MODEL

FT2A

Fox Thermal Gas Mass Flow Meter

Instruction Manual

Document #105397

Rev F

831.384.4300 | 399 Reservation Rd, Marina, CA 93933 | foxthermal.com

This publication must be read in its entirety before performing any operation. Failure to understand and follow these instructions could result in serious personal injury and/or damage to the equipment. Should this equipment require repair or adjustment beyond the procedures given herein, contact the factory at:

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Download Technical Data Sheets from our website:
www.foxthermal.com

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Fox Thermal FT2A Manuals:

- **Fox Thermal FT2A View™ Manual**
- **Fox Thermal FT2A Anybus (Profibus, DeviceNet, Ethernet) Manual**

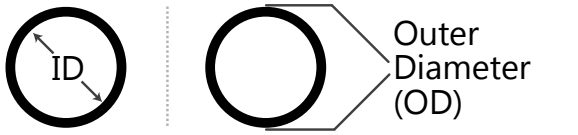
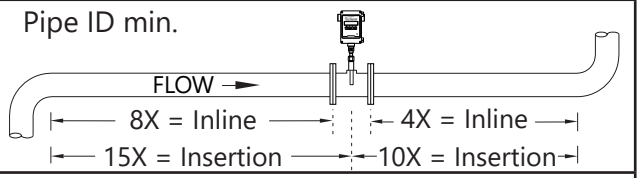
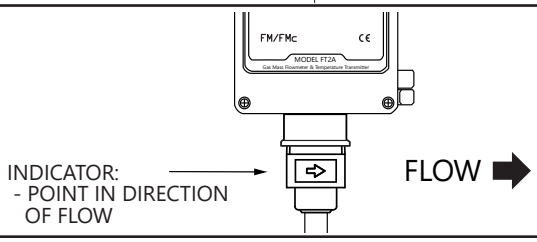
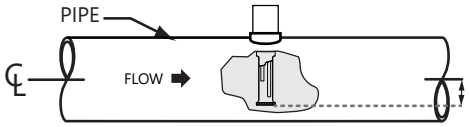
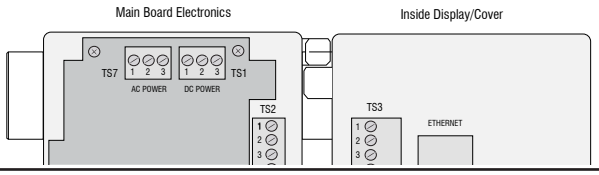
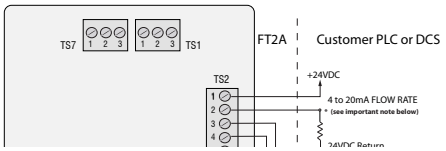
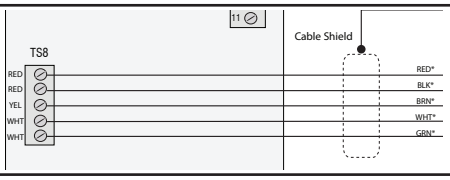
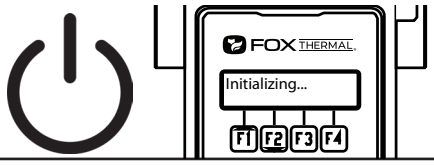
All Fox Thermal Manuals and software available in English only.

Model FT2A

Table of Contents

Use the table below as a guide while using the worksheet on the next page to record your notes.

NOTE! Please read the entire quick-start procedure before beginning installation.

1.	Record inside diameter (ID). Ensure the actual pipe ID matches the pipe ID shown on the factory calibration certificate. If IDs do not match, refer to "Pipe Area" on page 60.	
2.	Record up/downstream straight-pipe requirements based on Pipe ID and meter style (insertion or inline). [refer to p. 17]	
3.	The Flow Direction Indicator must point in the direction of flow.	
4.	Ensure correct probe depth setting. If using 1 ½" size pipe, please see note on p. 20.	
5.	Ensure power wiring is properly connected.	
6.	Verify the input/output and serial communication wiring is correct. [refer to p. 34 for more information]	
7.	Ensure remote wiring is correct if remote option ordered. [refer to p. 43 - p. 43 for more information]	
8.	Power on the flow meter.	
9.	Check the remaining flow meter settings by accessing the meter settings either through the front panel of the display or by using the FT2A View™ software tool. Record the settings in the spaces given for items A - F on the following page.	

Before powering on your meter, use this worksheet to record your notes.

	Item to verify	*Serial Number:*	*Serial Number:*	*Serial Number:*	*Serial Number:*
1.	What is the Pipe ID?	ID =	ID =	ID =	ID =
2.	Calculate the Upstream/ Downstream straight-pipe requirements	UP = DN =	UP = DN =	UP = DN =	UP = DN =
3.	Is the flow indicator pointed in direction of flow?	Y / N	Y / N	Y / N	Y / N
4.	Is the probe depth setting correct?	Y / N	Y / N	Y / N	Y / N
5.	Verify proper power wiring				
6.	Verify proper remote wiring (if ordered)				
7.	Verify proper input/output wiring				

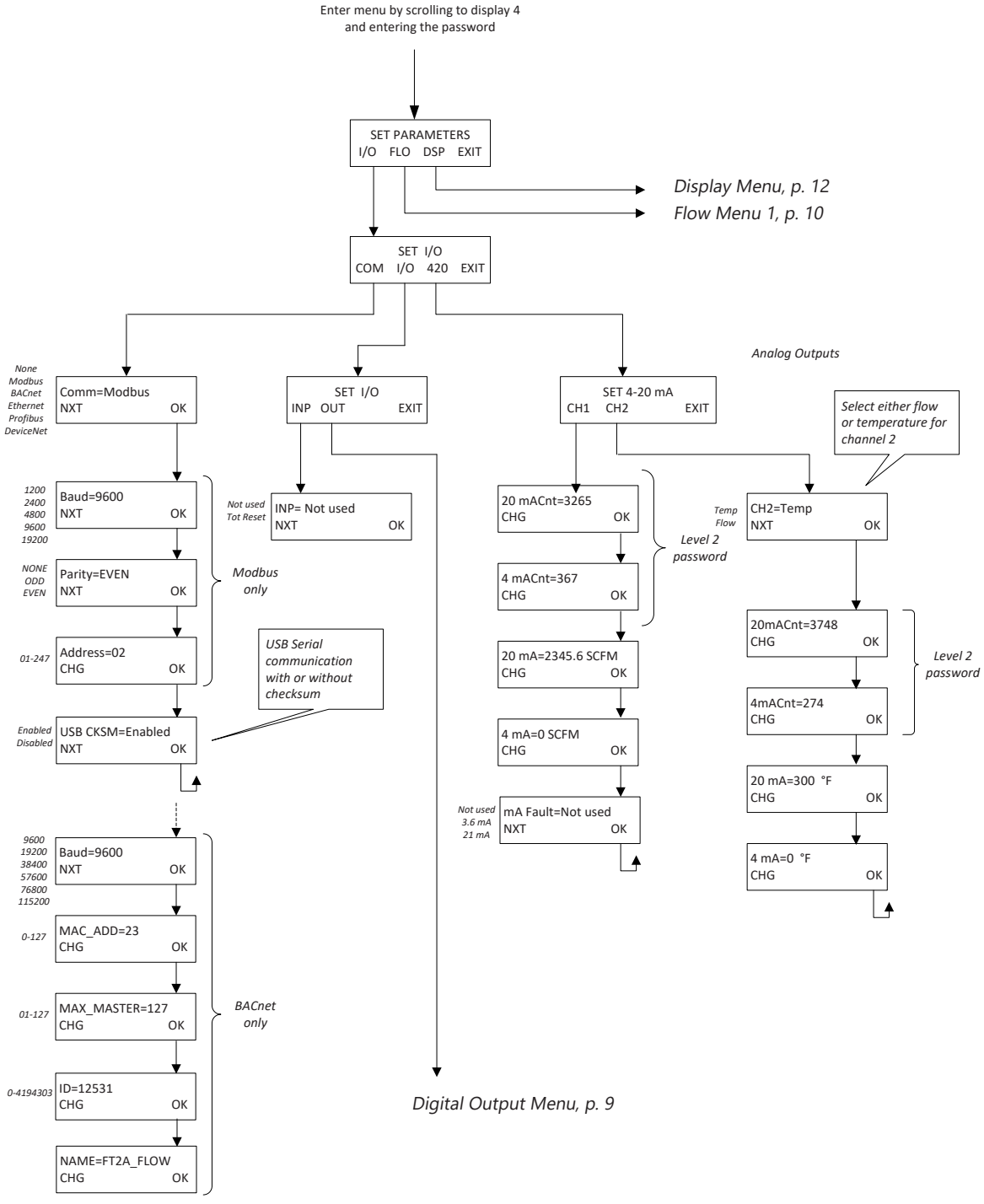
After powering on your meter, check items A - E below by accessing the meter settings either through the front panel of the meter's display or by using the FT2A View™ software tool.

A.	Which flow units have been set in meter? (SCFM, KG/H, etc..)				
B.	Correct values for reference temperature and pressure?	Y / N	Y / N	Y / N	Y / N
C.	Confirm the pipe ID listed above same as "Pipe_id="				
D.	Verify the 1st 4mA and 20mA meter settings	4mA = 20mA =	4mA = 20mA =	4mA = 20mA =	4mA = 20mA =
E.	Verify the 2nd 4mA and 20mA meter settings	4mA = 20mA =	4mA = 20mA =	4mA = 20mA =	4mA = 20mA =

Your Notes:

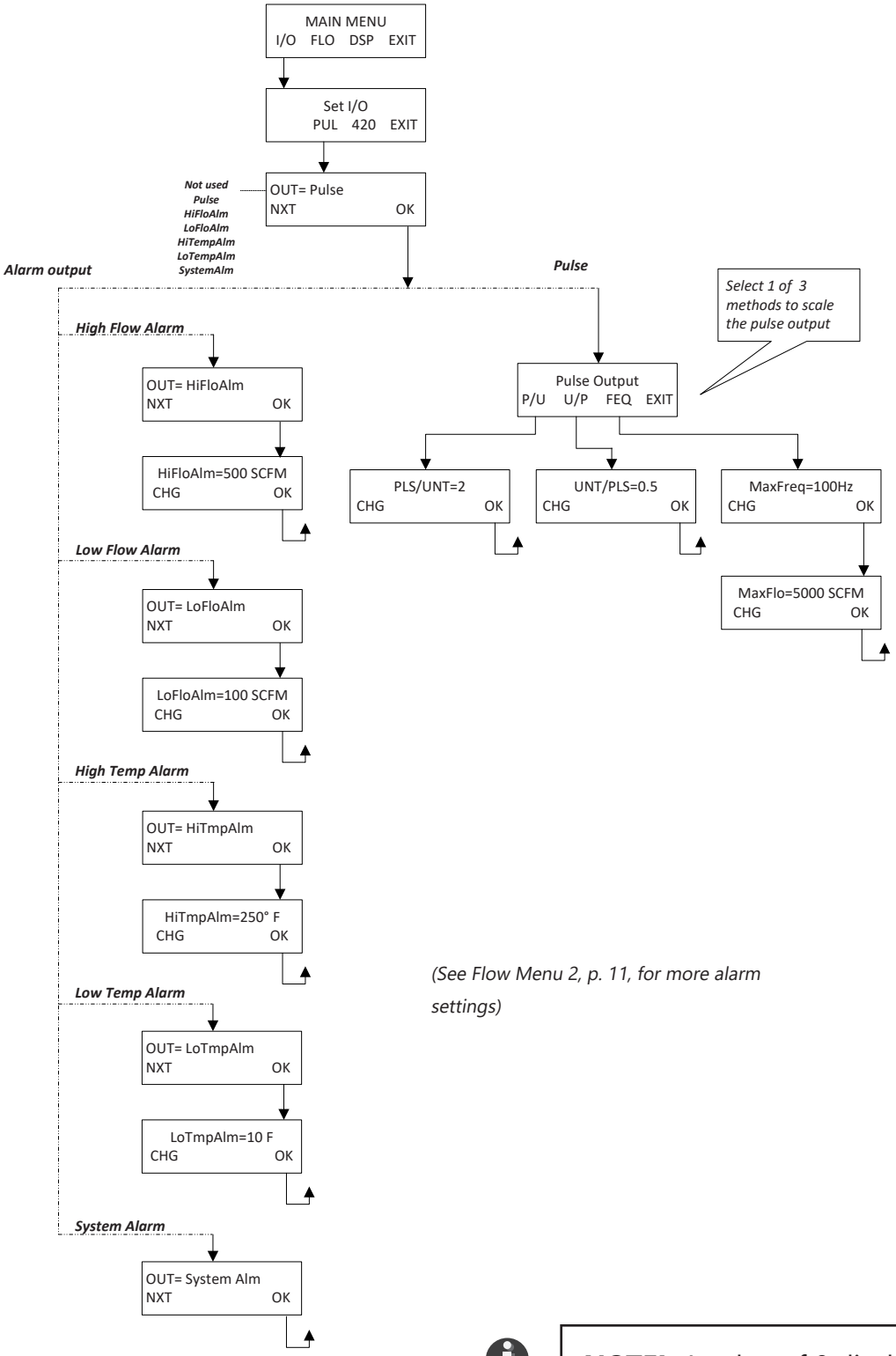
If you are experiencing any problems after completing this procedure, please call the Fox Thermal Service Department at 831-384-4300 to review this information.

Fig. 1.1: FT2A Menu Tree - Main Menu



NOTE! Reference the FT2A Anybus manual for communication operation of Ethernet, Profibus, or DeviceNet communication options, if ordered.
NOTE! Some menus will only be available with a level 2 password.
NOTE! Menu tree boxes are populated with example values.

Fig. 1.2: FT2A Menu Tree - Digital Outputs



(See Flow Menu 2, p. 11, for more alarm settings)

NOTE! A value of 0 disables the alarms

Fig. 1.3: FT2A Menu Tree - Flow Parameter Menu 1

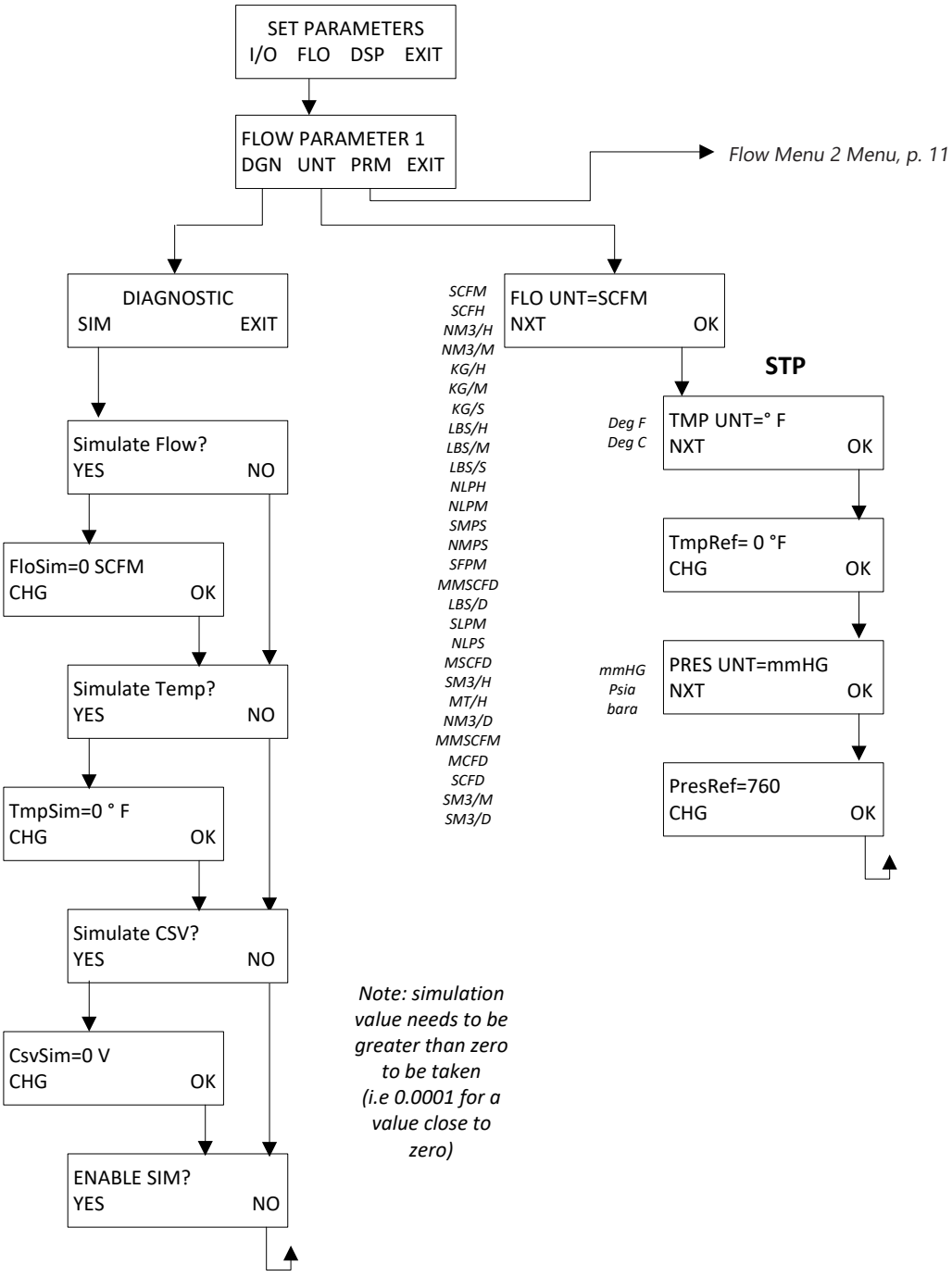


Fig. 1.4: FT2A Menu Tree - Flow Parameter Menu 2

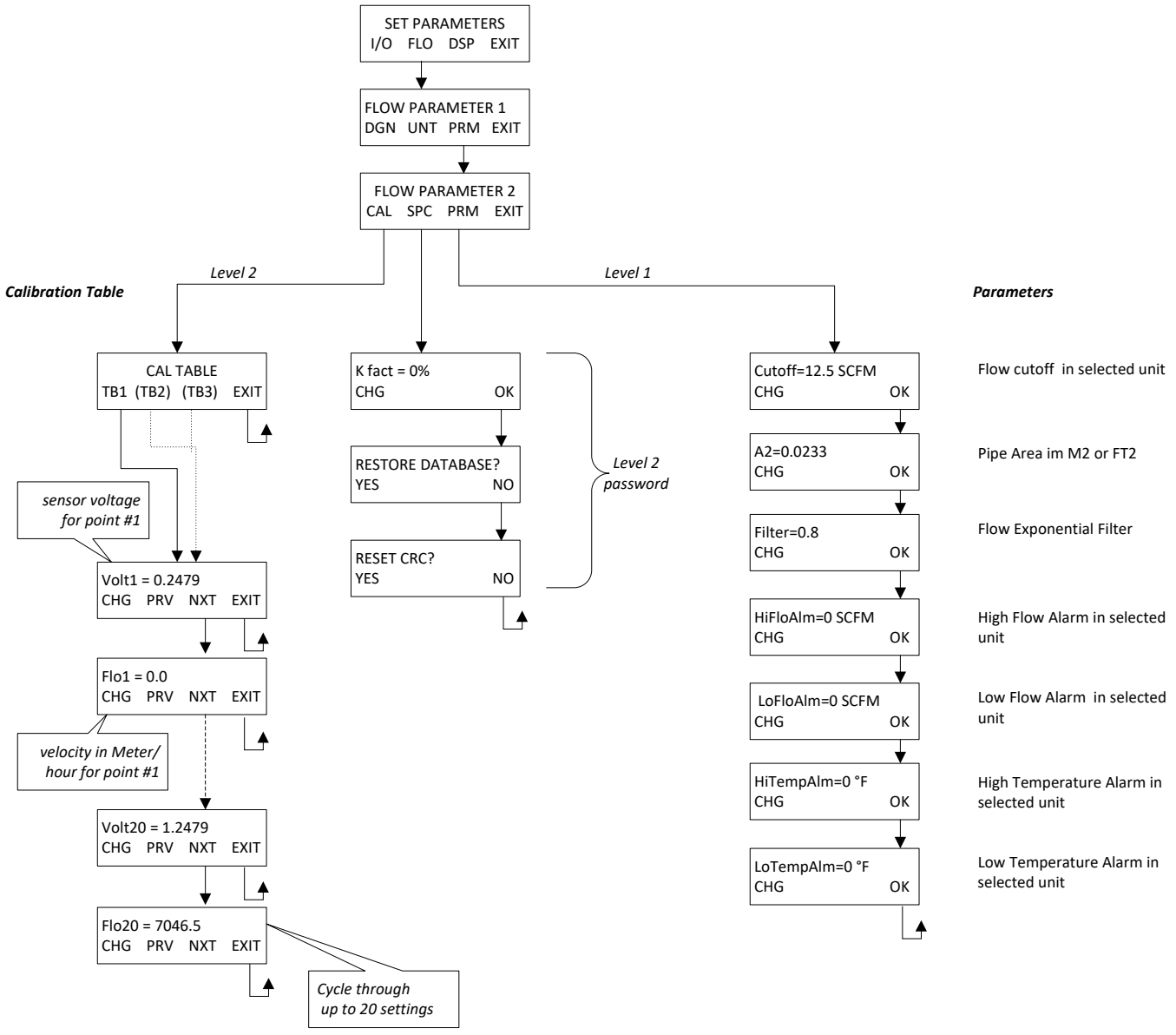
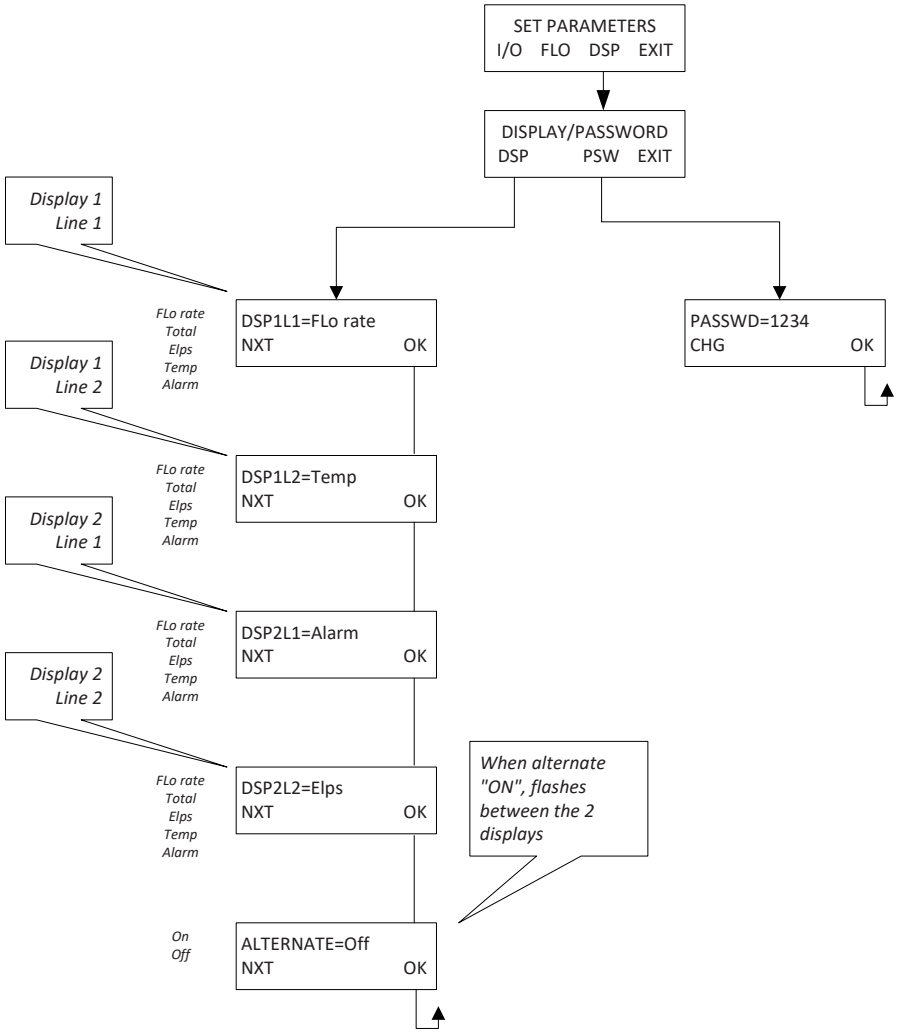


Fig. 1.5: FT2A Menu Tree - Display Menu



NOTE! All readings updated every second

- *Flo Rate = Flow rate of process gas*
- *Total = Total flow of process gas*
- *Elps = Elapsed time since reset of flow total*
- *Temp = Temperature of process gas*
- *Alarm = Notification of errors; diagnostic errors*

Fig. 1.6: FT2A Menu Tree - Engineering Screens

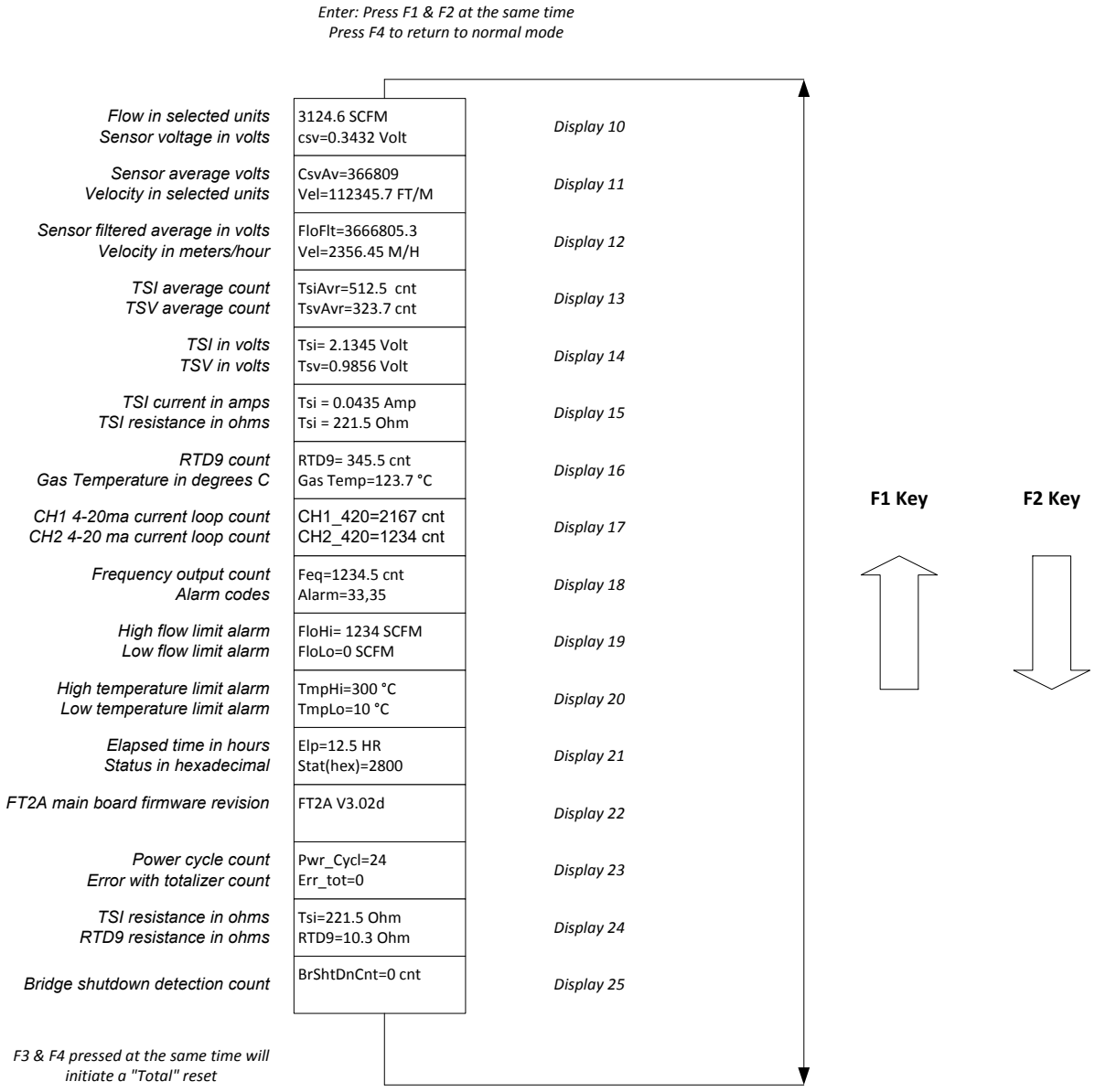
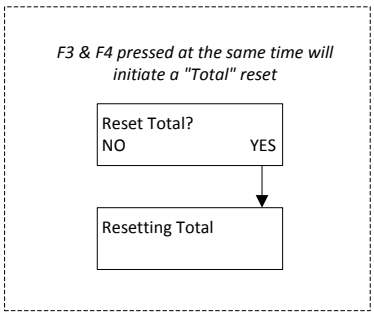


Fig. 1.7: FT2A Menu Tree - Reset Flow Total



Welcome
Thank you for purchasing the model FT2A thermal gas mass flow meter and temperature transmitter from Fox Thermal. The model FT2A is one of the most technically advanced flow meters in the world. Extensive engineering effort has been invested to deliver advanced features, accuracy measurement performance and outstanding reliability.

This instruction manual contains the electrical and mechanical installation instructions as well as details for programming, maintaining and troubleshooting the meter. This manual is divided into the following sections: Introduction, Installation, Wiring, Operation, Maintenance, Troubleshooting, Appendices, Glossary and Index.

Theory of Operation
The model FT2A is an innovative thermal mass gas flow meter and temperature transmitter. It is microprocessor-based and field programmable. The FT2A thermal sensor operates on the law that gases absorb heat. A heated sensor placed in an air or gas stream transfers heat in proportion to the stream's mass velocity. There are two sensor elements connected to a balanced bridge circuit. One sensor element detects the gas temperature and a second element is maintained at a constant temperature above the gas temperature. The energy applied to the heated sensor to maintain a constant temperature differential (constant Δ T) is directly proportional to the mass flow velocity. The FT2A flow meter maintains accurate flow measurement over a large temperature and pressure range.

Mass Flow
The model FT2A measures mass flow; an advantage over other flow meters which measure volumetric flow rate. Volumetric flow is incomplete because temperature and pressure are unknown and must be measured separately. For example, the mass flow of a gas depends on its temperature and pressure. As temperature and pressure changes, the gas volume changes but not its mass. Therefore a device measuring mass flow is independent of temperature and pressure. The model FT2A provides a direct measurement of gas flow in mass units (kg/hr, lb/hr), standard units (SCFM, SLPM) or normal units (NM3/hr, NLPM) with no additional temperature or pressure measurements required.

Flow Calibration
The Fox Calibration Lab maintains instrument calibration records on every flow meter. Computer-generated calibration documents describe specific instrument details that can be sorted by serial number, tag number or customer purchase order. Calibration files include details on process conditions, calibration fluid, line size and other information. All NIST-traceable equipment utilized for the calibration procedure is identified, as is the calibration history of all reference equipment. In addition to the Calibration Certificate, a certified flow table that correlates current outputs with scaled units of flow is produced for each calibrated device. Calibration data curve tables can also be accessed in the flow meter with a computer using FT2A View™ software.

I/O Description
The FT2A features two galvanically isolated 4-20mA analog outputs, one isolated digital output, one discrete input, and a USB port for communication with a computer. The first 4-20mA output is for flow rate. The second 4-20mA output can be configured either for flow rate or process gas

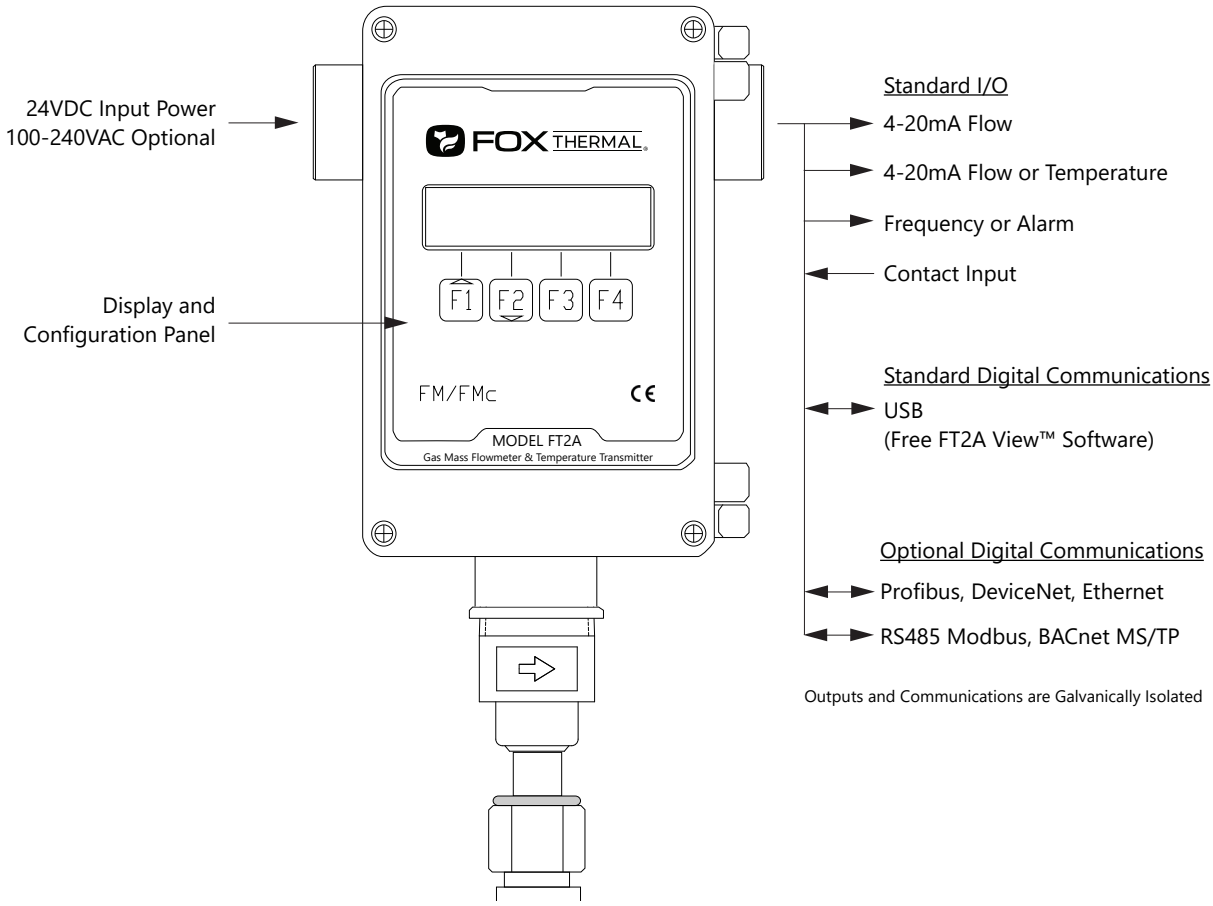
temperature. Both 4-20mA outputs can be scaled by the user. The digital output can be used for frequency or alarm, is programmable to represent flow rate and can be scaled for maximum flow/ maximum frequency, units-per-pulse or pulse-per-units. The maximum frequency is 100 Hz. FT2A View™ interfaces to the USB port and is a free Fox PC-based software program that displays flow meter readings and permits flow meter configuration. The software is available for download on the Fox website.

