# Fox Thermal

## THERMAL MASS FLOW METER & TEMPERATURE TRANSMITTER

### Model FT2A

Fox Thermal
**Precision Mass Flow Measurement**
*An ONICON Brand*

## Notice

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

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

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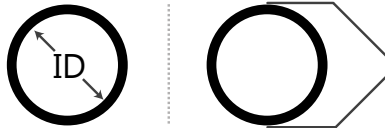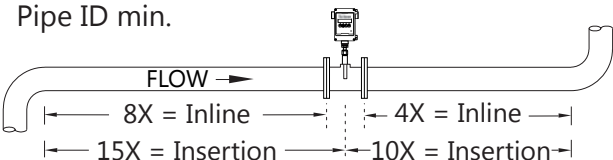> - **Fox FT2A View™ Manual**

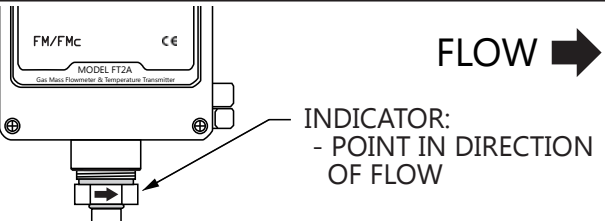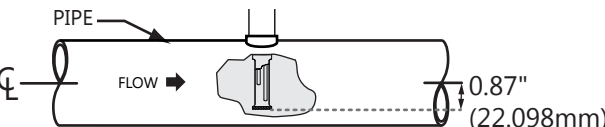*All Fox Manuals and software available in English only.*

# Table Of Contents

# Introduction: Quick Start Guide

Use the table below as a guide while using the worksheet on the next page to record your notes.
**NOTE!** Please read the entire quick-start procedure before beginning installation.

| | |
|---|---|
| 1. | Record inside diameter (ID). Ensure the actual pipe ID matches the pipe ID shown on the factory calibration certificate. If IDs do not match, refer to p. 423. |
| 2. | Record up/downstream straight-pipe requirements based on Pipe ID and meter style (insertion or inline). [refer to p. 19] |
| 3. | The Flow Direction Indicator must point in the direction of flow. |
| 4. | Ensure correct probe depth setting. If using 1 ½" size pipe, please see note on p. 21. |
| 5. | Ensure power wiring and 4-20mA wiring properly connected. [refer to p. 30 - p. 32 for more information] |
| 6. | Ensure remote wiring is correct if remote option ordered. [refer to p. 38 - p. 39 for more information] |
| 7. | Verify you have the proper output signal wiring [refer to p. 33 - p. 36 for more information] |
| 8. | Power on the flow meter. |
| 9. | Check the remaining flow meter settings by accessing the meter settings either through the front panel of the display or by using the FT2A View™ software tool. Record the settings in the spaces given for items A - E on the following page. |

# Introduction: Quick Start Guide

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

| | Item to verify | Serial Number: | Serial Number: | Serial Number: | Serial Number: |
|---|---|---|---|---|---|
| 1. | What is the Pipe ID? | ID = | ID = | ID = | ID = |
| 2. | Calculate the Upstream/ Downstream straight-pipe requirements | UP = DN = | UP = DN = | UP = DN = | UP = DN = |
| 3. | a. Is the flow indicator pointed in direction of flow? | Y / N | Y / N | Y / N | Y / N |
| 4. | Is the probe depth setting correct? | Y / N | Y / N | Y / N | Y / N |
| 5. | Verify proper power wiring setup | | | | |
| 6. | Verify proper remote wiring setup (if ordered) | | | | |
| 7. | Verify proper input/output wiring setup | | | | |
| After powering on your meter, check items A - E below by accessing the meter settings either through the front panel of the meter's display or by using the FT2A View™ software tool. | | | | | |
| A. | Which flow units have been set in meter? (SCFM, KG/H, etc..) | | | | |
| B. | Correct values for reference temperature and pressure? | Y / N | Y / N | Y / N | Y / N |
| C. | Confirm the pipe ID listed above same as "Pipe_id=" | | | | |
| D. | Verify the 1st 4mA and 20mA meter settings | 4mA = 20mA = | 4mA = 20mA = | 4mA = 20mA = | 4mA = 20mA = |
| E. | Verify the 2nd 4mA and 20mA meter settings | 4mA = 20mA = | 4mA = 20mA = | 4mA = 20mA = | 4mA = 20mA = |

Your Notes:

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

# Introduction

Thank you for purchasing the Model FT2A Thermal Gas Mass Flow Meter and Temperature Transmitter from Fox Thermal.  The Model FT2A is one of the most technically advanced flow meters in the world.  Extensive engineering effort has been invested to deliver advanced features, accuracy measurement performance and outstanding reliability.

This Instruction Manual contains the electrical and mechanical installation instructions as well as details for programming, maintaining and troubleshooting the meter.

This manual is divided into the following sections: Introduction, Installation, Wiring, Operation, Maintenance, Troubleshooting, Appendices, Glossary and Index.

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

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

# Introduction

### 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

The FT2A features two galvanically isolated 4-20mA analog outputs, one isolated digital output, one discrete input and a USB port for communication with a computer.

The first 4-20mA output is for flow rate. The second 4-20mA output can be configured either for flow rate or process gas temperature. Both 4-20mA outputs can be scaled by the user. The digital output can be used for frequency or alarm, is programmable to represent flow rate and can be scaled for maximum flow/maximum frequency, units-per-pulse or pulse-per-units. The maximum frequency is 100 Hz.

FT2A View™ interfaces to the USB port and is a free Fox PC-based software program that displays flow meter readings and permits flow meter configuration. The software is available for download on the Fox website.

Industry standard communication options are available including optional 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**

## Introduction

### FT2A Functional Diagram

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

*Fig. 1.1: FT2A Function Diagram*

# Installation

## 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. Close any unused conduit openings in the enclosure with plugs certified for your application.
3. The enclosure covers must be closed except during installation.
4. Mounting FT2A in direct sunlight can cause the temperature inside the enclosure to increase beyond design limits, resulting in failure of LCD display and reduced component life. It is recommended that a sunshade be installed to avoid direct sunlight.
5. Ensure the flow direction arrow points in the direction of flow.
6. Do not install the FT2A enclosure near an igniter, igniter-controller or switching equipment.
7. Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
8. Ensure that good engineering practices and applicable industry codes are followed throughout the installation process.
9. For accurate flow measurement: review flow meter placement instructions before installation to ensure a proper flow profile in the pipe.

