Fox Thermal Instruments, Inc.

THERMAL MASS FLOW METER & TEMPERATURE TRANSMITTER

Model FT2A
Notice

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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Fox FT2A Manuals:
• Fox FT2A Modbus / BACnet MS/TP Manual
• Fox FT2A Profibus, DeviceNet, Ethernet Manual
• Fox FT2A View™ Manual

All Fox Manuals and software available in English only.
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Thank you for purchasing the Model FT2A Thermal Gas Mass Flow Meter and Temperature Transmitter from Fox Thermal Instruments. 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 ∆ 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.
Introduction

Flow Calibration

**Flow Calibration**
The Fox Calibration Lab maintains instrument calibration records on every flow meter. This data can also be accessed via a computer using FT2A View™ software within the instrument. 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.

I/O Description

**I/O Description**
The FT2A features two galvanically isolated 4 to 20mA analog outputs, one isolated digital output, one discrete input and a USB port for communication with a computer.

The first 4 to 20mA output is for flow rate. The second 4 to 20mA output can be configured either for flow rate or process gas temperature. Both 4 to 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 RS485 Modbus, BACnet MS/TP, 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.
Introduction

Display

**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 to 20mA scaling, frequency output scaling, pipe area, zero flow cutoff, flow filtering or damping, display configurations, diagnostics and alarm limits.

*Fig. 1.1: FT2A Function Diagram*
Installation - Model FT2A Flow Meter

Scope

This section describes how to install the Fox Model FT2A Flow Meter and how to get started. Installation methods will vary according to the flow meter type (insertion or inline).

For Insertion Types:
1. Determine lateral position on the pipe
2. Sensor installation depth
3. Sensor orientation in relation to sensor length and direction of flow
4. Proper tightening of compression fitting for mounting meter

For Inline Types:
1. Determine lateral position on the pipe
2. Flow body orientation in relation to direction of flow in pipe
3. Proper tightening of compression fitting

Installation procedures must be performed using a combination of the end user’s best engineering practices, in compliance with local codes, and 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. The enclosure covers must be closed except during installation.
3. 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.
4. Ensure the flow direction arrow points in the direction of flow.
5. Do not install the FT2A enclosure near an igniter, igniter-controller or switching equipment.
6. Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
7. Ensure that good engineering practices and applicable industry codes are followed throughout the installation process.
8. For accurate flow measurement: review flow meter placement instructions before installation to ensure a proper flow profile in the pipe.
Installation: Insertion Type

Instructions for Insertion Flow Meter Lateral Placement
Install the Model FT2A Insertion style 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. Fifteen diameters of straight pipe upstream and ten downstream are recommended.

For example, a 2” pipe would require 30” upstream and 20” downstream, but a 4” pipe would require 60” upstream and 40” downstream.

Note: The probe diameter is 1/2”.

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

Special Conditions of Use:
- Consult the manufacturer if dimensional information on the flameproof joints is necessary.
- Follow the manufacturer’s instructions to reduce the potential of an electrostatic charging hazard.
Installation: Insertion Type

Installation Depth

The installation depth of the sensor in the pipe is dependent on the pipe size. To get the most accurate reading, proper placement of the sensor window within the pipe is necessary. As shown in Fig 2.2, the end of the sensor window should be 0.87" past the center line of the pipe.

Fig. 2.2: Cross Section of Insertion Sensor Depth in Pipe
Installation: Insertion Type

Sensor Orientation -  

Fig. 2.3: Orientation of Insertion Type Flow Meter

Direction of Flow

Note: Some flow meters are shipped with the sensor elements that are offset (see figure 2.4). Others are shipped with sensors that have equal length elements (see figure 2.5). The sensor type supplied was selected at the factory to be the best suited for your application. Follow the appropriate sensor orientation instructions.

Unequal Length Sensor Elements
Install the shorter sensor element upstream from the longer one.

Fig. 2.4: Unequal Length Sensor Elements
Sensor Orientation
- Equal Length Sensors

**Equal Length Sensor Elements**
Install flow meter with *both sensor elements* facing the flow stream within ±10°.

![Fig. 2.5: Equal Length Sensor Elements](image)

**Insertion Mounting Instructions - Compression Fittings**
The Model FT2A is mounted through a ¾" hole and a ¾" female NPT half coupling provided 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-inch female NPT half coupling.
- When installing in a 2" pipe or larger, install the end of the probe 0.87" past the center line of the pipe and tighten the compression fitting nut (refer to figure 2.2 on p. 9).
- When installing into a 1½" pipe carefully install the probe into the pipe until it touches the opposite wall and pull back 0.1". Tighten the compression fitting nut.
- While holding the fitting body steady, tighten the nut one and one-quarter turn to the 9 o'clock position. See Figure 2.6.

**Caution:** Once the compression fitting is locked onto the probe, the probe can be removed or rotated, but the insertion depth is locked in place.

**Note:** Do not overtighten compression fitting.

![Fig. 2.6: Proper Tightening of the Compression Fitting Nut](image)
Instructions for Inline Flow Meter Placement

Install the Model FT2A Inline style 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. Eight diameters of straight pipe upstream and four downstream are recommended (for ¼" meters: 6" (152 mm) of straight, unobstructed pipe upstream and downstream are required).

For example, a 2" pipe would require 16" upstream from the edge of the flow body and 8" downstream from the other end of the flow body, whereas a 4" pipe would require 32" upstream and 16" downstream.

The Model FT2A is welded, threaded or flanged to the customer’s pipe. Care should be taken to ensure that the diameter of the mating pipe is the same diameter as the Model FT2A flow body or errors in flow readings can occur. The installation procedure should be a combination of the end user’s best engineering practices, in compliance with local codes, and the manufacturer’s recommendations.

See Figure 2.7 for a detailed look at upstream and downstream pipe diameters for inline meters.

Fig. 2.7: Upstream and Downstream Pipe IDs for Inline Meters
Installation: Inline Type

Flow Body
Orientation - Inline Type

**Inline Orientation**
Install the flow body so that the engraved arrow on the fitting and the arrow on the flow body are pointing with the direction of flow.

*Fig. 2.8: Orientation of an Inline Meter - Directional Arrows*

Mounting - Inline Type

**Tightening Compression Fittings**
The compression fitting has been placed according to the proper depth in the flow body by Fox factory technicians. After the flow body has been correctly fitted to the process pipe, the compression fitting may need to be tightened correctly (see figure 2.6 on p. 11).

*Note:* Do not overtighten compression fitting.
Wiring: General

Scope

Wiring Instructions
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.

Precautions

Wiring Precautions
• WARNING - DO NOT OPEN THE ENCLOSURE WHEN ENERGIZED OR AN EXPLOSIVE ATMOSPHERE IS PRESENT.
• 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.
• 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 steel material 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 entries using suitably 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

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

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

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. AC power wires must enter left-hand conduit entry.

Serial Communication Wiring

If you have purchased communications options, please refer to one of the following appropriate Fox Instructions Manuals:
- Fox FT2A Modbus / BACnet MS/TP Manual
- Fox FT2A Profibus, DeviceNet, Ethernet Manual

Remote Sensor Wiring

Note: Remote wiring is only required when the Remote Electronics option is provided.

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.

Fig. 3.1: FT2A Wiring

3 X 3/4 \" NPT,
Female
AC or DC Input Power

Signal Wiring, DC Power

Remote Cable, 5 Conductor, Shielded, 100ft (30.48m) Max.
(Remote Electronics Enclosure option only)
**Wiring: General**

**FT2A Internal Components**

*Fig. 3.2: Internal Components for Wiring the FT2A*

Main Board Electronics

Inside Display/Cover

**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.

- Keep power and signal wires within the area of the metal shields.
- Keep power and signal wires out of the unshielded area.
Wiring: Input Power

Power Input Wiring

**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.

*Fig. 3.3: Connections for 24VDC Supply*

**Caution:**
- Supply connection wiring must be rated for at least 90°C.
Wiring: Input Power

Power Input Wiring

**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*

![Diagram of AC Power Connections]

**Caution:**
- Supply connection wiring must be rated for at least 90°C.
**Wiring: Signal Wiring**

4 to 20mA Loop Power Provided by Customer (Recommended)

---

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

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

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

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**Important Note**

The load resistor on the Fox Flow Meter 4 to 20mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4 to 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 to 20mA signal.**
Wiring: Signal Wiring

4 to 20mA
Loop Power
Provided by FT2A

4 to 20mA Output Wiring: Loop Power Provided by FT2A
Bring the 4 to 20mA wiring in through the right-hand conduit hub. Connect the 4 to 20mA wiring to terminal blocks TS1 and TS2 as shown in the diagram below.