Industry standard communication options are available including optional Modbus RTU (RS485), BACnet MS/TP (RS485), Profibus-DP, DeviceNet, or Ethernet Modbus TCP. These serial communication options can be selected when ordering the meter. Modbus and BACnet may be enabled after purchase.

FT2A Functional Diagram

An on-board 2 line x 16 character backlit LCD display shows flow rate, total flow, elapsed time, process gas temperature and alarms. The display is also used in conjunction with the Configuration Panel for field configuration of flow meter settings such as 4-20mA scaling, frequency output scaling, pipe area, zero flow cutoff, flow filtering or damping, display configurations, diagnostics and alarm limits.

Fig. 1.8: FT2A Function Diagram



Installation Scope
This section describes how to install the Fox Thermal model FT2A Flow Meter:

For Insertion Types:

1. Determine lateral position on the pipe.
2. Determine radial position of probe if moisture or condensation present in the gas.
3. Verify sensor installation depth.
4. Determine sensor orientation in relation to sensor length and direction of flow.
5. Ensure proper tightening of compression fitting for mounting meter.

For Inline Types:

1. Determine lateral position on the pipe.
2. Ensure the correct flow body orientation in relation to direction of flow in pipe.
3. Ensure proper tightening of compression fitting for mounting meter.

Installation procedures must be performed using a combination of the end user's best engineering practices, in compliance with local codes, and with manufacturer's recommendations.

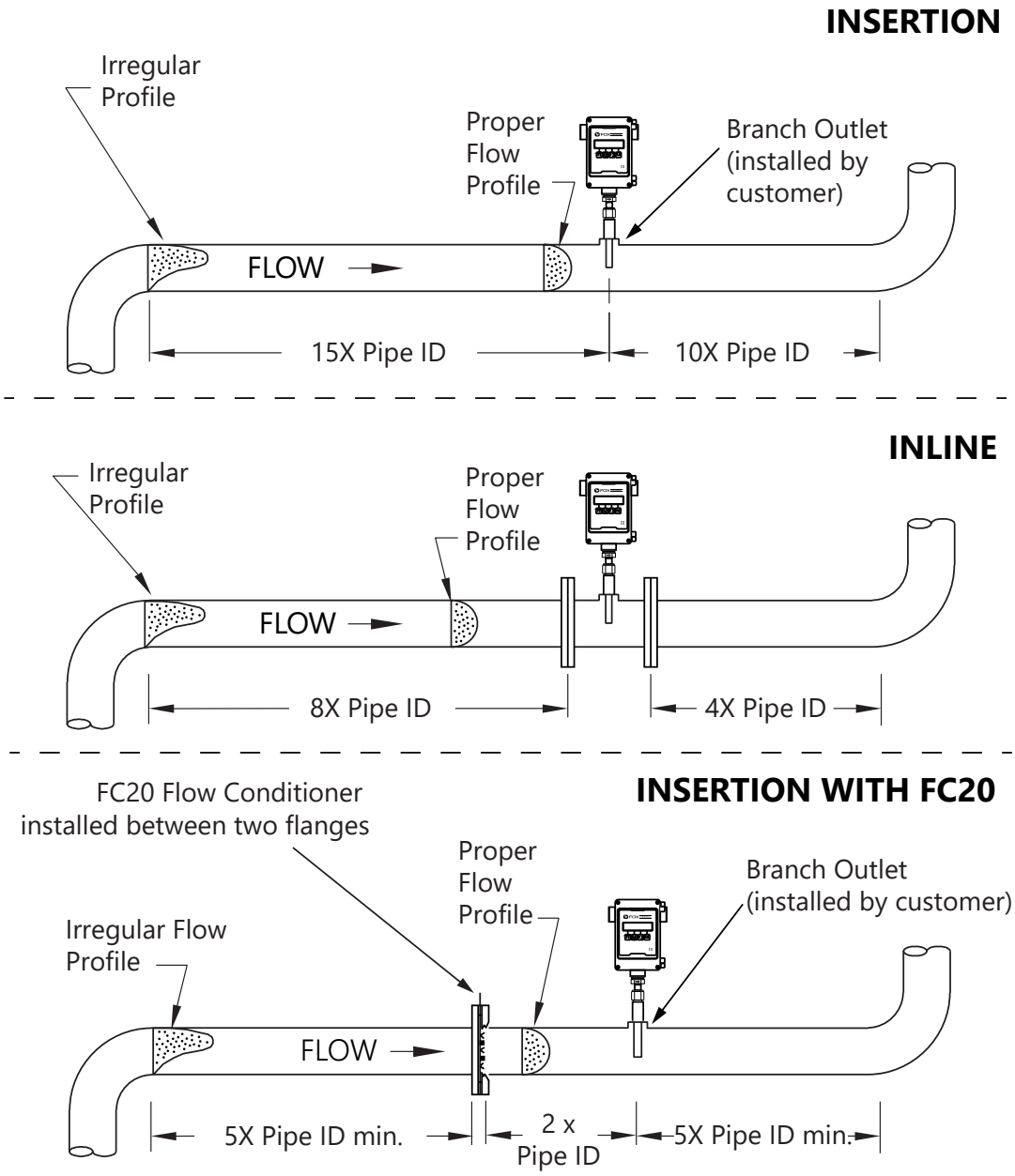
General Precautions
The following general precautions should be observed:

1. Exercise care when handling the flow meter to avoid damaging the probe, sensor or enclosure.
2. Close any unused conduit openings in the enclosure with plugs certified for your application.
3. The enclosure cover must be closed during installation except during configuration or during installation.
4. Mounting FT2A in direct sunlight can cause the temperature inside the enclosure to increase beyond design limits, resulting in failure of LCD display and reduced component life. It is recommended that a sunshade be installed to avoid direct sunlight (see maximum enclosure operating temperature specification).
5. Ensure the flow direction indicator for the meter is in line with the direction of flow in the pipe.
6. Do not install the FT2A enclosure near an igniter, igniter-controller or switching equipment.
7. Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
8. This flow meter contains components that can be damaged by static electricity. You must discharge yourself by touching a grounded steel pipe or other grounded steel material prior to working inside this flow meter.
9. Ensure that good engineering practices and applicable industry codes are followed throughout the installation process.
10. For accurate flow measurement, review flow meter placement instructions before installation to ensure a proper flow profile in the pipe.

Instructions for Flow Meter Lateral Placement

Install the model FT2A flow meter so that it is far enough away from bends in the pipe, obstructions, or changes in line sizes to ensure a consistent flow profile. See Fig. 2.1 below for your meter type.

Fig. 2.1: Upstream and Downstream Pipe IDs for Insertion and Inline Flow Meters

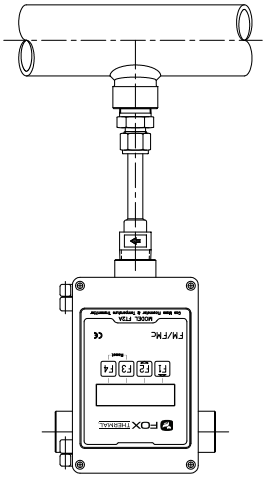


NOTE!

- Pipe ID = Inside Diameter
- The probe diameter is ½"
- An irregular flow profile will affect sensor accuracy
- See FC20 Installation Instructions (PN 109193) for more information

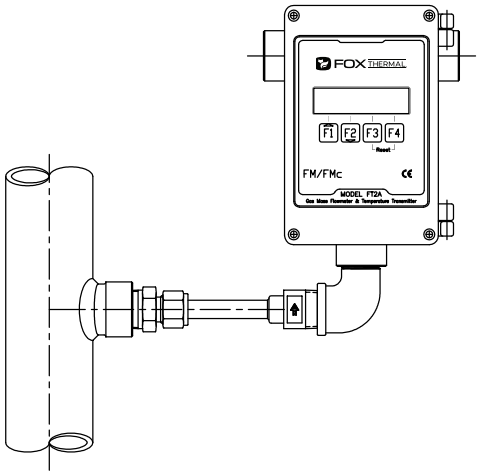
Radial Probe Positions - Moisture in the Gas or Condensation
The radial position of the meter may help reduce collection of moisture on the sensor. Condensing liquids contacting the meter's sensing elements will disrupt accurate flow measurement. Fox Thermal recommends the flow meter be used in dry gas conditions whenever possible for highest accuracy. Contact Fox for further recommendations.

Fig. 2.2: Installation at 180°

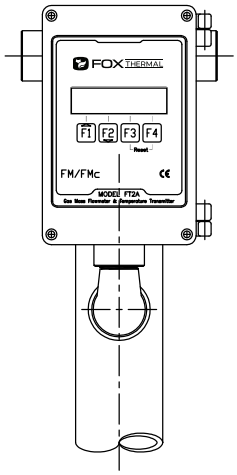


Alternate Installations - Vertical Pipes or Restricted Installation Spaces
When restricted physical installation space exists, the FT2A can also be installed at other angles. Please note that the display's orientation will remain aligned with the top of the meter. The display can be ordered in rotated orientations for better view.

Fig. 2.3: Alternate Installation Examples at 90° (CW) with Elbow Kit



"F3" Display Configuration Code



"F5" Display Configuration Code

See "FT2A Display Configuration Codes" (Fox Document F-142) for a complete list of display configuration codes.

Welding Branch Fitting to Pipe

The probe of the FT2A must be installed perpendicular in the pipe to measure flow accurately. Use the following steps to ensure that the ¾" branch fitting is correctly welded to the pipe.

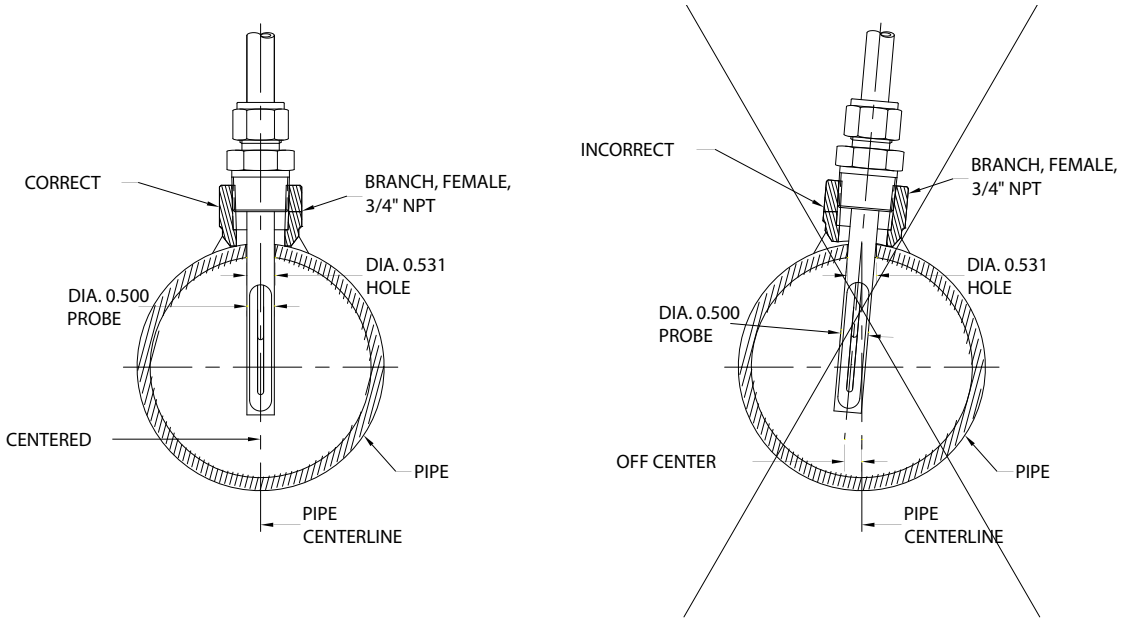
Directions:

1. Drill a 0.531" (17/32") (13.5mm) hole inside the fitting through the wall of the pipe (1 wall only).
2. Assemble the compression fitting and branch fitting hand tight onto the probe of the FT2A.
3. Insert the probe into the hole in the pipe and use the FT2A probe and compression fitting to align the branch fitting with the hole and the probe perpendicular to the pipe.
4. Tack-weld the branch fitting carefully onto the pipe.
   - Before welding the fitting completely, verify the probe is aligned to the center of the pipe and the hole is centered in the branch fitting (see Figure 2.4).
5. To verify that the correct hole position has been achieved, carefully slide the 0.50" sensor in and out of the branch fitting and 0.531" hole.

WARNING! Do not force the 0.50" sensor through the 0.531" hole. Forcing it through the 0.531" hole can damage the probe.

6. Verify that the temporary weld of the branch fitting positions the probe window on the pipe's centerline.
   - Figure 2.4 shows an incorrect welding of the branch fitting, causing the 0.50" sensor to be "off center".
7. Once the branch fitting is aligned properly, remove the 0.50" sensor from the branch fitting and finish welding. Then verify the probe is still aligned with the center of the pipe.
8. Set the depth of the flow meter (see "Fig. 2.5: Insertion Sensor Depth in Pipe" on page 20).
   - Do not tighten compression fitting until proper depth of flow meter is determined. See Fig. 2.5.

Fig. 2.4: Alignment of Branch Fitting



Installation Depth
The installation depth of the sensor in the pipe is dependent on the pipe size. To get the most accurate reading, the sensor window must be properly positioned within the pipe.

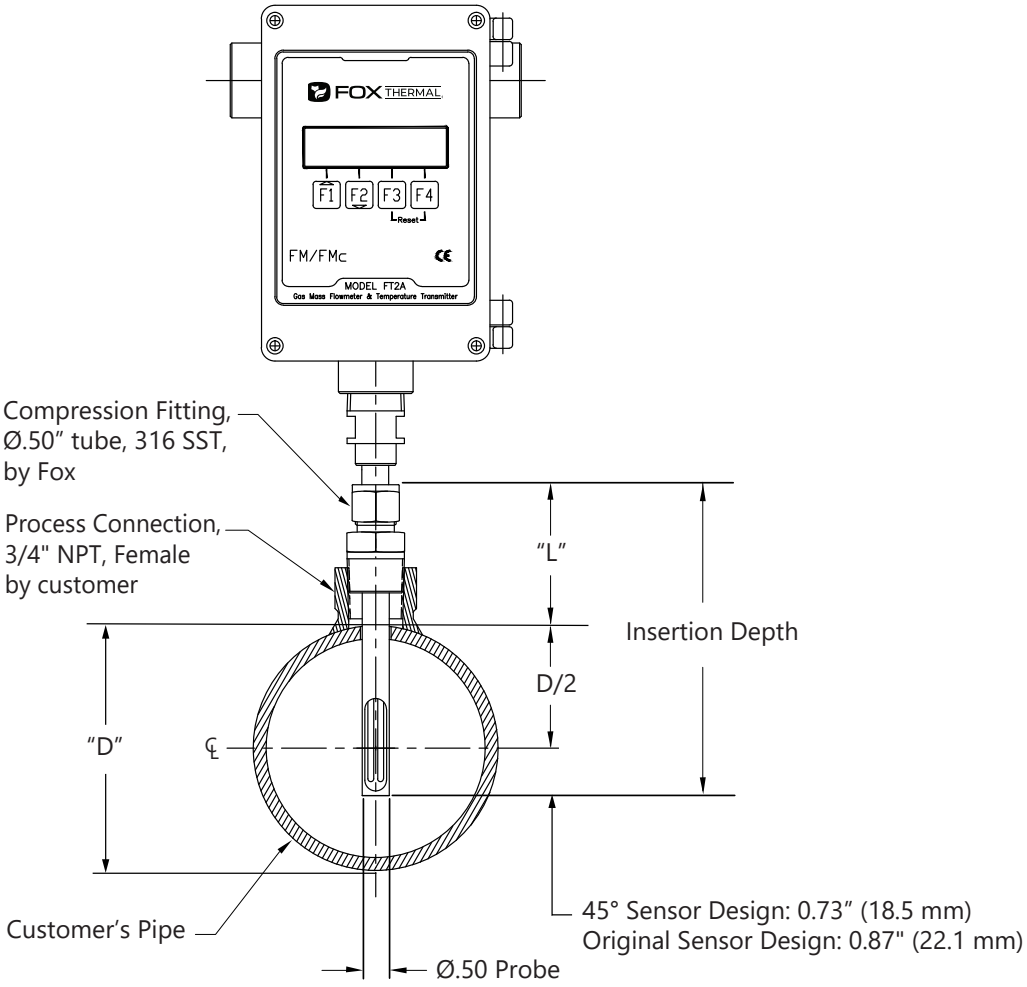
When installing the latest 45° sensor design, the end of the sensor should be 0.73" (18.5 mm) past the center of the pipe.

When installing an original sensor design, the end of the sensor window should be 0.87" (22.1 mm) past the center of the pipe. Reference sensor design figures on page 22.

Review Fig 2.5 below and use the following equations to calculate insertion depth. Insertion depth is measured from the top of the compression fitting to the bottom end of the probe.
For latest 45° sensor design, Insertion Depth = *L + D/2 + 0.73*"
For original sensor design, Insertion Depth = *L +D/2 + 0.87*"

CAUTION! For a 1½" pipe, do not tighten compression fitting without 0.2" distance from wall or damage to probe will occur.

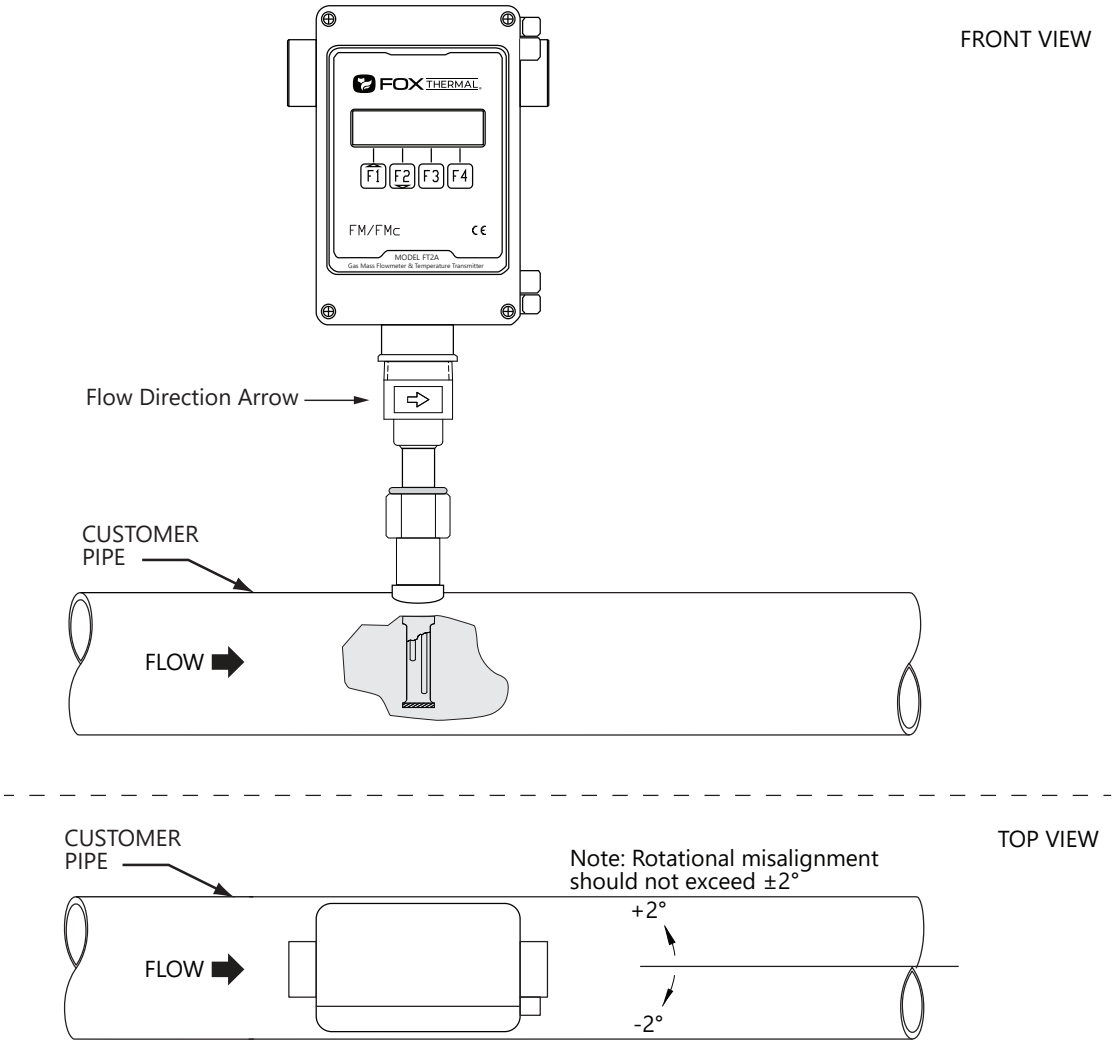
Fig. 2.5: Insertion Sensor Depth in Pipe



Direction of Flow and Orientation of the Probe

Install the meter with the flow direction indicator pointing in the direction of flow and centered on the middle of the pipe. The rotational misalignment of the flow direction indicator must be less than 2 degrees.

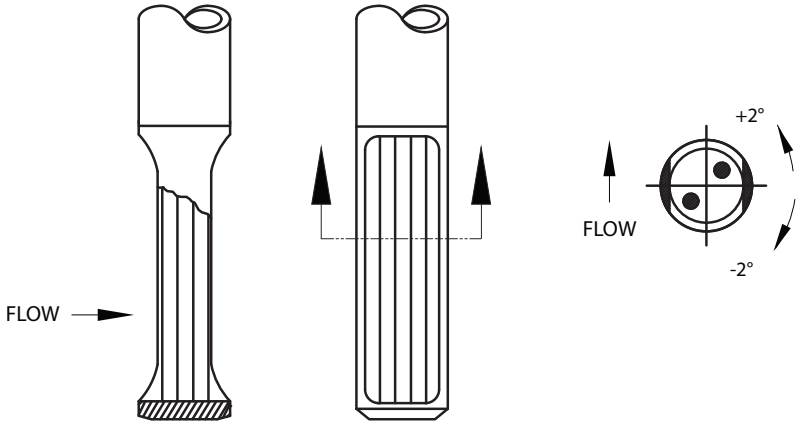
Fig. 2.6: Orientation of Flow Meter



NOTE! Some flow meters are shipped with the sensor elements that are offset. Others are shipped with sensors that have equal length elements (see figures 2.7 and 2.8 on next page). The sensor type supplied was selected at the factory to be the best suited for your application. Follow the appropriate sensor orientation instructions.

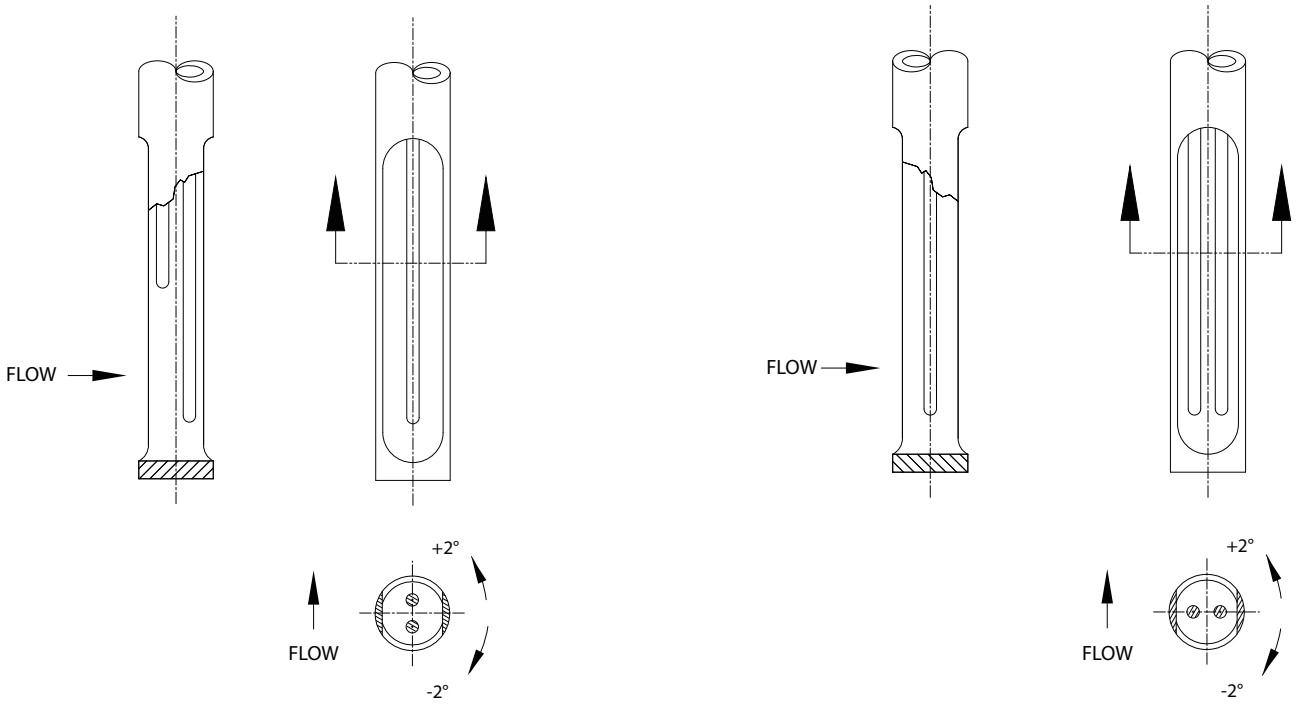
Sensor Orientation - Latest 45° Design
The sensor element tubes of the latest sensor design are connected at both ends and offset at 45 degrees in relation to the sensor window opening. Install the flow meter with the window opening facing the flow stream within ±2°.

Fig. 2.7: Latest Design 45° Sensor Elements



Sensor Orientation - Original Design
Unequal Length Sensor Elements Install the shorter element upstream from the longer one.
Equal Length Sensor Elements Install flow meter with both sensor elements facing the flow stream within ±2°.

Fig. 2.8: Equal and Unequal Length Sensor Elements

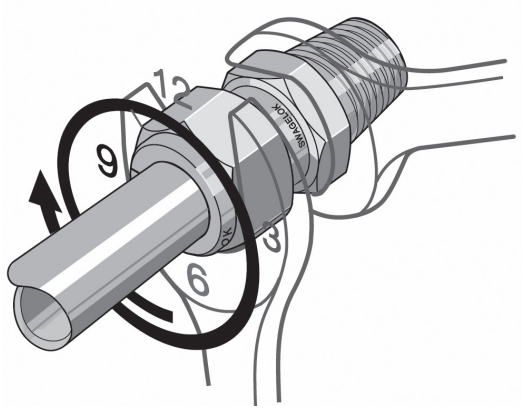


Unequal Length Sensor Elements *Equal Length Sensor Elements*

Mounting Instructions - Compression Fittings (New Insertion Meters Only)
The model FT2A insertion style flow meters are mounted through a 0.531" hole and a ¾" female NPT branch outlet in the customer's pipe. Insertion style flow meters are not designed for use in pipes smaller than 1½".

- Install the compression fitting into the ¾" female NPT branch outlet.
- When installing in a 2" pipe or larger, calculate the depth of the probe to center the window opening in the center of the pipe. (refer to figure 2.5).
- When installing into a 1½" pipe, carefully install the probe into the pipe until it touches the opposite wall and pull back 0.2".
- Rotate the nut finger-tight.
- Further tighten the nut just enough until the tube will not turn by hand or move axially in the fitting.
- Mark the nut at the 6 o'clock position.
- While holding the fitting body steady, tighten the nut one and one-quarter (1 ¼) turns to the 9 o'clock position. See Figure 2.9.

Fig. 2.9: Proper Tightening of the Compression Fitting Nut



NOTE! Before removing a probe with compression fitting, mark the tube at the back of the nut, and mark a line along the nut and fitting body. Use these marks when reinstalling the probe. Reference the instructions on p. 24.

NOTE! When installing a probe with compression fitting that has been tightened previously, use instructions on p. 24.

CAUTION! For a 1½" pipe, do not tighten compression fitting without 0.2" distance from wall or damage to probe will occur.

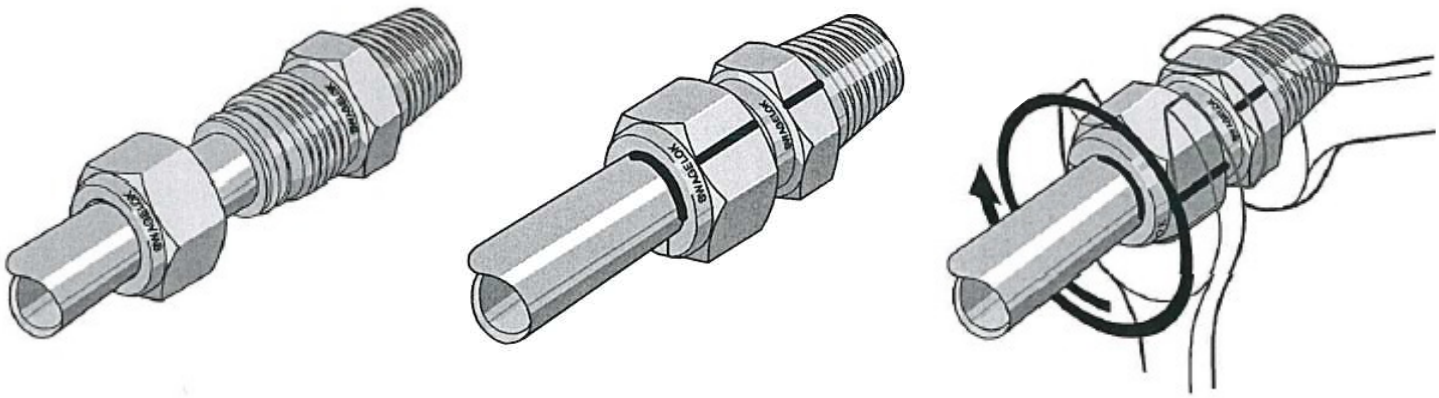
CAUTION! Once the stainless steel compression fitting ferrule is locked onto the probe, the probe can be removed or rotated, but the insertion depth is locked in place.

CAUTION! If the stainless steel or teflon ferrules are not properly tightened, and/or the recommended pressure is exceeded, the ferrules can slip on the stainless steel tubing causing damage to the meter or bodily harm.

Mounting Instructions - Compression Fittings (Inline and Insertion Meters Previously Installed)
In cases where a compression fitting has already been swaged in an inline flow body or an insertion meter, use the following procedure.

- Carefully insert the probe with swaged ferrules into the fitting until the front ferrule seats against the fitting (see Figure 2.10).
- Verify that the probe is installed the correct depth in the pipe (refer to Figure 2.5 on p. 20).
- Rotate the nut with a wrench until the probe and nut are in their previously marked positions, or you feel a significant increase in resistance (see Figure 2.10).
- Tighten the nut slightly (approximately 1/8 turn).