## Installation

**Instructions for Flow Meter Lateral Placement**

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

**NOTE!** Pipe ID = Inside Diameter.

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



INSERTION

Irregular Profile

Proper Flow Profile

Branch Outlet (installed by customer)

FLOW

15X Pipe ID        10X Pipe ID

INLINE

Irregular Profile

Proper Flow Profile

FLOW

8X Pipe ID        4X Pipe ID

**NOTE!**
• The probe diameter is ½"
• An irregular flow profile will affect sensor accuracy

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# Installation

**Welding NPT Female Fitting to Pipe**

The probe of the FT2A must be installed perpendicular in the pipe to measure flow accurately. Use the following steps to ensure that the 1" NPT female fitting is correctly welded to the pipe. Directions:

1. Drill a 0.781-inch hole inside the fitting through the wall of the pipe (1 wall only).
2. Assemble the compression fitting and NPT fitting hand tight onto the probe of the FT2A.
3. Insert the probe into the hole in the pipe and use the FT2A probe and compression fitting to align the NPT fitting with the hole and the probe perpendicular to the pipe.
4. Tack-weld the NPT female fitting carefully onto the pipe.
   - Before welding the fitting completely, verify the probe is aligned to the center of the pipe and the hole is centered in the NPT fitting (see Figure 2.2).
5. To verify that the correct hole position has been achieved, carefully slide the 0.75-inch sensor in and out of the NPT female fitting and 0.781-inch hole.

⚠️ **WARNING!** Do not force the 0.75-inch sensor through the 0.781-inch hole. Forcing it through the 0.781-inch hole can damage the probe!

6. Verify that the temporary weld of the NPT female fitting positions the probe window on the pipe's centerline.
   - Figure 2.2 shows an incorrect welding of the NPT female fitting, causing the 0.75-inch sensor to be "off center".
7. Once the NPT fitting is aligned properly, remove the 0.75-inch sensor from the NPT female fitting and finish welding. Then verify the probe is still aligned with the center of the pipe.
8. Set the depth of the flow meter (see "Fig. 2.3: Cross Section of Insertion Sensor Depth in Pipe" on page 21).
   - Do not tighten Swage fitting until proper depth of flow meter is determined. See Fig. 2.3.

*Fig. 2.2: Alignment of NPT Female Fitting*

# Installation

### 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. 2.3: Cross Section of Insertion Sensor Depth in Pipe*



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**Specific Conditions of Use:**
- The flameproof joints of the equipment are not intended to be repaired. Consult the manufacturer if dimensional information on the flameproof joints is necessary.
- The flamepaths of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flamepath joints is necessary.
- Follow the manufacturer's instructions to reduce the potential of an electrostatic charging hazard.

# Installation

*Fig. 2.4: Orientation of Type Flow Meter*



FRONT VIEW

Flow Direction Arrow

CUSTOMER PIPE

FLOW

CUSTOMER PIPE

TOP VIEW

FLOW

+2°

Note: Rotational misalignment should not exceed ±2°

-2°

**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.

# Installation

**INSTALLATION**

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

*Fig. 2.5: Unequal Length Sensor Elements*

FLOW

+2°

FLOW

-2°

FLOW

### Equal Length Sensor Elements
Install flow meter with *both sensor elements* facing the flow stream within ±2˚.

*Fig. 2.6: Equal Length Sensor Elements*

FLOW

+2°

FLOW

-2°

FLOW

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# Installation

## Mounting Instructions - Compression Fittings

The Model FT2A is mounted through a 7/8" 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. 12).
- 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!**  For a 1½" pipe, do not tighten compression fitting without 0.2" distance from wall or damage to probe will occur.

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

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

*Fig. 2.7: Proper Tightening of the Compression Fitting Nut*

# Installation

### Installation of a New Retractor Assembly

1. Remove collar clamp from probe using a 3/16" Hex Key.
2. Remove meter probe from retractor assembly and leave the ball valve open. Keep the collar spacer on the probe so it is not misplaced.
3. Install the valve assembly on the pipe, by tightening the Hex Nipple with a 1 3/8" wrench.

*Fig. 2.8: Retractor Assembly With and Without Probe Installed*

# Installation

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

*Fig. 2.9: Verify Probe Insertion*

## Installation

5.  Using the equation (L + D/2 + 0.73") from Figure 2.9, calculate the insertion depth and mark on the probe while measuring from the end of the probe.
6.  The Retractor Clearance table of Figure 2.9 lists the space required to remove the meter from the retractor. Use the model code of your meter to determine the dimension.

*Fig. 2.10: Determining and Marking Insertion Depth*

| RETRACTOR CLEARANCE | |
| --- | --- |
| CODE | "RC" DIMENSION |
| 15R | 23.9" [60.7 CM] |
| 18R | 26.5" [68.3 CM] |
| 24R | 32.5" [83.6 CM] |
| 30R | 38.5" [98.8 CM] |
| 36R | 44.5" [114.0 CM] |



"RC" RETRACTOR CLEARANCE

MARK ON PROBE

"L"

HALF COUPLING 3/4 INCH NPT, FEMALE

INSERTION DEPTH: L + D/2 + .87"

"D/2"

"D"

.87 [22.098mm]

# Installation

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

*Fig. 2.11: Installed Retractor*



Flow Direction Indicator

Collar Spacer
Collar Clamp

Swage Nut & Ferrules

Swage Fitting

Bracket

9.  Fully tighten compression fitting (refer to "Mounting Instructions - Compression Fittings" on page 15).

# Wiring

### 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.

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

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

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# Wiring

**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

**FT2A Internal Components**

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

Main Board Electronics                    Inside Display/Cover

TS7  1  2  3    1  2  3  TS1
     AC POWER   DC POWER

TS2
1
2
3
4
5
6
7
8
9
10
11

I/O WIRING
AND
OPTIONAL
MODBUS
COMMUNICATION

TS3
1
2
3
4
5
6
7
8

ETHERNET

J1

OPTIONAL
COMMUNICATION
(DEVICENET
PROFIBUS)

TS8
1
2
3
4
5

REMOTE
SENSOR
WIRING

USB
COMMUNICATION

J4

Keep power and signal wires within the area of the metal shields.

Keep power and signal wires out of the unshielded area.

**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.

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# 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

**Power Input Requirements: 100 to 240VAC Supply**

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

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

*Fig. 3.4: Connections for optional AC Power*



**CAUTION!**
• Supply connection wiring must be rated for at least 90°C.

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# Wiring

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

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

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



### Important Note

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

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

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

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



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**Important NOTE!**

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

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# Wiring

**Setting Up the NE-43 Alarms**

The FT2A flow meter supports the NAMUR specification NE-43 for alarms on the 4-20mA output. See p. 40 for the 4-20mA output NAMUR operation.

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

**4-20mA Failsafe Wiring: NAMUR NE-43**

When the 4-20mA output is used to control equipment in failsafe applications:
Wire the 4-20mA output in series with the Alarm output as shown in Figure 3.7
Configure the Pulse/Alarm output to Alarm and select System Alarm as shown in the "Alarm Output" on p. 40.