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

Important Note:
The load resistor on the Fox Flow Meter 4 to 20mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4 to 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 to 20mA signal.
Wiring: Frequency/Alarm Wiring

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 10mA 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. 3.7: Frequency/Alarm Output Isolated (Recommended)
Wiring: Frequency/Alarm Wiring

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.
Wiring: Remote Switch

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. 3.9: Remote Switch Wiring
Wiring: Remote Sensor Option

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. 25).

Fig. 3.10: Remote Wiring

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
Wiring: Remote Sensor Option

Remote Wiring

*Fig. 3.11: Remote Sensor Wiring*

Remote Sensor

Cable Wiring

*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

<table>
<thead>
<tr>
<th>Electronics Enclosure Terminal Numbers</th>
<th>Extension Cable Wire Color</th>
<th>Remote Enclosure Terminal Numbers</th>
<th>Sensor Wire Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
<td>1</td>
<td>Red</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
<td>2</td>
<td>Red</td>
</tr>
<tr>
<td>3</td>
<td>Brown</td>
<td>3</td>
<td>Yellow</td>
</tr>
<tr>
<td>No Connection</td>
<td>Shield</td>
<td>4</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>White</td>
<td>5</td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>Green</td>
<td>6</td>
<td>White</td>
</tr>
</tbody>
</table>
Operation: Start Up

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 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. A serial communication manual is available for users who want to create their own PC application.

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

Note: Fox also offers FT2A View™, a Windows-based PC program, that can be used to program the meter.

Fig. 4.1: FT2A Display and Configuration Panel
Operation: Display Screens

**Local Display Screens**

**Measurement Mode**

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. 36). 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 Engineering Menu screens (display 10 through 26). Keys F1 and F2 are used to scroll through the different screens and key F4 is used to exit to Display #1. Pressing the F3 and F4 keys at the same time enters the Reset Total screen (see p. 46).

**Fig. 4.2: FT2A Display Screen Navigation**

- Display #1
  - 1456.5 SCFM
  - 123456 SCF

- Display #2
  - ELP = 14.6 HR
  - 88.5˚ F

- Display #3
  - Alarm = None
  - ELP = 14.6 HR

- Display #4
  - Set Parameter?
    - No
    - Yes

F1 key: Moves up one screen
F2 key: Moves down one screen

Enter “totalizer reset screen” when F3 & F4 are pressed at the same time
(User programmable screen)

Alarm = None
ELP = 14.6 HR
(Fixed screen)

Enter programming screen requires password.
Default is 1234.
Operation: Engineering Displays

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
Operation: Programming

Programming Using the Local Display

Data Entry using the local display module
There are 2 basic types of menu entries: one for changing value or string and one for selecting from a selection list.

Value or String

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.

Selecting from a List

To Select from a List:

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

Enter Programming Mode

Entering the Programming Mode

To enter the programming mode, press the **F1** or **F2** key repeatedly in the normal running mode until the following screen is shown:

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

Programming Using the Local Display

Enter the correct password, then follow the instructions for changing a value as specified on page p. 29. 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 base programming screen will be shown:

Analog 4 to 20mA Output

The following menu allows the scaling of the analog 4 to 20mA outputs.

From the base screen, press I/O (F1) and then in the next screen press 420 (F3).

The display will show the 4 to 20mA output menu:

Select CH1 (F1) to program channel 1.
Operation: Programming

Programming Using the Local Display

Enter the value for the 20mA and press OK (F4) key to accept the setting.

Then the following screen will display:

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

Note: 4mA is normally set to 0.

This menu allows the user to select an alarm level on the 4 to 20mA when a serious issue is detected that is preventing the calculation of a correct flow value.

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

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.

Select CH2 (F2) to program channel 2.
Operation: Programming

Programming Using the Local Display

Channel 2 is programmable for flow (CH2=Flow) or temperature (CH2=Temp).

Press **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 setting.

Then the following screen will show:

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

Press **EXIT (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)**.

Press **OUT (F2)** to select output.
Operation: Programming

Programming Using the Local Display

The following screen may show:

<table>
<thead>
<tr>
<th>OUT = Frequency</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXT</td>
<td></td>
</tr>
</tbody>
</table>

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.

FREQUENCY OUTPUT

<table>
<thead>
<tr>
<th>P/U</th>
<th>U/P</th>
<th>FEQ</th>
<th>EXIT</th>
</tr>
</thead>
</table>

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 frequency 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:

<table>
<thead>
<tr>
<th>PLS/UNT = 1.2</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHG</td>
<td></td>
</tr>
</tbody>
</table>

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., 10 pulses per SCF).
Operation: Programming

Programming Using the Local Display

Unit per Pulse

**Entering data in Unit per Pulse:**
From the Frequency Output Menu on p. 33, press U/P (F2) and the following screen will show:

![Unit per Pulse Screen](unt pls = 0.01 chg ok)

Press CHG (F1) to change the setting and then OK (F4) to accept entry. The value entered is in unit per pulse (i.e., 0.01 flow unit total per pulse).

Max Flow and Frequency

**Entering data with flow and maximum frequency:**
From the Frequency Output Menu on p. 33, press FEQ (F3) and the following screen will show:

![Max Flow and Frequency Screen](max freq = 98.5 Hz chg ok)

Enter the maximum frequency and press OK (F4).

(Maximum frequency should not exceed 100 Hz)

The next screen will show:

![Max Flow and Frequency Screen](max flow = 4999.8 scfm chg ok)

Note: When the flow rate exceeds the maximum frequency set point, the output will stay at that maximum frequency but the FT2A will issue an alarm code.

Caution: Equation to ensure pulse rate must not exceed 100 Hz.

Alarm Output

**Alarm Output**
To program the Alarm output, press I/O (F1) key from the "SET PARAMETERS" menu screen, then select I/O (F2) and the screen will show:
Operation: Programming

Programming Using the Local Display

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

```
OUT = HiFloAlm
NXT OK
```

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

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

**Frequency**

```
HiFloAlm=500 SCFM
CHG OK
```

Enter the value for the limit by pressing **CHG (F1)** and then **OK (F4)**.

Note: There is only one output to operate as a frequency 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:

```
INP = Not Used
NXT OK
```

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

Programming Using the Local Display

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

Reset the totalizer
Switch between calibration curve 1 and curve 2 (only if 2 gas curve ordered)

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

Serial Communication

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

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 Communication Manual for specific programming information: FT2A Modbus & BACnet MS/TP manual or FT2A Profibus, DeviceNet & Ethernet Manual.

Display Setup

Display Setup
Remember, there are four display screens that you can cycle through in normal operating mode (see Figure 4.2 on p. 27). Two of the four display screens are fixed and cannot be changed (displays #3 & 4). The other two screens
Operation: Programming

Programming Using the Local Display

are programmable to show the information that you prefer and is discussed in this section.

Display #1

DSP1L1
DSP1L2

F1  F2  F3  F4

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 base programming menu press DSP (F3) to select the display menu:

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

DSP1L1 = Total
NXT  OK

These are the selections for the display #1 line #1.

Selections are:

Flo rate  Flow rate
Total  Total mass
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).
Operation: Programming

Programming Using the Local Display

After the last line of display 2 is accepted, the display will show the following menu:

- F1
- F2
- F3
- F4

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 factors and should normally never be changed unless advised by the Fox service department, or to set a new password in the event that the user forgets the Level 1 password.