Fig. 2.10: Proper Re-Tightening of the Compression Fitting Nut

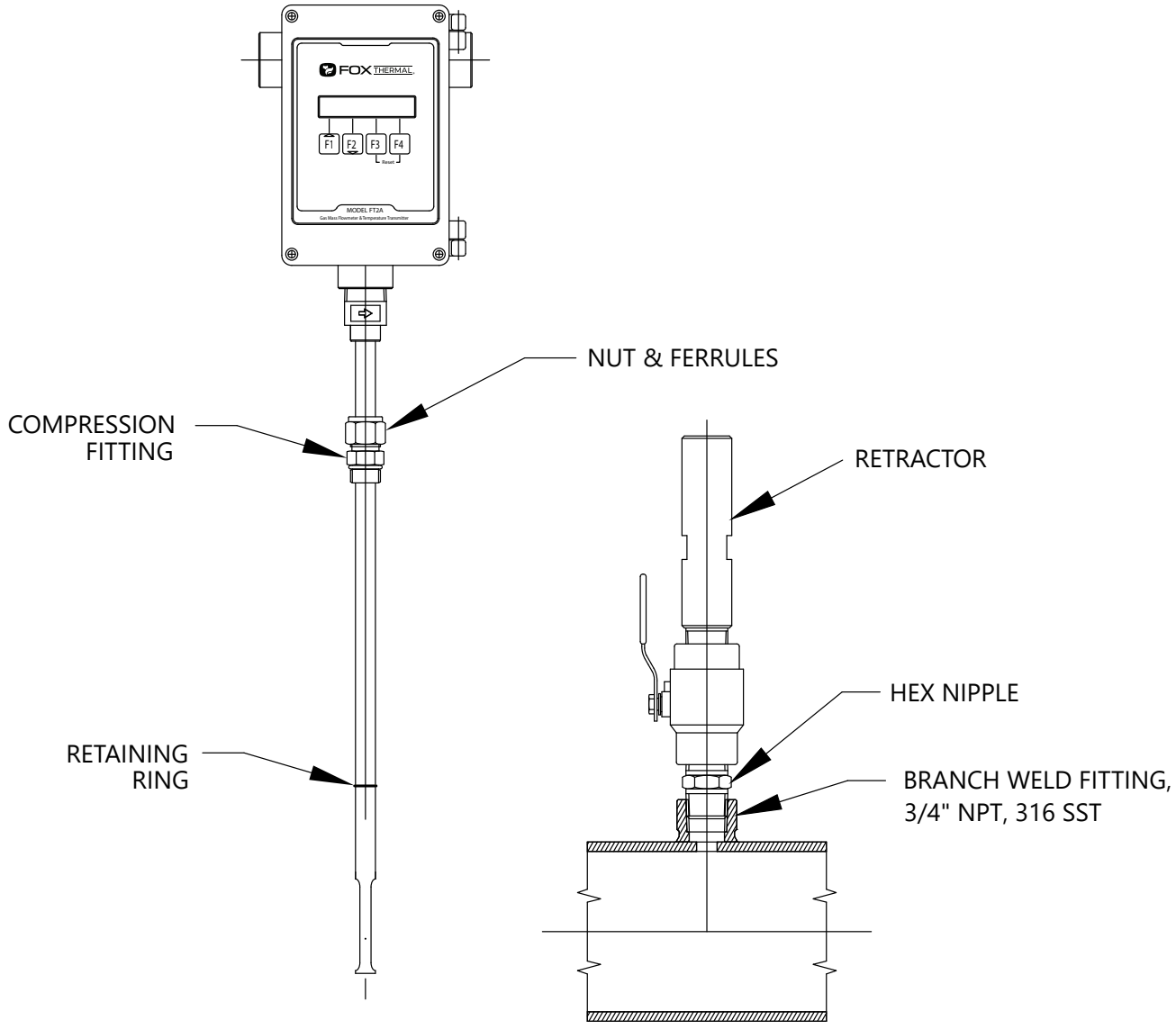


CAUTION! Do not use a gap inspection gauge with reassembled fittings.

Installation of a New Retractor Assembly

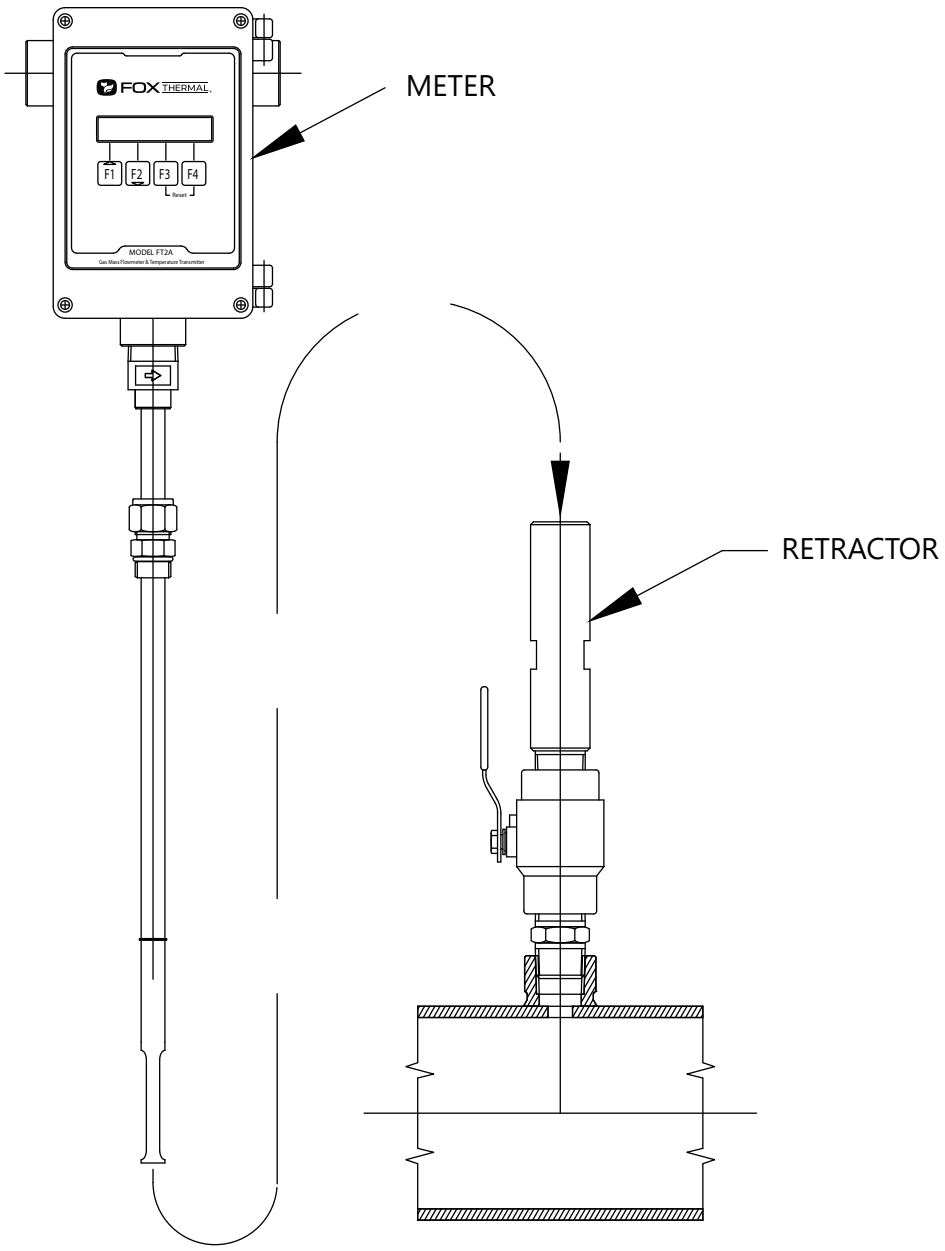
1. Remove meter probe from retractor assembly and leave the ball valve open.
2. Install the valve assembly on the pipe, by tightening the Hex Nipple with a 1 1/16" wrench.

Fig. 2.11: Retractor Assembly Without Probe Installed



3. Carefully slide the probe through the retractor assembly and through the hole to see if there is interference by touching the pipe wall with the end of the probe on the far side or until the probe cannot go deeper. Remove the probe. Remove the retractor and rework the hole, if required.

Fig. 2.12: Verify Probe Insertion



4. The installation depth of the sensor in the pipe is dependent on the pipe size. To get the most accurate reading, the sensor window must be properly positioned within the pipe.

When installing the latest 45° sensor design, the end of the sensor should be 0.73" (18.5 mm) past the center of the pipe.

When installing an original sensor design, the end of the sensor window should be 0.87" (22.1 mm) past the center of the pipe. Reference sensor design figures on page 22.

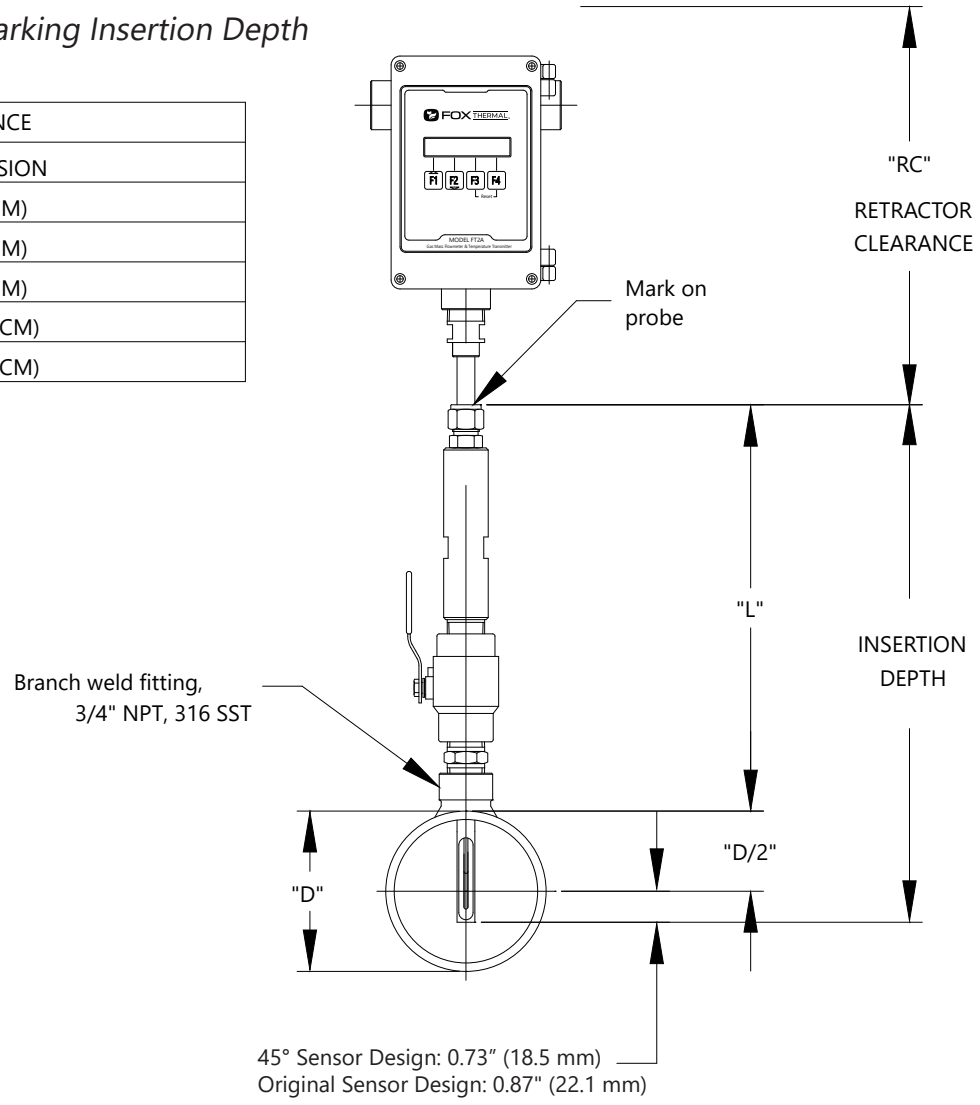
Review Fig 2.13 below and use the following equations to calculate insertion depth. Insertion depth is measured from the top of the compression fitting to the bottom end of the probe.
For latest 45° sensor design, Insertion Depth = *L + D/2 + 0.73*"
For original sensor design, Insertion Depth = *L +D/2 + 0.87*"

CAUTION! For a 1½" pipe, do not tighten compression fitting without 0.2" distance from wall or damage to probe will occur.

5. The Retractor Clearance table of Figure 2.13 lists the space required to remove the meter from the retractor. Use the model code of your meter to determine the dimension.

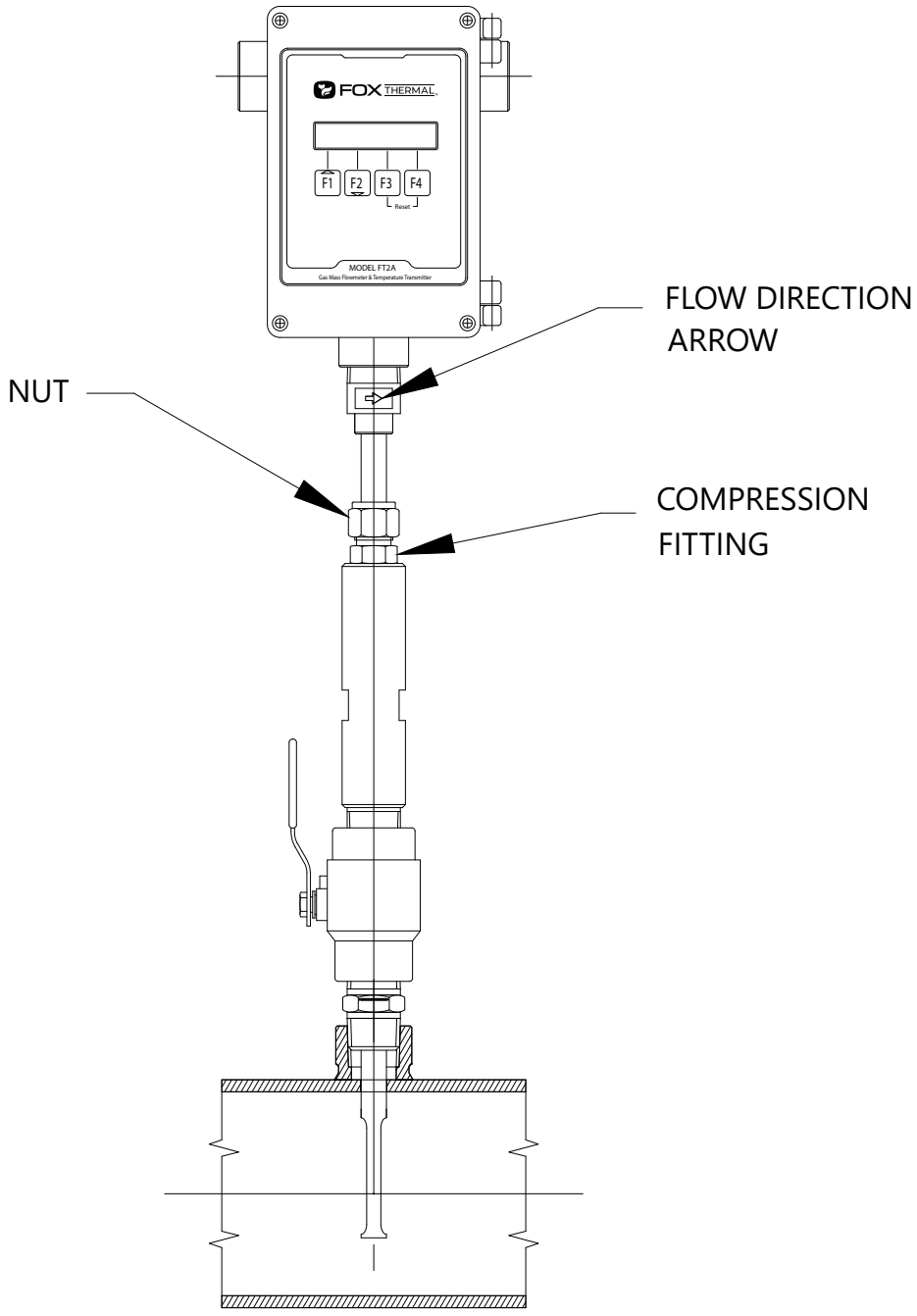
Fig. 2.13: Determining and Marking Insertion Depth

RETRACTOR CLEARANCE	
CODE	"RC" DIMENSION
15R	27.3" (69.4 CM)
18R	30.3" (77.0 CM)
24R	36.3" (92.2 CM)
30R	42.3" (107.4 CM)
36R	48.3" (122.7 CM)



6. Insert probe back into the retractor to the depth mark and hand-tighten the compression fitting.
7. Verify that flow direction indicator is in line with pipe and in the direction of flow.

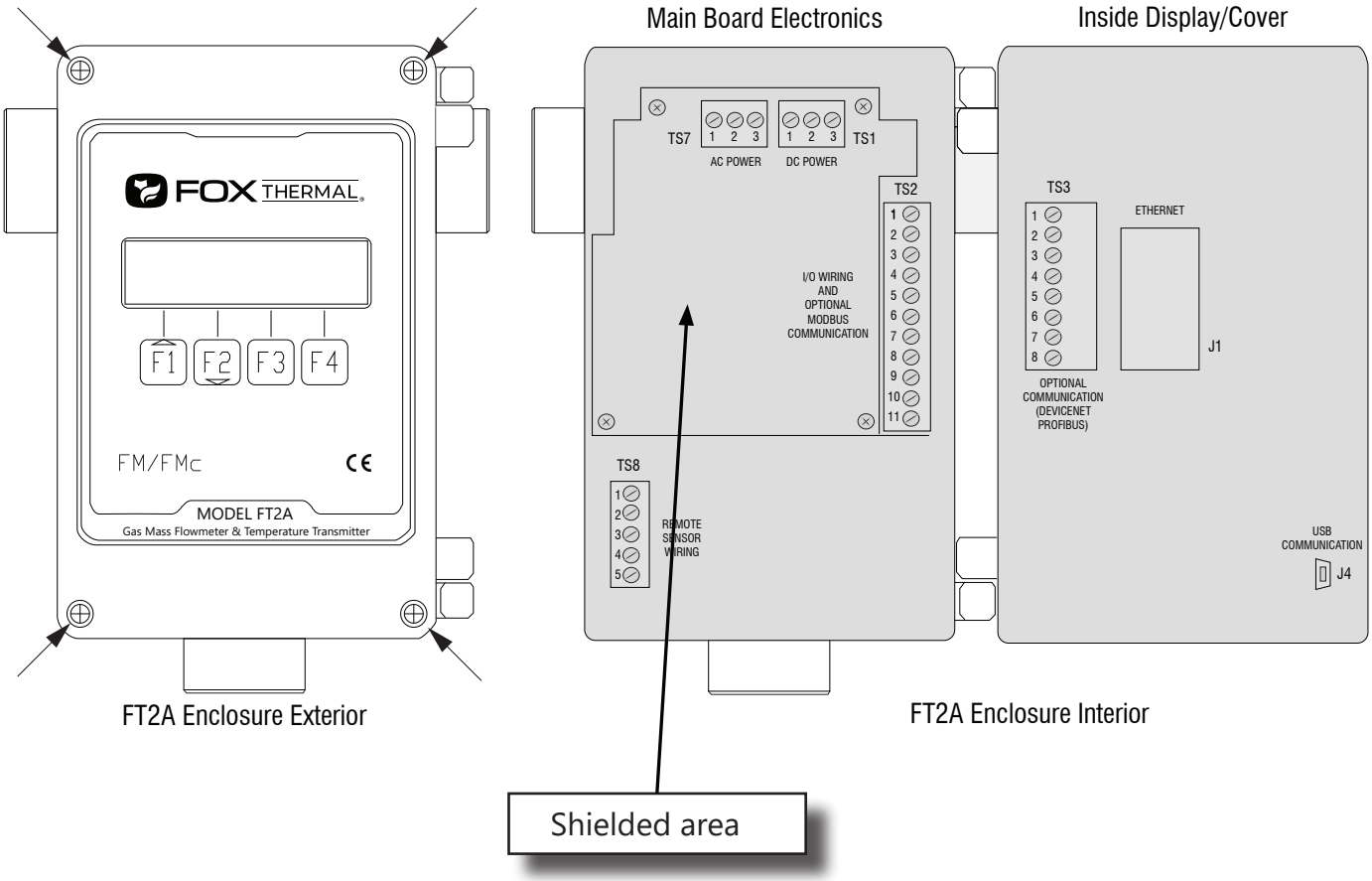
Fig. 2.14: Installed Retractor



8. Fully tighten compression fitting (refer to the instructions on p. 23).

Wiring Instructions
To wire the FT2A connect the power and signal wires to the terminal blocks according to the label and instructions on the following pages.

Fig. 3.1: FT2A Wiring Access



NOTE! Keep power and signal wires within the area of the metal shields and out of the unshielded area.

Wire the FT2A by opening the enclosure cover, bringing customer supplied wires in through the conduit openings and connecting to the terminal blocks. The FT2A has two conduit openings to maintain separation between AC input power and output signal wiring. To eliminate the possibility of noise interference; use a separate conduit for AC power, cut all wires short for a minimum service loop and keep the wires within the area of the FT2A internal metal shields.

Wiring Precautions

WARNING!

- DO NOT OPEN THE ENCLOSURE WHEN ENERGIZED OR AN EXPLOSIVE ATMOSPHERE IS PRESENT.
- Connect earth ground to a chassis ground screw on the inside of FT2A enclosure.
- All plumbing and electrical installations of flow meters must be in compliance with local codes, the end user's best engineering practices, and manufacturer's recommendations.
- An external power disconnect and 16A over-current protection are required for the AC and DC powered FT2A.
- Do not install the FT2A enclosure near an igniter, igniter-controller or switching equipment to eliminate the possibility of noise interference.
- Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
- This flow meter contains components that can be damaged by static electricity. You must discharge yourself by touching a grounded steel pipe or other grounded metal prior to working inside this flow meter.
- For the remote sensor option, the serial number of the electronics enclosure must match the remote sensor probe.
- Close any unused conduit openings with suitable certified plugs

Installation Wiring

Cut all wires short for a minimum service loop. Obtain the correct length for the FT2A wires using one of these methods:

- Trim the wires to extend 5 inches out of the enclosure after the conduit and wires are routed to the FT2A.
- Trim the wires to extend 6 inches from the end of the conduit before attaching them to the FT2A.

Power Wiring

For power wiring, use stranded copper wire, no larger than 16-gauge. If an external 24VDC power source is used, twisted pair shielded cable is recommended. Supply connection wiring must be rated for at least 90°C.

Grounding

The enclosure must be properly grounded with a quality earth ground. 16 gauge, stranded wire is recommended.

Signal Wiring

For signal wiring, the recommended wire gauge is 18 to 22 AWG. Always use twisted pair shielded cable. The cable shield should not be connected at the flow meter, it should be connected at the power supply AC ground terminal or instrumentation AC ground. Do not route the AC power and signal wires in the same conduit.

Modbus and BACnet Communication Wiring

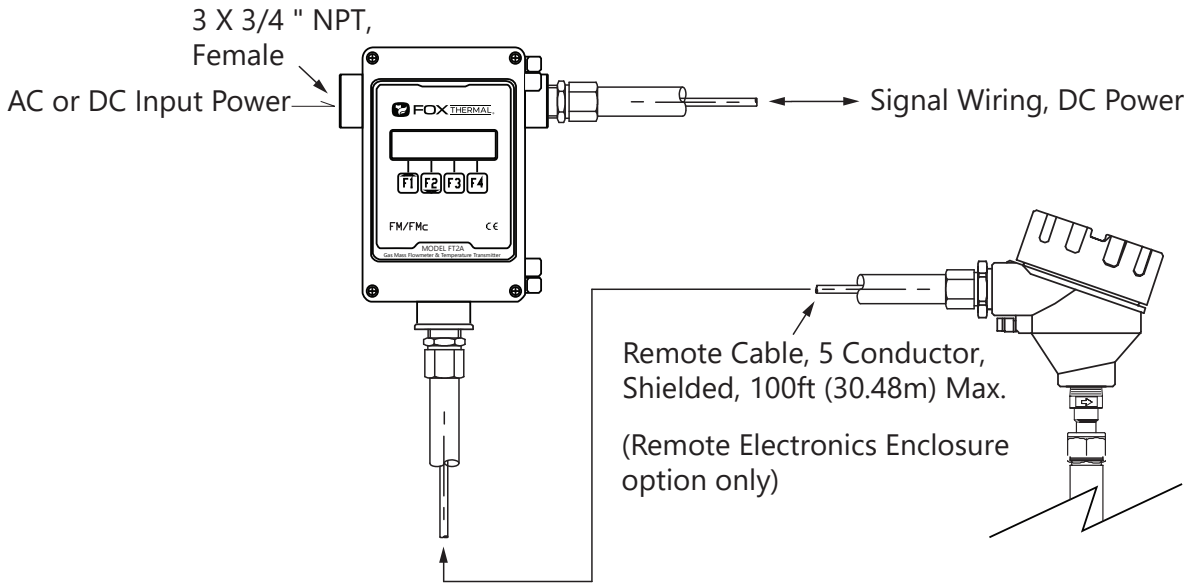
A shielded 22 to 18 gauge three conductor cable is recommended for Modbus and BACnet communication wiring. Two of the wires in the cable should be twisted pair and used for the transmit and receive signals. The third wire is for the communication common signal. The shield drain wire of

the cable should be connected to chassis or earth ground at the modem. Belden number 3106A or a similar type of calbe is recommended, depending on the environment or temperature requirements of the application.

Profibus, DeviceNet, Ethernet Communication Wiring
If you have purchased one of these communications options, please refer to the FT2A Profibus, DeviceNet, Ethernet Manual.

FT2A Wiring - Conduits
Five wire shielded cable required. The recommended wire gauge is 18 AWG. Run the shielded cable through a separate grounded steel conduit to the bottom conduit opening of the electronics enclosure (no other cables or wires in the conduit). If you are using your own cable, make sure that the cable length does not exceed 100 feet and the wire resistance does not exceed one ohm. Do not connect the cable shield at the electronics enclosure end.

NOTE! Remote wiring is only required when the Remote Electronics option is provided.



NOTE! Serial numbers: If you have more than one meter, you must ensure that the serial numbers of the probe/J-Box, remote electronics, housing, and/or flow body match one another. These items have been manufactured and calibrated to operate as a unit and cannot be mismatched.

Fig. 3.2: FT2A Wiring

For remote sensor wiring use Belden number 5306FE or similar type of cable, depending on environment or temperature requirements of the application. Make sure that the cable length does not exceed 100 feet and the wire resistance does not exceed one ohm. Connect the cable shield at the

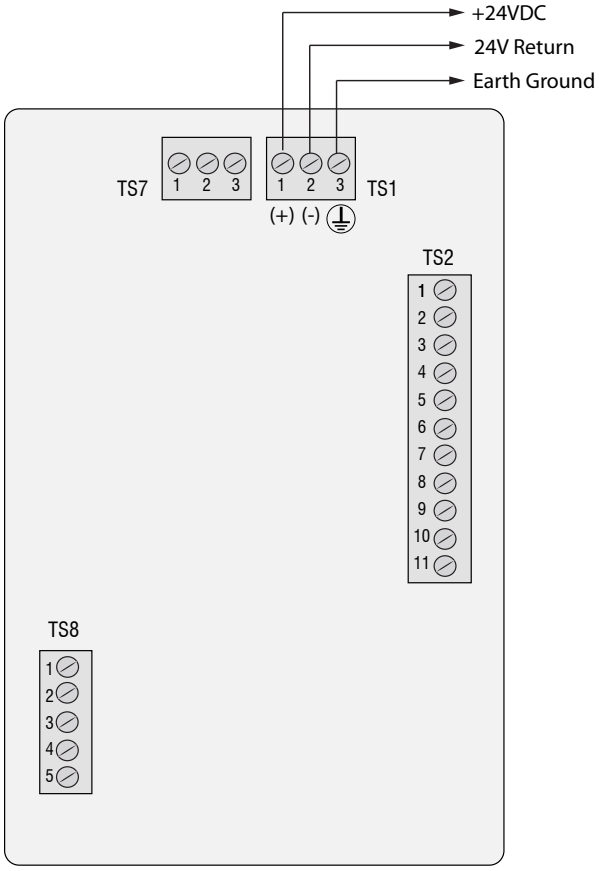
remote enclosure end.

Power Input Requirements: 24VDC Supply

External DC power supply must provide 24VDC ±10%, at 0.7 Amps minimum.

The enclosure must be properly grounded with a quality earth ground. Sixteen (16) gauge, stranded wire, is recommended for power and earth ground.

Connect the power wiring as shown in the diagram below.



CAUTION!

- Supply connection wiring must be rated for at least 90ºC.

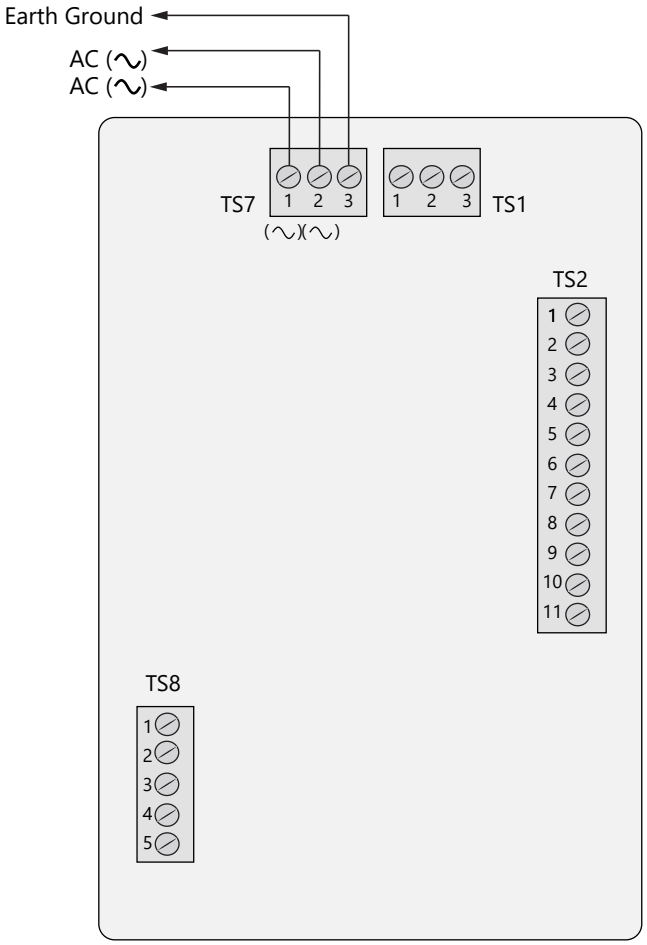
Fig. 3.3: Connections for 24VDC Supply Power Input Requirements: 100 to 240VAC Supply

Power Input Requirements: 100 to 240VAC Supply

If the FT2A has the AC power supply option, the AC power must provide 100 to 240VAC -15% / +10% (85 to 264VAC) at 0.2 Amps minimum.

The enclosure must be properly grounded with a quality earth ground. Sixteen (16) gauge, stranded wire, is recommended for power and earth ground.

Fig. 3.4: Connections for optional AC Power



CAUTION!

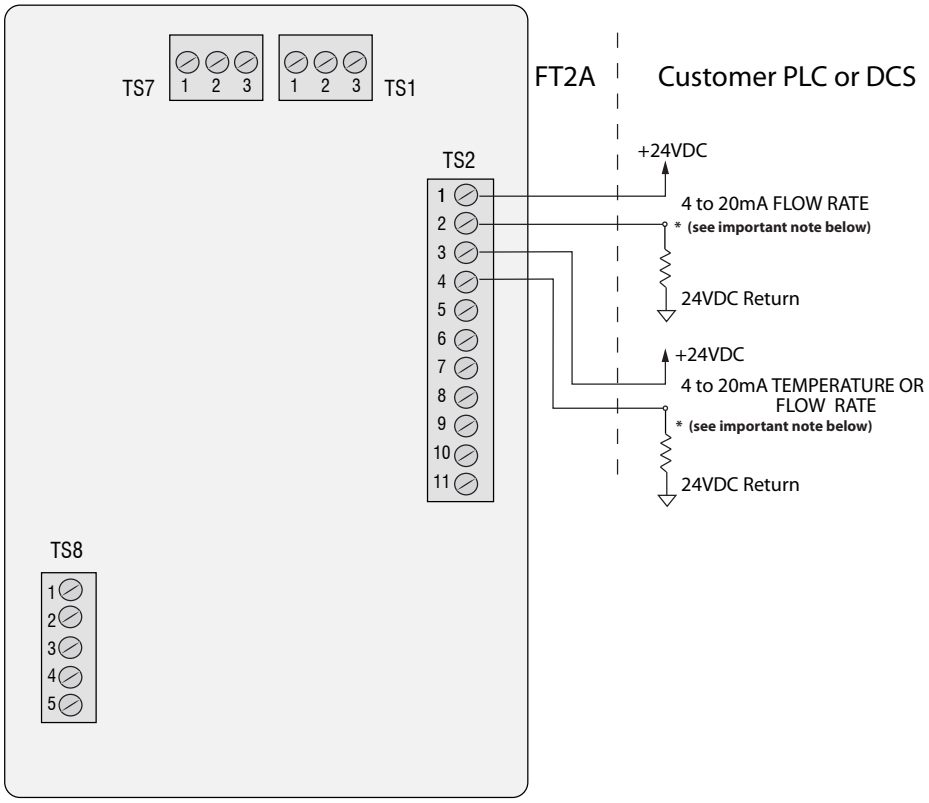
- Supply connection wiring must be rated for at least 90°C.

4-20mA Output Wiring: Customer-Supplied Power Source

Bring the 4-20mA wiring in through either conduit hub. Connect the FLOW RATE 4-20mA wiring to TS2 pin 1(+) and 2(-). Connect 4-20mA output #2 wiring to TS2 pin 3(+) and 4 (-).

CAUTION! Configure the FT2A with the failsafe setup (see p. 36).

Fig. 3.5: 4-20mA Output Wiring for Customer-Supplied Power Source



NOTE!