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

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

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

## Wiring

**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 20mA of current. Frequency or alarm selection is programmed using the display or FT2A View™.  Only one option, frequency or alarm, can be active at a time.

*Fig. 3.7: Frequency/Alarm Output Isolated (Recommended)*



*Fig. 3.8: Frequency/Alarm Output Local +24V Power Option*

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# Wiring

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> **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.

**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 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. 31).



2X 3/4 " NPT, Female

AC or DC Input Power

Signal Wiring, DC Power

Remote Cable, 5 Conductor, Shielded, 100ft (30.48m) Max.

*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

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# Wiring

*Fig. 3.11: Remote Sensor 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*

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

## Operation

**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

## 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. 41). 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. 50).

*Fig. 4.2: FT2A Display Screen Navigation*



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

Display #1

1456.5 SCFM
123456 SCF

(User programable screen)

F1   F2   F3   F4

Enter "totalizer reset screen" when F3 & F4 are pressed at the same time

(User programable screen)

Display #2

Elp = 14.6 HR
88.5° F

F1   F2

Display #3

Alarm = None
Elp = 14.6 HR

(Fixed screen)

F1   F2

Display #4

Set Parameter?
No                    Yes

(Fixed screen)

F2                    F4

Enter programming screen Requires password. Default is 1234.

# Operation: Engineering Displays

**OPERATION**

### 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*

| | | |
|---|---|---|
| *Flow in selected units*<br>*Sensor voltage in volts* | 3124.6 SCFM<br>csv=0.3432 Volt | *Display 10* |
| *Sensor average volts*<br>*Velocity in selected units* | CsvAv=366809<br>Vel=112345.7 FT/M | *Display 11* |
| *Sensor filtered average in volts*<br>*Velocity in meters/hour* | FloFlt=3666805.3<br>Vel=2356.45 M/H | *Display 12* |
| *TSI average count*<br>*TSV average count* | TsiAvr=512.5  cnt<br>TsvAvr=323.7 cnt | *Display 13* |
| *TSI in volts*<br>*TSV in volts* | Tsi= 2.1345 Volt<br>Tsv=0.9856 Volt | *Display 14* |
| *TSI current in amps*<br>*TSI resistance in ohms* | Tsi = 0.0435 Amp<br>Tsi = 221.5 Ohm | *Display 15* |
| *RTD9 count*<br>*Gas Temperature in degrees C* | RTD9= 345.5 cnt<br>Gas Temp=123.7 °C | *Display 16* |
| *CH1 4-20ma current loop count*<br>*CH2 4-20 ma current loop count* | CH1_420=2167 cnt<br>CH2_420=1234 cnt | *Display 17* |
| *Frequency output count*<br>*Alarm codes* | Feq=1234.5 cnt<br>Alarm=33,35 | *Display 18* |
| *High flow limit alarm*<br>*Low flow limit alarm* | FloHi= 1234 SCFM<br>FloLo=0 SCFM | *Display 19* |
| *High temperature limit alarm*<br>*Low temperature limit alarm* | TmpHi=300 °C<br>TmpLo=10 °C | *Display 20* |
| *Elapsed time in hours*<br>*Status in hexadecimal* | Elp=12.5 HR<br>Stat(hex)=2800 | *Display 21* |
| *FT2A main board firmware revision* | FT2A V3.02d | *Display 22* |
| *Power cycle count*<br>*Error with totalizer count* | Pwr_Cycl=24<br>Err_tot=0 | *Display 23* |
| *TSI resistance in ohms*<br>*RTD9 resistance in ohms* | Tsi=221.5 Ohm<br>RTD9=10.3 Ohm | *Display 24* |
| *Bridge shutdown detection count* | BrShtDnCnt=0 cnt | *Display 25* |

**F1 Key**          **F2 Key**

*F3 & F4 pressed at the same time will initiate a "Total" reset*

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# Operation

### 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.

### To Change a Value  or String :

```
VALUE = 0.91234
CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
VALUE = 0.91234
UP      DN    NXT    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

### To Select from a List:

```
FLO UNT = SCFM
NXT                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

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

```
   SET PARAMETERS ?
No                    Yes
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
PASWD:_
UP      DN    NXT    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

## Operation

Enter the correct password, then follow the instructions for changing a value as specified on page p. 35. 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:

```
SET PARAMETERS
I/O      FLO      DSP      EXIT
```
```
 F1      F2      F3      F4
```

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

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

```
      SET         I/O
COM      PUL      420      EXIT
```
```
 F1      F2      F3      F4
```

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

```
mA=Flow
NXT                      OK
```
```
 F1      F2      F3      F4
```

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

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

```
20 mA =   3500 SCFM
CHG                      OK
```
```
 F1      F2      F3      F4
```

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

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# Operation

**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.

```
4 mA =  0  SCFM
CHG                    OK
```

| F1 | F2 | F3 | F4 |

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

**NOTE!** 4mA is normally set to 0.

The following menu item allows the user to select an alarm level on the 4-20mA output when a serious issue is detected that is preventing the calculation of a correct flow value.
The options are:
- Force the 4-20mA signal to 3.6mA
- Force the 4-20mA signal to 21mA
- Do not force the 4-20mA signal (not used)

**CAUTION!** When using the 4-20mA output equipment in a failsafe application, use the wiring configuration on p. 27 and set the Pulse/Alarm Output to System Alarm as shown in "Alarm Output" on p. 40.

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

```
mA Fault = Not use
NXT                    OK
```

| F1 | F2 | F3 | F4 |

The following events will set the output to 3.6mA or 21mA if the alarm level is selected:
- Sensor resistance above high limit
- Bridge Shutdown

When the 4-20mA output is wired through the System Alarm, the following cause the output to go to 0mA:
- Power to the Microprocessor is lost
- Sensor or electronics failure

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

## Operation

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

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

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

```
          SET         I/O
  INP     OUT               EXIT
```
```
  F1      F2      F3      F4
```

Press **OUT (F2)** to select output.
The following screen may show:

```
OUT = Frequency
NXT                       OK
```
```
  F1      F2      F3      F4
```

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
  P/U     U/P     FEQ    EXIT
```
```
  F1      F2      F3      F4
```

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.

