.03$ ft/s (0.009 m/s) of reading 3/4 in. (20 mm) and smaller = $\pm 1\%$ of full scale
Repeatability	0.2% above 1.5 ft/s	
Mala stra	Medium and Large Pipes	Up to 40 ft/s, depending on pipe and fluid
velocity	Small Pipes	Up to 20 ft/s, depending on pipe and fluid
Straight Run Requirements	n nts 10 diameters upstream, 5 diameters downstream from single elbow	
	General Safety (all models): cCSAus, CE, Pollution Degree	2, CE compliance to Low Voltage Directive, 2014/35/EU
Certification and Compliance	 U.S./Canada Hazardous Location transmitter and transducers: Transmitter and transducers (certification option B): cCSAus 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 endpoin Transmitter (certification option R): cCSAus Ex ec ic nC IIC T4 Gc; Ex tc IIIB T100° C Dc; Class I, Zone 2, AEx ec ic nC IIC T4 Gc; Zone 22, AEx tc IIIB T100° C Dc; Class II, Division 2, Groups FG; Class III Not available with Auxiliary Dry Contact card or units with AquaCUE/BEACON endpoints Transducers RZ LZ, NZ, RZ, WZ, YZ (certification option R): cCSAus Ex ec IIC T6 Gc; Ex tc IIIB T60° C Dc; Class I, Zone 2, AEx ec IIC T6 Gc; Zone 22, AEx tc IIIB T60° C Dc; Class II, Division 2, Group: Class III Requires flexible conduit Not available with CA-CT, UZ, HZ or JZ and KZ (Easy Rail) transducers ATEX Hazardous Location: Transmitter (certification option V): II 3 G D Ex ec ic nC IIC T4 Gc, Ex tc IIIB T100° C Dc; Tamb: -2560° C JZ (DTTJ), KZ (DTTK), LZ (DTTL), NZ (DTTN) and RZ (DTTR) Transducers: II 3 G D Ex ec IIC T6 Gc; Ex tc IIIB T60°C Dc; Tamb: -2560° C Not available with UZ, CA to CT, or HZ transducers; flexible conduit, Auxiliary Dry Contact card or AquaCUE/BEACON endpoints IECEx Hazardous Location: 	
	IECEX Hazardous Location: Transmitter (certification option JZ, KZ, LZ, NZ and RZ Transduc Not available with UZ. CA to C	on V): Ex ec nC ic IIC T4 Gc; Ex tc IIIC T100° C Dc; Tamb: -25°C60° C cers: Ex ec IIC T6 Gc; Ex tc IIIB T60° C Dc; Tamb: -2560° C .T. or HZ transducers: flexible conduit. Auxiliary Dry Contact card or AquaCUE/BEACON endpoints

Transmitter

	24V DC/AC	928V DC @ 8 W max. or 2026 AC 4763 Hz @ 0.5 A max., 2 Amp slow-blow fuse, not field replaceable
Power Options	Mains AC	85264V AC 4763 Hz @ 24VA max. 1 Amp slow-blow fuse, manually field replaceable
		Over-Voltage Rating Category II (CAT II)
	Options	Display with keypad or no display/keypad
Display	Keypad	4-button navigation, keypad with tactile feedback; polyester film
Display	Display	128 × 64 pixel LED backlit graphical display; adjustable brightness and timeout; polycarbonate window
	Flow rate/total	8-digit
Enclosure	NEMA Type 4X, IP67	
Construction	Aluminum construction; pain	ted; wall, panel or pipe mounting; stainless steel fasteners and mounting hardware; EPDM gasket
construction	Conduit Holes	(4) 1/2 in. NPT, M20 \times 1.5 or 1/2 BSPP; cable glands available for NPT and M20
	Pollution Degree	2
F	Altitude Restriction	Up to 2000 m (6561 ft)
Environmental	Ambient Temperature Range	-4140° F (-2060° C)
natiliys	Storage Temperature Range	-40176° F (-4080° C)
	Humidity	085%, non-condensing
Configuration	Via optional keypad or SoloCl	JE configuration software; SoloCUE available on DVD or download
	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
Units (Field- Selectable)	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
	Temperature (energy meters)	Farenheit, Celcius, Kelvin