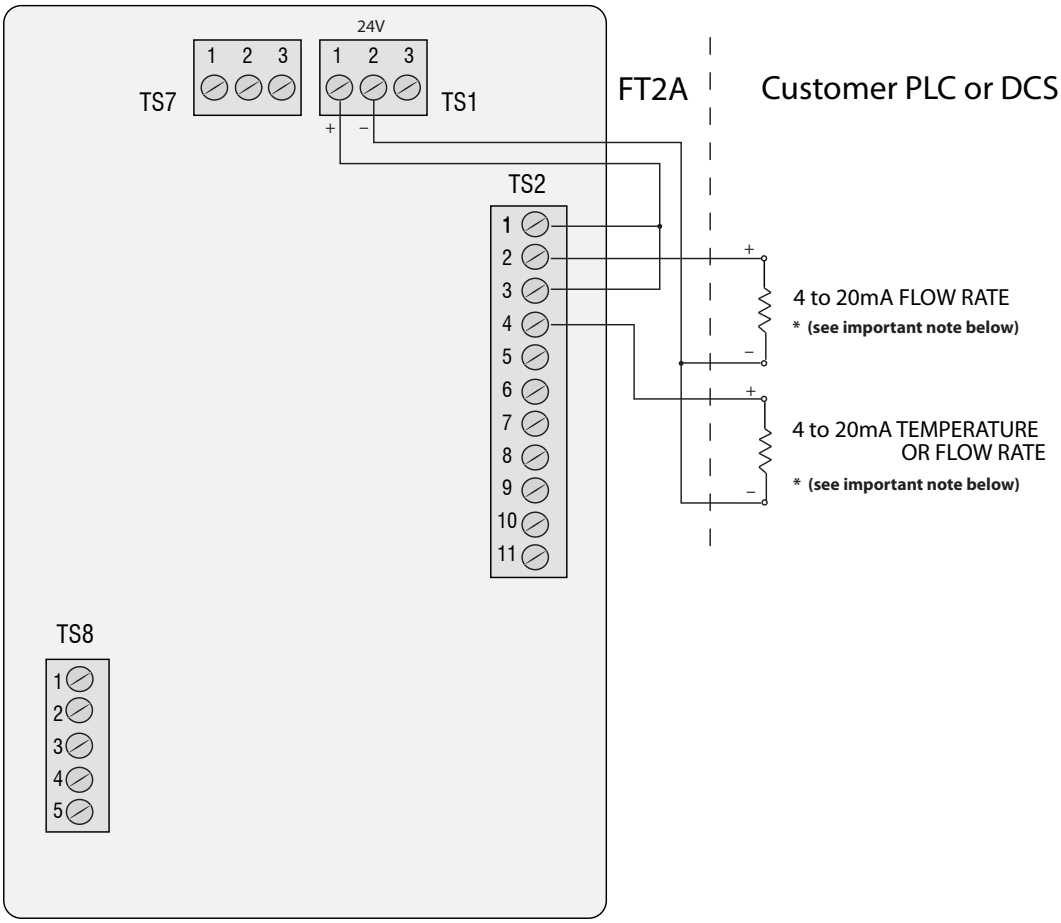
The load resistor on the Fox Flow Meter 4-20mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4-20mA line will result in a 1 to 5VDC signal to the PLC or DCS. Some PLC/DCS equipment has the load resistor built in to the unit; please refer to the PLC/DCS technical manual. **Do not exceed a 600 ohm load on the Fox Flow Meter 4-20mA signal.**

4-20mA Output Wiring: Loop Power Provided by FT2A

Bring the 4-20mA wiring in through either conduit hub. Connect the 4-20mA flow rate wiring to terminal blocks TS1 and TS2 as shown in the diagram below.

CAUTION! Configure the FT2A with the failsafe setup (see p. 36).

Fig. 3.6: 4-20mA Output Wiring for Loop Power Provided by FT2A



NOTE!

The load resistor on the Fox Flow Meter 4-20mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4-20mA line will result in a 1 to 5VDC signal to the PLC or DCS. Some PLC/DCS equipment has the load resistor built in to the unit; please refer to the PLC/DCS technical manual. **Do not exceed a 600 ohm load on the Fox Flow Meter 4-20mA signal.**

Setting Up the NE-43 Alarms

The FT2A flow meter supports the NAMUR specification NE-43 for alarms on the 4-20mA output. See p. 52 for the 4-20mA output NAMUR operation.

CAUTION! Configure the FT2A with the following setup when using the 4-20mA output to control equipment in a failsafe application.

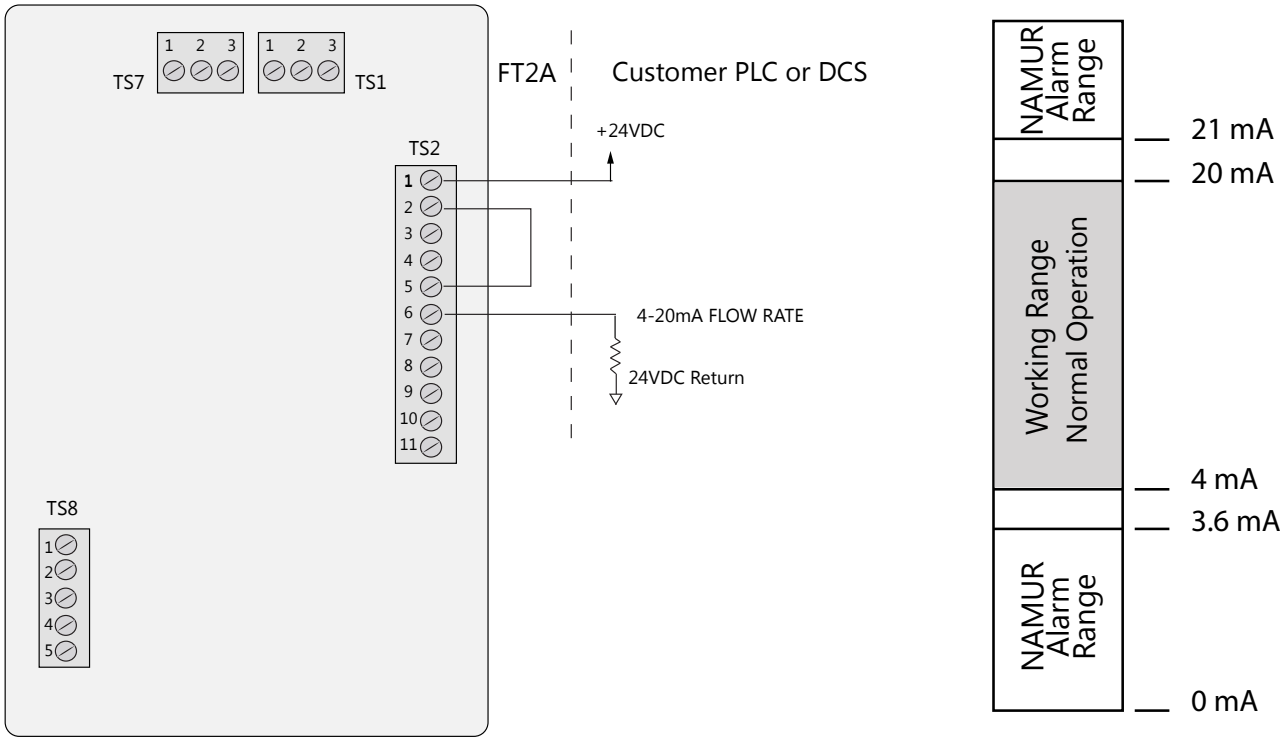
4-20mA Failsafe Wiring: NAMUR NE-43

When the 4-20mA output is used to control equipment in failsafe applications:
Wire the 4-20mA output in series with the Alarm output as shown in Figure 3.7.
Configure the Pulse/Alarm output to Alarm and select System Alarm as shown in the "Alarm Output" on p. 52.

The System Alarm output is designed to allow current to flow during normal operation and interrupts current when power to the meter is lost or in a System Alarm condition.

In the 4-20mA Failsafe Wiring configuration of Fig. 3.7, the 4-20mA signal goes to 0mA if power to the FT2A is lost or a System Alarm occurs.

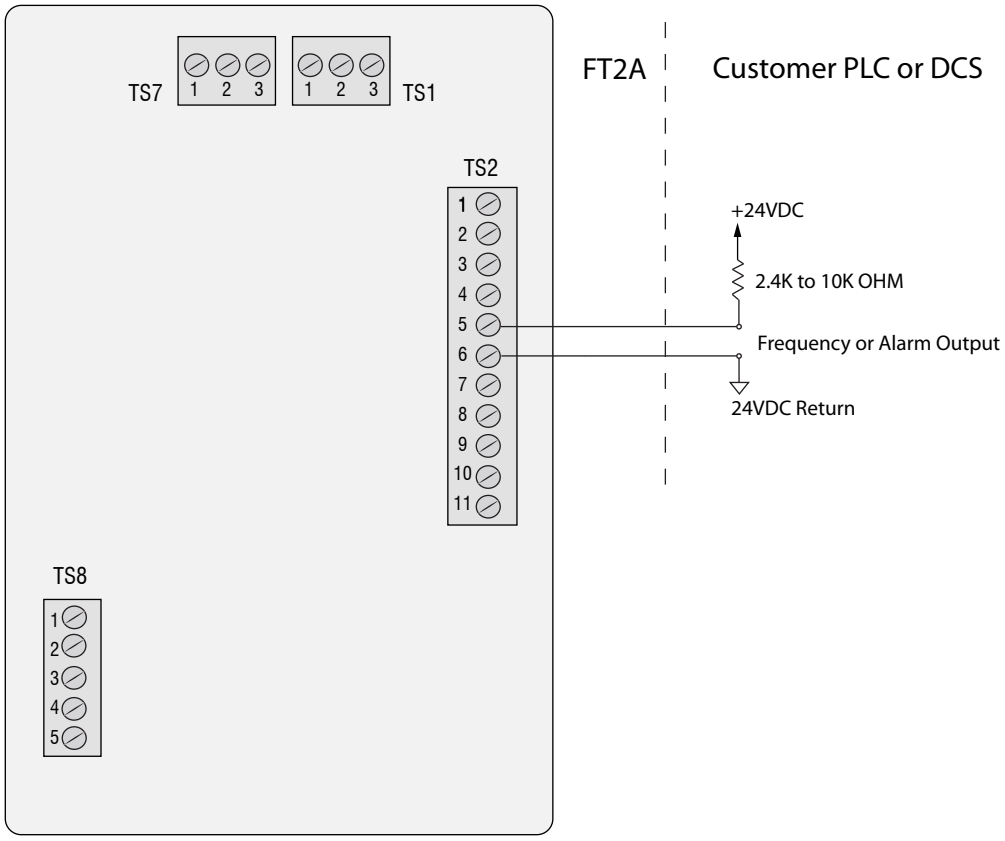
Fig. 3.7: 4-20mA Failsafe Wiring and Range of 4-20mA Output for NAMUR Alarm



Frequency/Alarm Output Wiring

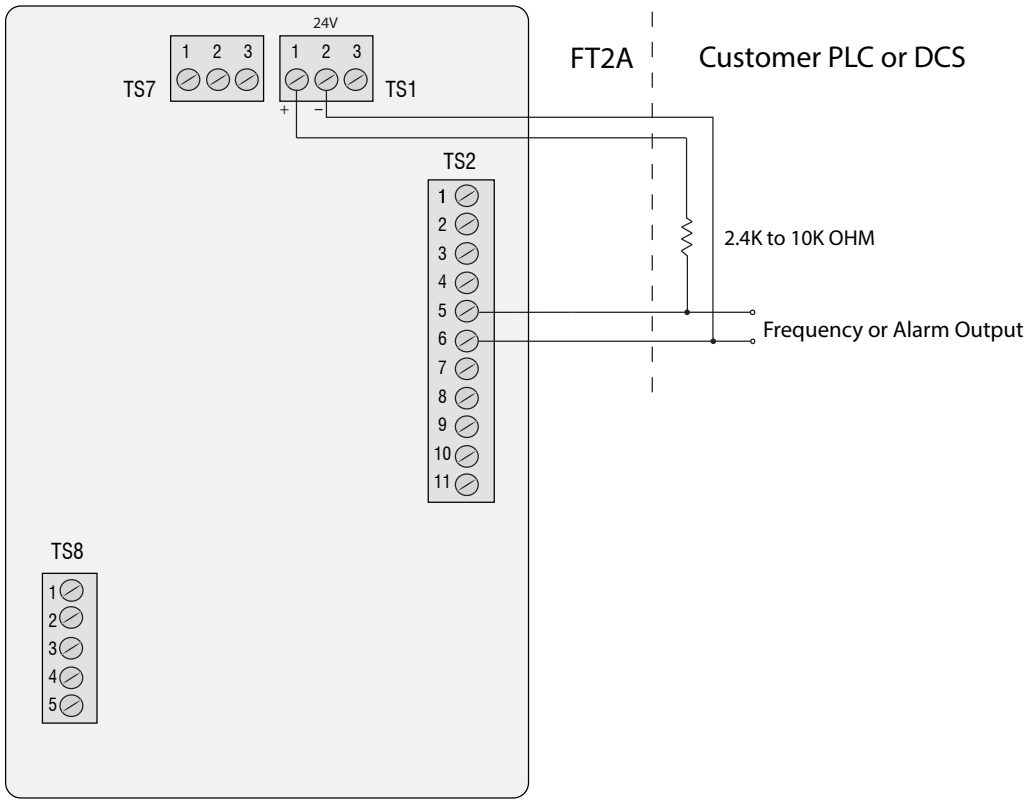
Bring frequency/alarm wiring in through the right-hand conduit hub. Connect to TS2 pin 5(+) and 6(-). The frequency/alarm output is an open collector circuit capable of sinking a maximum of 20mA of current. Frequency or alarm selection is programmed using the display or FT2A View™. Only one option, frequency or alarm, can be active at a time.

Fig. 3.8: Frequency/Alarm Output Isolated (Recommended)



Frequency/Alarm Output Wiring: Local +24V Power Option

Fig. 3.9: Frequency/Alarm Output Wiring: Local +24V Power Option



NOTE!
The FT2A Frequency/Alarm output is typically used to drive digital circuitry or solid-state relays. The output of a solid state relay may, in turn, operate loads such as electromechanical relays or alarm indicators.

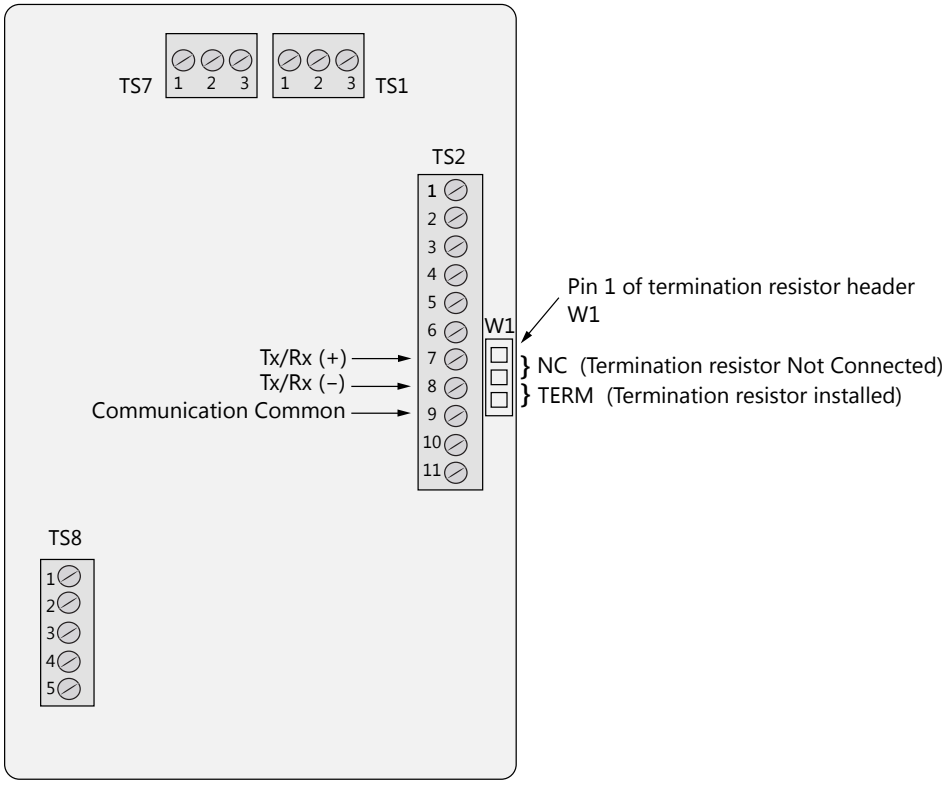
RS485 Wiring for Modbus
Wiring connections are made to terminal block TS2 for Modbus communication.

The Tx/Rx+ signal connects to pin 7, Tx/Rx- connects to pin 8 and communication common to pin 9 as shown in Figure 3.10.

Termination Resistor
Connect a termination resistor across the receive/transmit signals of the last device on the Modbus communication line. To connect the 121 ohm termination resistor on the FT2A, set jumper W1 to the TERM position.

Disconnect the termination resistor on all other external Modbus devices. The termination resistor of the FT2A is disconnected by setting jumper W1 to the NC (Not Connected) position.

Fig. 3.10: Modbus Wiring



NOTE! W1 jumper will either be in the NC or TERM position. It should be in the TERM position on the last meter in the Modbus daisy chain.

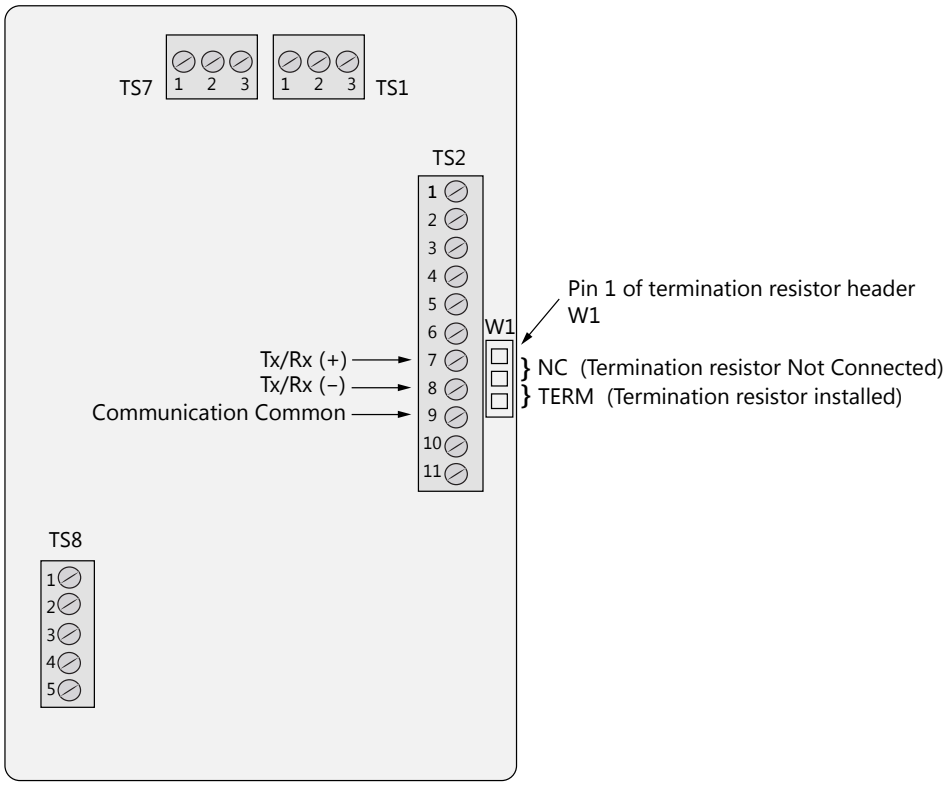
RS485 Wiring for BACnet MS/TP
Wiring connections are made to terminal block TS2 for BACnet MS/TP communication.

The Tx/Rx+ signal connects to pin 7, Tx/Rx- connects to pin 8 and communication common to pin 9 as shown in Figure 3.11.

Termination Resistor
Connect a termination resistor across the receive/transmit signals of the last device on the BACnet MS/TP communication line. To connect the 121 ohm termination resistor on the FT2A, set jumper W1 to the TERM position.

Disconnect the termination resistor on all other external BACnet MS/TP devices. The termination resistor of the FT2A is disconnected by setting jumper W1 to the NC (Not Connected) position.

Fig. 3.11: BACnet MS/TP Wiring

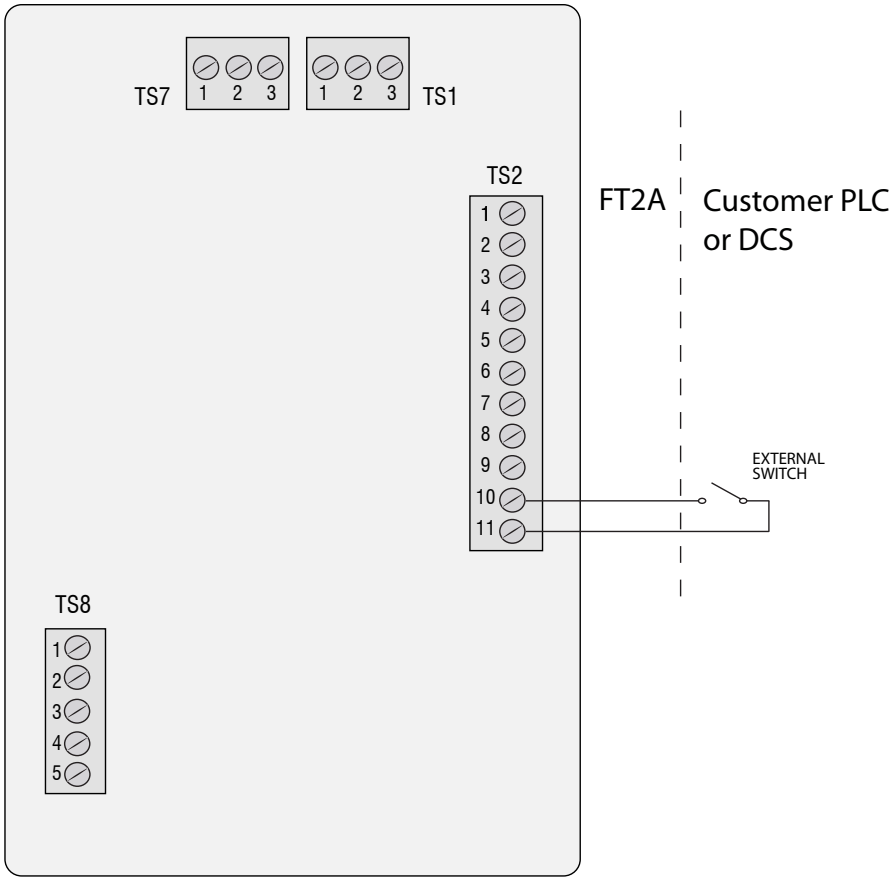


NOTE! W1 jumper will either be in the NC or TERM position. It should be in the TERM position on the last meter in the BACnet MS/TP daisy chain.

Remote Switch Wiring
A remote switch can be used to reset the Totalizer and elapsed time, if enabled in the programming settings. There is no polarity requirement on these connections. Use TS2 pin 10(+) and 11(-).

When the 2 gas curve option is ordered, the switch can be used to switch between curves.

Fig. 3.11: Switch Switch Wiring



Remote Wiring
Remote wiring is the same for both insertion and inline type FT2A flow meters.

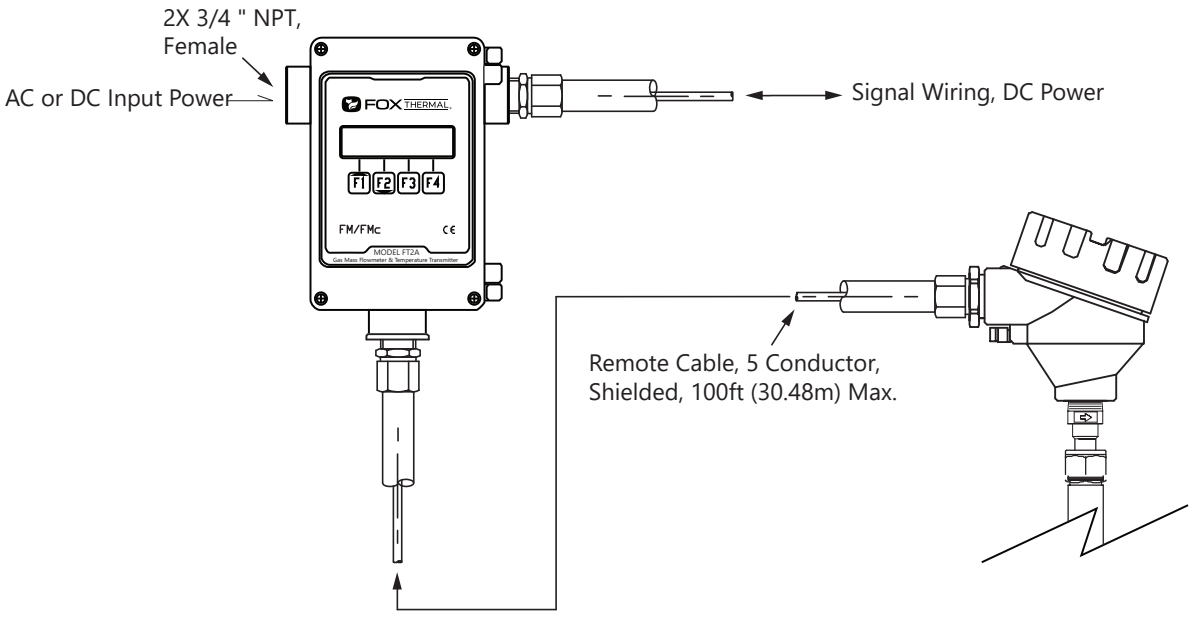
NOTE! Remote wiring is only required when the remote electronics option is provided.

Five wire 18 AWG shielded cable required. Run the cable through a separate grounded steel conduit (no other cables or wires in the conduit). Make sure that the cable length does not exceed 100 feet and the wire resistance does not exceed one ohm.

Do not connect the cable shield at the electronics enclosure end.

The extension cable connects the terminals of the remote probe enclosure to connector TS8 of the electronics enclosure as shown in Figure 3.11 and Table 3.1 (p. 43).

Fig. 3.12: Remote Wiring

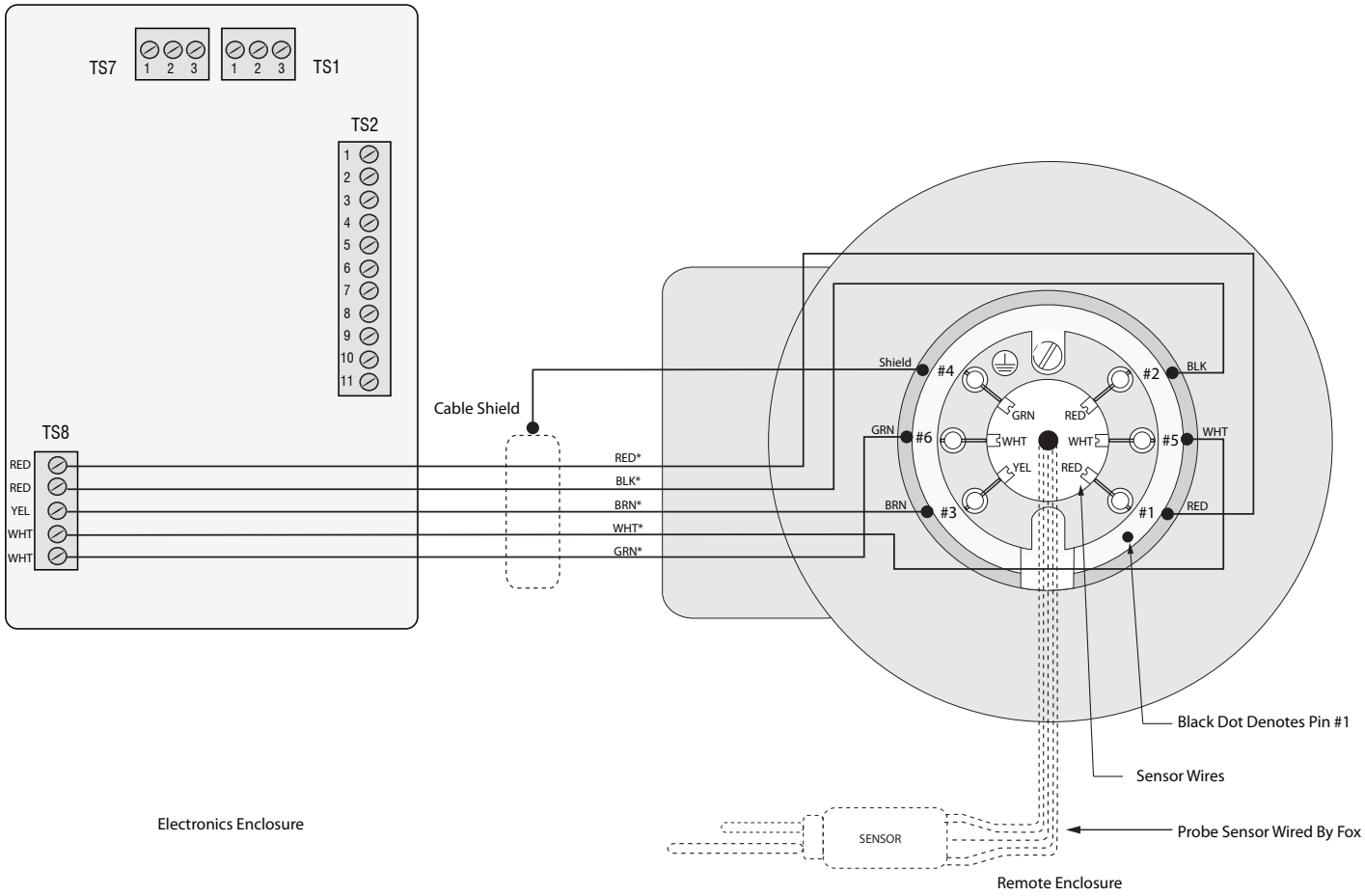


NOTE!
Installation wiring: Keep the wires inside the FT2A enclosure short. Obtain the correct length for the FT2A remote wires using one of these methods:
- Trim the wires to extend 5 inches out of the enclosure after the conduit and wires are routed to the FT2A.
- Trim the wires to extend 6 inches from the end of the conduit before it is attached to the FT2A.

Remote Sensor Wiring

Remote wiring is only necessary when the remote sensor option has been ordered.

Fig. 3.13: Remote Sensor Wiring



NOTE! Wire colors listed here represent the wire colors of cables supplied by Fox. Colors may vary if customer is supplying their own cable.

Table 3.1: Remote Sensor Cable Wiring

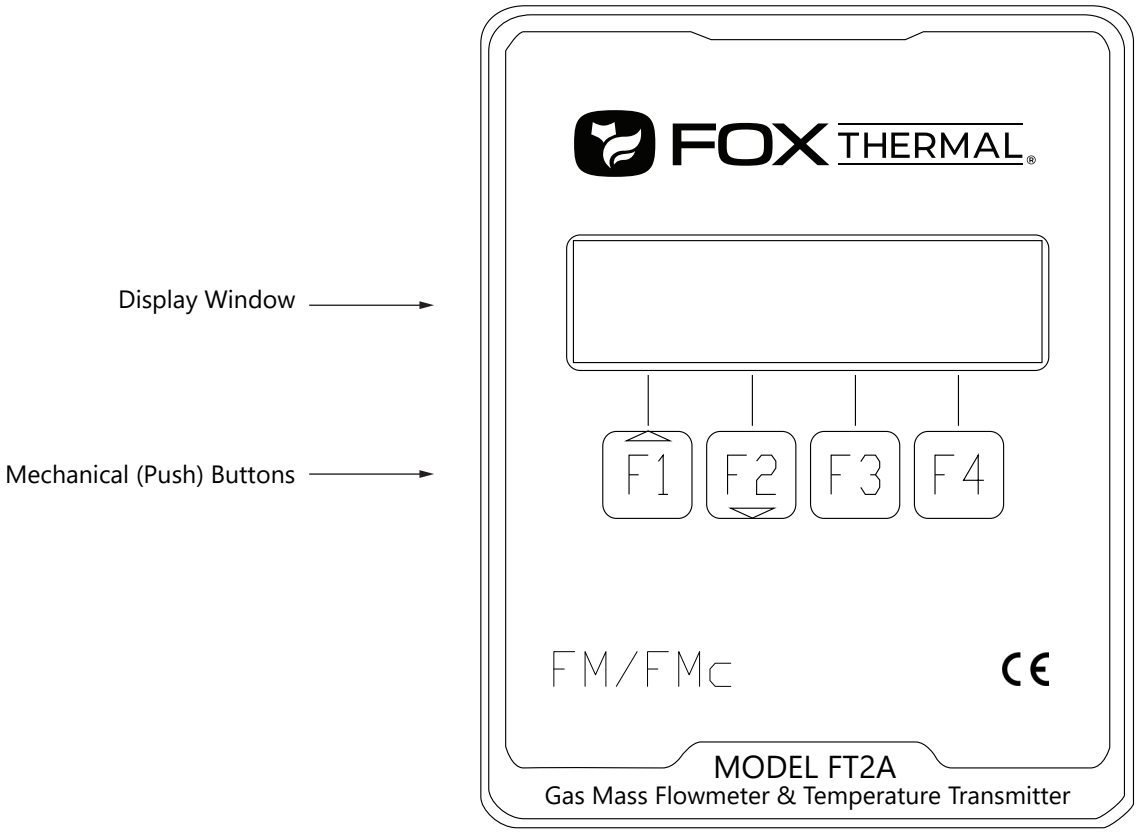
Electronics Enclosure Terminal numbers	Extension Cable Wire Color	Remote Enclosure Terminal Numbers	Sensor Wire Color
1	Red	1	Red
2	Black	2	Red
3	Brown	3	Yellow
No Connection	Shield	4	Green
4	White	5	White
5	Green	6	White

Start Up Sequence
The program automatically enters the Run/Measure mode after power up. The screen will show the software version of the FT2A during power up.

USB Interface
The USB interface is a standard feature which allows communication with a PC to monitor readings and configure settings. FT2A View™, is a free application program from Fox Thermal that connects to the USB interface and allows data monitoring, configuration setting, data logging to Excel, and an option to save and recall FT2A configuration data.

FT2A Display and Configuration Panel
The FT2A has a 2 line x 16 character display with 4 mechanical buttons. The meter can be programmed by using the display and configuration panel.