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

```
PLS/UNT = 1.2
CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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).

**Entering data in Unit per Pulse:**
From the Frequency Output Menu on p. 38, press **U/P (F2)** and the following screen will show:

```
UNT/PLS = 0.01
CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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)

**Entering data with flow and maximum frequency:**
From the Frequency Output Menu on p. 38, press **FEQ (F3)** and the following screen will show:

```
MaxFreq=98.5  Hz
CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

Enter the maximum frequency and press **OK (F4).**
(Maximum frequency should not exceed 100 Hz)

The next screen will show:

```
MaxFlo=4999.8 SCFM
CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

**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.

## Operation

**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:.

```
        SET        I/O
INP     OUT              EXIT
```
```
 F1     F2     F3     F4
```

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

```
OUT = HiFloAlm
NXT                      OK
```
```
 F1     F2     F3     F4
```

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
System Alm=    System Alarm
Not used
Frequency

```
HiFloAlm=500 SCFM
CHG                      OK
```
```
 F1     F2     F3     F4
```

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
```
```
 F1     F2     F3     F4
```

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

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# Operation

Selections are:
Not used
Tot Reset        Reset the totalizer
Switch Crv       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 Settings
To program the Serial communication settings, press **I/O (F1)** key from the base menu.

```
        SET  I/O
COM     I/O      420     EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

Press **COM (F1)** to select Serial communication:

```
Comm=Modbus
NXT                      OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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
Remember, there are four display screens that you can cycle through in normal operating mode (see Figure 4.2 on p. 33).  Two of the four display screens are fixed and cannot be changed (displays #3 & 4).  The other two screens are programmable to show the information that you prefer and is discussed in this section.

Display #1
```
DSP1L1
DSP1L2
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

Display #2
```
DSP2L1
DSP2L2
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

**OPERATION**

## Operation

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:

```
DISPLAY/PASSWORD
DSP              PSW      EXIT
```
[ F1 ]   [ F2 ]   [ F3 ]   [ F4 ]

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

```
DSP1L1 = Total
NXT                      OK
```
[ F1 ]   [ F2 ]   [ F3 ]   [ F4 ]

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).

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

```
ALTERNATE = Off
NXT                      OK
```
[ 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.

**OPERATION**

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# Operation

**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
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
PASSWD = 1234
CHG                   OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

This screen displays the current **Level 1** password.
Press CHG (F1) key to change the password and enter new value (see p. 35 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.

## Operation

### 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.

```
SET PARAMETERS
I/O      FLO      DSP      EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

Press **FLO (F2)**:

```
FLOW PARAMETERS 1
DGN     UNT      PRM     EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

The screen will show:

```
FLO = SCFM
NXT                       OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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 |

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OPERATION

# Operation

Selections for flow units are:

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

```
TMP UNT= Deg F
NXT              OK
```
F1   F2   F3   F4

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.

```
TmpRef = 60 °F
CHG              OK
```
F1   F2   F3   F4

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:

```
PRES UNT= Psia
NXT              OK
```
F1   F2   F3   F4

## Operation

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:

```
PresRef= 14.7
CHG                    OK
```
F1   F2   F3   F4

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
CHG                    OK
```
F1   F2   F3   F4

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.

```
SET PARAMETERS
 I/O      FLO      DSP     EXIT
```
F1   F2   F3   F4

# Operation

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

```
FLOW PARAMETER 1
DGN     UNT     PRM     EXIT
```
[ F1 ]   [ F2 ]   [ F3 ]   [ F4 ]

Then press **PRM (F3)**:

```
FLOW PARAMETER 2
CAL     SPC     PRM     EXIT
```
[ F1 ]   [ F2 ]   [ F3 ]   [ F4 ]

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

**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.

## Operation

### 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.

```
FILTER = 0.8
CHG                    OK
```
F1    F2    F3    F4

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

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

### High Flow Rate Alarm

To set the parameters for a High Flow Rate Alarm:

```
HiFloAlm = 1234  SCFM
CHG                    OK
```
F1    F2    F3    F4

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.

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# Operation

**Low Flow Rate Alarm**

To set the parameters for a Low Flow Rate Alarm:

```
LoFloAlm = 100 SCFM
CHG                  OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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.

**High Temperature Alarm**

To set the parameters for a High Temperature Alarm:

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

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 Temperature Alarm**

To set the parameters for a Low Temperature Alarm:

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

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.

**OPERATION**

## Operation

**OPERATION**

### 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.**

```
FLOW PARAMETER 2
CAL      SPC      PRM      EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
         CAL   TABLE
TB1     - - -       - - -      EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
Volt1 = 0.92367
CHG      PRV      NXT      EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
Flo1 = 0
CHG      PRV      NXT      EXIT
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

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

### Reset Total and Elapsed Time

Enter the flow totalizer and elapsed time screen by pressing the **F3** and **F4** keys at the same

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# Operation

time in the normal running mode (password required).

```
RESET TOTAL ?
NO                    YES
```

F1    F2    F3    F4

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: | 99,999,999,999 |
| 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**).

```
FLOW PARAMETER 2
CAL     SPC     PRM    EXIT
```

F1    F2    F3    F4

The following will show:

```
K fact=0%
CHG                    OK
```

F1    F2    F3    F4

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

```
RESTORE DATABASE ?
YES                    NO
```

F1    F2    F3    F4

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.

## Operation

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

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

```
RESET CRC?
YES                    NO
```
[F1]  [F2]  [F3]  [F4]

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 4-20mA 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)**:

```
FLOW PARAMETER 1
DGN    UNT    PRM    EXIT
```
[F1]  [F2]  [F3]  [F4]

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

```
        DIAGNOSTIC
SIM      TST            EXIT
```
[F1]  [F2]  [F3]  [F4]

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

**OPERATION**

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An ONICON Brand

# Operation

```
FloSim = 0 SCFM
CHG                    OK
```
F1   F2   F3   F4

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

**NOTE!** Enter zero to disable this feature.

```
TmpSim = 0 C
CHG                    OK
```
F1   F2   F3   F4

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

**NOTE!** Enter zero to disable this feature.

```
CsvSim = 0 V
CHG                    OK
```
F1   F2   F3   F4

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?
YES                    NO
```
F1   F2   F3   F4

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

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

## Operation

*Fig. 4.4: FT2A Menu Tree - Main Menu*

Enter menu by scolling to display 4
and entering the password

SET PARAMETERS
I/O   FLO   DSP   EXIT

*Display Menu, p. 58*
*Flow Parameters 1 Menu, p. 56*

SET  I/O
COM   I/O   420   EXIT

*Analog Outputs*

SET  I/O
INP   OUT         EXIT

SET 4-20 mA
CH1   CH2         EXIT

*Select either flow
or temperature for
channel 2*

None
Modbus
BACnet
Ethernet
Profibus
DeviceNet

Comm=Modbus
NXT              OK

Not used
Tot Reset

INP= Not used
NXT              OK

20 mACnt=3265
CHG              OK

*Temp
Flow*

CH2=Temp
NXT              OK

*Level 2*

4 mACnt=367
CHG              OK

20mACnt=3748
CHG              OK

*Level 2*

20 mA=2345.6 SCFM
CHG              OK

4mACnt=274
CHG              OK

*Refer to appropriate Serial
Communication Manual*

4 mA=0 SCFM
CHG              OK

20 mA=300  °F
CHG              OK

Not use
3.6 mA
21 mA

mA Fault=Not use
NXT              OK

4 mA=0  °F
CHG              OK

*Digital Output Menu, p. 55*

# Operation

*Fig. 4.5: FT2A Menu Tree - Digital Output*

*Not used*
*Frequency*
*HiFloAlm*
*LoFloAlm*
*HiTempAlm*
*LoTempAlm*
*System Alm*