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”.

From the base programming menu press DSP (F3) to select the display menu:

To Program the Password:

- Display/Password
- DSP
- PSW
- EXIT

Press PSW (F3) key to select password.
**Operation: Programming**

**Programming Using the Local Display**

This screen displays the current Level 1 password. Press CHG (F1) key to change the password and enter new value (see p. 29 for further details).

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**

This menu is used to set the units for mass flow, temperature, pressure reference and the settings of reference temperature, reference pressure and density of gas when using Lbs/time or Kg/time.

These values will be set at Fox, using the Application Data Sheet values. If the customer changes the application, these values can be changed to match the new application. Check with Fox customer service before changing the application gas.

The unit setting is accessed from the base programming menu.

Press FLO (F2):

Press UNT (F2) for Unit selection.
Operation: Programming

Programming Using the Local Display

The screen will show:

<table>
<thead>
<tr>
<th>FLO = SCFM</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXT</td>
<td></td>
</tr>
</tbody>
</table>

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.

Maximum Total Rollover Value:

- Most flow units: 99,999,999,999
- MSCFD: 999,999,999
- MMSCFM: 9,999,999
- MMSCFD: 999,999

Selections for flow units are:

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

**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.

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

Programming Using the Local Display

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

Selections for Temperature units are:
- Deg C
- Deg F

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.

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

Press **NXT (F1)** to select next entry and **OK (F4)** to accept.

Selections are:
- mmHG Millimeters of mercury
- Psia Pounds per square inch atmosphere
- bara Bar atmosphere

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

Programming Using the Local Display

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

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

DNS = 0.988876 KG/m³

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

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

Density conditions are referenced to 0 °C at 760 mmHg.

Flow Parameters

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.

The menu is accessed from the base programming menu by pressing FLO (F2):

FLOW PARAMETER 1
DGN UNT PRM EXIT

Then press PRM (F3):

FLOW PARAMETER 2
CAL SPC PRM EXIT

Note: The CAL and SPC function keys will only appear and be accessible from a Level 2 password.
Operation: Programming

Programming Using the Local Display

Flow Cutoff

Then press PRM (F3). The first parameter is Flow Cutoff:

CUTOFF = 2.0 SCFM
CHG OK
F1 F2 F3 F4

Enter the value for the percent low flow cutoff and then press OK (F4).

When the flow rate falls below the zero flow cutoff, the flow meter will display a flow value of zero.

Pipe Area

To set the Pipe Area:

A^2 = 0.05672 Ft^2
CHG OK
F1 F2 F3 F4

Enter the pipe area in square meters or square feet and then press OK (F4). Use square meters for metric flow unit selections and square feet for English flow unit selections.

Filter Value

The Filter Value is also referred to as a 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.

Enter the filter value and then press OK (F4).
Operation: Programming

Programming Using the Local Display

<table>
<thead>
<tr>
<th>Filter</th>
<th>Response (Sec.) 65% of Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td>0.8</td>
<td>0.15</td>
</tr>
<tr>
<td>0.7</td>
<td>0.20</td>
</tr>
<tr>
<td>0.6</td>
<td>0.25</td>
</tr>
<tr>
<td>0.5</td>
<td>0.30</td>
</tr>
<tr>
<td>0.4</td>
<td>0.35</td>
</tr>
<tr>
<td>0.3</td>
<td>0.40</td>
</tr>
<tr>
<td>0.2</td>
<td>0.60</td>
</tr>
<tr>
<td>0.1</td>
<td>1.00</td>
</tr>
<tr>
<td>0.05</td>
<td>2.00</td>
</tr>
<tr>
<td>0.03</td>
<td>3.00</td>
</tr>
<tr>
<td>0.01</td>
<td>10.3</td>
</tr>
</tbody>
</table>

High Flow Rate Alarm

To set the parameters for a High Flow Rate Alarm:

```
HiFloAlm = 1234 SCFM
CHG                      OK
```

This is the upper flow limit alarm value that can be associated with a discrete output. An alarm code is generated when the flow value exceeds this limit. If no checking is needed, this value should be set to zero.

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

Low Flow Rate Alarm

To set the parameters for a Low Flow Rate Alarm:

```
LoFloAlm = 100 SCFM
CHG                      OK
```

This is the lower flow limit alarm value that can be associated with a discrete output. An alarm code is generated when the flow value is below this limit. If no checking is needed, this value should be set to zero.

Press **OK (F4)** to accept the value.
Operation: Programming

Programming Using the Local Display

High Temp Alarm

To set the parameters for a **High Temperature Alarm**:

```
F1 F2 F3 F4
HiTmpAlm = 230 C
CHG OK
```

This is the upper temperature limit alarm value that can be associated with a discrete output. An alarm code is generated when the temperature value exceeds this limit. If no checking is needed, this value should be set to zero. Press **OK (F4)** to accept the value.

Low Temp Alarm

To set the parameters for a **Low Temperature Alarm**:

```
F1 F2 F3 F4
LoTmpAlm = 50 C
CHG OK
```

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

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

Note: If the programming menu was entered with a **Level 2** password, then more menus will be shown concerning factory-set parameters that should not be changed.

Calibration Parameters

This menu allows 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 normally never be changed except by Fox Thermal Instrument personnel at the factory.**

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

Programming Using the Local Display

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

```
CAL TABLE
TB1 - - - - -
```

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

```
Volt1 = 0.92367
```

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

```
Flo1 = 0
```

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 Flow Total

**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).
Operation: Programming

Programming Using the Local Display

Press **YES (F4)** to reset total and **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 the following values:

- Most flow units: 9,999,999,999
- 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:

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".
Operation: Programming

Programming Using the Local Display

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 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 the 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 to 20mA and/or the pulse outputs are connected to controllers, set the controllers to “manual”. This will ensure that the simulated signals do not cause false controller action.

The menu is accessible from the main programming menu by pressing FLO, and DGN (F1):

Pressing DGN (F1) will show:

Pressing SIM (F1) will show:
Operation: Programming

Programming Using the Local Display

**FloSim = 0 SCFM**

<table>
<thead>
<tr>
<th>CHG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
</tr>
</tbody>
</table>

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

Note: Enter zero to disable this feature.

**TmpSim = 0 C**

<table>
<thead>
<tr>
<th>CHG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
</tr>
</tbody>
</table>

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

Note: Enter zero to disable this feature.

**CsvSim = 0 V**

<table>
<thead>
<tr>
<th>CHG</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
</tr>
</tbody>
</table>

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

Note: This value is used to simulate the Current Sense Voltage (CSV) and should be set to zero for normal mode.

**ENABLE SIM?**

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
</tr>
</tbody>
</table>

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 menu.