Fig. 4.1: FT2A Display and Configuration Panel

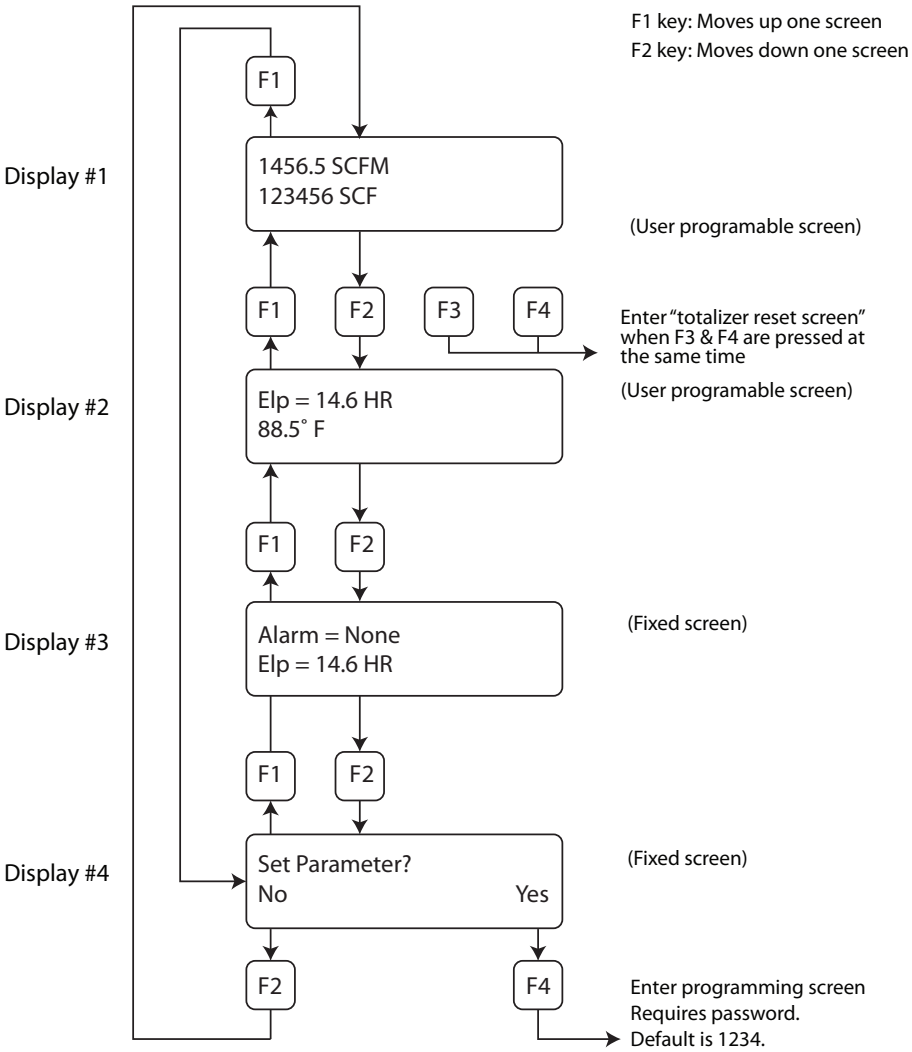


Measurement Mode Display Screens
In the measurement mode, there are four different display screens (display 1, 2, 3 and a prompt screen to enter the programming mode). Two display screens are user programmable (refer to Display Setup p. 54). Scrolling through the display is accomplished by pressing the **F1** or **F2** key to view the next or previous screen.

Pressing the **F1** and **F2** keys at the same time enters the Log Menu and Engineering Menu screens (refer to p. 13).

Pressing the **F3** and **F4** keys at the same time brings up the Reset Total screen prompt.

Fig. 4.2: FT2A Measurement Mode Display Screen Navigation

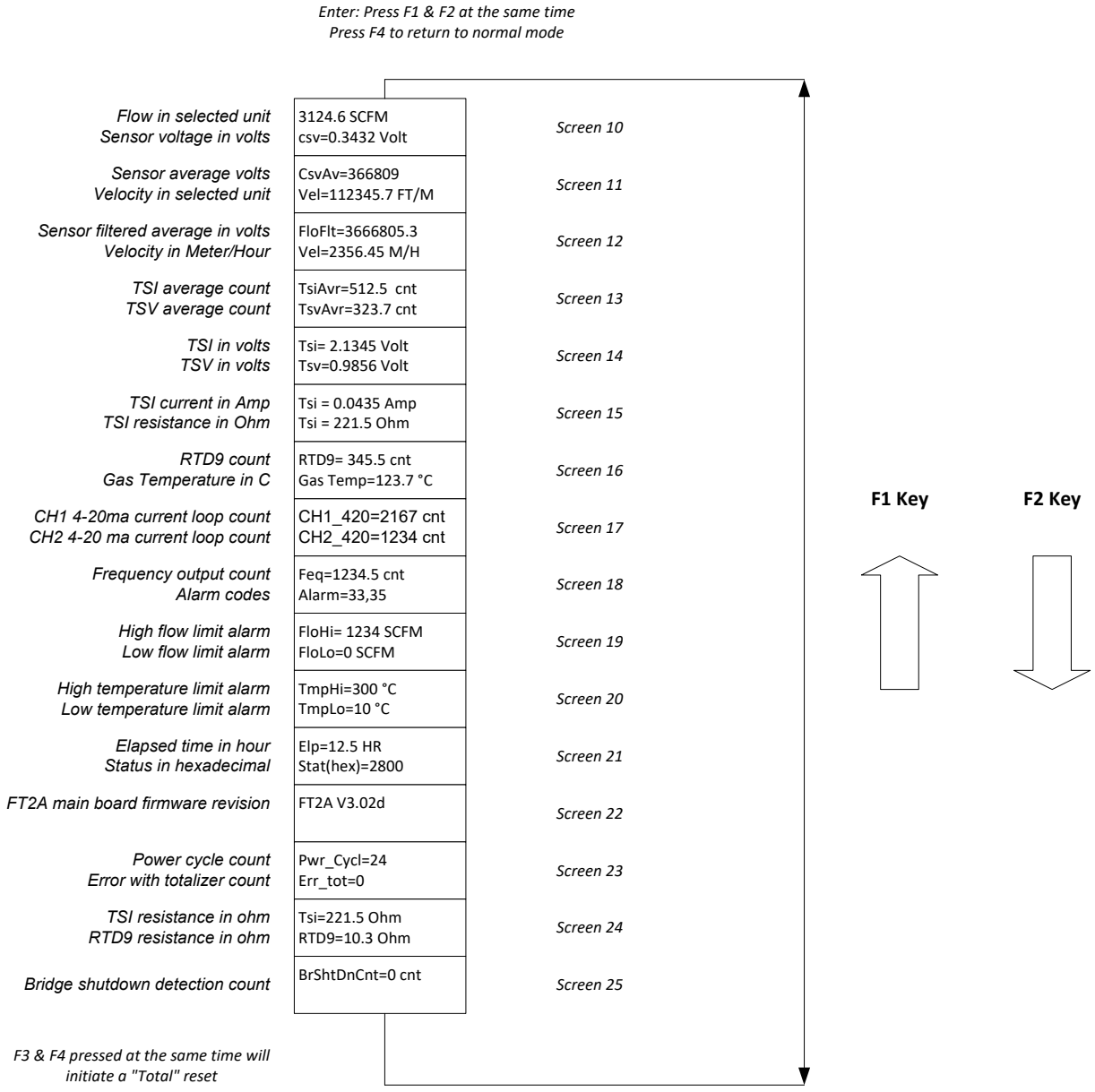


FT2A Engineering Displays

Pressing the **F1** & **F2** keys at the same time in the normal mode, brings up the engineering displays. These displays show internal parameters of the FT2A which are used by Fox service technicians.

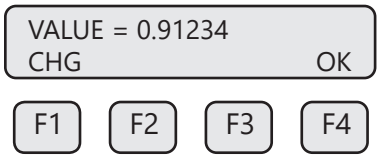
Use the **F1** & **F2** keys to navigate. Press **F4** to exit.

Fig. 4.3: FT2A Engineering Displays

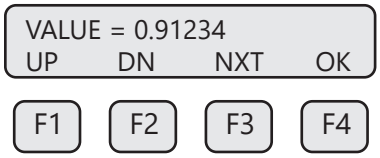


Programming: Data Entry using the Display and Configuration Panel
There are 2 basic types of menu entries: one for changing value or string and one for selecting from a selection list.

To Change a Value or String :

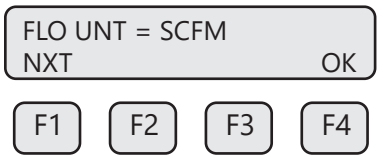


Press **CHG (F1)** key to change the value, **OK (F4)** to accept the value.



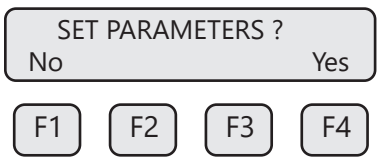
Press the **UP (F1) or DN (F2)** key to select a new digit or character, the cursor points to the selected digit. Press **NXT (F3)** to select the next digit and **OK (F4)** to accept the entry.

To Select from a List:

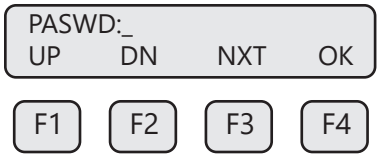


Press **NXT (F1)** key repeatedly until the correct selection is made and **OK (F4)** key to accept the entry.

Entering the Programming Mode
To enter the programming mode and access the Main Menu, press the **F1** or **F2** key in the normal running mode until the following screen is shown:



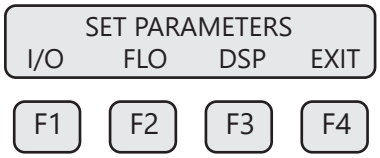
Press **YES (F4)** and the following screen will prompt user to enter password:



Enter the correct password, then follow the instructions for changing a value as specified on page p. 47. The default Level 1 password is "1234".

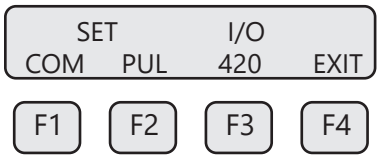
If the wrong password is entered, the message "Wrong Password" will display and then return to the programming entry screen.

If the password is accepted, the Main Menu screen will be shown:

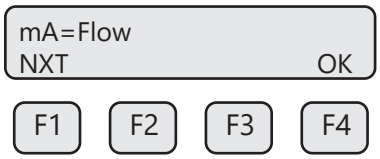


This is the Main Menu screen for the programming mode. Press **EXIT (F4)** repeatedly until "Normal Mode" is seen briefly to exit the programming mode.

Analog 4-20mA Outputs
The following menu allows the scaling of the analog 4-20mA output. From the Main Menu, press **I/O (F1)** to move to the 4-20mA output selection. In this screen press **420 (F3)** (screen appearance may vary according to options).

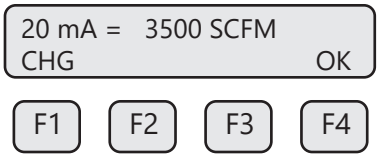


The 4-20mA output is programmable for flow or temperature:



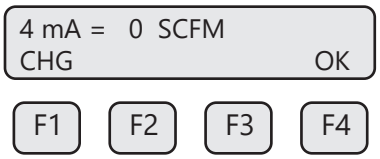
Selections for the 4-20mA output are:
Flow
Temp

Select **NXT (F1)** to select Flow or Temperature and then press **OK (F4)**.



Enter the value for the 20mA and press **OK (F4)** key to accept the setting. Then the following screen will display:

NOTE! When the flow rate exceeds the programmed value for the 20mA set point, the analog output will stay at 20mA and an alarm code will be generated.



Enter the value for the 4mA and press **OK (F4).**

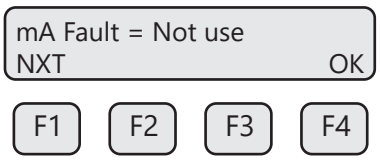
NOTE! 4mA is normally set to 0.

The following menu item allows the user to select an alarm level on the 4-20mA output when a serious issue is detected that is preventing the calculation of a correct flow value.
The options are:

- Force the 4-20mA signal to 3.6mA
- Force the 4-20mA signal to 21mA
- Do not force the 4-20mA signal (not used)

CAUTION! When using the 4-20mA output equipment in a failsafe application, use the wiring configuration on p. 36 and set the Pulse/Alarm Output to System Alarm as shown in "Alarm Output" on p. 52.

After setting the 4mA output value, choose the mA fault value:



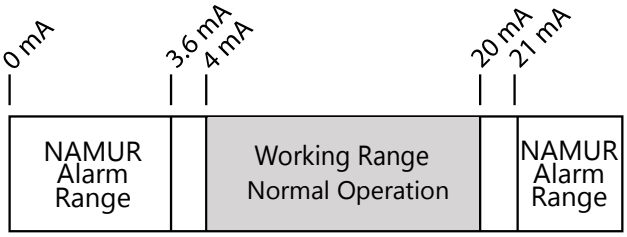
The following events will set the output to 3.6mA or 21mA if the alarm level is selected:

- Sensor resistance above high limit
- Bridge Shutdown

When the 4-20mA output is wired through the System Alarm, the following cause the output to go to 0mA:

- Power to the Microprocessor is lost
- Sensor or electronics failure

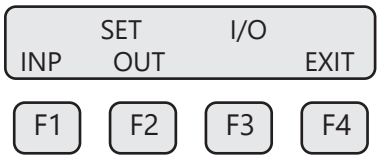
Fig. 4.3: Range of 4-20mA Output and NAMUR Alarm



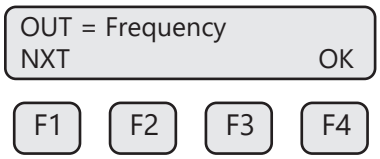
Press **(F4)** repeatedly until "Normal Mode" is seen briefly to exit the programming mode.

NOTE! When the flow rate exceeds the programmed value for the 20mA set point, the analog output will stay at 20mA and an alarm code will be generated.

Frequency Output
From the Main Menu, press **I/O (F1)**, **I/O (F2)** and then **OUT (F2).**

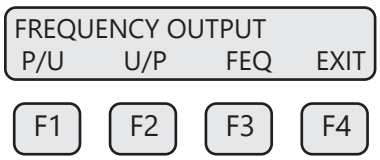


From the "SET I/O" menu, press **OUT (F2)** to select the output. The following screen will show:



Press **NEXT (F1)** to cycle through output options until you have the selection for "OUT=Frequency" and press **OK (F4).**

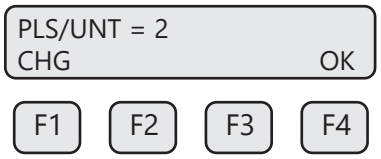
The frequency output can be configured in one of three ways: (1) specifying a maximum frequency to a defined maximum value of flow rate, (2) specifying how many flow units total per pulse, U/P (i.e., 0.1 SCF per pulse) or (3) specifying how many pulses per unit, P/U (i.e., 10 pulses per SCF). All of these approaches are equivalent.



Use **P/U (F1)** to enter pulse per unit, **U/P (F2)** for unit per pulse or **FEQ (F3)** to enter the flow and maximum frequency to scale the pulse/alarm output.

NOTE! When data is entered with any of the three described methods, the other values will be re-calculated according to the settings.

Entering data in Pulse per Unit:
From the Frequency Output Menu above, press **P/U (F1)** and the following screen will show:



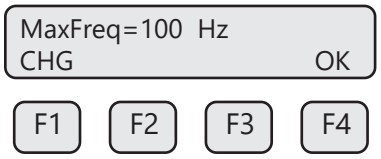
Press **CHG (F1)** to change the setting and then **OK (F4)** to accept entry.

The value entered is in pulse per selected flow unit total (i.e., 2 pulses per SCF).

Entering data in Unit per Pulse:
From the Frequency Output Menu, press **U/P (F2)** and the following screen will show:

Press **CHG (F1)** to change the setting and then **OK (F4)** to accept entry.
The value entered is in unit per pulse (i.e. 0.5 flow unit total per pulse)

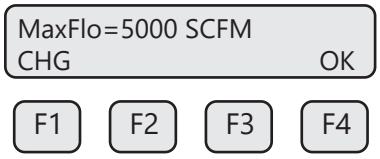
Entering data with flow and maximum frequency:
From the Frequency Output Menu, press **FEQ (F3)** and the following screen will show:



Enter the maximum pulse rate (frequency) and press **OK (F4).**

CAUTION! Maximum pulse rate (frequency) cannot exceed 100 Hz.

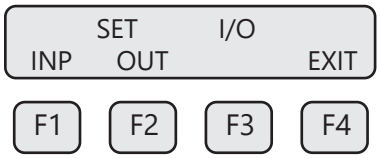
The next screen will show:



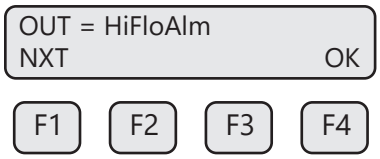
NOTE! If the flow rate exceeds the maximum pulse rate (frequency), the output will stay at that maximum frequency but the FT2A will issue an alarm code.

CAUTION! Calculate the pulse rate at the maximum flow rate to ensure it does not exceed 100 Hz.

Alarm Output
To access the Alarm output, press **I/O (F1)** key from the "SET PARAMETERS" screen, then select **I/O (F2)**. The screen will show:



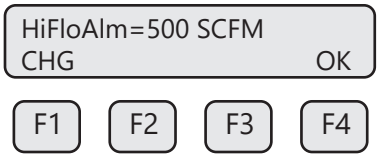
Then press **OUT (F2)** and the screen may show:



Then press **NXT (F1)** to select the correct alarm and press **OK (F4).**

Selections are:
- Not used
- Frequency
- HiFloAlm = High Flow Alarm
- LoFloAlm = Low Flow Alarm
- HiTempAlm = High Temperature Alarm
- LoTempAlm = Low Temperature Alarm
- System Alm = System Alarm

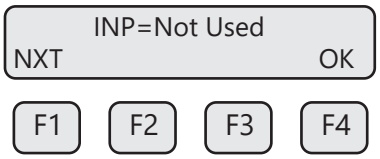
When the output is set to Alarm and there is no alarm condition, the output will be on (0 volts). When an alarm is active, the output is turned off (12 to 24 volts).



Enter the value for the limit by pressing **CHG (F1)** and then **OK (F4).** A value of 0 disables the alarm.

NOTE! There is only one output to operate as a pulse output or an alarm output. Both cannot operate at the same time.

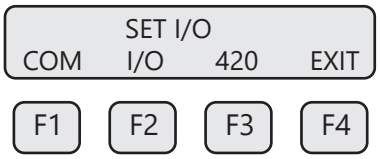
For Discrete Input Settings
From the Main Menu, press **I/O (F1)** and then **I/O (F2)** and then **INP (F1)** key to select input. The following menu will display:



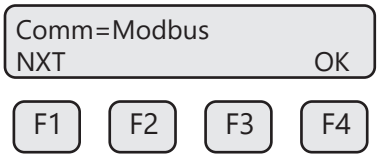
Press **NXT (F1)** until the correct selection is shown and then press **OK (F4)** to accept the setting.
Selections are:
Not used
Tot Reset = Reset the totalizer
Switch Crv = Switch between calibration curves (only if 2-gas curve ordered)

Press **EXIT (F4)** repeatedly until you exit programming mode.

Serial Communication Settings
To program the serial communication settings, press **I/O (F1)** key from the base menu:



Press **COM (F1)** to select Serial communication. The screen may show:



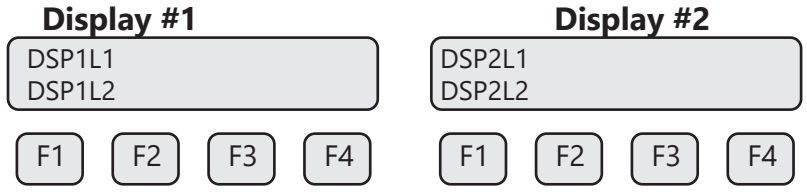
Options for serial communication are:

None
Modbus
BACNET
PROFIBUS
DEVICENET
ETHERNET

NOTE! Any selection other than "None" requires the communication option for the selected communication type. If enabling a communication option, see the associated Fox Communications Manual for specific programming information: FT2A Modbus RTU (RS485) & BACnet MS/TP (RS485) manual or FT2A Profibus, DeviceNet, & Ethernet Manual.

Display Setup

There are four display screens that you can cycle through in normal operating mode (see Figure 4.2 on p. 45). Two of the four display screens are fixed and cannot be changed (Display 3 and Display 4). The other two screens are programmable to show the information that you prefer and is discussed in this section.

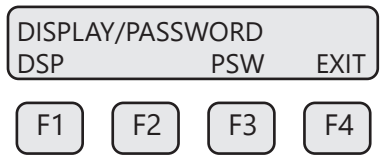


Selections are:

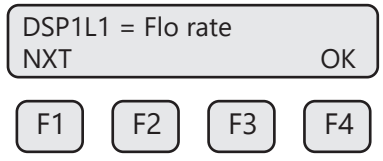
DSP1L1 = Display 1, Line 1
DSP1L2 = Display 1, Line 2
DSP2L1 = Display 2, Line 1
DSP2L2 = Display 2, Line 2

To Program Display Screens #1 & 2:

From the Main Menu press **DSP (F3)** to select the display menu:



Press **DSP (F1)** key. The display will show:

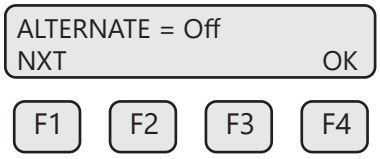


These are the selections for the Display 1, Line 1.

Selections are:

Flo rate	Flow rate
Total	Total mass or volume
Elps	Elapsed time
Temp	Temperature
Alarm	Error codes

When the selection is correct, press **OK (F4)** to accept. The display will then go through the same process for all 4 lines of the 2 programmable displays (DSP1L1, DSP1L2, DSP2L1 and DSP2L2). After the last line of Display 2 is accepted, the display will show the following menu:



This menu allows you to alternate between menu display 1 and 2 every few seconds.

Selections are: On or Off

Press **OK (F4)** to accept selection. Press **EXIT (F4)** repeatedly until "Normal Mode" is seen briefly to exit the programming mode.

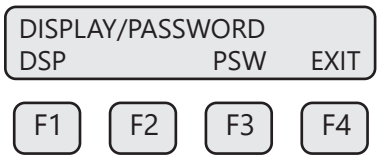
Password

There are two user level passwords, only **Level 1** is programmable and gives access to all the normal settings. The second password is used to allow access to calibration settings.

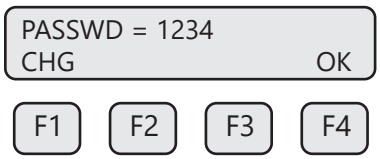
Default **Level 1** password is "1234", and **Level 2** password is "9111". The **Level 1** programmable password can be disabled by setting it to "0".

To Program the Password:

From the Main Menu press **DSP (F3)** to select the display menu.



Press **PSW (F3)** key to select password.



This screen displays the current **Level 1** password.
Press **CHG (F1)** key to change the password and enter new value.

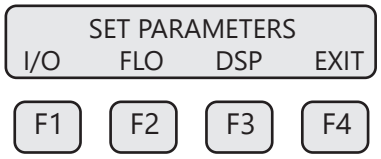
Press **OK (F4)** to accept new data and exit programming by pressing **EXIT (F4)** key repeatedly until out of the programming mode.

NOTE! Password can be number or letter characters up to 4 digits.

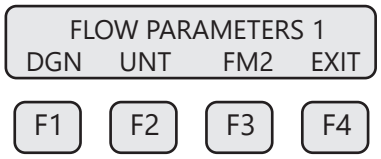
Units Settings Menu
This menu is used to set the units for flow, temperature, and pressure reference as well as the setting of reference temperature, reference pressure, and density of gas when using Lbs/time or Kg/time.

These values will be set at Fox Thermal using information supplied by the customer. These values can be changed to match a new application. Check with Fox Thermal Customer Service before changin the application gas.

The units setting is accessed from the Main Menu. To access the Unit Settings Menu:

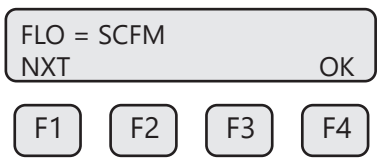


Press **FLO (F2)**:



Press **UNT (F2)** for Unit selection.

The screen will show:



Press **NXT (F1)** to change selection and **OK (F4)** to accept.

NOTE! The totalizer (total flow measured) will roll over when reaching a certain value. The maximum value is dependent on the flow units selected (see Totalizer Rollover p. 64).

Flow Units

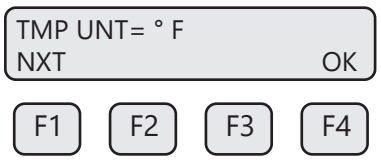
Selections for flow units are:

SCFM	KG/M	LBS/D	SM3/H	MSCFD (MCFD)
SCFH	KG/S	NLPH	SM3/D	MMSCFD (MMCFD)
NM3/H	LBS/H	NLPM	NM3/D	MCFD (MSCFD)
NM3/M	LBS/M	NLPS	SLPM	MMSCFM (MMCFM)
KG/H	LBS/S	SM3/M	SCFD	MT/H
SMPS	NMPS	SFPM		

WARNING! The FT2A re-calculates area, 4 and 20mA values, maximum flow for the frequency output and zero flow cutoff when changing flow units except for velocity units. When going to or from velocity units, the FT2A will not recalculate these values and these values must be re-entered manually.

Temperature Units

After pressing **OK (F4)** to accept the Flow unit the display will prompt for the temperature unit setting:

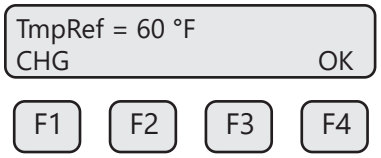


Press **NXT (F1)** to change selection and **OK (F4)** to accept.

Selections for Temperature units are: °C or °F

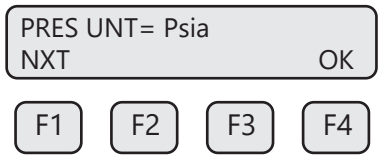
Reference Temperature

After pressing **OK (F4)** to accept the temperature unit setting, the display will prompt for temperature reference in selected unit.



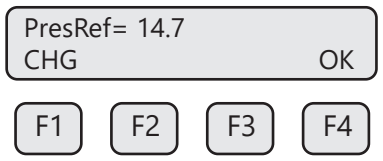
Press **CHG (F1)** to change the reference and **OK (F4)** to accept.

Pressure Units
After pressing **OK (F4)** to accept the reference temperature, the display will prompt for the reference pressure unit selection:



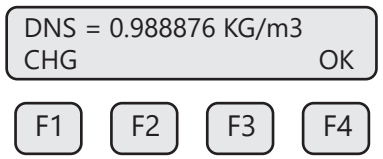
Press **NXT (F1)** to select next entry and **OK (F4)** to accept.
Selections are:
mmHG = Millimeters of mercury (absolute)
Psia = Pounds per square inch absolute
bara = Bar absolute

Reference Pressure
After the pressure unit selection is made, the display will show a menu to enter the reference pressure:



Press **CHG (F1)** to change it and **OK (F4)** to accept.

Gas Density
After the pressure reference is accepted, the display will prompt for the gas density if LBS or KG was selected for the flow unit:

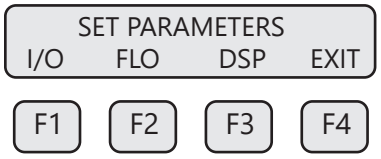


Press **CHG (F1)** to change it and **OK (F4)** to accept. Density conditions are referenced to 0ºC at 760 mmHg.

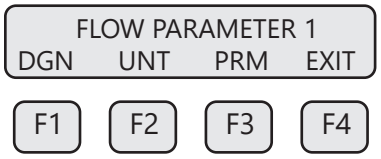
NOTE! The density entry is only used when KG/time or LBS/time is selected for flow rate units.

Accessing Flow Parameters and Alarm Settings
This is the menu used to set various flow parameter values. They are: Flow cutoff, pipe area, filter, high and low alarm for flow and temperature.

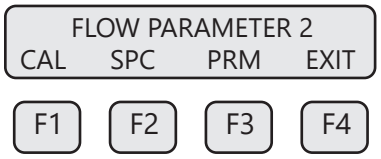
NOTE! The parameters in this menu are set to the customer specifications at the factory. They should only be changed when changing the application of the flow meter.



The menu is accessed from the Main Menu by pressing **FLO (F2)**:



Then press **FM2 (F3)**:

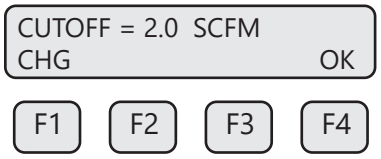


NOTE! The **CAL** AND **SPC** function key will only appear and be accessible from a **Level 2** password.

Then press **PRM (F3)**. This will move into settings for flow cutoff, pipe area, and filter value. These settings will be followed by the high and low alarm settings for flow rate and/or temperature.

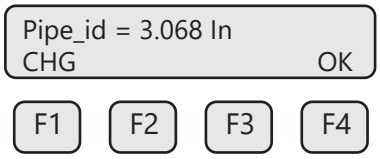
Programming Flow Parameters

Flow Cutoff
The first parameter is Flow Cutoff:



Enter the value for the flow cutoff and then press **OK (F4)**. When the flow rate falls below the flow cutoff, the flow meter will display a flow value of zero.

Pipe Area
To set the pipe area, enter the pipe area in **inches** or **millimeters** and then press **OK (F4)**.



Use square meters for metric flow unit selections and square feet for English flow unit selections. This selection is dependent on the flow unit selected (English vs metric).

Filter Value
The filter value is also referred to as dampening factor and is used to quiet the readings.
The filter value is an exponential filter that dampens the noise and is used as follows:

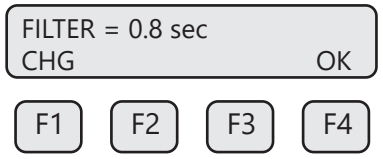
Flow Value = (FA * new value) + (FB * average)
Where FA = filter value, FA + FB is equal to 1.0.

A lower filter value will increase dampening of the flow rate and smooth the reading. A lower filter value will also slow the meter's response. For example, if we enter a filter of 0.8, the weight ratio for the new average is:

New average = (80% new sample) + (20% last average)
Filter range is 0.01 to 1.0, 0.01 being a high filter value and 1.0 = no filter

Filter	Response (Sec.) 65% of Target
0.09	0.10
0.8	0.15
0.7	0.20
0.6	0.25
0.5	0.30
0.4	0.35
0.3	0.40
0.2	0.60
0.1	1.00
0.05	2.00
0.03	3.00
0.01	10.3

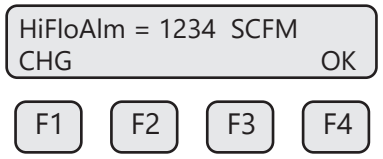
Enter the filter value and then press **OK (F4)**.



Programming High and Low Alarm Settings
Settings for the alarms directly follow the flow parameters for flow cutoff, pipe diameter, and filter value. These alarms can be used without the digital output assigned to the alarm. If that is the case, the alarm status will only be shown on the display, through serial communication, or FT1 View™. If the digital output is assigned to an alarm, changing the value here will change that setting.

High Flow Rate Alarm
This is the upper flow limit alarm value that can be associated with the alarm output. An alarm code is generated when the flow value exceeds this limit. If no alarm is needed, set this value to zero.

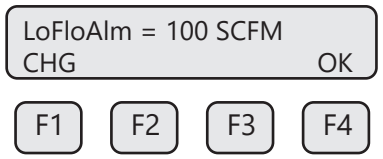
To set the parameters for a high flow rate alarm, press **CHG (F1)**:



Press **OK (F4)** to accept the value.

Low Flow Rate Alarm
This is the lower flow limit alarm value that can be associated with the alarm output. An alarm code is generated when the flow value is below this limit. If no alarm is needed, set this value to zero.

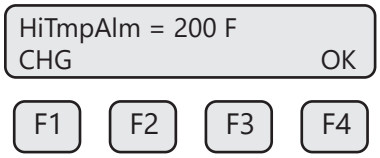
To set the parameters for a low flow rate alarm, press **CHG (F1)**:



Press **OK (F4)** to accept the value.

High Temperature Alarm
This is the upper temperature limit alarm value that can be associated with the alarm output. An alarm code is generated when the temperature value exceeds this limit. If no alarm is needed, set this value to zero.

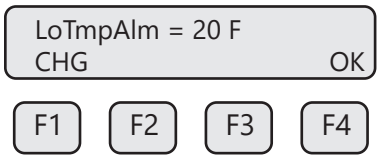
To set the parameters for a high temperature alarm, press **CHG (F1)**:



Press **OK (F4)** to accept the value.

Low Temperature Alarm
This is the lower temperature limit alarm value that can be associated with the alarm output. An alarm code is generated when the temperature value is below this limit. If no alarm is needed, set this value to zero.

To set the parameters for a high temperature alarm, press **CHG (F1)**:

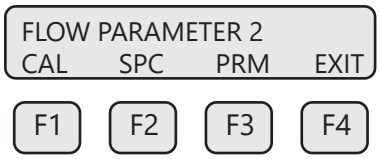


Press **OK (F4)** to accept the value.

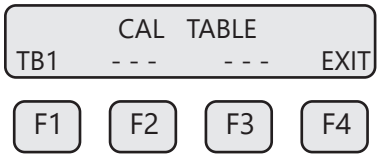
Calibration Parameters
This menu allow changing the factory calibrated setting of the flow meter and is accessible with a **Level 2** password. Calibration parameter values are set for temperature and pressure at 0 degree C and 760 mmHg.

These settings should never be changed (except by Fox technicians at the factory).