OUT= Not used
NXT　　　　OK

*Frequency*

OUT= FREQUENCY
NXT　　　　OK

*Select 1 of 3 methods to scale the frequency output*

FREQUENCY OUTPUT
P/U　U/P　FEQ　EXIT

PLS/UNT=2
CHG　　　　OK

UNT/PLS=0.5
CHG　　　　OK

MaxFreq=100Hz
CHG　　　　OK

MaxFlo=5678.5 SCFM
CHG　　　　OK

*High Limit Alarm*

OUT= HiFloAlm
NXT　　　　OK

HiFloAlm=500 SCFM
CHG　　　　OK

*Low Limit Alarm*

OUT= LoFloAlm
NXT　　　　OK

LoFloAlm=100 SCFM
CHG　　　　OK

*High Temp Alarm*

OUT= HiTmpAlm
NXT　　　　OK

HiTmpAlm=300° F
CHG　　　　OK

*Low Temp Alarm*

OUT= LoTmpAlm
NXT　　　　OK

LoTmpAlm=10 F
CHG　　　　OK

*System Alarm*

OUT= SYSTEM ALM
NXT　　　　OK

**OPERATION**

## Operation

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

FLOW PARAMETER 1
DGN   UNT   PRM   EXIT

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

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

FLO UNT=SCFM
NXT                    OK

**STP**

*Deg F*
*Deg C*

TMP UNT=° F
NXT                    OK

TmpRef= 0 °F
CHG                    OK

*mmHG*
*Psia*
*bara*

PRES UNT=mmHG
NXT                    OK

PresRef=760
CHG                    OK

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

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*An ONICON Brand*

# Operation

*Fig. 4.7: FT2A Menu Tree - Parameter Menu 2*

```
                              FLOW PARAMETER 2
                              CAL   SPC   PRM   EXIT

           Level 2                                    Level 1

Calibration Table                                                           Parameters

    CAL TABLE              K fact = 0%                  Cutoff=12.5 SCFM        Flow cutoff in selected units
TB1 (TB2) (TB3)  EXIT      CHG            OK            CHG            OK

                           RESTORE DATABASE?            A2=0.0233              Pipe Area in m² or ft²
  sensor voltage           YES             NO   Level 2 CHG            OK
  for point #1
                           RESET CRC?                   Filter=0.8            Flow Exponential Filter
                           YES             NO           CHG            OK
Volt1 = 0.2479
CHG   PRV   NXT   EXIT                                  HiFloAlm=0 SCFM       High Flow Alarm in selected
                                                        CHG            OK     units

Flo1 = 0.0                                              LoFloAlm=0 SCFM       Low Flow Alarm in selected
CHG   PRV   NXT   EXIT                                  CHG            OK     units

  velocity in Meter/                                    HiTempAlm=0 °F        High Temperature Alarm in
  hour for point #1                                     CHG            OK     selected units

Volt20 = 1.2479                                         LoTempAlm=0 °F        Low Temperature Alarm in
CHG   PRV   NXT   EXIT                                  CHG            OK     selected units

Flo20 = 7046.5
CHG   PRV   NXT   EXIT       Cycle through
                            up to 20 settings
```

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# Operation

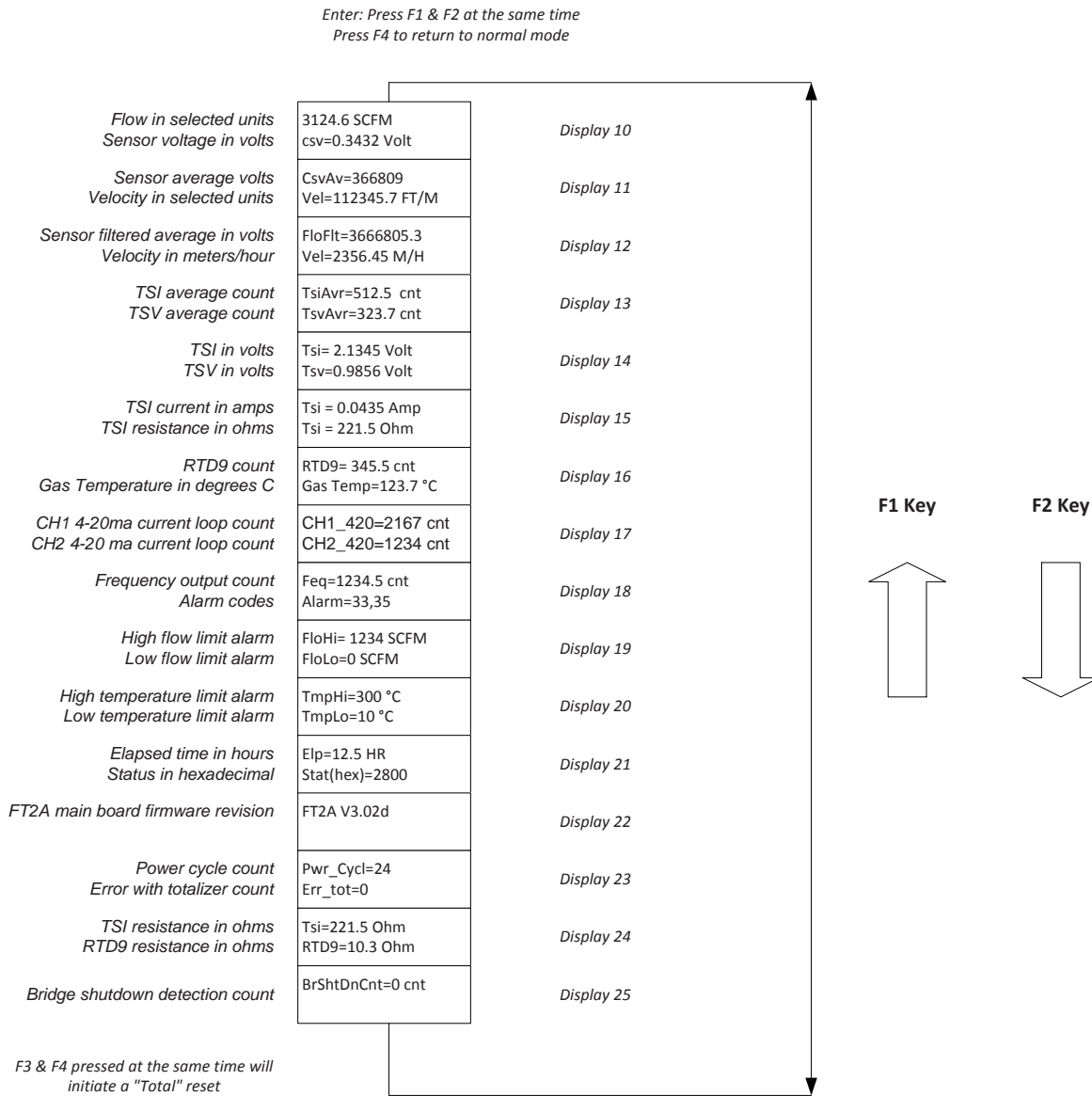*Fig. 4.8: FT2A Menu Tree - Display Menu*