Note: Simulation Mode will be cleared if the power is cycled.
Operation: Menu Tree

Main Menu

Enter menu by scrolling to display 4 and entering the password

SET PARAMETERS
I/O FLO DSP EXIT

Display Menu, p. 54
Flow Parameters 1 Menu, p. 52

SET I/O
COM I/O 420 EXIT

SET I/O
INP OUT EXIT

Referring to appropriate Serial Communication Manual

Comm=Modbus
NXT OK

INP= Not used
NXT OK

Select either flow or temperature for channel 2

Level 2

CH2=Temp
NXT OK

Choose either Level 2

Level 2

CHG

mA Fault=Not use
NXT OK

mA Fault=Not use
NXT OK

mA Fault=Not use
NXT OK

mA Fault=Not use
NXT OK

mA Fault=Not use
NXT OK

mA Fault=Not use
NXT OK
Operation: Menu Tree

Digital Output

Fig. 4.5: FT2A Menu Tree - Digital Output

Select 1 of 3 methods to scale the frequency output
Operation: Menu Tree

Parameter Menu 1

FLOW PARAMETER 1
DGN UNT PRM EXIT

FLO UNT=SCFM
NXT OK

DIAGNOSTIC
SIM EXIT

Simulate Flow?
YES NO
FloSim=0 SCFM
CHG OK

Simulate Temp?
YES NO
TmpSim=0 °F
CHG OK

Simulate CSV?
YES NO
CsvSim=0 V
CHG OK

ENABLE SIM?
YES NO

Note: simulation value needs to be greater than zero to be taken (i.e. 0.0001 for a value close to zero)

STP

TMP UNT=° F
NXT OK

TmpRef= 0 °F
CHG OK

PRES UNT=mmHG
NXT OK

PresRef=760
CHG OK

Flow Parameter 2 Menu, p. 53

Flow Parameter 2 Menu, p. 53

FLO UNT=SCFM
NXT OK

SCF
SCFH
NM3/H
NM3/M
KG/H
KG/M
KG/S
LBS/H
LBS/M
LBS/S
NLPH
NLPM
SMPS
NMPS
SFFP
SMSCFD
LBS/D
SLPM
NLPS
MSCFD
SM3/H
MT/H
NM3/D
MMSCFM
MCFD
SCFD
SM3/M
SM3/D

Deg F
Deg C

mmHG
Psia
bara

Model FT2A

Fig. 4.6: FT2A Menu Tree - Parameter Menu 1
Operation: Menu Tree

Parameter Menu 2

Fig. 4.7: FT2A Menu Tree - Parameter Menu 2

FLOW PARAMETER 2
CAL SPC PRM EXIT

- Volt1 = 0.2479
  CHG PRV NXT EXIT

- Flo1 = 0.0
  CHG PRV NXT EXIT

- Volt20 = 1.2479
  CHG PRV NXT EXIT

- Flo20 = 7046.5
  CHG PRV NXT EXIT

K fact = 0%
CHG OK

RESTORE DATABASE?
YES NO

RESET CRC?
YES NO

Cutoff=12.5 SCFM
CHG OK

Parameters
- Flow cutoff in selected units
- Pipe Area in m² or ft²
- Flow Exponential Filter
- High Flow Alarm in selected units
- Low Flow Alarm in selected units
- High Temperature Alarm in selected units
- Low Temperature Alarm in selected units
Operation: Menu Tree

Display Menu

Fig. 4.8: 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 = High/Low Flow Rate or Temperature Alarm
### Operation: Menu Tree

#### Engineering Display

**Display 10:**
- Flow in selected units: 3124.6 SCFM
- Sensor voltage in volts: Csv = 0.3432 Volt
- Sensor average volts: CsvAv = 366809
- Velocity in selected units: Vel = 112345.7 FT/M

**Display 11:**
- Sensor filtered average in volts: FloFlt = 3666805.3
- Velocity in meters/hour: Vel = 2356.45 M/H

**Display 12:**
- TSI average count: TsiAvr = 512.5 cnt
- TSV average count: TsvAvr = 323.7 cnt
- TSI in volts: Tsi = 2.1345 Volt
- TSV in volts: Tsv = 0.9856 Volt

**Display 13:**
- TSI current in amps: Tsi = 0.0435 Amp
- TSI resistance in ohms: Tsi = 221.5 Ohm

**Display 14:**
- RTD9 count: RTD9 = 345.5 cnt
- Gas Temperature in degrees C: Gas Temp = 123.7 °C

**Display 15:**
- CH1 4-20ma current loop count: CH1_420 = 2167 cnt
- CH2 4-20 ma current loop count: CH2_420 = 1234 cnt

**Display 16:**
- Frequency output count: Feq = 1234.5 cnt
- Alarm codes: Alarm = 33,35

**Display 17:**
- High flow limit alarm: FloHi = 1234 SCFM
- Low flow limit alarm: FloLo = 0 SCFM
- High temperature limit alarm: TmpHi = 300 °C
- Low temperature limit alarm: TmpLo = 10 °C
- Elapsed time in hours: Elp = 12.5 HR
- Status in hexadecimal: Stat(hex) = 2800
- FT2A main board firmware revision: FT2A V3.02d

**Display 18:**
- Power cycle count: Pwr_Cycl = 24
- Error with totalizer count: Err_tot = 0

**Display 20:**
- TSI resistance in ohms: Tsi = 221.5 Ohm
- RTD9 resistance in ohms: RTD9 = 10.3 Ohm

**Display 21:**
- Bridge shutdown detection count: BrShDtCnt = 0 cnt

**Display 22:**
- F3 & F4 pressed at the same time will initiate a "Total" reset

---

**Fig. 4.10: FT2A Menu Tree - Engineering Display**

Enter: Press F1 & F2 at the same time
Press F4 to return to normal mode
Maintenance: Precautions

**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.

¡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 ESTÉ 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.
Maintenance: Precautions

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 ETÉ 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.

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

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

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

ACHTUNG! EINGANGSLEISTUNG AUSSCHALTEN, BEVOR LEITERPLATTEBAUGRUPPEN 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 ZUGREIFEN. 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.
Maintenance: General

**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 p. 86.

**Flow Calibration and Calibration Validation**
To ensure continued high accuracy of your Model FT2A Flow Meter, Fox Thermal Instruments Inc. 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.
### Troubleshooting: General

**Caution!** The electronics, sensor and sensor interconnect wires supplied by Fox are calibrated as a single precision mass flow meter. Interchanging sensors or sensor wiring will affect the accuracy of the flow meter. If you experience any problem with your Model FT2A Flow meter, call Fox Customer Service Department, Technical Assistance at (831) 384-4300.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Error</td>
<td>Display not operating properly.</td>
<td>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.</td>
</tr>
<tr>
<td>Meter does not read up to full scale</td>
<td>Calibration table may be corrupted</td>
<td>• Check the calibration table for a corrupted location.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enter the password 9111.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Start on p. 42 of the FT2A manual and follow the steps to get to Flow Parameters 2 menu screen.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Select CAL (F1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Select NXT (F1) to cycle through calibration table to verify entries match calibration certificate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for CRC error code</td>
</tr>
<tr>
<td>Velocity measurement seems low</td>
<td>1. Probe not oriented properly</td>
<td>1. Orient probe per installation sections: Insertion (p. 8), Inline (p. 12).</td>
</tr>
<tr>
<td></td>
<td>2. Sensor dirty</td>
<td>2. Clean sensor (p. 58)</td>
</tr>
</tbody>
</table>
## Troubleshooting: General

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit will not power-up</td>
<td>a) No power input</td>
<td>• Check fuse (F1) located next to TS1 on main board.</td>
</tr>
<tr>
<td></td>
<td>b) Bad fuse</td>
<td>• Check for correct power supply voltage at TS1 on main board.</td>
</tr>
<tr>
<td></td>
<td>c) Bad Power supply</td>
<td>If fuse is OK and unit still won’t power up, call Fox for additional assistance</td>
</tr>
<tr>
<td>Meter does not initialize</td>
<td>Electromechanical interference</td>
<td>• Check meter power cycles.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Press and release F1 and F2 at the same time; the display will enter Engineering screens.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Press F1 to get to screen #23; record power cycle value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Press F4 to return to normal operation; monitor meter until problem returns.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Return to screen #23 to see if power cycles have increased; microprocessor is resetting due to EMI electrical noise entering the meter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check Power input and output cables grounding and routing.</td>
</tr>
</tbody>
</table>
## Troubleshooting: General

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity measurement is erratic or fluctuating</td>
<td>1. Very turbulent flow</td>
<td>1. Increase dampening (see filter settings in &quot;Flow Parameters&quot; on p. 42)</td>
</tr>
<tr>
<td></td>
<td>2. Sensor dirty</td>
<td>2. Clean sensor (Refer to Maintenance section, p. 58)</td>
</tr>
<tr>
<td></td>
<td>3. Sensor broken</td>
<td>3. Return flow meter to Fox for repair (Refer to p. 86 for shipping instructions)</td>
</tr>
<tr>
<td></td>
<td>4. Probe not mounted securely</td>
<td>4. Remount probe (see Installation section, p. 8 and p. 12); must be mounted securely without vibration. If vibration persists, choose a new mounting location without vibration.</td>
</tr>
<tr>
<td></td>
<td>5. Malfunction in flow meter</td>
<td>5. Return flow meter to Fox for repair (Refer to p. 86 for shipping instructions)</td>
</tr>
<tr>
<td></td>
<td>6. Meter installed incorrectly</td>
<td>6. Re-install meter according to instructions (Refer to installation section, p. 8 and p. 12)</td>
</tr>
</tbody>
</table>
Troubleshooting: Installation Problems