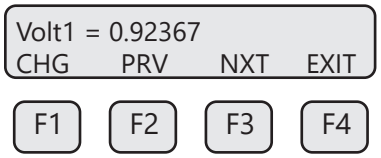
This menu is entered from the base menu and pressing **FLO**, **PRM** and **CAL.**



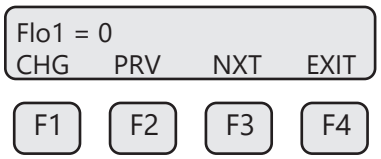
Press **CAL (F1)** then the display will show:



Press **TB1 (F1)** then the display will show:



Press **NXT (F3)** then the display will show:

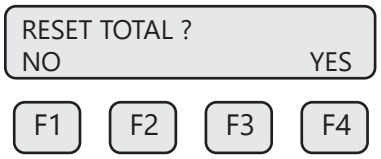


Use the **CHG (F1)** key to change the entry, **PRV (F2)** to move to the previous entry, **NXT (F3)** to move to the next entry and **EXIT (F4)** to return.

Pressing the **NXT (F3)** key will show the data point voltage, then mass velocity, and then go to the next data point. The number after Volt (i.e., Volt1) or Flo (i.e., Flo1) indicated the data point number. The calibration table can hold up to 20 data pair points. Each data point has a voltage and mass velocity associated with it.

Reset Total and Elapsed Time

Enter the flow totalizer and elapsed time screen by pressing the **F3** and **F4** keys at the same time in the normal running mode (password required).



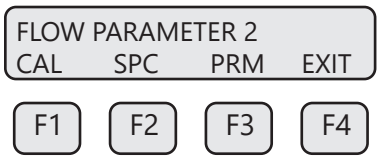
Press **YES (F4)** and enter password to reset total and elapsed time. Press **NO (F1)** to cancel.

NOTE! This feature is not available on non-resettable units.

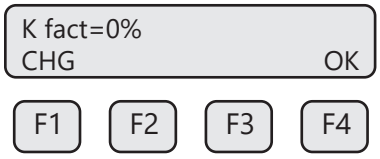
Totalizer Rollover
The FT2A has an automatic roll-over function. The total flow count of the FT2A will roll over after 99,999,999,999. Except for:

MSCFD:	999,999,999
MMSCFM:	9,999,999
MMSCFD:	999,999

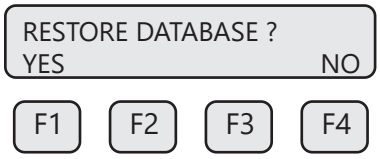
Restore Database
Restoring the original factory settings is accomplished from the "Flow Parameter 2" menu by entering a **Level 2** password "9111" and pressing the **SPC** key (**F2**).



The following will show:



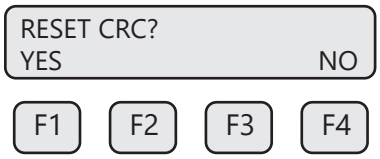
Upon pressing **OK (F4)**, an option to restore the database will follow:



Press **YES (F1) ONLY** if you want to restore your database to the initial factory setting that the meter was shipped with. All current user-entered settings will be overwritten.

The green LP1 LED will flash at a faster pace until the recall is performed. The "RESET CRC" screen will follow "RESTORE DATABASE".

Reset CRC
If the NVRAM CRC check fails (Error Code 36), the programmed settings values will need to be verified and corrected before clearing the error. Call Fox Thermal Customer Service if you need assistance.



Press **YES (F1) ONLY** if you want to reset the CRC and generate a new CRC value.

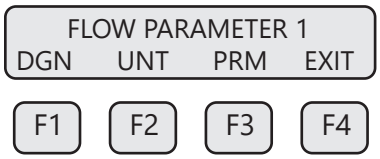
Simulation
This menu allows for simulation of flow rate, temperature, and flow input voltage. It should only be used for testing and demonstration purposes.

Make sure to return all of these simulation values to zero, before returning to the normal mode of operation.

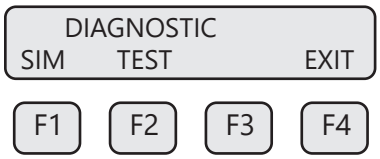
NOTE! Simulated values are only enabled when not set to zero.

CAUTION! If the 4-20mA and/or the pulse outputs are connected to controllers, set the controllers to "manual" to ensure that the simulated signals do not cause false controller action.

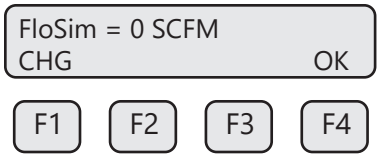
The menu is accessible from the Main Menu by pressing **FLO**:



Pressing **DGN (F1)** will show:



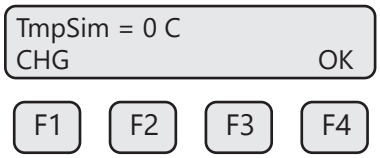
Pressing **SIM (F1)** will show:



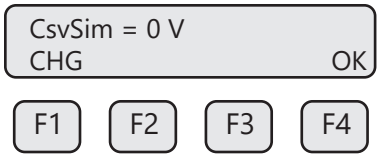
Enter the value and then press **OK (F4)**.

NOTE! Enter zero to disable this feature.

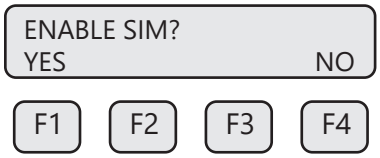
Temperature will be displayed according to Temperature Units settings.



Enter the value and then press **OK (F4)**. Enter zero to disable this feature.



Enter the CSV value and then press **OK (F4)**.



Press **YES** (**F1**) to start the simulation mode, otherwise press **NO** (**F4**). Upon pressing either key, the program will return to the FLOW PARAMETER 1 screen.

NOTE! Simulation Mode will be cleared if the power is cycled.

Scope - Modbus Communications
This section describes the Modbus implementation using RS485 serial communication physical layer for the Fox Thermal FT2A mass flow meter based on the Modicon Modbus Protocol (PI-MBUS-300 Rev. J).

Modbus Protocol
MODBUS Protocol is an application layer messaging protocol that provides client/sever communications between devices. MODBUS is a request/reply protocol and offers services specified by function codes.

The size of the MODBUS Protocol Data Unit is limited by the size constraint inherited from the first MODBUS implementation on Serial Line network (max. RS485 Application Data Unit = 256 bytes).

Therefore, MODBUS PDU for serial line communication = 256 – Server address (1 byte) – CRC (2 bytes) = 253 bytes.

RS485 ADU = 253 + Server address (1 byte) + CRC (2 bytes) = 256 bytes.

For more information on MODBUS go to the web site http://www.modbus.org/.

Command Request:
<Meter Address> <Function code> <Register start address high> <Register start address low> <Register count high> <Register count low> <CRC high> <CRC low>

Command Response:
<Meter Address> <Function code> <Data byte count> <Data register high> <Data register low> ... <Data register high> <Data register low> <CRC high> <CRC low>

NOTE! The data in shown in brackets < > represents one byte of data.

FT2A Commands Supported
The FT2A supports the following commands:

1) Command 03: Read holding registers
2) Command 04: Read input register.
3) Command 06: Preset single register

Read Holding Registers (command 03)
This command reads the basic variable from the FT2A and has the following format:

Request:
<Meter Address> <Command code=03> <Register start address high> <Register start address low> <Register count high> <Register count low> <CRC high> <CRC low>

Response:
<Meter Address> <Command code=03> <Byte count> <Data high><Data low> ... <Data high><Data low> <CRC high> <CRC low>

Example:
Request data register at starting address 0x0000 and specifying only 1 register

<0x01> <0x03> <0x00> <0x00> <0x00> <0x01> <0x0a> <0x84>

Response:
<0x01> <0x03> <0x02> <xx> <xx> <CRC high> <CRC low>

Where xx xx is the data register value.

Table 5.1: FT2A Modbus Holding Registers

Modbus Register	Data Type	Description	Units
40001	32-bit int LSW	Flow	User selected
40002	32-bit int MSW		
40003	32-bit int LSW	Total	User selected
40004	32-bit int MSW		
40005	32-bit int LSW	Temperature x 10	User selected
40006	32-bit int MSW		
40007	32-bit int LSW	Elapsed Time x 10	Hours
40008	32-bit int MSW		
40009	32-bit int LSW	Flow Velocity	meters/hour
40010	32-bit int MSW		
40011	16-bit int	Flow x 10	User selected/10
40012	16-bit int	Flow x 100	User selected/100
40013	16-bit int	Total x 100	User selected/100
40014	32-bit int LSW	Total2 (2 gas curves only)	User selected
40015	32-bit int MSW		
40016	16-bit int	Status	n/a
40017	16-bit int	Status2	n/a
40018	16-bit int	Control Register (Write Only)	n/a
40019	16-bit int	Reserved	

Modbus Register	Data Type	Description	Units
40020	32-bit float LSW	Flow	User selected
40021	32-bit float LSW		
40022	32-bit float LSW	Total	User selected
40023	32-bit float LSW		
40024	32-bit float LSW	Total2 (2 gas curves only)	User selected
40025	32-bit float LSW		
40026	32-bit float LSW	Temperature	User selected
40027	32-bit float LSW		
40028	32-bit float LSW	Elapsed Time	Hours
40029	32-bit float LSW		
40030	32-bit float LSW	Flow Velocity	meters/hour
40031	32-bit float LSW		
40032	16-bit int	Reserved	
40033	16-bit int	Reserved	
40034	16-bit int	Reserved	
40035	16-bit int	Reserved	
40036	16-bit int	Reserved	
40037	32-bit int LSW	Total 24 Hrs, Last Total Record	User selected
40038	32-bit int MSW		
40039	16-bit int	Total 24 Hrs, Current Day (0-6)	Day
40040	16-bit int	Total 24 Hrs, Current Hour (0-23)	Hour
40041	32-bit int LSW	Total 24 Hrs, Record Day 1	User selected
40042	32-bit int MSW		
40043	32-bit int LSW	Total 24 Hrs, Record Day 2	User selected
40044	32-bit int MSW		
40045	32-bit int LSW	Total 24 Hrs, Record Day 3	User selected
40046	32-bit int MSW		
40047	32-bit int LSW	Total 24 Hrs, Record Day 4	User selected
40048	32-bit int MSW		
40049	32-bit int LSW	Total 24 Hrs, Record Day 5	User selected
40050	32-bit int MSW		
40051	32-bit int LSW	Total 24 Hrs, Record Day 6	User selected
40052	32-bit int MSW		
40053	32-bit int LSW	Total 24 Hrs, Record Day 7	User selected
40054	32-bit int MSW		
40055	32-bit int LSW	Total 24 Hrs, Last Total	User selected
40056	32-bit int MSW		
40057	16-bit int	Reserved	
40058	16-bit int	Reserved	

Modbus Register	Data Type	Description	Units
40059	16-bit int	Reserved	
40060	16-bit int	Reserved	
40061	16-bit int	Reserved	
40062	16-bit int	Reserved	
40063	16-bit int	Reserved	
40064	16-bit int	Reserved	
40065	16-bit int	Reserved	
40066	16-bit int	Reserved	
40067	16-bit int	Reserved	
40068	16-bit int	Reserved	
40069	16-bit int	Reserved	

NOTE! Registers 40011, 40012, and 40013 are provided to get more resolution for low flow and total. When value exceeds the 16 bit registers, they will be frozen with all 16 bits set. It is also possible to use the velocity to calculate the flow in engineering units by using the pipe area and conversion factor for the selected units.

Read Input Register (FT2A Status, Command 04)
This command is used to report the FT2A status information.

Request:
<Meter Address> <Command code=04> <Register address =0> <Register address =0>
<Register count =0> <Register count =1> <CRC high> <CRC low>

Response:
<Meter Address> <Command code=04> <Byte count =2> <Status High><Status Low>
<CRC high> <CRC low>

Table 5.2: Status Bits Definitions for Command 04, Modbus Address 30001

Bit	Definition	Comment
0	Power up indication	Cleared when out of the power up sequence
1	Flow rate reached high limit threshold	Set limit to zero to disable
2	Flow rate reached low limit threshold	Set limit to zero to disable
3	Temperature reached high limit threshold	Set limit to zero to disable
4	Temperature reached low limit threshold	Set limit to zero to disable
5	Sensor reading is out of range	Check sensor wiring
6	Velocity flow rate outside of calibration table	Check sensor wiring
7	Incorrect Settings	Check settings
8	In simulation mode	Set simulation value to 0 to disable
9	Frequency output is out of range	Check frequency output settings
10	Analog 4-20 mA for flow is out of range	Check analog output settings
11	Analog 4-20 mA for temperature is out of range	Check analog output settings
12	Anybus error	Replace display board
13	Bridge Shut Down	Check sensor wiring
14	CRC error	Check parameters and reset CRC
15	Error in Total	Reset total to clear alarm

Table 5.3: Status 2 Bits Definitions for Command 04, Modbus Address 30002

Bit	Definition	Comment
0	Not used	Not used
1	Busy	Busy
2	Not used	Not used
3	Curve #2 Selected (for 2 gas curves only)	Curve #2 Selected (for 2 gas curves only)
4	Not used	Not used
5	Not used	Not used
6	Not used	Not used

Preset Single Register (Command 06)
This command is used to perform miscellaneous functions such as clearing the totalizer and elapsed time. The register address is Modbus=40018 and the data to write is described below.

Request:

<Meter Address> <Command code=06> <Register address high=0x00> <Register address low=0x11> <Register data high=0x00> <Register data low =0x02> <CRC high> <CRC low>

Response:

<Meter Address> <Command code=06> <Register address =0x00> <Register address =0x11> <Register data=0x00> <Register data =0x02> <CRC high> <CRC low>

Reset Total:

Address = 40018, data = 0x02
This command is used to clear the Totalizer and elapsed time registers

Reset 24 hours Total:

Address=40018, data = 180 (0xB4)
This command reset the 24 hours 7 days record including the day and hours counters

Reset 24 hour time:

Address=40018, data = 181 (0xB5)
This command reset the 24 hours day and hours counters

24 hours Event:

Address=40018, data = 182 (0xB6)

This command generates a 24 hours event, the same way as when the 24 hours counter rolls over.

This may be useful to record total over a shorter period.

Switch to Curve #1:

Address=40018, data = 170 (0xAA)

This command initiates a command to switch to gas curve 1 when configured for 2 gas curves.

Make sure that the input contact is not programmed for curve switching

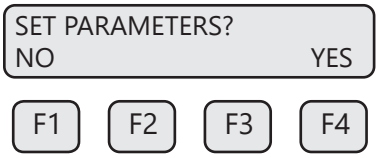
Switch to Curve #2:

Address=40018, data = 171 (0xAB)

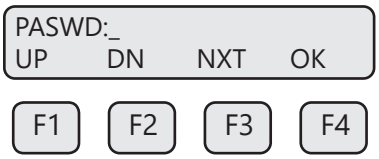
This command initiates a command to switch to gas curve 2 when configured for 2 gas curves.

Make sure that the input contact is not programmed for curve switching

Enter the Programming Mode
Press the F1 or the F2 key repeatedly, in the normal running mode, until the following screen is shown. This enters the programming mode:



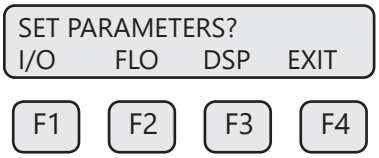
Press YES (F4) and then the following screen will prompt the user to enter the password if enabled:



Enter the correct password. Default password for Level 1 is 1234.

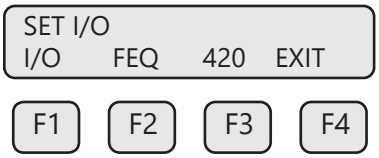
Press the UP (F1) or DN (F2) key to select a new digit or character, the cursor points to the selected digit. Press NXT (F3) to select the next digit and OK (F4) to accept the entry.

If the wrong password is entered, the message “Wrong Password” will be displayed for a few seconds and then return to the programming entry screen. If the password is accepted, the following screen will be shown:

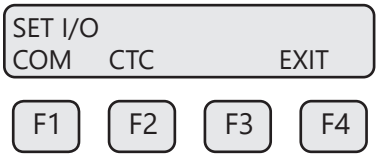


This is the base screen for the programming mode. To exit the programming mode, press EXIT (F4) repeatedly until “Normal Mode” is seen briefly.

Communication Protocol and Parameters
To program the communication parameters, press I/O (F1) key from the base menu.

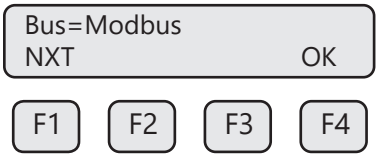


Then press I/O (F1) again:



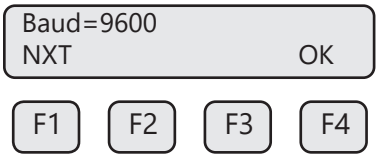
Then press COM (F1) to select communication parameters.

Set Bus protocol for Modbus:



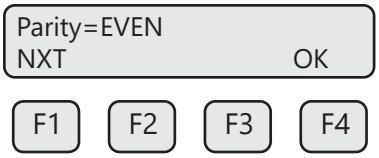
Press NXT (F1) repeatedly until Modbus is selected as shown and then press OK (F4) to accept the setting.

The following communication parameters are only available for MODBUS:



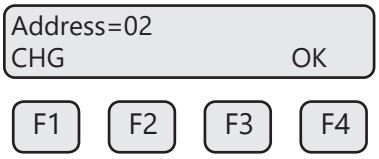
Press NXT (F1) repeatedly until the correct selection is shown and then press OK (F4) to accept the setting.

Selections are:
"115200"
"76800"
"57600"
"38400"
“19200”
“9600”
“4800”
“2400”
“1200”



Press NXT (F1) repeatedly until the correct selection is shown and then press OK (F4) to accept the setting.

Selections are: "NONE"
"ODD"
"EVEN"



Press CHG (F1) to change the address and then press OK (F4) to accept the setting.

Selections are between 01 and 247.

NOTE! Power cycle is required for the new settings to take effect.

Scope
Thank you for purchasing the model FT2A thermal gas mass flow meter from Fox Thermal. The model FT2A is one of the most technically advanced flow meters in the world. Extensive engineering effort has been invested to deliver advanced features, accuracy measurement performance and outstanding reliability.

This document describes the BACnet MS/TP implementation using RS485 serial communication physical layer for the Fox Thermal FT2A mass flow meter.

BACnet Protocol
BACnet MS/TP (Building Automation and Control Network /Master Slave Token Passing) is a data link layer protocol designed for communication between devices in building automation control systems. The protocol is based on devices, objects, properties, and services. Information inside a BACnet device is organized into a series of objects. Properties allow the data from the object to be written or read. The actions that a BACnet device uses to interact with another device are the services.

The FT2A Device profile: BACnet Smart Sensor (B-SS)

FT2A supports the following device binding methods:

Receive Who-Is, send I-Am (BIBB DM-DDB-B) Receive Who-Has, send I-Have (BIBB DM-DOB-B)

Objects for FT2A:

Analog Input 1 = Flow Analog Input 2 = Gas Temperature Analog Input 3 = Total Flow / Reset Total Analog Input 4 = Elapsed Time since reset

Device object property identifiers and restrictions: (properties that are writable)

Object _Name	< 10 bytes
Object _ Identifier	Device Type only
Max _ info_ Frames	<=255
Max _ Master	<=127

BACnet Interoperability Building Blocks (BIBB'S) provide function capabilities for data exchange between devices.

FT2A BIBB's supported:

DS-RP-B Read Property DS-WP-B Write Property DM-DDB-B Dynamic Device Binding DM-DOB-B Dynamic Object Binding DM-DCC-B Device Communication Control DS-RPM-B ReadPropertyMultiple DM-RD-B Reinitialize Device

MS/TP baud rates:

9600, 19200, 38400, 57600, 76800, 115200

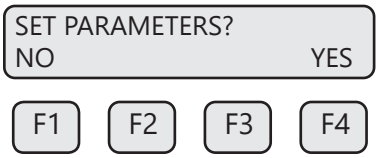
FT2A Character sets supported:

ANSI X3.4, UTF-8

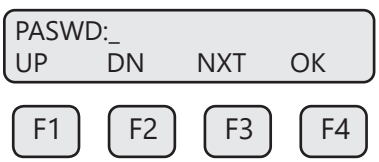
Fox Thermal BACnet vendor ID: 650

For more information about BACnet visit http://www.bacnet.org/.

Enter the Programming Mode
Press the F1 or the F2 key repeatedly, in the normal running mode, until the following screen is shown. This enters the programming mode:



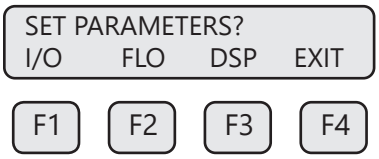
Press YES (F4) and then the following screen will prompt the user to enter the password if enabled:



Enter the correct password. Default password for Level 1 is 1234.

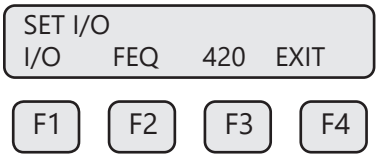
Press the UP (F1) or DN (F2) key to select a new digit or character, the cursor points to the selected digit. Press NXT (F3) to select the next digit and OK (F4) to accept the entry.

If the wrong password is entered, the message “Wrong Password” will be displayed for a few seconds and then return to the programming entry screen. If the password is accepted, the following screen will be shown:

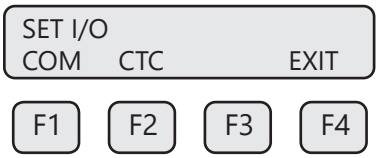


This is the base screen for the programming mode. To exit the programming mode, press EXIT (F4) repeatedly until “Normal Mode” is seen briefly.

Communication Protocol and Parameters
To program the communication parameters, press I/O (F1) key from the base menu.

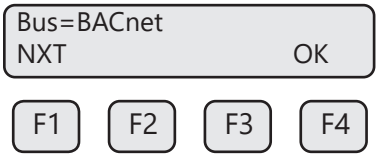


Then press I/O (F1) again:

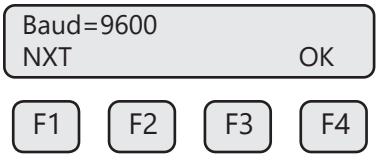


Then press COM (F1) to select communication parameters.

Set Bus protocol for BACnet:



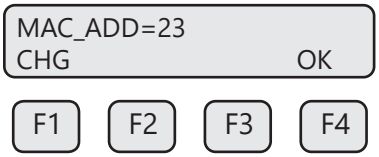
Press NXT (F1) repeatedly until BACnet is selected as shown and then press OK (F4) to accept the setting.



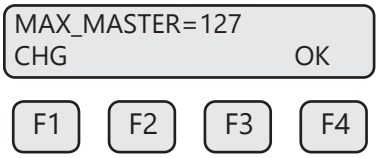
Press NXT (F1) repeatedly until the correct selection is shown and then press OK (F4) to accept the setting.

Selections are: "9600"
"19200"
"38400"
"57600"
"76800"
"115200"

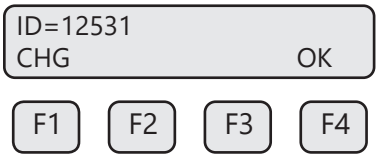
Next select the MS/TP Mac address. The selection is from 0-127. Please note that only one device can be on a MS/TP Mac address.



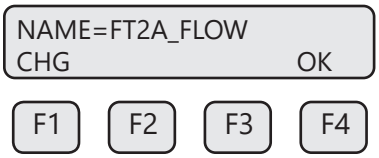
Next select the MS/TP Max Master. The selection is from 0-127.



Next input the device object instance. Selection is from 0-4194303.



Next enter the device object name (9 characters maximum).



NOTE! Power cycle is required for the new settings to take effect.

Precautions GB

WARNING! BEFORE ATTEMPTING ANY MAINTENANCE, TAKE THE NECESSARY SAFETY PRECAUTIONS BEFORE REMOVING THE PROBE FROM THE DUCT (EXAMPLE: PURGE LINES OF TOXIC AND/OR EXPLOSIVE GAS, DEPRESSURIZE, ETC...).

WARNING! EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE COMPONENTS OR FUSES UNLESS POWER HAS BEEN DISCONNECTED WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

WARNING! EXPLOSION HAZARD. DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

WARNING! TURN OFF INPUT POWER BEFORE REMOVING OR INSTALLING A CIRCUIT BOARD ASSEMBLY FROM THE ENCLOSURE.

Access to Electronics
Accessing electronics is not normally required for maintenance purposes. If a loose connection is suspected, unscrew the rear end-cap of the meter enclosure to access the terminations

CAUTION! BE SURE POWER TO METER IS SWITCHED OFF BEFORE ATTEMPTING TO ACCESS ELECTRONICS. If there is a problem and a loose connection is not found, please contact Fox Customer Service for technical assistance at (831) 384-4300.

Precauciones ES

¡ADVERTENCIA! ANTES DE INTENTAR CUALQUIER MANTENIMIENTO, TOME LAS PRECAUCIONES DE SEGURIDAD NECESARIAS ANTES QUE RETIRAR LA SONDA DEL DUCTO (EJEMPLO: PURGUE LAS LÍNEAS DE GASES TÓXICOS Y/O EXPLOSIVOS, DESPRESURICE, ETC...).

¡ADVERTENCIA! PELIGRO DE EXPLOSIÓN. NO RETIRE O REEMPLACE COMPONENTES O FUSIBLES A MENOS QUE LA ENERGÍA HAYA SIDO DESCONECTADA SIEMPRE QUE ESTÉ PRESENTE UNA ATMÓSFERA INFLAMMABLE O COMBUSTIBLE.

¡ADVERTENCIA! PELIGRO DE EXPLOSIÓN. NO DESCONECTE NINGÚN EQUIPO CUANDO UNA ATMÓSFERA INFLAMABLE O COMBUSTIBLE ESTÉ PRESENTE PRONTO.

¡ADVERTENCIA! DESCONECTE LA ENERGÍA DE ALIMENTACIÓN ANTES DE REMOVER O INSTALAR UN ENSAMBLE DE TARJETA DE CIRCUITO DEL GABINETE.

Acceso a la Electrónica
Normalmente no se requiere tener acceso a la electrónica para propósitos de mantenimiento. Si se sospecha de una conexión suelta, desatornille la tapa posterior de la caja del medidor para tener acceso a las terminales

PRECAUCIÓN: ASEGÚRESE QUE LA ALIMENTACIÓN DEL MEDIDOR ESTE DESCONECTADA ANTES DE INTENTAR EL ACCESO A LA ELECTRÓNICA. Si existe algún problema y no se encuentra ninguna conexión suelta, por favor póngase en contacto con el Servicio al Cliente de Fox para asistencia técnica al número (831) 384-4300.

Précautions FR

AVERTISSEMENT ! AVANT TOUTE TENTATIVE DE MAINTENANCE, OBSERVER LES CONSIGNES DE SECURITE NECESSAIRES AVANT DE RETIRER LA SONDE DE LA CONDUITE (PAR EXEMPLE, PURGER LES LIGNES DES GAZ EXPLOSIFS/TOXIQUES QU'ELLES POURRAIENT CONTENIR, DEPRESSURISER LE CONTENEUR, ETC.).

AVERTISSEMENT ! RISQUE D'EXPLOSION. NE PAS RETIRER NI REMPLACER DES COMPOSANTS OU DES FUSIBLES SI LA SOURCE D'ALIMENTATION N'A PAS ETE DEBRANCHEE DANS UNE ATMOSPHERE INFLAMMABLE OU COMBUSTIBLE.

AVERTISSEMENT ! RISQUE D'EXPLOSION. NE PAS DEBRANCHER UN EQUIPEMENT DANS UNE AMBIANCE COMBUSTIBLE OU INFLAMMABLE.

AVERTISSEMENT ! COUPER L'ALIMENTATION AVANT DE RETIRER OU D'INSTALLER UN ENSEMBLE DE CARTE DE CIRCUITS IMPRIMES DU BOITIER.

Accès aux composants électroniques
L'accès aux composants électroniques n'est généralement pas nécessaire dans le cadre de la maintenance. Si une connexion lâche est suspectée, dévisser le capuchon d'extrémité arrière du boîtier du compteur pour accéder aux terminaisons

ATTENTION : S'ASSURER QUE L'ALIMENTATION DU COMPTEUR EST COUPEE AVANT D'ACCER AUX COMPOSANTS ELECTRONIQUES. En cas de problème et qu'aucune connexion lâche n'est détectée, veuillez contacter le service client de Fox pour obtenir une assistance technique au (831) 384-4300.

Vorsichtsmaßnahmen DE

ACHTUNG! BITTE ERGREIFEN SIE DIE ERFORDERLICHEN SICHERHEITSMAßNAHMEN, BEVOR SIE IRGENDWELCHE WARTUNGSARBEITEN DURCHFÜHREN UND DIE MESSSONDE AUS DEM ROHR ENTFERNEN (BEISPIEL: LEITUNGEN ZUR ENTFERNUNG VON GIFTIGEN UND/ODER EXPLOSIVEN GASEN REINIGEN, DRUCK SENKEN, USW.).

ACHTUNG! EXPLOSIONSGEFAHR. KOMPONENTEN ODER SICHERUNGEN BITTE ERST DANN ENTFERNEN ODER AUSTAUSCHEN, WENN DER STROM GETRENNT WURDE, FALLS EINE ENTZÜNDLICHE ODER BRENNBARE ATMOSPHÄRE VORHANDEN IST.

ACHTUNG! EXPLOSIONSGEFAHR. GERÄT NICHT VOM STROM TRENNEN, WENN EINE ENTZÜNDLICHE ODER BRENNBARE ATMOSPHÄRE VORHANDEN IST.

ACHTUNG! EINGANGSLEISTUNG AUSSCHALTEN, BEVOR LEITERPLATTENBAUGRUPPEN AUS DEM GEHÄUSE AUSGEBAUT ODER IN DIESES EINGEBAUT WERDEN.

Zugriff auf die Elektronik
Der Zugriff auf die Elektronik ist zu Wartungszwecken normalerweise nicht erforderlich. Falls eine lose Verbindung vermutet wird, schrauben Sie die hintere Endkappe des Messgerätgehäuses ab, um auf die Anschlüsse zugreifen zu können.

VORSICHT: STELLEN SIE SICHER, DASS DER STROM AN DAS MESSGERÄT AUSGESCHALTET IST, BEVOR SIE VERSUCHEN, AUF DIE ELEKTRONIK ZUZUGREIFEN. Falls Probleme auftreten und keine lose Verbindung gefunden werden kann, wenden Sie sich bitte zwecks technischer Unterstützung an den Fox-Kundendienst unter der Nummer (831) 384-4300.

Broken or Damaged Probe
If the sensor is broken or damaged, the probe and electronics must be returned to the factory. A new sensor will be installed and calibrated. Refer to "Returning Your Meter" on page 107.

Flow Calibration
To ensure continued high accuracy of your model FT2A Flow Meter, Fox Thermal provides a full NIST traceable calibration. It is recommended that the meter be returned to Fox for a calibration check in our NIST traceable labs after two years of operation.

Fuse Replacement
Verify the fuse is defective by measuring it with an Ohm Meter (Two replacement fuses are provided with each unit). The fuse F1 is located near the power terminal block and can be removed by using tweezers or needle-nose pliers. Replacement fuse is Littelfuse part number 0454.750MR.

WARNING!

- Turn input power OFF before removing or installing a fuse. Use only recommended fuse replacements.
- It is the user's responsibility to install the flow meter in an appropriately designed system with adequate safety protections.
- DO NOT remove the flow instrument from the flow body while the system is under flow conditions.
- This product may experience temperatures from as low as -40F (-40C) and as high as 649F (343C). It is the user's responsibility to take safety precautions regarding operating temperature of the flow meter.
- If large flow body has been purchased, user is advised to use a double sling to prevent rotation of flow body during installation or other method to prevent damage of flow instrument.

Sensor Wiring
NOTE! Sensor terminations are performed at the factory except when the Remote Electronics option is used or ordered.

Sensor Cleaning
The sensor is insensitive to small amounts of residue, but continued use in dirty environments will necessitate periodic cleaning. To inspect the sensor, remove power from electronics and remove the unit from the pipe or duct, exposing the sensor elements. If they are visibly dirty, clean them with water or alcohol (ethanol) using an appropriate brush until they appear clean again. Even though the sensor elements are rugged, avoid touching them with any solid object and use a light touch while cleaning them.

Instructions for Removing and Inserting the Meter from a Pressurized Pipe using the Retractor

WARNING! Possible injury or damage to equipment may occur if the retractor is not used correctly. Please read the following instructions carefully prior to using the retractor.

CAUTION! Never remove the swage fitting without first closing the ball valve and bleeding off pressure.

WARNING! When working with the retractor, do not stand or position any part of your body in the path of the flow meter. An injury may occur if the probe is forced outward by system pressure.

How to Remove the Meter from the Retractor (System Pressurized)

Step 1 - Remove the Probe from the Flow Stream

1. Disconnect power from the meter.

NOTE! At 125 psig of max system pressure, the probe will have approximately 25 lbs. of force pushing it out.

2. System pressure may force the probe out of the retractor when the swage nut is loosened. Hold the flow meter to counteract the force of the system pressure, and carefully loosen and unscrew the swage nut (see figure 5.1 on next page).
3. Slide the probe out of the retractor until it stops.
4. Close the ball valve all the way.

CAUTION! At this point there is still pressure inside of the retractor.

Step 2 - Remove the Probe from the Retractor Body

5. After removing the probe from the flow stream (#1-4 above), slowly loosen the swage fitting (see figure 5.1 on next page), until the pressure in the retractor is relieved.
6. Remove the swage fitting from the retractor nipple.
7. Carefully slide the probe out of the retractor while supporting the meter.