**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

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

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

| | | |
|---|---|---|
| Flow in selected units<br>Sensor voltage in volts | 3124.6 SCFM<br>csv=0.3432 Volt | Display 10 |
| Sensor average volts<br>Velocity in selected units | CsvAv=366809<br>Vel=112345.7 FT/M | Display 11 |
| Sensor filtered average in volts<br>Velocity in meters/hour | FloFlt=3666805.3<br>Vel=2356.45 M/H | Display 12 |
| TSI average count<br>TSV average count | TsiAvr=512.5  cnt<br>TsvAvr=323.7 cnt | Display 13 |
| TSI in volts<br>TSV in volts | Tsi= 2.1345 Volt<br>Tsv=0.9856 Volt | Display 14 |
| TSI current in amps<br>TSI resistance in ohms | Tsi = 0.0435 Amp<br>Tsi = 221.5 Ohm | Display 15 |
| RTD9 count<br>Gas Temperature in degrees C | RTD9= 345.5 cnt<br>Gas Temp=123.7 °C | Display 16 |
| CH1 4-20ma current loop count<br>CH2 4-20 ma current loop count | CH1_420=2167 cnt<br>CH2_420=1234 cnt | Display 17 |
| Frequency output count<br>Alarm codes | Feq=1234.5 cnt<br>Alarm=33,35 | Display 18 |
| High flow limit alarm<br>Low flow limit alarm | FloHi= 1234 SCFM<br>FloLo=0 SCFM | Display 19 |
| High temperature limit alarm<br>Low temperature limit alarm | TmpHi=300 °C<br>TmpLo=10 °C | Display 20 |
| Elapsed time in hours<br>Status in hexadecimal | Elp=12.5 HR<br>Stat(hex)=2800 | Display 21 |
| FT2A main board firmware revision | FT2A V3.02d | Display 22 |
| Power cycle count<br>Error with totalizer count | Pwr_Cycl=24<br>Err_tot=0 | Display 23 |
| TSI resistance in ohms<br>RTD9 resistance in ohms | Tsi=221.5 Ohm<br>RTD9=10.3 Ohm | Display 24 |
| Bridge shutdown detection count | BrShtDnCnt=0 cnt | Display 25 |

**F1 Key**          **F2 Key**

F3 & F4 pressed at the same time will
initiate a "Total" reset

## Precautions  GB

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

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

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

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

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

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

## Precauciones  ES

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

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

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

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

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

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

# Maintenance

## Précautions (FR)

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

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

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

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

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

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

## Vorsichtsmaßnahmen (DE)

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

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

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

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

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

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

## Maintenance

**MAINTENANCE**

### Broken or Damaged Probe
If the sensor is broken or damaged, the probe and electronics must be returned to the factory. A new sensor will be installed and calibrated.  Refer to "Returning Your Meter" on page 93.

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

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

⚠ **WARNING!**

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

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

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

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# Maintenance

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

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

**CAUTION!** Never remove the restraint cable without first closing the Ball Valve and bleeding off pressure.

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

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

**Step 1 - Remove the Probe from the Flow Stream**

1. Disconnect power from the meter.

    **NOTE!** At 125psig of max system pressure, the probe will have approximately 66 lbs. of force pushing it out.

2. System pressure may force the probe out of the retractor when the Swage Nut is loosened. Hold the flow meter to counteract the force of the system pressure, and carefully loosen and unscrew the Swage nut.

3. Close the ball valve all the way.

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

*Figure 5.1*



Swage Nut,
1 1/8" Wrench

Swage Fitting,
1 1/4" Wrench

## Maintenance

### Step 2 - Remove the Probe from the Retractor Body

4. After removing the probe from the flow stream (#1-4 on previous page), slowly loosen the Swage Fitting (see figure 8.2), until the pressure in the retractor is relieved.

5. Retighten the Swage Fitting.

6. Remove the Collar Clamp by using a 3/16" Hex Key.

7. Carefully slide the probe out of the retractor while supporting the meter.

*Figure 5.2*



COLLAR SPACER

COLLAR CLAMP

SWAGE NUT

SWAGE FITTING

BALL VALVE

# Maintenance

**How to Insert the Probe into the Flow Stream (Valve closed, System Pressurized)**
1.  Carefully, slide the probe into the retractor.
2.  Install the collar clamp just below the collar spacer, and tighten it in place on the probe. Slide the probe back out of the retractor until the cable is straight and taut.

*Figure 5.3*



COLLAR SPACER

COLLAR CLAMP

SWAGE NUT

SWAGE FITTING

BALL VALVE

**NOTE!** At a maximum system pressure of 150psig, the force required to push the probe in place to tighten the Swage Nut will be approximately 66 lbs.

## Maintenance

3. Slowly open the ball valve to the full open position. Push the meter and probe into the pipe, then hand tighten the Swage Nut onto the Swage Fitting.

4. Verify that the probe is aligned with the centerline of the pipe, and pointed in the direction of flow.

*Figure 5.4*



SWAGE NUT & FERRULES

SWAGE FITTING

5. Secure the probe in place by tightening the Swage Nut with a 1 1/8" wrench and a 1 1/4" wrench on the Swage Fitting.

6. Power may now be applied to the meter.

# Troubleshooting

**Troubleshooting**

⚠️ **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.

| Problem | Possible Cause | Action |
|---------|----------------|--------|
| Display Error | Display not operating properly. | Check status of LP1 on the display board. Is green LED blinking once per second?<br>If LED is not blinking, cycle power to reset meter.  Call Fox Tech Support. |
| Meter does not read up to full scale | Calibration table may be corrupted | •Check the calibration table for a corrupted location.<br>•Enter the password 9111.<br>•Start on p. 46 of the FT2A manual and follow the steps to get to Flow Parameters 2 menu screen.<br>•Select CAL (F1)<br>•Select NXT (F1) to cycle through calibration table to verify entries match calibration certificate.<br>•Check for CRC error code |
| Velocity measurement seems low | 1.Probe not oriented properly<br><br>2.Sensor dirty | 1.Orient probe per installation sections: Insertion (p. 10), Inline (p. 14).<br><br>2.Clean sensor (p. 62) |