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 to 20mA output signal.**
The FT2A requires a separate power source for the main board and the two 4 to 20mA output signals. Two wires supply 24VDC power to the main board. Two wires are used for each of the 4 to 20mA output signals. Refer to Figure 3.4 and Figure 3.5 (p. 17). Also refer to "Wiring Precautions" and "Helpful Hints" in Wiring section (p. 14) 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 Figure 2.8 (p. 13). 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. 9).
   - For inline meter types, ensure that there are a minimum of ten diameters of straight pipe upstream of the sensor and five diameters downstream (¼" meters: 6" [152 mm] of straight, unobstructed pipe upstream and downstream required). 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 Flow
Troubleshooting: Installation Problems

Installation Problems

Parameters, p. 42). 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.

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 is 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. 45). Check meter data for any non-whole numbers and call customer service for assistance.

6. **Display and/or 4 to 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.
# Troubleshooting: Alarm Codes

**Alarm Codes**

Information to diagnose and clear alarm codes is on p. 53 under the Menu Tree section. Enter password (9111) and follow the block diagram to get to the section affected by the error code.

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Reason</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Flow rate above high limits</td>
<td>Refer to the PARAMETER MENU 2 section on p. 42 of this Manual to verify limit is within range. Check ALM = HiFloAlm under PRM.</td>
</tr>
<tr>
<td>14</td>
<td>Flow rate below low limits</td>
<td>Refer to the PARAMETER MENU 2 section on p. 42 of this Manual to verify limit is within range. Check ALM = LoFloAlm under PRM.</td>
</tr>
<tr>
<td>15</td>
<td>Temperature above high limits</td>
<td>Refer to the PARAMETER MENU 2 section on p. 42 of this Manual to verify limit is within range. Check ALM = HiTempAlm under PRM.</td>
</tr>
<tr>
<td>16</td>
<td>Temperature below low limits</td>
<td>Refer to the PARAMETER MENU 2 section on p. 42 of this Manual to verify limit is within range. Check ALM = LoTempAlm</td>
</tr>
<tr>
<td>22</td>
<td>Sensor out of range</td>
<td>Refer to the ENGINEERING DISPLAY MENU on p. 55 of this Manual and the Fox factory Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.</td>
</tr>
<tr>
<td>23</td>
<td>Velocity out of calibration table range</td>
<td>Refer to the ENGINEERING DISPLAY MENU on p. 55 of this Manual and the Fox factory Calibration Certificate to check CSV voltage. Compare Display 10 value to Calibration Certificate CSV voltage and verify it's within range.</td>
</tr>
<tr>
<td>24</td>
<td>Check settings</td>
<td>One or more internal settings are corrupted or out of spec. Contact Fox Service for instructions to verify settings.</td>
</tr>
<tr>
<td>25</td>
<td>Simulation mode</td>
<td>Meter is in Simulation Mode. Refer to the PARAMETER MENU 1 section on p. 48 of this Manual. Use the SIM Section under Diagnostics to return to normal operation.</td>
</tr>
<tr>
<td>26</td>
<td>Frequency output over range</td>
<td>Refer to the DIGITAL OUTPUT MENU on p. 51 of this Manual. Verify the Frequency Output settings are within limits.</td>
</tr>
</tbody>
</table>
## Troubleshooting: Alarm Codes

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Reason</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>4 to 20mA for flow rate is out of range</td>
<td>Refer to the MAIN MENU on p. 50 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4 to 20mA.</td>
</tr>
<tr>
<td>33</td>
<td>4 to 20mA for temperature is out of range</td>
<td>Refer to p. 30 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4 to 20mA. Channel #2 can be set for flow or temperature. Be sure to check the Alarm limits (refer to p. 45).</td>
</tr>
<tr>
<td>34</td>
<td>Busy</td>
<td>Meter is recalculating new parameters.</td>
</tr>
<tr>
<td>35</td>
<td>Sensor Bridge Shutdown</td>
<td>The FT2A probe is getting too hot. Open wiring compartment and check sensor wiring.</td>
</tr>
<tr>
<td>36</td>
<td>Database CRC Error</td>
<td>Refer to the Reset CRC section on pages 50 and 51 of this manual. Verify the programmed values are verified and corrected before clearing the error. Contact Fox Service Department for possible causes.</td>
</tr>
<tr>
<td>37</td>
<td>Totalizer Error Detected</td>
<td>See &quot;Reset the Total and Elapsed Time&quot; on p. 46 for steps to clear Error Code. Contact Fox for possible causes.</td>
</tr>
</tbody>
</table>
Appendices: Specifications

Performance Specs

Flow Accuracy:
Inline meter: ± 1% of reading ± 0.2% of full scale.
¼" size: 6” (152 mm) of straight, unobstructed pipe upstream and downstream required.
All other sizes: 8 diameters of straight, unobstructed pipe upstream and 4 downstream required.
Insertion meter: ± 1% of reading ± 0.2% of full scale.
15 diameters of straight, unobstructed pipe upstream and 10 downstream required.

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 250° F (-40 to 121° C);
± 3.6° F (± 2.0° C), over the range 250 to 650° F (121 to 343° 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,
MT/H

Flow Rates for Insertion Flow Meter:
15 to 60,000 SFPM (0.07 to 280 NMPS) - Air at 70°F (20°C) & 1 ATM
Turndown: up to 1000:1; 100:1 typical

<table>
<thead>
<tr>
<th>Typical Flow Ranges for Insertion Flow Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe size</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>1.5&quot; (40mm)</td>
</tr>
<tr>
<td>2&quot; (50mm)</td>
</tr>
<tr>
<td>3&quot; (80mm)</td>
</tr>
<tr>
<td>4&quot; (100mm)</td>
</tr>
<tr>
<td>6&quot; (150mm)</td>
</tr>
<tr>
<td>8&quot; (200mm)</td>
</tr>
<tr>
<td>12&quot; (300mm)</td>
</tr>
</tbody>
</table>
Appendices: Specifications

Full Scale Flow Ranges for In-Line Flow meters:

<table>
<thead>
<tr>
<th>Size</th>
<th>SCFM</th>
<th>NM³/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25&quot;</td>
<td>0-20</td>
<td>0-32</td>
</tr>
<tr>
<td>0.5&quot;</td>
<td>0-90</td>
<td>0-140</td>
</tr>
<tr>
<td>0.75&quot;</td>
<td>0-180</td>
<td>0-280</td>
</tr>
<tr>
<td>1&quot;</td>
<td>0-320</td>
<td>0-500</td>
</tr>
<tr>
<td>1.25&quot;</td>
<td>0-580</td>
<td>0-910</td>
</tr>
<tr>
<td>1.5&quot;</td>
<td>0-840</td>
<td>0-1,320</td>
</tr>
<tr>
<td>2&quot;</td>
<td>0-1,400</td>
<td>0-2,200</td>
</tr>
<tr>
<td>2.5&quot;</td>
<td>0-2,000</td>
<td>0-3,150</td>
</tr>
<tr>
<td>3&quot;</td>
<td>0-3,080</td>
<td>0-4,860</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0-5,300</td>
<td>0-8,360</td>
</tr>
<tr>
<td>6&quot;</td>
<td>0-12,000</td>
<td>0-18,900</td>
</tr>
</tbody>
</table>

Note: Standard conditions of air at 70°F and one atmosphere. Consult factory for other gases and for flow ranges above those listed.