		Flow Meter	Energy Meter						
	0/420 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 530V DC, isolated, externally or internally sou	rced, reset totalizer or alarm output						
Inputs and		Two selectable pulse, alarm, flow direction, sink isolated open collector, 530V DC, max. 50 mA externally or internally sourced, leakage current 1uA max.	Three selectable pulse, frequency, alarm, flow direction, isolated open collector, 530V DC, externally or internally sourced, leakage current 1uA max.						
Outputs	Digital output	Frequency output: 50% duty cycle, 6310k Hz maxin	mum frequency						
		Pulse (totalizer) output: Open collector, pulse width 1	1500 ms programmable						
Inputs and 0/42 Digital Digital RTD (eigendation of the second sec		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 12-bit inputs; Range of -40200° C; Clamp-on resistor kits available						
	Programming	USB 2.0 mini B connector for connection to a device	with SoloCUE configuration software						
Ports	EIA-485	Modbus RTU command set or BACnet MS/TP; Baud ra terminating resistor selectable	ates 9600, 14400,19200, 38400, 57600, 76800, 115k;						
	Ethernet	Optional 10/100 Base T RJ45, communication via Mo	dbus TCP/IP, BACnet/IP or EtherNet/IP						
	AquaCUE/BEACON	Connectivity to AquaCUE/BEACON endpoint (LTE cel	lular)						
	Number of points	Up to 8 parameters per record. Selectable 1 second to Transfer logs via memory card	o 1 day						
Data Logging	Real Time Clock	Backed up with a super capacitor, minimum of 32 da	ys of data retention without power; Requires no servicing						
	MicroSD card slot	8 GB card, included with transmitter							
Alarms	Records 150 previou	s alarms, warnings or errors							
Languages	English, French, Gerr	nan, Italian, Spanish							
Security	nd Digital output isolated open collector, S30V DC, max, 50 mA externally or internally sourced, leakage current 1uA max. isolated open collector, S30V DC, externally or internal sourced, leakage current 1uA max. Pigital output Frequency output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Pulse (totalizer) output: 50% duty cycle, 6310k Hz maximum frequency Two 2-wire, 3-wire or 4-wire Pt100/Pt1000 RTD 12-bit in Range of -40200° C; Clamp-on resistor kits available 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, BACnet/IP or EtherNet/IP AquaCUE/BEACON								

Transducers

Model	Construction	Cable Length Max.	Pipe/Tubing Sizes ¹	Flow Rate Max. GPM (LPM)	Pipe/ Tubing Materials
CA-CT ⁵ fixed small pipe	CPVC, Ultem [®] , Nylon cord grip, PVC cable jacket; -40194° F	100 ft	0.52 in.	190	
UZ adjustable small pipe	CPVC, Ultem, and anodized aluminum track system; Nickel-plated brass connector with Teflon insulation; PVC cable jacket, –40194° F (–4090° C)	100 ft (30 m)	0.52 in. (1250 mm)	190 (720)	
NZ (IP67) standard pipe	CPVC, Ultem [®] , Nylon cord grip, PVC cable jacket; -40194° F (-4090° C)	300 ft (90 m)	2.512 in. (DN65DN300)	4000 (15,000)	
RZ (IP54) standard pipe	PBT glass filled, Ultem [®] , Nylon cord grip; PVC cable jacket; , –40250° F (–40121° C)	300 ft (90 m)	2.512 in. (DN65DN300)	4000 (15,000)	
JZ, KZ (IP54) standard pipe, integrated rail	PBT glass filled, Ultem, Nylon cord grip; PVC cable jacket; –40250° F (–40121° C)	300 ft (90 m)	2.56 in. (DN65DN150) 2.512 in. (DN65DN300)	4000 (15,000)	See ²
WZ (IP68) ⁷ standard pipe, submersible	CPVC, Ultem, Nylon cord grip; Polyethylene cable jacket; –40194° F (–4090° C)	300 ft (90 m)	2.512 in. (DN65DN300)	4000 (15,000)	
HZ high temperature	PTFE, Vespel, Nickel-plated brass cord grip; FEP cable jacket; -40350° F (-40176° C)	300 ft (90 m)	2.512 in. (DN65DN300)	4000 (15,000)	
LZ (IP67) large pipe	CPVC, Ultem, Nylon cord grip PVC cable jacket; –40194° F (–4090° C)	300 ft (90 m) ⁶	848 in. (DN200DN1200) ^{3,4}	33,000 (125,000)	
YZ (IP68) ⁷ large pipe, submersible	CPVC, Ultem, Nylon cord grip; Polyethylene cable jacket; –40194° F (–4090° C)	300 ft (90 m) ⁶	848 in. (DN200DN1200) ^{3,4}	33,000 (125,000)	

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.