**TROUBLESHOOTING**

**Troubleshooting** *(cont'd)*

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

# Troubleshooting

**Troubleshooting** *(cont'd)*

| Problem | Possible Cause | Action |
|---------|----------------|--------|
| Velocity measurement is erratic or fluctuating | 1.Very turbulent flow | 1.Increase dampening (see filter settings in "Flow Parameters" on p. 46) |
| | 2.Sensor dirty | 2.Clean sensor (Refer to Maintenance section, p. 62) |
| | 3.Sensor broken | 3.Return flow meter to Fox for repair (Refer to p. 93 for shipping instructions) |
| | 4.Probe not mounted securely | 4.Remount probe (see Installation section, p. 10 and p. 14); must be mounted securely without vibration.  If vibration persists, choose a new mounting location without vibration. |
| | 5.Malfunction in flow meter | 5.Return flow meter to Fox for repair (Refer to p. 93 for shipping instructions) |
| | 6.Meter installed incorrectly | 6.Re-install meter according to instructions (Refer to installation section, p. 10 and p. 14) |

**Installation Problems**
The following is a summary listing of problems that may be encountered with the installation of the FT2A Thermal Mass Flow Meter.

1.  *Improper wiring connections for power and/or 4-20mA output signal.*
    The FT2A requires a separate power source for the main board and the two 4-20mA output signals.  Two wires supply 24VDC power to the main board. Two wires are used for each of the 4-20mA output signals. Refer to Figure 3.4 and Figure 3.5 (p. 25).  Also refer to "Wiring Precautions" and "Helpful Hints" in Wiring section (p. 20) for further guidance.

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

3.  *Flow measurement seems inaccurate.*
    •   Check to ensure that the flow meter is installed so that the Flow Direction Arrow engraved on the flat surface of the fitting below the electronics housing is properly pointing in the direction of flow. Refer to "Fig. 2.4: Orientation of Type Flow Meter" on page 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. 12).
    •   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 Parameters, p. 46).  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.

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**Installation Problems (Cont'd)**

5. *Flow meter is not responding to flow.*
   This problem could be caused by a number of reasons:
   • Check to ensure adequate power is supplied to the flow meter. If things appear to be correct, perform this functional test before calling Fox.  Carefully remove the probe and sensor from the pipe or flow body.  **CAUTION!** the sensor 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. 50).  Check meter data for any non-whole numbers and call customer service for assistance.

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

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

**TROUBLESHOOTING**

### Alarm Codes

Information to diagnose and clear alarm codes is on p. 57 under the Menu Tree section. Enter password (9111) and follow the block diagram to get to the section affected by the error code.

| Alarm Code | Reason | Action |
|---|---|---|
| 13 | Flow rate above high limits | Refer to the PARAMETER MENU 2 section on p. 46 of this Manual to verify limit is within range. Check ALM = HiFloAlm under PRM. |
| 14 | Flow rate below low limits | Refer to the PARAMETER MENU 2 section on p. 46 of this Manual to verify limit is within range. Check ALM = LoFloAlm under PRM. |
| 15 | Temperature above high limits | Refer to the PARAMETER MENU 2 section on p. 46 of this Manual to verify limit is within range. Check ALM=HiTempAlm under PRM. |
| 16 | Temperature below low limits | Refer to the PARAMETER MENU 2 section on p. 46 of this Manual to verify limit is within range. Check ALM = LoTempAlm |
| 22 | Sensor out of range | Refer to the ENGINEERING DISPLAY MENU on p. 59 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. |
| 23 | Velocity out of calibration table range | Refer to the ENGINEERING DISPLAY MENU on p. 59 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. |
| 24 | Check settings | One or more internal settings are corrupted or out of spec. Contact Fox Service for instructions to verify settings. |
| 25 | Simulation mode | Meter is in Simulation Mode. Refer to the PARAMETER MENU 1 section on p. 52 of this Manual. Use the SIM Section under Diagnostics to return to normal operation. |
| 26 | Frequency output over range | Refer to the DIGITAL OUTPUT MENU on p. 55 of this Manual. Verify the Frequency Output settings are within limits. |
| 32 | 4-20mA for flow rate is out of range | Refer to the MAIN MENU on p. 54 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4-20mA. |
| 33 | 4-20mA for temperature is out of range | Refer to p. 36 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4-20mA. Channel #2 can be set for flow or temperature. Be sure to check the Alarm limits (refer to p. 46). |
| 34 | Busy | Meter is recalculating new parameters. |

# Troubleshooting

| Alarm Code | Reason | Action |
|---|---|---|
| 35 | Sensor Bridge Shutdown | The FT2A probe is getting too hot.  Open wiring compartment and check sensor wiring. |
| 36 | Database CRC Error | Refer to the Reset CRC section on 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. |
| 37 | Totalizer Error Detected | See "Reset the Total and Elapsed Time" on p. 50 for steps to clear Error Code. Contact Fox for possible causes. |

## Appendices

**APPENDICES**

### 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, MMSCFM, SMPS, SM3/D, SM3/H, SM3/M, LB/S, LB/M, LB/H, LB/D, KG/S, KG/M,
   KG/H, SLPM, SFPM, MT/H

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

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

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## Operating Specs (cont'd)

Full Scale Flow Ranges for In-Line Flow meters:

| Size | SCFM | MSCFD | NM$^3$/hr |
|------|------|-------|-----------|
| 0.25" | 0-7.5 | 0-10.8 | 0-11.8 |
| 0.5" | 0-125 | 0-180 | 0-200 |
| 0.75" | 0-220 | 0-320 | 0-350 |
| 1" | 0-360 | 0-520 | 0-570 |
| 1.25" | 0-625 | 0-900 | 0-990 |
| 1.5" | 0-840 | 0-1,220 | 0-1,325 |
| 2" | 0-1,400 | 0-2,020 | 0-2,210 |
| 2.5" | 0-2,000 | 0-2,880 | 0-3,150 |
| 3" | 0-3,100 | 0-4,440 | 0-4,890 |
| 4" | 0-5,300 | 0-7,650 | 0-8,360 |
| 6" | 0-12,000 | 0-17,340 | 0-18,930 |

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

Gas Pressure (maximum):
  Insertion: 500 psig (34.5 barg)
  Inline with NPT: 500 psig (34.5 barg)
  Inline with 150lb. flange: 230 psig (16 barg)
  Retractor Assembly: 125 psig (8.62 barg)
  High pressure (crank) retractor: NPT 600 psig (41.4 barg), ANSI 150 flange & ANSI 300 flange, no valve supplied.
  Check with factory for higher pressure options.
  **NOTE!** Pressure ratings stated for temperature of 100°F (38°C).