Gas Pressure (maximum):
- Insertion: 500 psig (34.5 barg)
- Inline (1/4" through 6"): NPT 500 psig (34.5 barg); 150# flange 230 psig (16 barg)
- Check with factory for higher pressure options.

Relative Humidity:
- 90% RH maximum; non-condensing

Maximum Altitude: 6,562ft (2,000m) max.

Temperature:
- ST sensor: -40 to 250°F (-40 to 121°C)
- HT Sensor: -40 to 650°F (-40 to 343°C)
- Enclosure: -40 to 158°F (-40 to 70°C) DC power
- -4 to 158°F (-20 to 70°C) AC power

*Note: Display dims below -4°F (-20°C), function returns once temperature rises again.

Remote sensor junction box ambient temperature: -40 to 212°F (-40 to 100°C)

Input Power (without the Anybus serial communication option):
- 24 VDC ≡ (± 10%), 0.4 Amps (standard DC power)
- 100 to 240VAC~(+10%/-15%), 50-60Hz, 0.2 Amps (with AC power option)

Input Power (with Anybus serial communication option):
- 24 VDC ≡ (± 10%), 0.7 Amps (standard DC power)
- 100 to 240VAC~(+10%/-15%), 50-60Hz, 0.2 Amps (with AC power option)
Appendices: Specifications

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.

Outputs:
- Two isolated 4 to 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 0 to 100Hz, 5 to 24 volts p/p for flow (the pulse output can be used as an isolated solid state output for alarms); 10mA max.

Serial Communication:
- USB connector 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: RS485 Modbus, BACnet MS/TP, Profibus-DP, DeviceNet, or Ethernet Modbus TCP.

4 to 20mA Loop Verification:
- Simulation mode used to align 4 to 20mA output with the input to customer’s PLC/DCS.

Physical Specs
Sensor material:
- 316 stainless steel standard; Hastelloy C276 optional

Enclosure:
- NEMA 4X, aluminum, dual conduit entries with ¾” NPT or optional M20 x 1.5mm.

Remote Sensor Cable:
- To Fox remote enclosure: 5-conductor, 18 AWG, twisted, shielded, 100 feet maximum.

Retractor Assemblies:
- Packing gland assembly: 125 psig (8.6 barg ) max.
- High pressure (crank) retractor: NPT 600 psig (41.4 barg), ANSI 150 flange & ANSI 300 flange, no valve supplied.

Insertion Flow Meter Installation:
- Fox-supplied compression fitting connects to customer-supplied ¾” female coupling welded to pipe.
Appendices: Agency Approvals

Agency Approvals
CE: Approved
   EMC Directive; 2004/108/EC
   Low Voltage Directive (LVD): 2006/95/EC
   Product Safety Testing: EN 61010-1: 2010
   Pressure Equipment Directive: 97/23/EC
   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

Note: The EU Pressure Equipment Directive (PED) requires that the minimum ambient and fluid temperature rating for carbon steel flow bodies not be below -29C.
Appendices: FT2A with 2 Gas Curves

Scope
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.

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:
Appendices: FT2A with 2 Gas Curves

FT2A 2 Gas Curves

3) Programming Contact Input for Curve Switching:
Enter the menu using steps outlined in "Discrete Input Settings" section (p. 35) 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"

Helpful Hint:
From normal display mode, press F4 to view the current gas curve selection.
Appendices: FT2A with 2 Gas Curves

FT2A 2 Gas Curves

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.

<table>
<thead>
<tr>
<th>Density</th>
<th>CHG</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS1 = 0.9876</td>
<td>CHG</td>
<td>OK</td>
</tr>
<tr>
<td>DNS2 = 1.2876</td>
<td>CHG</td>
<td>OK</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>20mA</th>
<th>CHG</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>20mA = 500SCFM</td>
<td>CHG</td>
<td>OK</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>4mA</th>
<th>CHG</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4mA = 0</td>
<td>CHG</td>
<td>OK</td>
</tr>
</tbody>
</table>

4mA is the lower limit associated with curve 1. Change it as needed and press OK.
Appendices: FT2A with 2 Gas Curves

FT2A 2 Gas Curves

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 maCv2=450 SCFM</td>
<td>CHG</td>
<td>OK</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 maCv2=0</td>
<td>CHG</td>
<td>OK</td>
<td></td>
</tr>
</tbody>
</table>

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

6) Operation:

- To avoid confusion, only one of two techniques is enabled. 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.
Appendices: Dimensions

Local with Retractor

Table 7.1 Local Insertion Meter with Retractor

<table>
<thead>
<tr>
<th>Probe Size [model code]</th>
<th>Probe Size [inches]</th>
<th>Dimension “LL” ± 0.10 [inches / centimeters]</th>
</tr>
</thead>
<tbody>
<tr>
<td>15R</td>
<td>15&quot;</td>
<td>15.0&quot; (38.1cm)</td>
</tr>
<tr>
<td>18R</td>
<td>18&quot;</td>
<td>18.0&quot; (45.7cm)</td>
</tr>
<tr>
<td>24R</td>
<td>24&quot;</td>
<td>24.0&quot; (61.0cm)</td>
</tr>
<tr>
<td>30R</td>
<td>30&quot;</td>
<td>30.0&quot; (76.2cm)</td>
</tr>
<tr>
<td>36R</td>
<td>36&quot;</td>
<td>36.0&quot; (91.4cm)</td>
</tr>
</tbody>
</table>
Appendices: Dimensions

Remote with Retractor

Fig. 7.2 Remote Insertion Meter with Retractor Dimensions

Table 7.2 Remote Insertion Meter with Retractor

<table>
<thead>
<tr>
<th>Probe Size</th>
<th>Probe Size</th>
<th>Dimension “LL” ± .10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[inches]</td>
<td>[inches / centimeters]</td>
</tr>
<tr>
<td>15R</td>
<td>15&quot;</td>
<td>15.0&quot; (38.1cm)</td>
</tr>
<tr>
<td>18R</td>
<td>18&quot;</td>
<td>18.0&quot; (45.7cm)</td>
</tr>
<tr>
<td>24R</td>
<td>24&quot;</td>
<td>24.0&quot; (61.0cm)</td>
</tr>
<tr>
<td>30R</td>
<td>30&quot;</td>
<td>30.0&quot; (76.2cm)</td>
</tr>
<tr>
<td>36R</td>
<td>36&quot;</td>
<td>36.0&quot; (91.4cm)</td>
</tr>
</tbody>
</table>
Appendices: Dimensions

Local Insertion Meter

Table 7.3 Insertion Meter with 316 stainless steel probe

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>06I</td>
<td>6&quot;</td>
<td>6.0&quot; (15.2cm)</td>
<td>14.4&quot; (36.7cm)</td>
</tr>
<tr>
<td>09I</td>
<td>9&quot;</td>
<td>9.0&quot; (22.9cm)</td>
<td>17.4&quot; (44.3cm)</td>
</tr>
<tr>
<td>12I</td>
<td>12&quot;</td>
<td>12.0&quot; (30.5cm)</td>
<td>20.4&quot; (51.9cm)</td>
</tr>
<tr>
<td>15I</td>
<td>15&quot;</td>
<td>15.0&quot; (38.1cm)</td>
<td>23.4&quot; (59.5cm)</td>
</tr>
<tr>
<td>18I</td>
<td>18&quot;</td>
<td>18.0&quot; (45.7cm)</td>
<td>26.4&quot; (67.1cm)</td>
</tr>
<tr>
<td>24I</td>
<td>24&quot;</td>
<td>24.0&quot; (61.0cm)</td>
<td>32.4&quot; (82.4cm)</td>
</tr>
<tr>
<td>30I</td>
<td>30&quot;</td>
<td>30.0&quot; (76.2cm)</td>
<td>38.4&quot; (97.6cm)</td>
</tr>
<tr>
<td>36I</td>
<td>36&quot;</td>
<td>36.0&quot; (91.4cm)</td>
<td>44.4&quot; (112.9cm)</td>
</tr>
</tbody>
</table>
Appendices: Dimensions