⁵ Not for metric pipes.

⁶ Cable lengths up to 600 ft are available. Consult factory for lead times.

⁷ IP68 tested at 1 meter for 24 hours.

RTD Kits

Part Number	Description	Installation	RTD Type	Construction	Temperature Range
68996-001	RTD pair; 15 ft (4.5 m) cable	Dia a dama			
68996-002	RTD pair; 50 ft (15 m) cable	Pipe clamp,	Pt 1000, Class A \pm (0.15 + 0.002^ t)	Aluminum body,	-58356° F
68996-003	RTD pair; 100 ft (30 m) cable	surface mount, if 34	with t as temperature. C	SIIICOTTE CADIE JACKEL	(-30180 C)

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 with English, French, German, Italian and Spanish menus. Additionally, it has numerous troubleshooting tools to make diagnosing and correcting installation problems easier.

SoloCUE	Jsed 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								

DQ G ΧХ Model TFX-5000 Ultrasonic Clamp-On Meter DQ Certification General Area US/Canada, CE G Transducer Type 1/2 inch ANSI Pipe CA 3/4 inch ANSI Pipe СВ 1 inch ANSI Pipe сс 1-1/4 inch ANSI Pipe CD 1-1/2 inch ANSI Pipe CE 2 inch ANSI Pipe CF CG 1/2 inch Copper Tube 3/4 inch Copper Tube СН 1 inch Copper Tube СТ 1-1/4 inch Copper Tube CJ 1-1/2 inch Copper Tube СК CL 2 inch Copper Tube Small pipe, universal, DTTSU (not available with conduit) UZ Transmitter Type 110/220V AC Remote Mounted R в 24V DC/AC Remote Mounted Display **Display and Keypad** s w No Display/Keypad Remote Cable Length 15 feet (4.5 m) AC 30 feet (9 m) AF 50 feet (15 m) AK AR 75 feet (23 m) 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 AK 50 feet (15 m) 75 feet (23 m) AR 100 feet (30 m) BW Hardware 1/2 in. NPT Threads, Poly cable glands S т 1/2 in. NPT Threads, Nickel Plated Brass cable glands 1/2 in. NPT Threads, no cable glands Ν M20 Threads, Poly cable glands С D M20 Threads, Nickel Plated Brass cable glands M20 Threads, no cable glands Α Endpoint Wiring Method хх None Communication/Output Standard Output (Modbus RTU or BACnet MS/TP field selectable) S **Standard Output plus Modbus TCP Ethernet** т v **Standard Output plus BACnet/IP Ethernet** Standard Output plus EtherNet/IP U **Standard Output plus Aux Output** q Units of Measure Totalizer/Flow Rate² Gallons/gallons per minute G Liters/liters per minute Ρ Testing & Tagging **Factory Calibrated** F S Factory Calibrated/Stainless Steel Tag ¹Stainless steel tube 1/2...2 in. options are available.

PART NUMBER CONSTRUCTION

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

TFX-5000 Flow Meters for Pipes 2 in. and Smaller for Class I, Div 2 Hazardous Locations