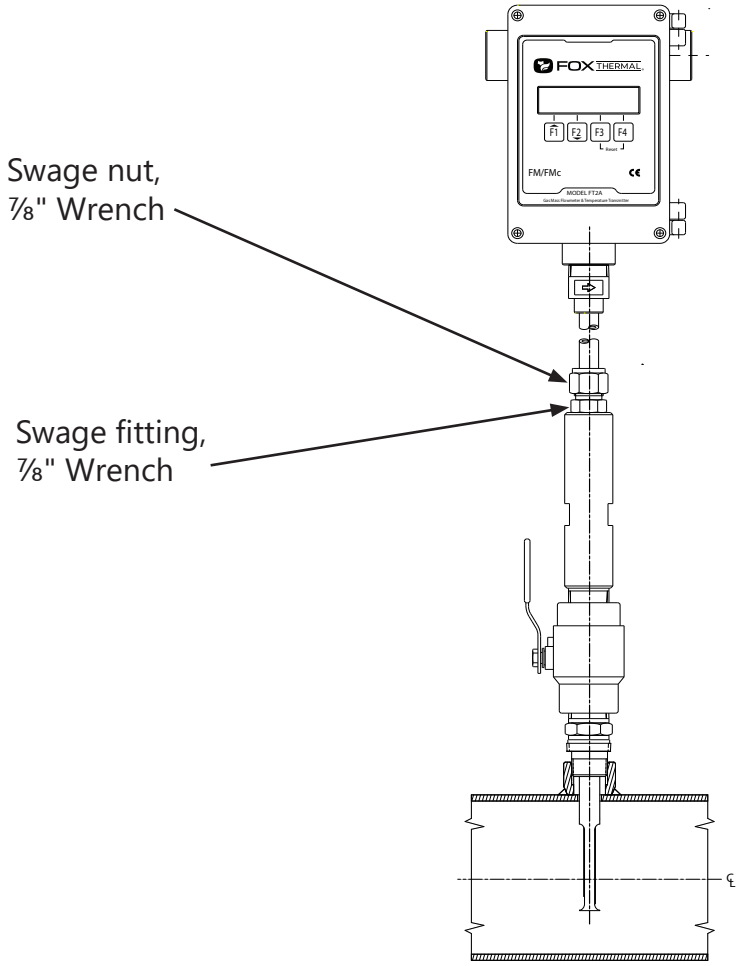
How to Insert the Probe into the Flow Stream (Valve closed, System Pressurized)

1. Carefully, slide the probe into the retractor.
2. Tighten the swage fitting into the retractor nipple.
3. Slowly open the ball valve to the full open position. Push the meter and probe into the pipe, then hand tighten the swage nut onto the swage fitting.

NOTE! At a maximum system pressure of 125 psig, the force required to push the probe in place to tighten the swage nut will be approximately 25 lbs.

4. Verify that the probe is aligned with the centerline of the pipe, and pointed in the direction of flow.
5. Secure the probe in place by tightening the swage Nut with a ⅞" wrench and a ⅞" wrench on the swage fitting.
6. Power may now be applied to the meter.

Fig. 6.1: Locating the Swage Nut and Swage Fitting



Troubleshooting

CAUTION! The electronics and sensor supplied by Fox Thermal are calibrated as a single precision mass flow meter. Interchanging sensors will decrease the accuracy of the flow meter. If you experience any problem with your model FT2A flow meter, call Fox Thermal Customer Service Department, Technical Assistance at (831) 384-4300.

Problem	Possible Cause(s)	Action(s)
Display Error	Display not operating properly.	Check status of LP1 on the display board. Is green LED blinking once per second? If LED is not blinking, cycle power to reset meter. Call Fox Tech Support.
Meter does not read up to full scale	Calibration table may be corrupted	• Check the calibration table for a corrupted location. • Enter the password 9111. • Start on p. 59 of the FT2A manual and follow the steps to get to Flow Parameters 2 menu screen. • Select CAL (F1) • Select NXT (F1) to cycle through calibration table to verify entries match calibration certificate. • Check for CRC error code
Velocity measurement seems low	1. Probe not oriented properly 2. Sensor dirty	1. Orient probe per installation section starting on p. 18. 2. Clean sensor (p. 82)
Unit will not power-up	a) No power input b) Bad fuse c) Bad Power supply	• Check fuse (F1) located next to TS1 on main board. • Check for correct power supply voltage at TS1 on main board. If fuse is OK and unit still won't power up, call Fox for additional assistance

Problem	Possible Cause(s)	Action(s)
Meter does not initialize	Electromagnetic Interference (EMI)	• Check meter power cycles. • Press and release F1 and F2 at the same time; the display will enter Engineering screens. • Press F1 to get to screen #23; record power cycle value. • Press F4 to return to normal operation; monitor meter until problem returns. • Return to screen #23 to see if power cycles have increased; microprocessor is resetting due to EMI electrical noise entering the meter. • Check Power input and output cables grounding and routing.
Velocity measurement is erratic or fluctuating	1. Very turbulent flow	1. Increase dampening (see filter settings in "Flow Parameters" on p. 59).
	2. Sensor dirty	2. Clean sensor (Refer to Maintenance section, p. 82).
	3. Sensor broken	3. Return flow meter to Fox for repair (Refer to p. 107 for shipping instructions).
	4. Probe not mounted securely	4. Remount probe (see Installation section starting on p. 16; must be mounted securely without vibration. If vibration persists, choose a new mounting location without vibration.
	5. Malfunction in flow meter	5. Return flow meter to Fox for repair (Refer to p. 107 for shipping instructions).
	6. Meter installed incorrectly	6. Re-install meter according to instructions (Refer to installation section starting on p. 16).
	7. Moisture in the process gas	7. Try to install the flow meter in a radial installation (refer to p.p. 18 for installation options).

Installation Problems

The following is a summary listing of problems that may be encountered with the installation of the FT2A thermal mass flow meter.

1. *Improper wiring connections for power and/or 4-20mA output signal.*
   The FT2A requires a separate power source for the main board and the two 4-20mA output signals. Two wires supply 24VDC power to the main board. Two wires are used for each of the 4-20mA output signals. Refer to Figure 3.5 and Figure 3.6 (p. 101-26). Also refer to "Wiring Precautions" and "Helpful Hints" in Wiring section (p. 30) for further guidance.

2. *Inadequate power source.*
   For those models that are powered by 24VDC, a 24VDC ±10%, 0.7 Amp or greater power supply is recommended. If the voltage supplied is not within this range or if the power supply is not rated for 25 watts minimum, a variety of problems can occur including inaccurate flow readings, dim display and faulty programming action. The input voltage must be within the range of 21.6 to 26.4VDC as measured at the power input terminals of the flow meter electronics.

3. *Flow measurement seems inaccurate.*
   - Check to ensure that the flow meter is installed so that the Flow Direction Arrow engraved on the flat surface of the fitting below the electronics housing is properly pointing in the direction of flow. Refer to "Fig. 2.6: Orientation of Flow Meter" on page 21. If not, change orientation of meter.
   - If you have a Fox insertion type flow meter, check that the insertion depth of the sensor/probe is correct. The end of the probe should be adjusted as per Figure 2.2 (p. 20).
   - For inline meter types, ensure that there are a minimum of ten diameters of straight pipe upstream of the sensor and five diameters downstream. For insertion meter types, ensure that there are a minimum of fifteen diameters of straight pipe upstream of the sensor and ten diameters downstream. If complex flow disturbances are upstream of the sensor, extension of the straight pipe may be required to ensure accurate flow measurement. Contact Fox for assistance.
   - Ensure that pipe area data in the meter matches data on the Fox Calibration Certificate. The pipe internal cross sectional area is programmed into the flow meter through the front panel (see Programming Flow Parameters, p. 59). This area is programmed in square feet or square meters. The Calibration Certificate delivered with the flow meter contains the area that was programmed into the flow meter at the Fox factory. Check to ensure that this area is correct.

4. *Erratic flow reading (especially a flow reading spiking high).*
   This may be a symptom of moisture in the flow stream. Fox flow meters are designed to work in relatively dry gas applications only. Contact Fox to discuss resolutions to this problem.

Installation Problems (Cont'd)

5. *Flow meter is not responding to flow.*
   This problem could be caused by a number of reasons:
   - Check to ensure adequate power is supplied to the flow meter. If things appear to be correct, perform this functional test before calling Fox. Carefully remove the probe and sensor from the pipe or flow body. **CAUTION!** The sensor can get HOT. For those flow meters with a display - and if the display is reading zero - blow on the sensor to see if a response occurs. If nothing happens, take a damp rag or sponge and place it in contact with the sensor. A reading should occur. Contact Fox Customer Service with this information.
   - A corrupted calibration table may lead to a zero flow reading. Verify that all Cal Flow Parameter settings are correct by accessing the "Calibration Parameters" information on meter (see p. 63). Check meter data for any non-whole numbers and call customer service for assistance.

6. *Display and/or 4-20mA signal reading above zero flow when no flow is occurring in the pipe.*
   If the reading is less than 5% of full scale, it is likely this is a normal condition caused by convection flow created by the heated sensor. It does not mean that the zero of the instrument is improperly set. The Fox sensor is extremely sensitive to gas flow and can even read the small flow caused by convection. If this is an unacceptable condition, please contact Fox Customer Service for alternatives.

7. *Mismatched serial numbers*
   If you have more than one meter, you must ensure that the serial numbers of meter, remote, and/or flow body match one another. These items have been manufactured and calibrated to operate as a unit and cannot be mismatched.

Alarm Codes

Alarm Code	Reason	Action
13	Flow rate above high limits	Refer to the PARAMETER MENU 2 section on p. 59 of this Manual to verify limit is within range. Check ALM = HiFloAlm under PRM.
14	Flow rate below low limits	Refer to the PARAMETER MENU 2 section on p. 59 of this Manual to verify limit is within range. Check ALM = LoFloAlm under PRM.
15	Temperature above high limits	Refer to the PARAMETER MENU 2 section on p. 59 of this Manual to verify limit is within range. Check ALM=HiTempAlm under PRM.
16	Temperature below low limits	Refer to the PARAMETER MENU 2 section on p. 59 of this Manual to verify limit is within range. Check ALM = LoTempAlm
22	Sensor out of range	Refer to the ENGINEERING SCREENS MENU on p. 13 of this Manual and the Fox Thermal factory Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.
23	Velocity out of calibration range	Refer to ENGINEERING DISPLAY MENU on p. 46 of this manual and the Fox Thermal Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.
24	Check settings	One or more internal settings are corrupted or out of spec. Contact Fox Thermal Service for instructions to verify settings.
25	Simulation mode	Meter is in Simulation Mode. Refer to the PARAMETER MENU 1 section on p. 62 of this Manual. Use the SIM Section under Diagnostics to return to normal operation.
26	Frequency output over range	Refer to the DIGITAL OUTPUT MENU on p. 9 of this Manual. Verify the Frequency Output settings are within limits.
32	4-20mA for flow rate is out of range	Refer to the MAIN MENU on p. 8 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4-20mA.
33	4-20mA for temperature is out of range	Refer to p. 48 of this manual. Use the Set I/O section to verify range limits under FLO Set 4-20mA. Channel #2 can be set for flow or temperature. Be sure to check the Alarm limits (refer to p. 52).
34	Busy	Meter is recalculating new parameters.
35	Sensor Bridge Shutdown	The FT2A probe is getting too hot. Open wiring compartment and check sensor wiring.
36	Database CRC Error	Refer to the Reset CRC section on p. 65 of this manual. Verify the programmed values are verified and corrected before clearing the error. Contact Fox Thermal Service Department for possible causes.
37	Totalizer Error Detected	See "Reset Total and Elapsed Time" on page 63 for steps to clear Error Code. Contact Fox for possible causes.

Performance Specs

Flow Accuracy:

±1% of reading ±0.2% of full scale
Insertion meters: 15 diameters upstream; 10 downstream
Inline meters (½" size): 6" (152mm) upstream and downstream
Inline meters (all other sizes): 8 diameters upstream; 4 downstream
Insertion Meters with FC20: 5 diameters upstream of FC20; 2 diameters between FC20 and FT2A; 5 diameters downstream of FT2A

Flow Repeatability: ±0.2% of full scale

Flow Response Time: 0.9 seconds (one time constant)

Temperature Accuracy:

±1.8° F (±1.0° C) over the range -40 to 250º F (-40 to 121º C)
±3.6° F (±2.0° C) over the range 250 to 650º F (121 to 343º C)
Minimum velocity 60 SFPM.

Calibration: Factory Calibration to NIST traceable standards

Operating Specs

Units of Measurement (field selectable):
SCFM, SCFH, NMPS, NM3/M, NM3/H, NM3/D, NLPS, NLPM, NLPH, MCFD, MSCFD, SCFD, MMSCFD, MMSCFM, SMPS, SM3/D, SM3/H, SM3/M, LB/S, LB/M, LB/H, LB/D, KG/S, KG/M, KG/H, SLPM, SFPM, MT/H

Gas Pressure (maximum at 100º F):
Insertion meter: 500 psig (34.5 barg)
316 SS inline meter with NPT ends: 500 psig (34.5 barg)
316 SS inline meter with 150 lb. flanges: 230 psig (15.86 barg)
Carbon steel inline meter with NPT ends: 500 psig (34.5 barg)
Carbon steel inline meter with 150 lb. flanges: 285 psig (19.65 barg)

Hot Tap/Retractor Assembly: 125 psig (8.62 barg)
Check with factory for higher pressure options.
NOTE! When teflon ferrule option ordered, gas pressure is 60psig (4.1 barg) maximum
NOTE! The EU Pressure Equipment Directive (PED) requires that the minimum ambient and fluid temperature rating for carbon steel flow bodies not be below -29°C.

Temperature:
ST Sensor: -40 to 250°F (-40 to 121°C)
Enclosure: -40 to 158°F (-40 to 70°C) DC power*
-4 to 158ºF (-20 to 70ºC) AC power
Remote Sensor Enclosure: -40 to 158°F (-40 to 70°C)
*__NOTE!__ Display dims below -4˚F (-20˚C), function returns once temperature rises again.

Operating Specs (cont'd)

Relative Humidity: 90% RH maximum; non-condensing

NOTE! Condensing liquids contacting the sensor can cause erratic flow indication.

Flow Velocity Range:

15 to 60,000 SFPM (0.07 to 280 NMPS) - Air at 70ºF (20ºC) & 1 ATM

Turndown: up to 1000:1; 100:1 typical

Maximum Flow Ranges for Insertion Flow Meters			
Pipe Diameter	**SCFM**	**MSCFD**	**NM^3/hr**
1.5" (40mm)	0-840	0-1,220	0-1,325
2" (50mm)	0-1,400	0-2,020	0-2,210
2.5" (63mm)	0-2,000	0-2,880	0-3,150
3" (80mm)	0-3,100	0-4,440	0-4,890
4" (100mm)	0-5,300	0-7,650	0-8,360
6" (150mm)	0-12,000	0-17,340	0-18,930
8" (200mm)	0-20,840	0-30,020	0-32,870
10" (250mm)	0-32,800	0-47,250	0-51,740
12" (300mm)	0-46,600	0-67,180	0-73,500

Maximum Flow Ranges for Inline Flow Meters			
Size	**SCFM**	**MSCFD**	**NM^3/hr**
0.5"	0-125	0-180	0-200
0.75"	0-220	0-320	0-350
1"	0-360	0-520	0-570
1.25"	0-625	0-900	0-990
1.5"	0-840	0-1,220	0-1,325
2"	0-1,400	0-2,020	0-2,210
2.5"	0-2,000	0-2,880	0-3,150
3"	0-3,100	0-4,440	0-4,890
4"	0-5,300	0-7,650	0-8,360
6"	0-12,000	0-17,340	0-18,930

NOTE! Standard conditions of air at 70°F and one atmosphere. Consult factory for other gases and for flow ranges above those listed. Inline meters above 5,000 SCFM (7,900 NM3/H) air may require third party calibration. Contact Fox Thermal.

Input Power (without Anybus serial communication option):

24VDC , ⎓ (±10%), 0.4 Amps (standard DC power)

100 to 240VAC~(+10/-15%), 50-60Hz, 0.2Amps (AC power option)

Input Power (Anybus serial communication option):

24VDC , (±10%), 0.7 Amps (standard DC power)

100 to 240VAC~(+10%/-15%), 50-60Hz, 0.2Amps (AC power option)

NOTE! Fluctuations of AC and DC power supply are not to exceed ±10% of rating.

Class I Equipment (Electrical Grounding Required for Safety).

Installation (Over-voltage) Category II for transient over-voltages.

Operating Specs (cont'd)

Outputs:

Two isolated 4-20mA outputs (output one is for flow rate and output two is programmable for flow rate or temperature); fault indication per NAMUR NE43.

Isolated pulse output: Isolated open collector output rated for 5 to 24VDC, 20mA maximum load, 0 to 100Hz (the pulse output can be configured to either transmit a 0 to 100Hz signal proportional to flow rate or an on/off alarm.

Serial Communication:

USB for connecting to a laptop or computer is standard; free PC-based software tool - FT2A View™ - provides complete configuration, remote process monitoring, and data logging functions.

Optional isolated communication outputs: Modbus MS/TP (RS485), BACnet MS/TP (RS485), Profibus-DP, DeviceNet, or Ethernet Modbus TCP.

4-20mA and Loop Verification:

Simulation mode used to align 4-20mA output with the input to customer's PLC/DCS.

Physical Specs

Sensor material:

316 stainless steel standard; contact Fox Thermal for other material options

Enclosure:

NEMA 4X (IP67), aluminum, dual ¾" FNPT conduit entries or optional M20 x 1.5mm.

Cabling to remote enclosure: 5-conductor, 18 AWG, twisted, shielded, 100 feet maximum.

Insertion Flow Meter Installation:

Fox Thermal-supplied compression fitting connects to customer-supplied ¾" female branch outlet welded to pipe.

Agency Approvals

CE: Approved

EMC Directive; 2014/30/EU
Electrical Equipment for Measurement, Control and Lab Use: EN61326-1:2013
Low Voltage Directive (LVD): 2014/35/EU
Product Safety Testing: EN 61010-1: 2010
Pressure Equipment Directive: 2014/68/EU
Weld Testing: EN ISO 15614-1 and EN ISO 9606-1, ASME B31.3

FM and FMc: Approved

Class I, II, III, Division 2, Groups A,B,C,D,E,F,G, T4A hazardous locations.
NEMA 4X Approved

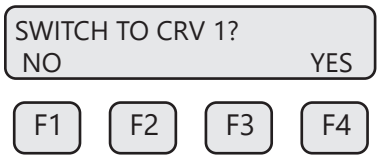
Scope - 2 Gas Curves
This section describes added features to the standard FT2A flow meter when using the 2 gas curves firmware option.

FT2A 2 Gas Curves
The 2 Gas Curves firmware allows the use of two different calibration tables when running with different gases. One of two methods can be used to switch between the two calibration curves:

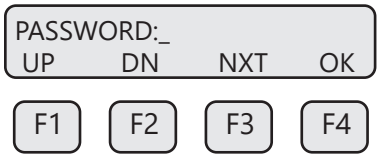
1) Use of Contact Input:
When the contact input is programmed for curve switching, an open contact will select curve #1 and a contact closure will select curve #2. Refer to p. 41 for wiring instructions for contact input and refer to p. 53 for how to program the contact input switch for curve-switching.

2) Use of the Keypad:
If the contact input is not programmed for curve switching, pressing F2 and F3 simultaneously will prompt an operator to manually switch curve upon entering a password and confirming the action by pressing the appropriate key.

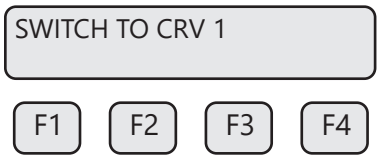
Pressing F2 & F3 simultaneously:



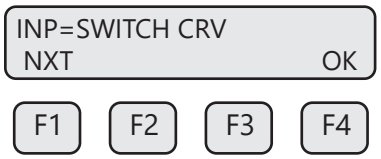
Password needs to be entered if active (default: 1234):



After entering a valid password, a brief confirmation message will be displayed for 1 second:



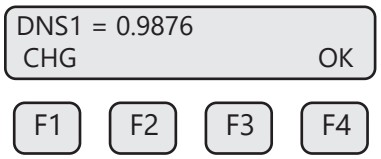
3) Programming Contact Input for Curve Switching:
Enter the menu using steps outlined in "Discrete Input Settings" section (p. 53) and select "Switch CRV". Please note that the flow meter needs to be programmed for 2 gas curves at the Fox factory before you can select this function. Flow meters are shipped with pre-programmed user requested settings.



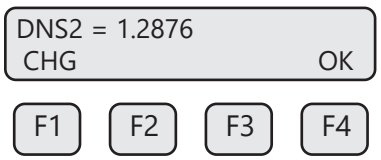
Selections are: "Not used"
"Tot Reset"
"Switch Crv"

4) Programming Densities for Curve 1 and Curve 2:
When the selected flow unit is mass/time, a separate density will be used for each curve if the meter has been programmed for 2 gas curves. To change the densities:

Go to the unit menu following "Unit Settings" section.



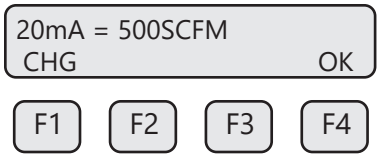
DNS1 is the density associated with curve 1. Change it as needed and press OK.



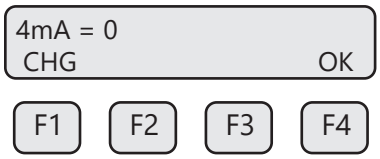
DNS2 is the density associated with curve 2. Change it as needed and press OK.

5) Programming 4-20mA settings for Curve 1 and Curve 2:
When the meter has been programmed for 2 gas curves, 2 sets of 4-20mA settings for flow rate are used. To program these settings:

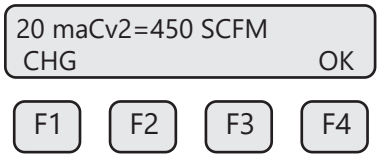
Go to the 4-20mA setting following the "Analog 4-20mA Settings" section.



20mA is the upper limit associated with curve 1. Change it as needed and press OK.



4mA is the lower limit associated with curve 1. Change it as needed and press OK.



20 maCv2 is the upper limit associated with curve 2. Change it as needed and press OK.

4 maCv2 is the lower limit associated with curve 2. Change it as needed and press OK.

6) Operation - Curve 1 and Curve 2:

- When using the 2 Gas Curve feature, only one of two techniques for selecting the gas curve is enabled to avoid confusion. If the contact input is assigned to switch gas curves, then the ability to switch using the F2 and F3 function keys on the front panel is disabled.
- Two totalizers (Total 1 and Total 2) and two elapsed time counters are available on the display and through the USB serial communication. The reset function will reset all totalizers and elapsed time counter to zero.
- In the event of a power failure, the software will remember the last curve in use. Upon powering up again, the FT2A unit will continue to use that curve.
- Switching between gas curves will require a password unless the password is set to "0", which disables it.
- The calibration certificates for flow meters with 2 gas curves will identify which gas is Gas 1 and Gas 2.
- When measuring in mass units, a density value must be entered for each gas curve.

Fig 7.1: Insertion Meter Dimensions

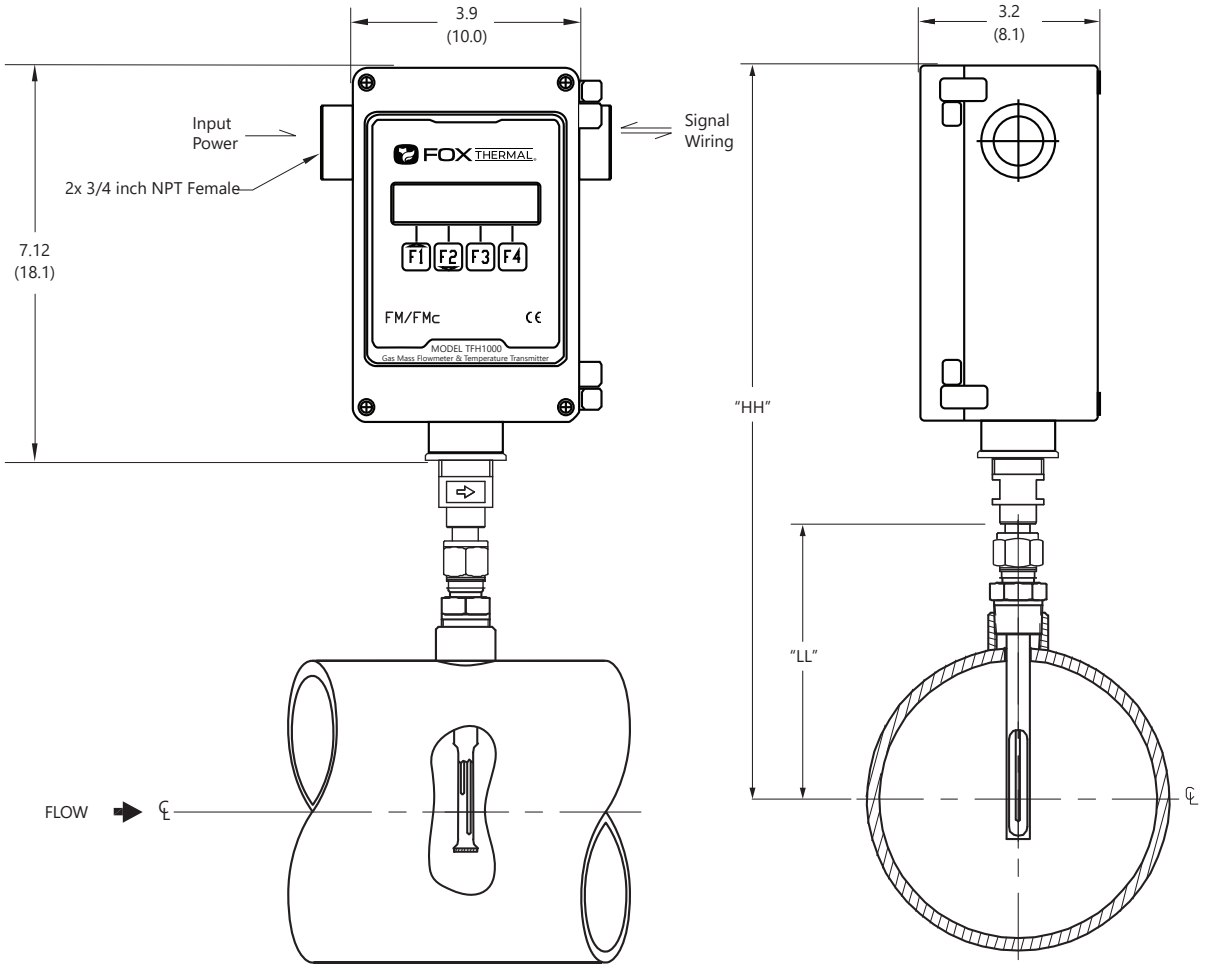


Table 7.1: Insertion Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension "LL" ± .10	Dimension "HH" ± .10
[model code]	[inches]	[inches / millimeters]	[inches / millimeters]
06I	6"	6.0" (152mm)	14.4" (367mm)
09I	9"	9.0" (229mm)	17.4" (443mm)
12I	12"	12.0" (305mm)	20.4" (519mm)
15I	15"	15.0" (381mm)	23.4" (595mm)
18I	18"	18.0" (457mm)	26.4" (671mm)
24I	24"	24.0" (610mm)	32.4" (824mm)
30I	30"	30.0" (762mm)	38.4" (976mm)
36I	36"	36.0" (914mm)	44.4" (1129mm)

Fig. 7.2: Insertion Remote Meter Dimensions

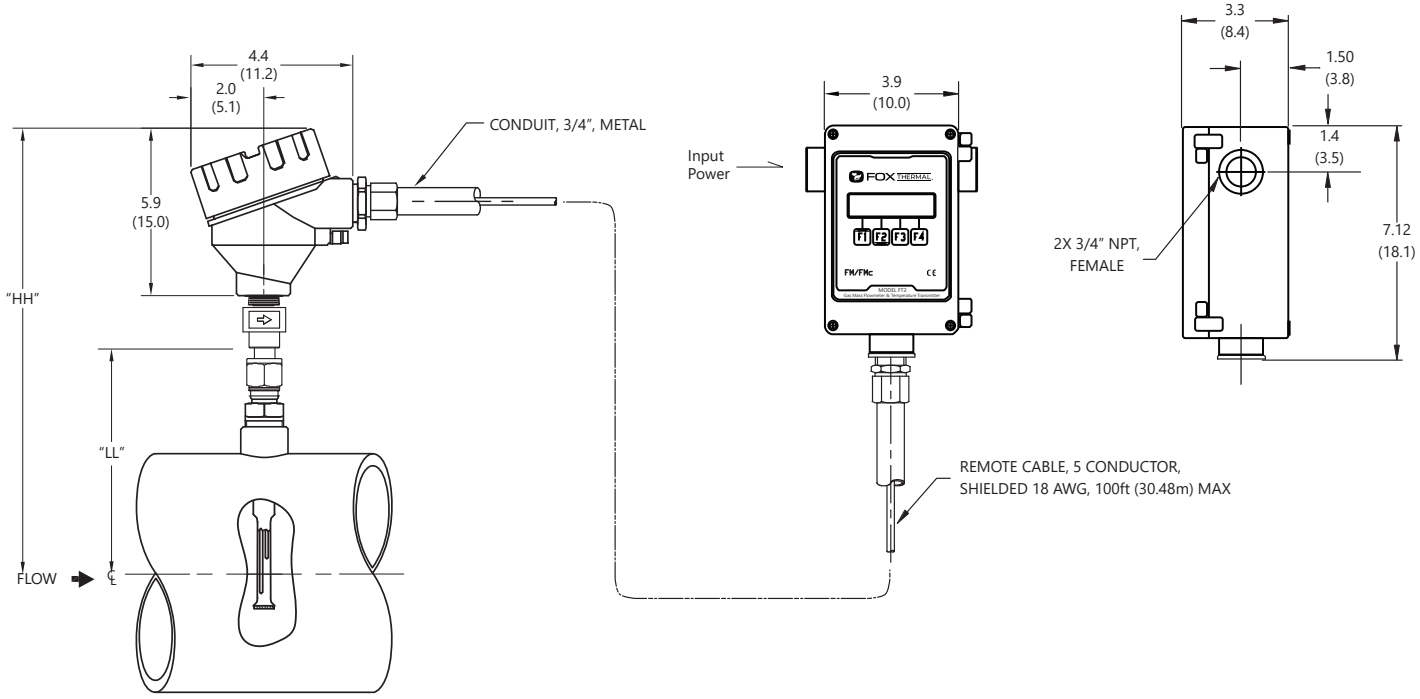


Table 7.2: Insertion Remote Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension "LL" ± .10	Dimension "HH" ± .10
[model code]	[inches]	[inches / millimeters]	[inches / millimeters]
06I	6"	6.0" (152mm)	11.9" (302mm)
09I	9"	9.0" (229mm)	14.9" (379mm)
12I	12"	12.0" (305mm)	17.9" (455mm)
15I	15"	15.0" (381mm)	20.9" (531mm)
18I	18"	18.0" (457mm)	23.9" (607mm)
24I	24"	24.0" (610mm)	29.9" (760mm)
30I	30"	30.0" (762mm)	35.9" (912mm)
36I	36"	36.0" (914mm)	41.9" (1064mm)

Fig. 7.3: Insertion Meter with Retractor Dimensions
Dimensions shown in inches (millimeters).

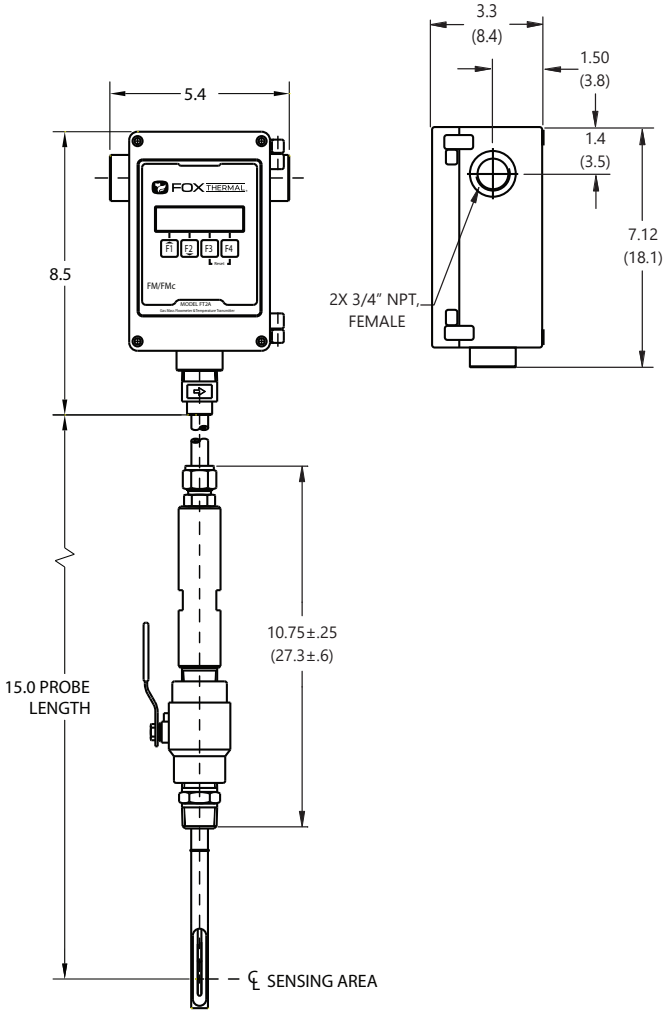


Table 7.3: Insertion Meter with Retractor

Probe Size	Probe Size	Dimension "LL" ± .10
[model code]	[inches]	[inches / millimeters]
15R	15"	15.0" (381mm)
18R	18"	18.0" (457mm)
24R	24"	24.0" (609mm)
30R	30"	30.0" (762mm)
36R	36"	36.0" (914mm)

Fig. 7.4: Remote Insertion Meter with Retractor Dimensions
Dimensions shown in inches (millimeters).