Remote Insertion Meter

**Fig 7.4: Insertion Remote Meter Dimensions**

![Diagram of Insertion Remote Meter Dimensions]

**Table 7.4 Insertion Remote Meter with 316 stainless steel probe**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>06I</td>
<td>6”</td>
<td>6.0” (15.2cm)</td>
<td>11.9” (30.2cm)</td>
</tr>
<tr>
<td>09I</td>
<td>9”</td>
<td>9.0” (22.9cm)</td>
<td>14.9” (37.9cm)</td>
</tr>
<tr>
<td>12I</td>
<td>12”</td>
<td>12.0” (30.5cm)</td>
<td>17.9” (45.5cm)</td>
</tr>
<tr>
<td>15I</td>
<td>15”</td>
<td>15.0” (38.1cm)</td>
<td>20.9” (53.1cm)</td>
</tr>
<tr>
<td>18I</td>
<td>18”</td>
<td>18.0” (45.7cm)</td>
<td>23.9” (60.7cm)</td>
</tr>
<tr>
<td>24I</td>
<td>24”</td>
<td>24.0” (61.0cm)</td>
<td>29.9” (76.0cm)</td>
</tr>
<tr>
<td>30I</td>
<td>30”</td>
<td>30.0” (76.2cm)</td>
<td>35.9” (91.2cm)</td>
</tr>
<tr>
<td>36I</td>
<td>36”</td>
<td>36.0” (91.4cm)</td>
<td>41.9” (106.4cm)</td>
</tr>
</tbody>
</table>
Appendices: Dimensions

Local Inline NPT Meter

Fig. 7.5: Inline Meter with 316 Stainless Steel Flow Body and NPT End Connections Dimensions

Table 7.5 Inline Meter with 316 stainless steel flow body and NPT End Connections

<table>
<thead>
<tr>
<th>Body Size</th>
<th>Body Size</th>
<th>Dimension “L” ± .10</th>
<th>Dimension “H” ± .25</th>
</tr>
</thead>
<tbody>
<tr>
<td>[model code]</td>
<td>[inches]</td>
<td>[inches]</td>
<td>[inches / centimeters]</td>
</tr>
<tr>
<td>025P</td>
<td>0.25&quot;</td>
<td>5.8&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>05P</td>
<td>0.50&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>075P</td>
<td>0.75&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>10P</td>
<td>1.00&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>125P</td>
<td>1.25&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>15P</td>
<td>1.50&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>20P *</td>
<td>2.00&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>25P *</td>
<td>2.50&quot;</td>
<td>18&quot;</td>
<td>12.6&quot; (32.0cm)</td>
</tr>
<tr>
<td>30P *</td>
<td>3.00&quot;</td>
<td>18&quot;</td>
<td>12.6&quot; (32.0cm)</td>
</tr>
<tr>
<td>40P *</td>
<td>4.00&quot;</td>
<td>18&quot;</td>
<td>13.1&quot; (33.3cm)</td>
</tr>
</tbody>
</table>

* Also available in A106 Grade B carbon steel pipe (20PC, 25PC, 30PC, and 40PC model codes)
Appendices: Dimensions

Remote Inline NPT

Table 7.6 Inline Remote Meter with 316 stainless steel flow body and NPT End Connections Dimensions

<table>
<thead>
<tr>
<th>Body Size</th>
<th>Body Size</th>
<th>Dimension “L” ± .10</th>
<th>Dimension “HH” ± .25</th>
</tr>
</thead>
<tbody>
<tr>
<td>[model code]</td>
<td>[inches]</td>
<td>[inches]</td>
<td>[inches / centimeters]</td>
</tr>
<tr>
<td>025P</td>
<td>0.25&quot;</td>
<td>5.8</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>05P</td>
<td>0.50&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>075P</td>
<td>0.75&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>10P</td>
<td>1.00&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>125P</td>
<td>1.25&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>15P</td>
<td>1.50&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>20P *</td>
<td>2.00&quot;</td>
<td>12&quot;</td>
<td>9.9&quot; (25.1cm)</td>
</tr>
<tr>
<td>25P *</td>
<td>2.25&quot;</td>
<td>18&quot;</td>
<td>10.0&quot; (25.4cm)</td>
</tr>
<tr>
<td>30P *</td>
<td>3.00&quot;</td>
<td>18&quot;</td>
<td>10.0&quot; (25.4cm)</td>
</tr>
<tr>
<td>40P *</td>
<td>4.00&quot;</td>
<td>18&quot;</td>
<td>10.5&quot; (26.7cm)</td>
</tr>
</tbody>
</table>

* Also available in A106 Grade B carbon steel pipe (20PC, 25PC, 30PC, and 40PC model codes)
Appendices: Dimensions

Local Inline Flange Meter

Fig. 7.7: Inline Meter with 316 Stainless Steel Flow Body and 150# RF Flange End Connections Dimensions

Table 7.7 Inline Meter with 316 stainless steel flow body and 150# RF Flange End Connections

<table>
<thead>
<tr>
<th>Body Size</th>
<th>Body Size</th>
<th>Dimension “L” ± .10</th>
<th>Dimension “H” ± .25</th>
</tr>
</thead>
<tbody>
<tr>
<td>[model code]</td>
<td>[inches]</td>
<td>[inches]</td>
<td>[inches / centimeters]</td>
</tr>
<tr>
<td>05F</td>
<td>0.50&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>075F</td>
<td>0.75&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>10F</td>
<td>1.00&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>125F</td>
<td>1.25&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>15F</td>
<td>1.50&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>20F *</td>
<td>2.00&quot;</td>
<td>12&quot;</td>
<td>12.5&quot; (31.8cm)</td>
</tr>
<tr>
<td>25F *</td>
<td>2.50&quot;</td>
<td>18&quot;</td>
<td>12.6&quot; (32.0cm)</td>
</tr>
<tr>
<td>30F *</td>
<td>3.00&quot;</td>
<td>18&quot;</td>
<td>12.6&quot; (32.0cm)</td>
</tr>
<tr>
<td>40F *</td>
<td>4.00&quot;</td>
<td>18&quot;</td>
<td>13.1&quot; (33.3cm)</td>
</tr>
<tr>
<td>60F</td>
<td>6.00&quot;</td>
<td>24&quot;</td>
<td>14.2&quot; (36.1cm)</td>
</tr>
</tbody>
</table>

* Also available in A106 Grade B carbon steel pipe with A105 flanges (20FC, 25FC, 30FC, and 40FC model codes)
Appendices: Dimensions

Remote Inline Flange Meter

![Image of Inline Remote Meter with Stainless Steel Flow Body and 150# RF Flange End Connections Dimensions]

Table 7.8 Inline Remote Meter with stainless steel flow body and 150# RF Flange End Connections Dimensions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>05F</td>
<td>0.50”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>075F</td>
<td>0.75”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>10F</td>
<td>1.00”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>125F</td>
<td>1.25”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>15F</td>
<td>1.50”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>20F *</td>
<td>2.00”</td>
<td>12”</td>
<td>9.9” (25.1cm)</td>
</tr>
<tr>
<td>25F *</td>
<td>2.50”</td>
<td>18”</td>
<td>10.0” (25.4cm)</td>
</tr>
<tr>
<td>30F *</td>
<td>3.00”</td>
<td>18”</td>
<td>10.0” (25.4cm)</td>
</tr>
<tr>
<td>40F *</td>
<td>4.00”</td>
<td>18”</td>
<td>10.5” (26.7cm)</td>
</tr>
<tr>
<td>60F</td>
<td>6.00”</td>
<td>24”</td>
<td>11.6” (29.5cm)</td>
</tr>
</tbody>
</table>

* Also available in A106 Grade B carbon steel pipe with A105 flanges (20FC, 25FC, 30FC, and 40FC model codes)
Appendices: FT2A Enclosure Mounting

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.
Appendices: FT2A Mounting Bracket

**FT2A Mounting Bracket**

**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. 7.10 for dimensions.

Fig. 7.10: Model FT2A Mounting Kit
Appendices: Warranty

Warranty

(a) FOX warrants that the products furnished under this Agreement will be free from defects in material and workmanship for a period of one year from the date of shipment. The customer shall provide notice of any defect to FOX, within one week after the Customer’s discovery of such defect. The sole obligation and liability of FOX, under this warranty shall be repair or replace, at its option, without cost to the Customer, the defective product or part.