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							L		
TFX-5000 Ultrasonic Clamp-On Meter	DQ								
<u>Certification</u> General Area US/Canada, CE	c								
Transducer Type									
Medium pipe, DTTR, 2.5 in. (65 mm) or larger	RZ								
Medium pipe, submersible DTTN, 2.5 in. (65 mm)	or larger ¹ WZ								
2.56 inches (65150 mm) Easy Rail (not availa	ble with condui JZ								
2.512 Incnes (65300 mm) Easy Kall (not avail Medium nine, high temperature (not available w	able with condinkz								
Large pipe, DTTL, 8 in. (200 mm) or larger	LZ								
Large pipe, submersible DTTL, 8 in. (200 mm) or l	arger ¹ YZ								
Transmitter Type	•								
110/220V AC Remote Mounted		R							
24V DC/AC Remote Mounted		В							
Display and Keypad		s							
No Display/Keypad		w							
Remote Cable Length									
15 feet (4.5 m)			AC						
30 feet (9 m) 50 feet (15 m)			AF						
50 feet (15 m) 75 feet (23 m)									
100 feet (30 m)			BW						
150 feet (46 m)			вк						
200 feet (61 m)			DW						
250 feet (76 m)			DK						
300 feet (90 m)			EW						
350 feet (107 m) (DTTL "L2" and "Y2" only) 400 feet (122 m) (DTTL "L7" and "Y7" only)			EK						
400 feet (122 m) (DTTL "LZ" and "Z" only) 450 feet (137) (DTTL "LZ" and "YZ" only)			FK						
500 feet (152 m) (DTTL "LZ" and "YZ" only)			GW						
550 feet (168) (DTTL "LZ" and "YZ" only)			GK						
600 feet (183 m) (DTTL "LZ" and "YZ" only)			нw						
<u>Conduit Type and Length (Conduit length is less the</u>	an or equal to cable l	ength)							
None 5 feet (1 5 m)				ww					
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) 200 feet (61 m)				BK					
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 gla	inds				I N				
M20 Threads, Poly cable glands					c				
M20 Threads, Nickel Plated Brass cable glands					D				
M20 Threads, no cable glands					Α				
Endpoint Wiring Method									
None						XX			
Standard Output (Modbus RTU or BACnet MS/TP	field selectable)						s		
Standard Output plus Modbus TCP Ethernet							т		
Standard Output plus BACnet/IP Ethernet							v		
Standard Output plus EtherNet/IP							U		
Standard Output plus Aux Output							9		
Units of Measure Totalizer/Flow Rate ²									
Gallons/gallons per minute								G	
								٢	
Factory Calibrated									F
Factory Calibrated/Stainless Steel Tag									s
¹ Submersible transducer cables use two conduit	openings.								
² Field selectable, additional options available.									

FFX-5000 Flow Meters for Pipes 2.5 in. and Larger for	r U.S./	Canad	da Haz	zardou	is Lo	catio	าร		
DQ	٦-٢]-[-	- 🗌 -	— -	XX -	-		
Model TFX-5000 Ultrasonic Clamp-On Meter DQ									
Certification Hazardous Location, Class I, Division 2 B Hazardous Location Class L Div 2, Zone 2/22; Class B									
Hazardous Location Class I, Div 2, Zone 2/22; Class R Transducer Type Medium pipe, DTTR, 2.5 in. (65 mm) or larger RZ Medium pipe, submersible DTTN, 2.5 in. (65 mm) or larger WZ Large pipe, DTTL, 8 in. (200 mm) or larger LZ Large pipe, submersible DTTL, 8 in. (200 mm) or larger Z Transmitter Type YZ 110/220V AC Remote Mounted Z 24V DC/AC Remote Mounted Z Display Standard No Display/Keypad Ts feet (4.5 m) 30 feet (9 m) Standard	<u>z</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u> <u>,</u>	S W	AC	AC					
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)			AK AR BW BK DW DK EW	AK AR BW BK DW DK EW					
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					S T N C D A	xx			
Communication/Output Standard Output (Modbus RTU or BACnet MS/TP field selectable) Standard Output plus Modbus TCP Ethernet Standard Output plus BACnet/IP Ethernet Standard Output plus EtherNet/IP <u>Units of Measure Totalizer/Flow Rate</u> ² Gallons/gallons per minute Liters/liters per minute							S T V U	G	
<u>Testing & Tagging</u> Factory Calibrated Factory Calibrated/Stainless Steel Tag									F

¹ Submersible transducer cables use two conduit openings.