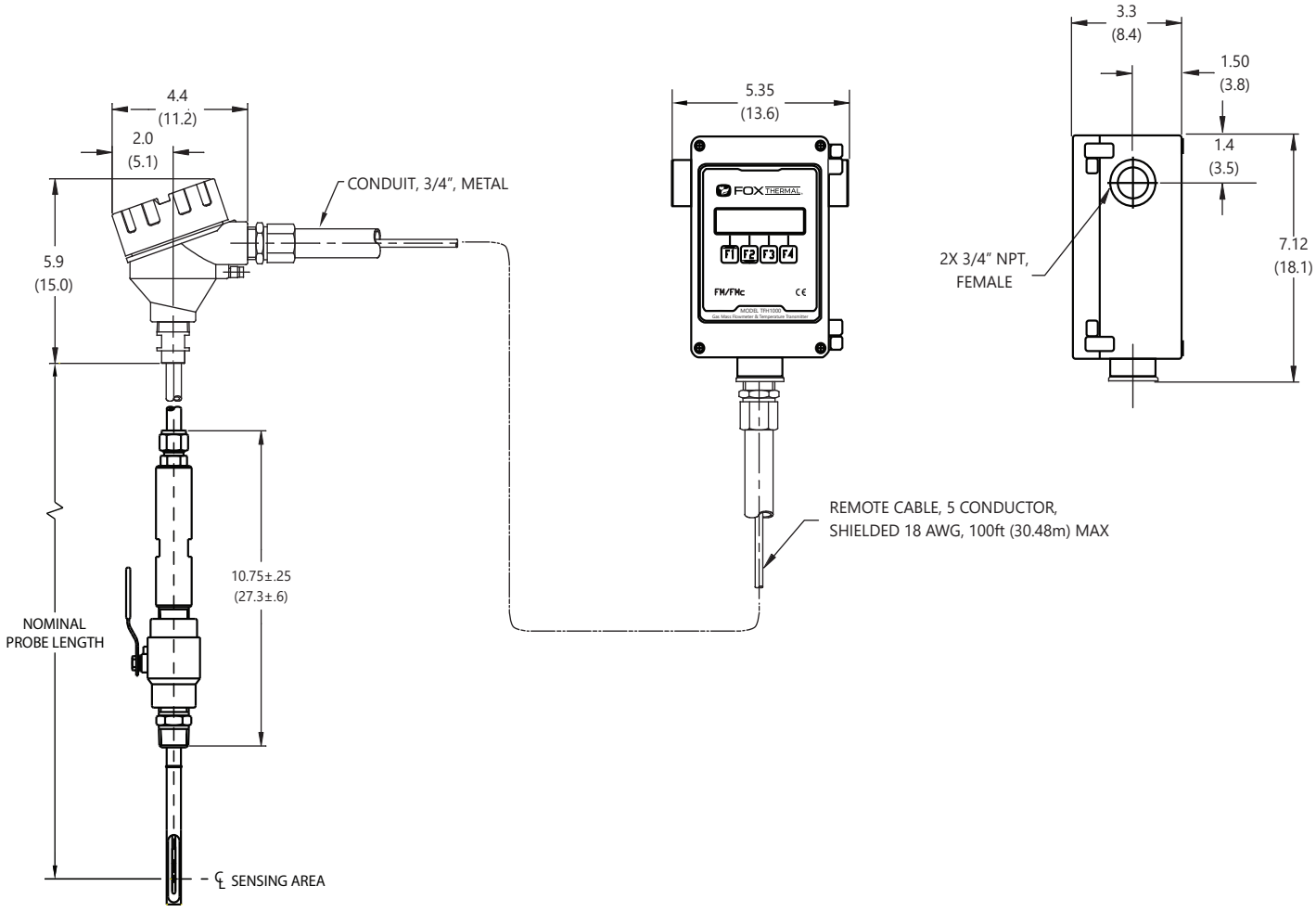


Table 7.4: Remote Insertion Meter with Retractor

Probe Size	Probe Size	Dimension "LL" ± .10
[model code]	[inches]	[inches / millimeters]
15R	15"	15.0" (381mm)
18R	18"	18.0" (457mm)
24R	24"	24.0" (609mm)
30R	30"	30.0" (762mm)
36R	36"	36.0 " (914mm)

Fig 7.5: Inline Meter with Flow Body and NPT End Connections Dimensions

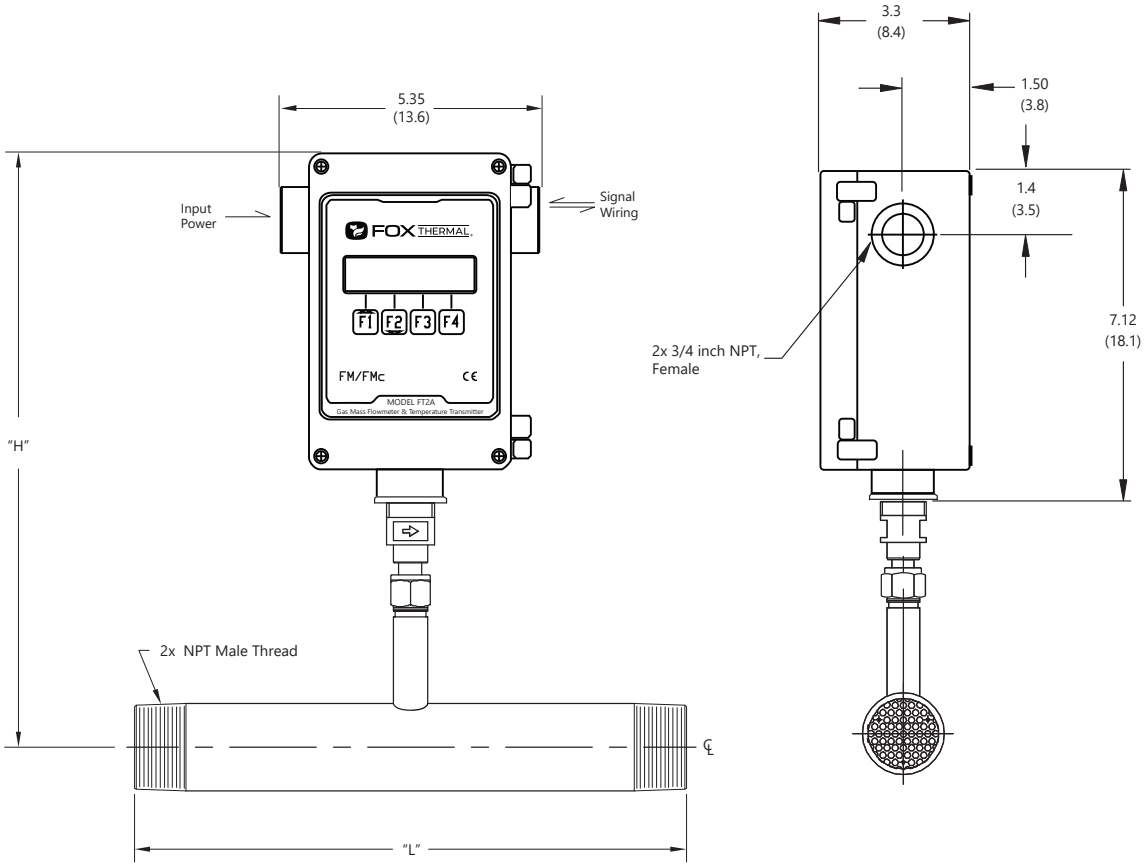


Table 7.5: Inline Meter with Flow Body and NPT End Connections

Body Size	Body Size	Dimension "L" ± .10	Dimension "HH" ± .10
[model code]	[inches]	[inches]	[inches / millimeters]
05P*	0.50"	12"	12.5" (318mm)
075P*	0.75"	12"	12.5" (318mm)
10P*	1.00"	12"	12.5" (318mm)
125P*	1.25"	12"	12.5" (318mm)
15P*	1.50"	12"	12.5" (318mm)
20P **	2.00"	12"	12.5" (318mm)
25P **	2.50"	18"	12.6" (320mm)
30P **	3.00"	18"	14.5" (368mm)

**Available in 316 stainless steel only.*
***Available in 316 stainless steel or A106 Grade B Carbon steel pipe.*

Fig. 7.6: Inline Remote Meter with Flow Body and NPT End Connections Dimensions

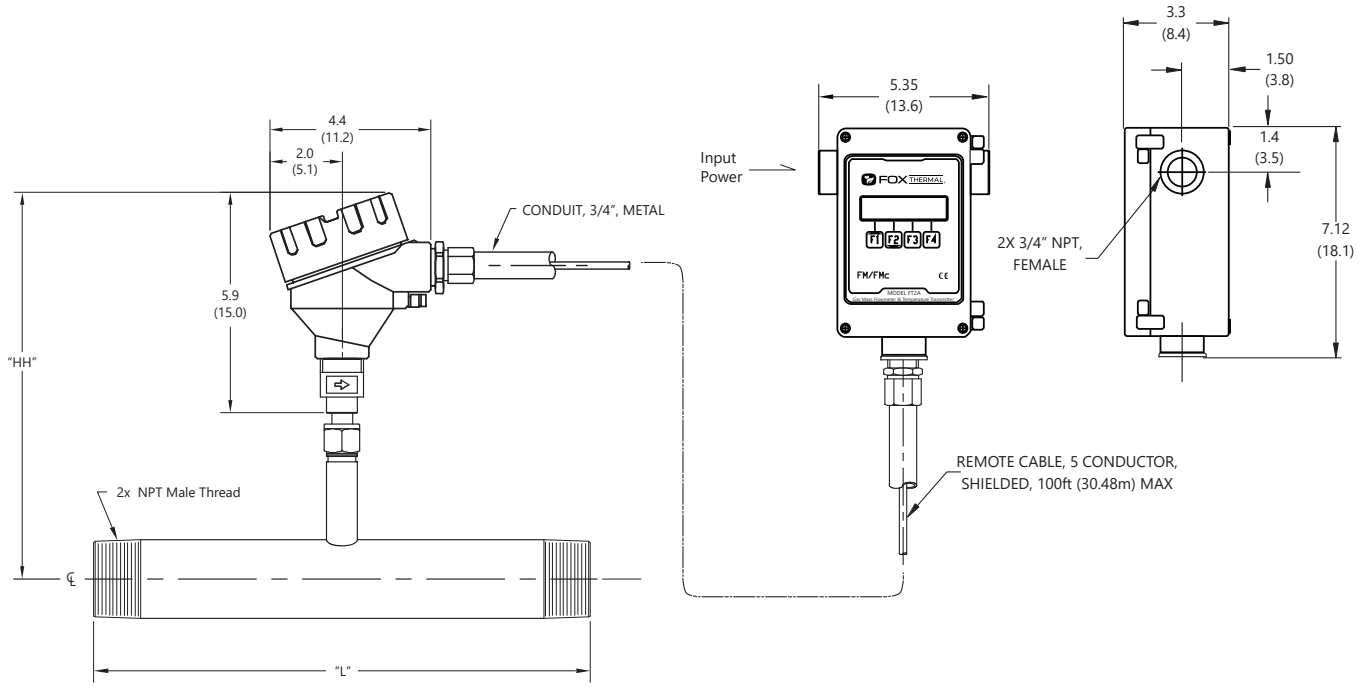


Table 7.6: Inline Remote Meter with Flow Body and NPT End Connections Dimensions

Body Size	Body Size	Dimension "L" ± .10	Dimension "H" ± .10
[model code]	[inches]	[inches]	[inches / millimeters]
05P*	0.50"	12"	9.9" (251mm)
075P*	0.75"	12"	9.9" (251mm)
10P*	1.00"	12"	9.9" (251mm)
125P*	1.25"	12"	9.9" (251mm)
15P*	1.50"	12"	9.9" (251mm)
20P **	2.00"	12"	9.9" (251mm)
25P **	2.50"	18"	10.0" (254mm)
30P **	3.00"	18"	11.9" (302mm)

**Available in 316 stainless steel only.*
***Available in 316 stainless steel or A106 Grade B Carbon steel pipe.*

Fig 7.7: Inline Meter with Flow Body and 150 lb. RF Flange End Connections Dimensions

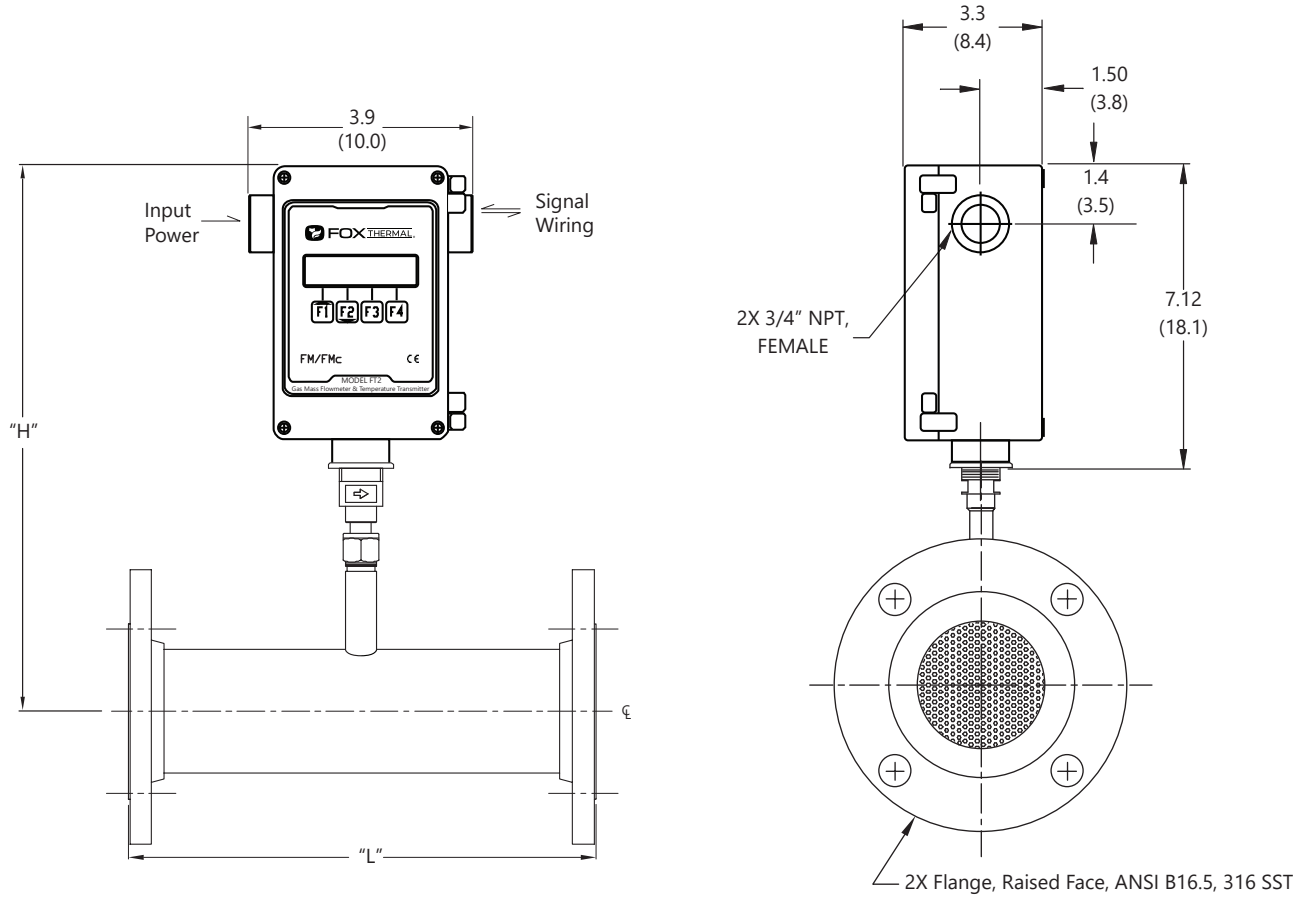


Table 7.7: Inline Meter with Flow Body and 150 lb. RF Flange End Connections Dimensions

Body Size [model code]	Body Size [inches]	Dimension "L" ± .10 [inches]	Dimension "H" ± .10 [inches / millimeters]
05F*	0.50"	12"	12.5" (318mm)
075F*	0.75"	12"	12.5" (318mm)
10F*	1.00"	12"	12.5" (318mm)
125F*	1.25"	12"	12.5" (318mm)
15F*	1.50"	12"	12.5" (318mm)
20F **	2.00"	12"	12.5" (318mm)
25F **	2.50"	18"	12.6" (320mm)
30F **	3.00"	18"	14.5" (368mm)
40F **	4.00"	18"	14.5" (368mm)
60F **	6.00"	24"	14.5" (368mm)

**Available in 316 stainless steel only.*
***Available in 316 stainless steel or A106 Grade B Carbon steel pipe.*

Fig. 7.8: Inline Remote Meter with Flow Body and 150 lb. RF Flange End Connections Dimensions

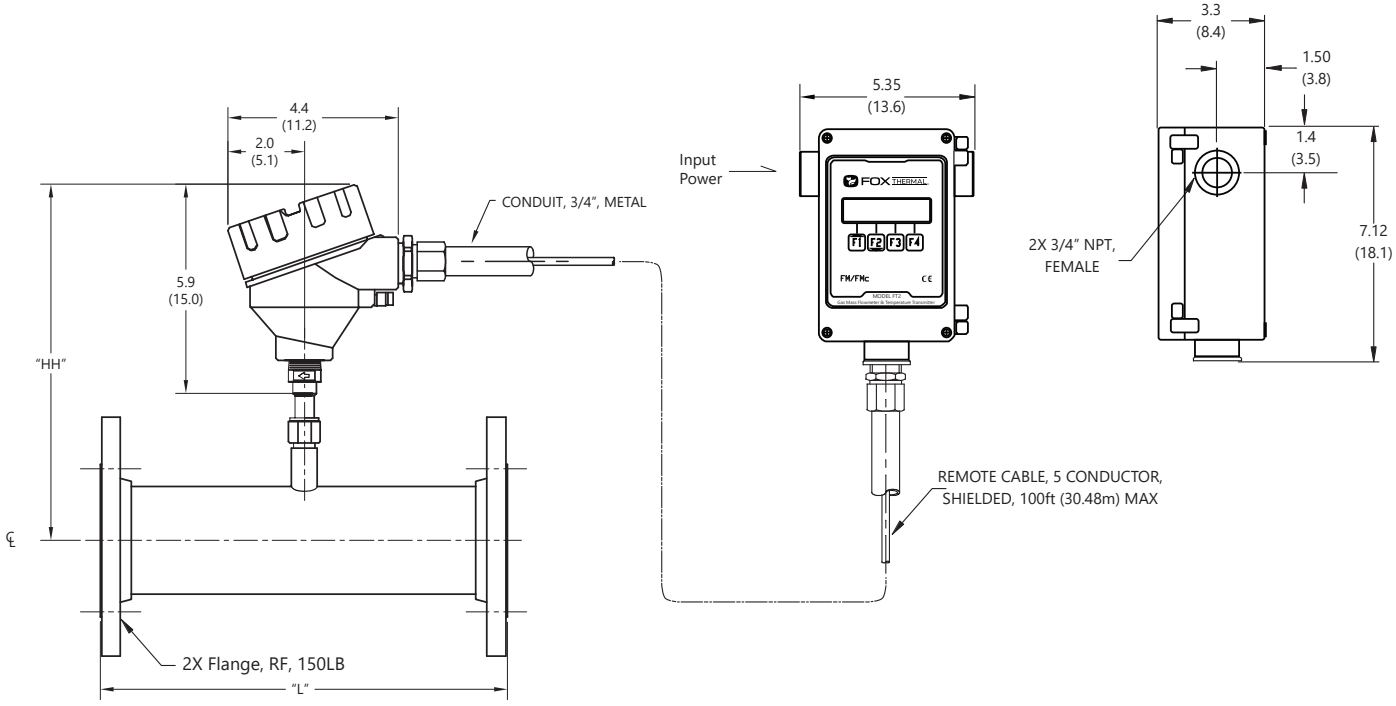


Table 7.8: Inline Remote Meter with Flow Body and 150 lb. RF Flange End Connections Dimensions

Body Size	Body Size	Dimension "L" ± .10	Dimension "H" ± .10
[model code]	[inches]	[inches]	[inches / millimeters]
05F*	0.50"	12"	9.9" (251mm)
075F*	0.75"	12"	9.9" (251mm)
10F*	1.00"	12"	9.9" (251mm)
125F*	1.25"	12"	9.9" (251mm)
15F*	1.50"	12"	9.9" (251mm)
20F **	2.00"	12"	9.9" (251mm)
25F **	2.25"	18"	10.0" (254mm)
30F **	3.00"	18"	11.9" (302mm)
40F **	3.00"	18"	11.9" (302mm)
60F **	3.00"	18"	11.9" (302mm)

**Available in 316 stainless steel only.*
***Available in 316 stainless steel or A106 Grade B Carbon steel pipe.*

Mounting the FT2A Enclosure
When restricted physical installation space exists, the FT2A enclosure can be mounted in a location away from the remote sensor. Use the dimensional diagram below to help mount the enclosure properly.

Fig. 7.9: Rear of FT2A Enclosure Showing Mounting Pattern

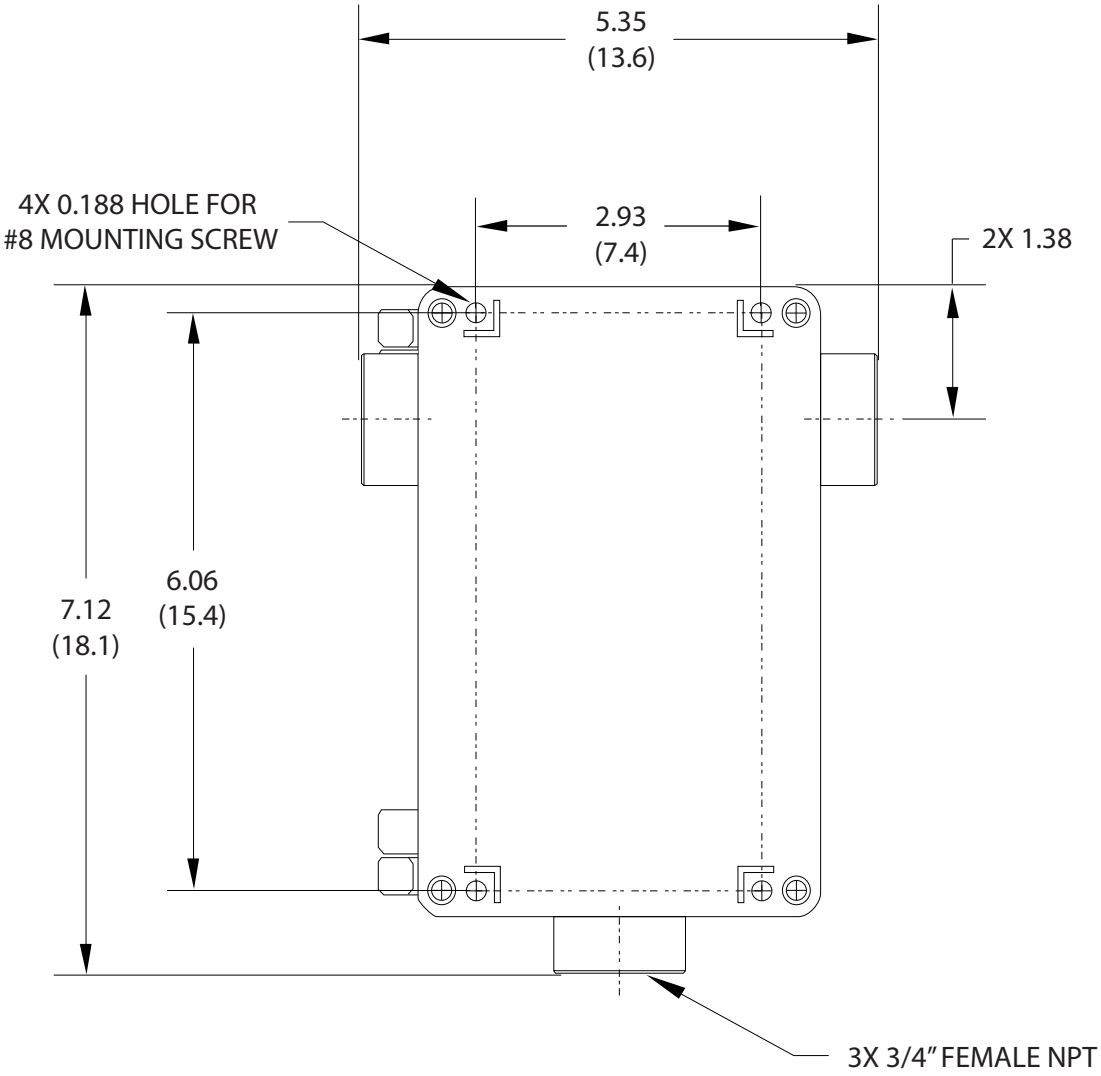
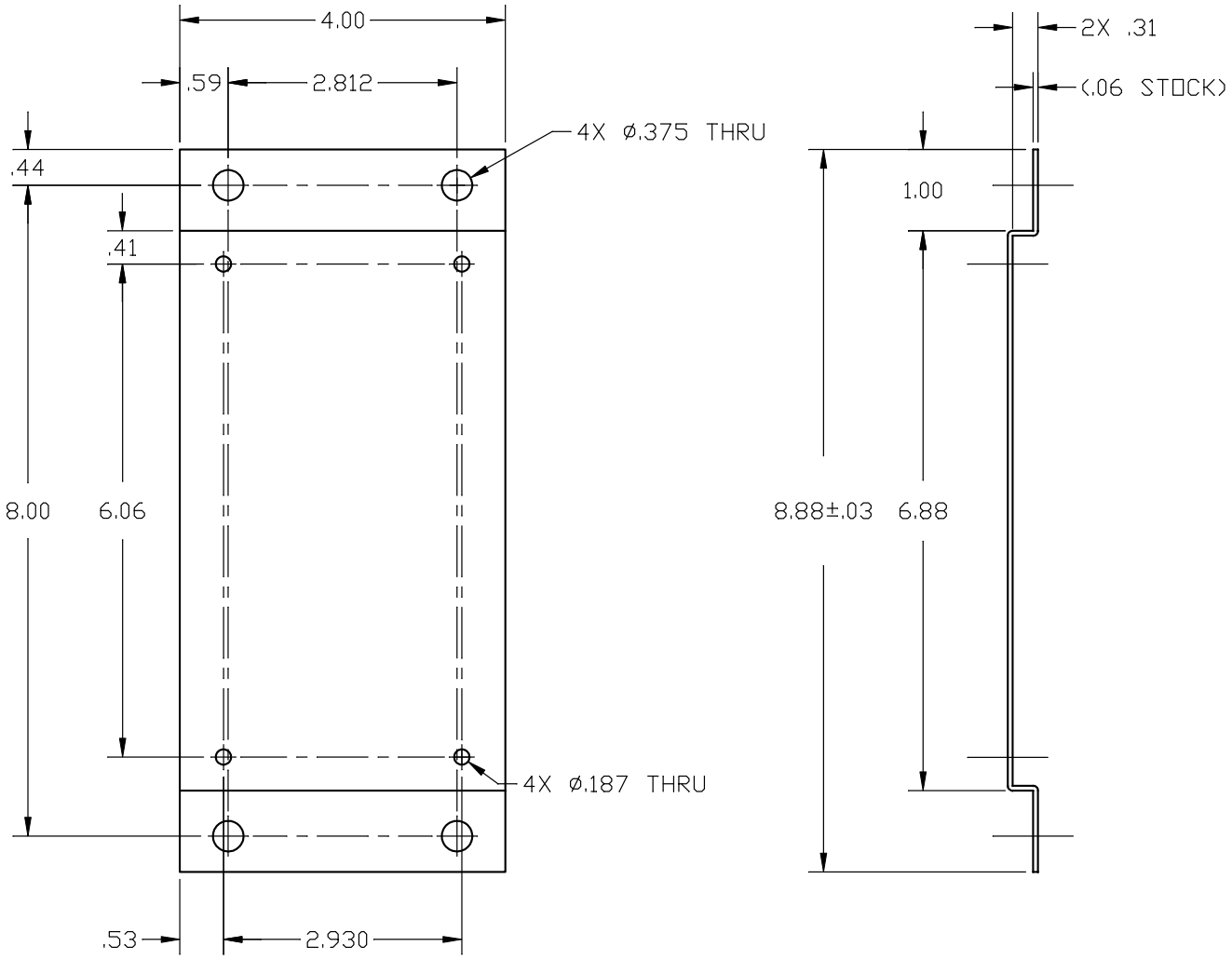


Figure 7.9 shows the rear view of the FT2A enclosure without sensor or conduit. AC power enters on one side, DC power and signals enter on either side.

Mounting Bracket for the Model FT2A

A Fox model FT2A Mounting Kit can be ordered at any time. The kit includes a mounting bracket with mounting screws and U-bolts. The bracket has been designed specifically to allow easy mounting of the FT2A to a surface. See Fig. 7.9 for dimensions.

Fig. 7.10: FT2A Mounting Bracket



Warranty Statement and Terms and Conditions

Limited Warranty - All Products

Fox Thermal warrants that for a period of one year following the date of original shipment of Fox's products that the product will conform to Fox's standard written specifications applicable to such product and will be free from defects in workmanship. For more details, view the Limited Warranty section in the Terms & Conditions of Sale. Find that document at this link:

https://www.foxthermal.com/pdf/terms-and-conditions.pdf

Consumable and Fragile Material Warranty

Fox warrants that consumable materials, supplied by Fox either as part of an instrument or system, or separately, will be free from defects in material and workmanship at the time of shipment. A list of key consumables and expected lifetimes may be found in the applicable Seller equipment operation and maintenance manual.

Terms and Conditions of Sale

For more details about Fox's warranty statement and exclusions, please download the Terms & Conditions of Sale document. Find that document at this link:

https://www.foxthermal.com/pdf/terms-and-conditions.pdf

Returning Your Meter
The Fox Thermal Customer Service Department
(PH: 831- 384-4300 can help you through the process of returning a meter for service.

If it becomes necessary to return a Fox Thermal flow meter for service or recalibration, please follow these steps:

1. A Return Material Authorization (RMA) Number must be obtained from the Fox Thermal Customer Service Department prior to returning any Fox Thermal meter(s).
2. Please have your meter's serial number(s) available.
3. Read and complete the Fox Thermal RMA Customer Information Form. Be sure to initial the decontamination statement as well as provide complete return shipping instructions (we cannot deliver to post office boxes).
4. The entire flow meter must be returned, including all electronics (unless specifically instructed to do otherwise). **ALL** serial numbers must match their corresponding meters. This is especially necessary when returning flow body models.
5. Clean and decontaminate all wetted parts before returning to Fox Thermal.
6. Ship the meter to the following address:

   Fox Thermal Instruments, Inc.
   399 Reservation Road
   Marina, CA 93933
   Attn: Service Dept.
   [RMA Number]

NOTE! Be sure to review all of the information on the Customer Information Form before sending your meter to the Fox Thermal Customer Service Department. The Fox Thermal Shipping/Receiving Department cannot accept meters that have not been prepared appropriately.

What to expect while your meter is being serviced
Depending on the type of service required when returning your Fox Thermal meter, there are varying turnover times for servicing a meter. The average time needed to service the meter is 7-10 days (not including shipping or peak production times).

If you have already shipped your meter to Fox Thermal for servicing and would like to check the status of your meter, please fill out our online Service Order Status form located at www.foxthermal.com and you will hear from a Customer Service Rep within 1 business day of your requested update.

Rush recalibration service is available for a fee. Restrictions apply.

Glossary of Terms and Definitions

AWG	American Wire Gauge
Bara	Bar absolute
CTC	Contact
CAL	Calibration
CHG	Change
COM	Communication
CSV	Current Sense Voltage
DC	Direct Current
DN	Down
DSP	Display
ELP	Elapsed time
Feq	Frequency
Ft^2	Square Feet
I/O	Input/Output
INP	Input
LB	Pound
LB/D	Pound per Day
LB/H	Pound per Hour
LB/M	Pound per Minute
LB/S	Pound per Second
LCD	Liquid Crystal Display
KG	Kilogram
KG/H	Kilogram per Hour
KG/M	Kilogram per Minute
KG/S	Kilogram per Second
M^2	Square Meter
mmHG	Pressure in millimeters of mercury
MMSCFD	Million Standard Cubic Feet per Day
MXFLO	Maximum Flow
NEMA	National Electrical Manufactures Association
NIST	National Institute of Standards and Technology
NL	Normal Liter
NLPH	Normal Liter per Hour
NLPM	Normal Liter per Minute
NM3	Normal cubic Meter
NM3/H	Normal cubic Meter per Hour
NM3/M	Normal cubic Meter per Minute
NPT	National Pipe Thread
PC	Personal Computer
P/U	Pulse per Unit
PIP A^2	Pipe Area
PLC	Programmable Logic Controller
PRM	Parameters
PRS	Pressure
PSIA	Pounds per Square Inch Absolute
Pt	Point
PSW	Password
SIM	Simulation
SCF	Standard Cubic Feet
SCFM	Standard Cubic Feet per Minute
SCFH	Standard Cubic Feet per Hour
SCFD	Standard Cubic Feet per Day
SPC	Special Control
STP	Standard Temperature and Pressure
TMP	Temperature
TSI	Internal Variable
TSV	Internal Variable
UNT	Unit
U/P	Unit per Pulse
420	4-20mA output

Index

Wiring

Definition of Terms

Troubleshooting Tips

NOTE! is used for Notes and Information

WARNING! is used to indicate a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION! is used to indicate a hazardous situation which, if not avoided, could result in minor or moderate injury.

Indicates compliance with the WEEE Directive. Please dispose of the product in accordance with local regulations and conventions.

Indicates compliance with the applicable European Union Directives for Safety and EMC (Electromagnetic Compatibility Directive).

IP67 **Enclosure Protection Classification per IEC 60529: Protected against the ingress of dust and Immersion.**

Make Downtime a Thing of the Past

THERMAL MASS FLOW METERS
NON-STOP PERFORMACNE

SALES@FOXTHERMAL.COM

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Marina, CA 93933 USA

Phone
831.384.4300

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