(b) Upon request by FOX, the product or part claimed to be defective shall immediately be returned at the Customer’s expense to FOX. Replaced or repaired products or parts will be shipped to the Customer at the expense of FOX. FOX shall have the right of final determination as to the existence and cause of defect.

(c) There shall be no warranty or liability for any products or parts that have been subject to misuse, accident, negligence, failure of electric power or modifications by the Customer without the written approval of FOX. Final determination of warranty eligibility shall be made by FOX. If a warranty claim is considered invalid for any reason, the Customer will be charged for services performed and expenses incurred by FOX, in handling and shipping the returned unit.

(d) The liability of FOX shall be limited to replacing or repairing, at its option, any defective parts which are returned. Labor and related expenses incurred to install replacement parts are not covered by this warranty.

(e) As to replacement parts supplied or repairs made during the original warranty period, the warranty period for the replacement or repaired part shall terminate with the termination of the warranty period of the original product or part.

(f) The use of these products is under exclusive control of the purchaser and FOX specifically denies any responsibility for the calibration of units and/or accuracy of work performed or the safety of the system in which FOX products is used. EXTERNAL SAFETY DEVICES MUST BE USED WITH THIS EQUIPMENT.
Appendices: Warranty

Warranty

(g) No warranty is made with respect to custom equipment or products produced to Buyer’s specifications except as specifically stated in writing by FOX and contained in the agreement.

(h) THE FOREGOING WARRANTY CONSTITUTES THE SOLE LIABILITY OF FOX, AND THE CUSTOMER’S SOLE REMEDY WITH RESPECT TO THE PRODUCTS AND IS IN LIEU OF ALL OTHER WARRANTIES, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, LIABILITIES, AND REMEDIES. EXCEPT AS THUS PROVIDED, FOX, DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
Appendices: Returning Your Meter

Returning Your Meter

The Fox Thermal Instruments, Inc. Customer Service Department (PH: 831-384-4300 or FAX: 831-337-5787) can help you through the process of returning a meter for service.

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

1. A Return Material Authorization (RMA) Number must be obtained from the Fox Customer Service Department prior to returning any Fox meter(s).
2. Please have your meter’s serial number(s) available.
3. Read and complete the Fox 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 remote and/or flow body models.
5. Clean and decontaminate all wetted parts before returning to Fox.
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 Customer Service Department. The Fox 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 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 for servicing and would like to check the status of your meter, please fill out our online Service Order Status form located at www.foxthermalinstruments.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.
## Definitions

### Glossary of Terms and Definitions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gauge</td>
</tr>
<tr>
<td>Bara</td>
<td>Bar absolute</td>
</tr>
<tr>
<td>CTC</td>
<td>Contact</td>
</tr>
<tr>
<td>CAL</td>
<td>Calibration</td>
</tr>
<tr>
<td>CHG</td>
<td>Change</td>
</tr>
<tr>
<td>COM</td>
<td>Communication</td>
</tr>
<tr>
<td>CSV</td>
<td>Current Sense Voltage</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>DN</td>
<td>Down</td>
</tr>
<tr>
<td>DSP</td>
<td>Display</td>
</tr>
<tr>
<td>ELP</td>
<td>Elapsed time</td>
</tr>
<tr>
<td>Feq</td>
<td>Frequency</td>
</tr>
<tr>
<td>Ft(^2)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>INP</td>
<td>Input</td>
</tr>
<tr>
<td>IR</td>
<td>Infrared (IR Buttons = optical switches)</td>
</tr>
<tr>
<td>LB</td>
<td>Pound</td>
</tr>
<tr>
<td>LB/D</td>
<td>Pound per Day</td>
</tr>
<tr>
<td>LB/H</td>
<td>Pound per Hour</td>
</tr>
<tr>
<td>LB/M</td>
<td>Pound per Minute</td>
</tr>
<tr>
<td>LB/S</td>
<td>Pound per Second</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
</tr>
<tr>
<td>KG</td>
<td>Kilogram</td>
</tr>
<tr>
<td>KG/H</td>
<td>Kilogram per Hour</td>
</tr>
<tr>
<td>KG/M</td>
<td>Kilogram per Minute</td>
</tr>
<tr>
<td>KG/S</td>
<td>Kilogram per Second</td>
</tr>
<tr>
<td>M(^2)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>mmHG</td>
<td>Pressure in millimeters of mercury</td>
</tr>
<tr>
<td>MMSCFD</td>
<td>Million Standard Cubic Feet per Day</td>
</tr>
<tr>
<td>MXFLO</td>
<td>Maximum Flow</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufactures Association</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NLP</td>
<td>Normal Liter</td>
</tr>
<tr>
<td>NLPH</td>
<td>Normal Liter per Hour</td>
</tr>
<tr>
<td>NLPm</td>
<td>Normal Liter per Minute</td>
</tr>
<tr>
<td>NM3</td>
<td>Normal cubic Meter</td>
</tr>
</tbody>
</table>
## Definitions

<table>
<thead>
<tr>
<th>Glossary of Terms and Definitions</th>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>NM3/H</td>
<td>Normal cubic Meter per Hour</td>
<td></td>
</tr>
<tr>
<td>NM3/M</td>
<td>Normal cubic Meter per Minute</td>
<td></td>
</tr>
<tr>
<td>NPT</td>
<td>National Pipe Thread</td>
<td></td>
</tr>
<tr>
<td>PDA</td>
<td>Personal hand held computer</td>
<td></td>
</tr>
<tr>
<td>UNT</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>U/P</td>
<td>Unit per Pulse</td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
<td></td>
</tr>
<tr>
<td>P/U</td>
<td>Pulse per Unit</td>
<td></td>
</tr>
<tr>
<td>PIP $A^2$</td>
<td>Pipe Area</td>
<td></td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
<td></td>
</tr>
<tr>
<td>PRM</td>
<td>Parameters</td>
<td></td>
</tr>
<tr>
<td>PRS</td>
<td>Pressure</td>
<td></td>
</tr>
<tr>
<td>PSIA</td>
<td>Pounds per Square Inch Absolute</td>
<td></td>
</tr>
<tr>
<td>Pt</td>
<td>Point</td>
<td></td>
</tr>
<tr>
<td>PSW</td>
<td>Password</td>
<td></td>
</tr>
<tr>
<td>SIM</td>
<td>Simulation</td>
<td></td>
</tr>
<tr>
<td>SCF</td>
<td>Standard Cubic Feet</td>
<td></td>
</tr>
<tr>
<td>SCFM</td>
<td>Standard Cubic Feet per Minute</td>
<td></td>
</tr>
<tr>
<td>SCFH</td>
<td>Standard Cubic Feet per Hour</td>
<td></td>
</tr>
<tr>
<td>SCFD</td>
<td>Standard Cubic Feet per Day</td>
<td></td>
</tr>
<tr>
<td>SPC</td>
<td>Special Control</td>
<td></td>
</tr>
<tr>
<td>STP</td>
<td>Standard Temperature and Pressure</td>
<td></td>
</tr>
<tr>
<td>TMP</td>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>TSI</td>
<td>Internal Variable</td>
<td></td>
</tr>
<tr>
<td>TSV</td>
<td>Internal Variable</td>
<td></td>
</tr>
<tr>
<td>420</td>
<td>4 to 20mA output</td>
<td></td>
</tr>
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</table>
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Caution - (refer to accompanying documents): Please follow the specified instructions and general safety practices.

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