		- -	└───┘╴└		
TFX-5000 Ultrasonic Clamp-On Meter DQ					
Certification					
Hazardous Location, ATEX Zone 2/22, IECEx Zone 2 V					
Transducer Type					
Medium pipe, DTTR, 2.5 in. (65 mm) or larger RZ					
Medium pipe, submersible DTTN, 2.5 in. (65 mm) or larger ' WZ					
2.56 inches (65150 mm) Easy Rail (not available with conduit JZ					
2.512 inches (65300 mm) Easy Rail (not available with condu KZ					
Large pipe, DTTL, 8 in. (200 mm) or larger LZ					
Large pipe, submersible DTTL, 8 in. (200 mm) or larger YZ					
<u>Transmitter Type</u>					
110/220V AC Remote Mounted R					
24V DC/AC Remote Mounted B					
<u>Display</u>					
Display and Keypad S					
No Display/Reypad W					
<u>nemole Cable Lengin</u>					
15 feet (4.5 m) AC					
50 feet (5 m) AF					
75 feet (13 m) AR					
100 feet (30 m) BW					
150 feet (46 m) BK					
200 feet (61 m) DW					
250 feet (76 m) DK					
Conduit Type and Length (Conduit length is less than or equal to cable length)					
None W	w				
<u>Hardware</u>					
1/2 in. NPT Threads, Poly cable glands	S				
1/2 in. NPT Threads, Nickel Plated Brass cable glands	т				
1/2 in. NPT Threads, no cable glands	Ν				
M20 Threads, Poly cable glands	С				
M20 Threads, Nickel Plated Brass cable glands	D				
M20 Threads, no cable glands	Α				
Endpoint Wiring Method					
None		XX			
Communication/Output					
Standard Output (Modbus RTU or BACnet MS/TP field selectable)			S		
Standard Output plus Modbus TCP Ethernet			т		
Standard Output plus BACnet/IP Ethernet			v		
Standard Output plus EtherNet/IP			U		
<u>Units of Measure Totalizer/Flow Rate</u> ²					
Gallons/gallons per minute				G	
Liters/liters per minute				Р	
Testing & Tagging					
Factory Calibrated					F
Factory Calibrated/Stainless Steel Tag				<u> </u>	S
1			-		

TFX-5000 Flow Meters for Pipes Larger than 2 in. for ATEX/EICEx Hazardous Locations

¹ Submersible transducer cables use two conduit openings.

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



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

	DR _ G			×	x.	
Model						
TFX-5000 Ultrasonic Clamp-On Meter	DR					
Certification						
General Area US/Canada, CE	<u> </u>					
Medium pipe, DTTR, 2.5 in, (65 mm) or larger	RZ					
Medium pipe, submersible DTTN, 2.5 in. (65 mm) or larger ¹	wz					
2.56 inches (65150 mm) Easy Rail (not available with con	duit) JZ					
2.512 inches (65300 mm) Easy Rail (not available with co	nduit) KZ					
Medium pipe, high temperature (not available with conduit)	HZ					
Large pipe, DTTL, 8 in. (200 mm) or larger	LZ					
Large pipe, submersible DTTL, 8 in. (200 mm) or larger	YZ					
110/220V AC Remote Mounted	R					
24V DC/AC Remote Mounted	В					
<u>Display</u>						
Standard		s				
No Display/Keypad		w				
Remote Cable Length ²						
15 feet (4.5 m)		AC				
30 feet (15 m)		AF				
75 feet (23 m)		AR				
100 feet (30 m)		BW				
150 feet (46 m)		ВК				
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 i	<u>o cable length)</u>	14/14/				
None 5 feet (1 5 m)		VV VV				
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) 200 feet (61 m)		BK				
250 feet (76 m)		DK				
300 feet (90 m)		EW				
RTD Type						
Surface, Commercial			с			
None (user provided)			Х			
<u>KID Length</u> 15 foot (4.5 m)				-		
50 feet (15 m)				ĸ		
100 feet (30 m)			BV	N		
None (user provided)			W	w		
<u>Hardware</u>						
1/2 in. NPT Threads, Poly cable glands				s		
1/2 in. NPT Enreads, Nickel Plated Brass cable glands						
M20 Threads, Poly cable glands				c		
M20 Threads, Nickel Plated Brass cable glands				D		
M20 Threads, no cable glands				Α		
Endpoint Wiring Method						
None	-			Х	X	
<u>communication/Output</u> Standard Output (Modbus RTU or RAC not MS/TP field coloctal	nle)				c	
Standard Output plus Modbus TCP Ethernet	,				т	
Standard Output plus BACnet/IP Ethernet					v	
Standard Output plus EtherNet/IP					U	
Standard Output plus Aux Output					9	
Units of Measure Totalizer/Flow Rate ³						
Gallons/gallons per minute						G
Liters/liters per minute						Р
Units of Measure Energy Totalizer/Rate						
KIIOWATT-hour/KIIOWATT (field selectable, additional options a	/allable)					к
Factory Calibrated						F
Factory Calibrated/Stainless Steel Tag						s
¹ Contact factory for DTTL cable lengths longer than 300 ft.						

² Submersible transducer cables use two conduit openings.

NORTH AMERICAN PIPE SCHEDULES

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

Si	Size in.		Class in.											
		Α	В	с	D	E	F	G	н					
	OD	3.80	3.96	3.96	3.96									
3	Wall	0.39	0.42	0.45	0.48] _	_	_	_					
	ID	3.02	3.12	3.06	3.00									
	OD	4.80	5.00	5.00	5.00									
4	Wall	0.42	0.45	0.48	0.52] _	_	_	_					
	ID	3.96	4.10	4.04	3.96									
	OD	6.90	7.10	7.10	7.10	7.22	7.22	7.38	7.38					
6	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					
	OD	9.05	9.05	9.30	9.30	9.42	9.42	9.60	9.60					
8	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					
	OD	11.10	11.10	11.40	11.40	11.60	11.60	11.84	11.84					
10	Wail	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.	SCF	160	X S	TG.	SCł	180	SCH 100		SCH 100		SCH 120/140		SCH 180	
		ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall		
		in.	in.	in.	in.	in.	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						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

NPS	OD	SCI	SCH 5 SCH 10 SCH 20 SCH 30 STD		SCH 20		SCH 20		SCH 20 SCH 30		STD		140
in.	in.	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall	ID	Wall
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	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	0.237	4.026	0.237
5	5.563	5.345	0.109	5.295	0.134	-	_	-	_	5.047	0.258	5.047	0.258
6	6.625	6.407	0.109	6.357	0.134	8.125 0.250				6.065	0.280	6.065	0.280
8	8.625	8.407	0.109	8.329	0.148			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

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

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

Copper Tubing, Copper and Brass Pipe, Aluminum

Nom	Nominal Diameter	Co	opper Tubii in.	ng	Copper & Brass	Alum.	Nom	ninal	Co	opper Tubii in.	ng	Copper & Brass	Alum.
Diam	heter		Туре		Pipe	in.	Dian	neter		Туре		Pipe	in.
		К	L	м	in.				К	L	м	in.	
	OD	0.625	0.625	0.625	0.840			OD	3.625	3.625	3.625	4.000	
0.5	Wall	0.049	0.040	0.028	0.108	_	3-1/2	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	
	OD	0.750	0.750	0.750				OD	4.125	4.125	4.125	4.500	4.000
0.6250	Wall	0.049	0.042	0.030] _	_	4	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
	OD	0.875	0.875	0.875	1.050			OD					5.000
0.75	Wall	0.065	0.045	0.032	0.114	_	4-1/2	Wall	_	—	_	_	0.250
	ID	0.745	0.785	0.811	0.822			ID					4.500
	OD	1.125	1.125	1.125	1.315			OD	5.125	5.125	5.125	5.563	5.000
1	Wall	0.065	0.050	0.035	0.127	—	5	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
	OD	1.375	1.375	1.375	1.660			OD	6.125	6.125	6.125	6.625	6.000
1.25	Wall	0.065	0.055	0.042	0.146	_	6	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
	OD	1.625	1.625	1.625	1.900			OD				7.625	7.000
1.5.	Wall	0.072	0.060	0.049	0.150	—	7	Wall	_	_	_	0.282	0.078
	ID	1.481	1.505	1.527	1.600			ID				7.062	6.844
	OD	2.125	2.125	2.125	2.375			OD	8.125	8.125	8.125	8.625	8 000
2	Wall	0.083	0.070	0.058	0.157	—	8	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
	OD	2.625	2.625	2.625	2.875	2.500		OD	10.125	10.125	10.125	10 000	_
2.5	Wall	0.095	0.080	0.065	0.188	0.050	10	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	—
	OD	3.125	3.125	3.125	3.500	3.000			_	_		_	
3	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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