Relative Humidity: 90% RH maximum, non-condensing

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)

**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.

## Appendices

**Operating Specs (cont'd)**
Outputs:

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

Isolated pulse output 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); 20mA 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.

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

**Physical Specs**
Sensor material:
316 stainless steel standard; 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.

Insertion Flow Meter Installation:
Fox-supplied compression fitting connects to customer-supplied ¾" female coupling welded to pipe.

# Appendices

**Agency Approvals**
CE:  Approved
EMC Directive; 2004/108/EC
Emissions and Immunity Testing: EN61326-1:2008
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

**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:

```
SWITCH TO CRV 1?
 NO                    YES
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
PASSWORD:_
 UP      DN     NXT     OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
SWITCH TO CRV 1
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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**3) Programming Contact Input for Curve Switching:**
Enter the menu using steps outlined in "Discrete Input Settings" section (p. 40) 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.

```
INP=SWITCH CRV
 NXT                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

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

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

```
DNS1 = 0.9876
 CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

```
DNS2 = 1.2876
 CHG                    OK
```
[ F1 ]  [ F2 ]  [ F3 ]  [ F4 ]

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

Helpful Hint:
    From normal display mode, press F4 to view the current gas curve selection.

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

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

```
20mA = 500SCFM
 CHG              OK
```
F1   F2   F3   F4

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

```
4mA = 0
 CHG              OK
```
F1   F2   F3   F4

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

```
20 maCv2=450 SCFM
 CHG              OK
```
F1   F2   F3   F4

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

```
4 maCv2=0
 CHG              OK
```
F1   F2   F3   F4

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

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# Appendices

**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

*Fig. 7.1 Local Insertion Meter with Retractor Dimensions*



*Table 7.1  Local Insertion Meter with Retractor*

| Probe Size | Probe Size | Dimension "LL" ± .10 |
|---|---|---|
| [model code] | [inches] | [inches / centimeters] |
| 15R | 15" | 15.0" (38.1cm) |
| 18R | 18" | 18.0" (45.7cm) |
| 24R | 24" | 24.0" (61.0cm) |
| 30R | 30" | 30.0" (76.2cm) |
| 36R | 36" | 36.0 " (91.4cm) |

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*Fig. 7.2 Remote Insertion Meter with Retractor Dimensions*

*Table 7.2  Remote Insertion Meter with Retractor*

| Probe Size | Probe Size | Dimension "LL" ± .10 |
|---|---|---|
| [model code] | [inches] | [inches / centimeters] |
| 15R | 15" | 15.0" (38.1cm) |
| 18R | 18" | 18.0" (45.7cm) |
| 24R | 24" | 24.0" (61.0cm) |
| 30R | 30" | 30.0" (76.2cm) |
| 36R | 36" | 36.0 " (91.4cm) |

## Appendices

*Fig. 7.3 Insertion Meter Dimensions*

*Table 7.3 Insertion Meter with 316 stainless steel probe*

| Probe Size | Probe Size | Dimension "LL" ± .10 | Dimension "HH" ± .25 |
|---|---|---|---|
| [model code] | [inches] | [inches / centimeters] | [inches / centimeters] |
| 06I | 6" | 6.0" (15.2cm) | 14.4" (36.7cm) |
| 09I | 9" | 9.0" (22.9cm) | 17.4" (44.3cm) |
| 12I | 12" | 12.0" (30.5cm) | 20.4" (51.9cm) |
| 15I | 15" | 15.0" (38.1cm) | 23.4" (59.5cm) |
| 18I | 18" | 18.0" (45.7cm) | 26.4" (67.1cm) |
| 24I | 24" | 24.0" (61.0cm) | 32.4" (82.4cm) |
| 30I | 30" | 30.0" (76.2cm) | 38.4" (97.6cm) |
| 36I | 36" | 36.0 " (91.4cm) | 44.4 " (112.9cm) |

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*Fig 7.4: Insertion Remote Meter Dimensions*

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

| Probe Size [model code] | Probe Size [inches] | Dimension "LL" ± .10 [inches / centimeters] | Dimension "HH" ± .25 [inches / centimeters] |
|---|---|---|---|
| 06I | 6" | 6.0" (15.2cm) | 11.9" (30.2cm) |
| 09I | 9" | 9.0" (22.9cm) | 14.9" (37.9cm) |
| 12I | 12" | 12.0" (30.5cm) | 17.9" (45.5cm) |
| 15I | 15" | 15.0" (38.1cm) | 20.9" (53.1cm) |
| 18I | 18" | 18.0" (45.7cm) | 23.9" (60.7cm) |
| 24I | 24" | 24.0" (61.0cm) | 29.9" (76.0cm) |
| 30I | 30" | 30.0" (76.2cm) | 35.9" (91.2cm) |
| 36I | 36" | 36.0" (91.4cm) | 41.9" (106.4cm) |

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

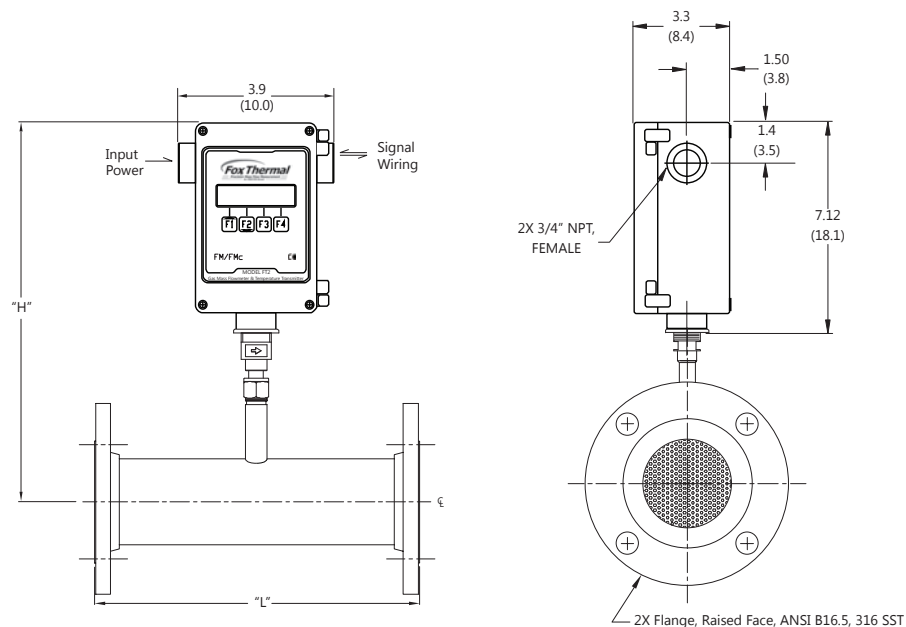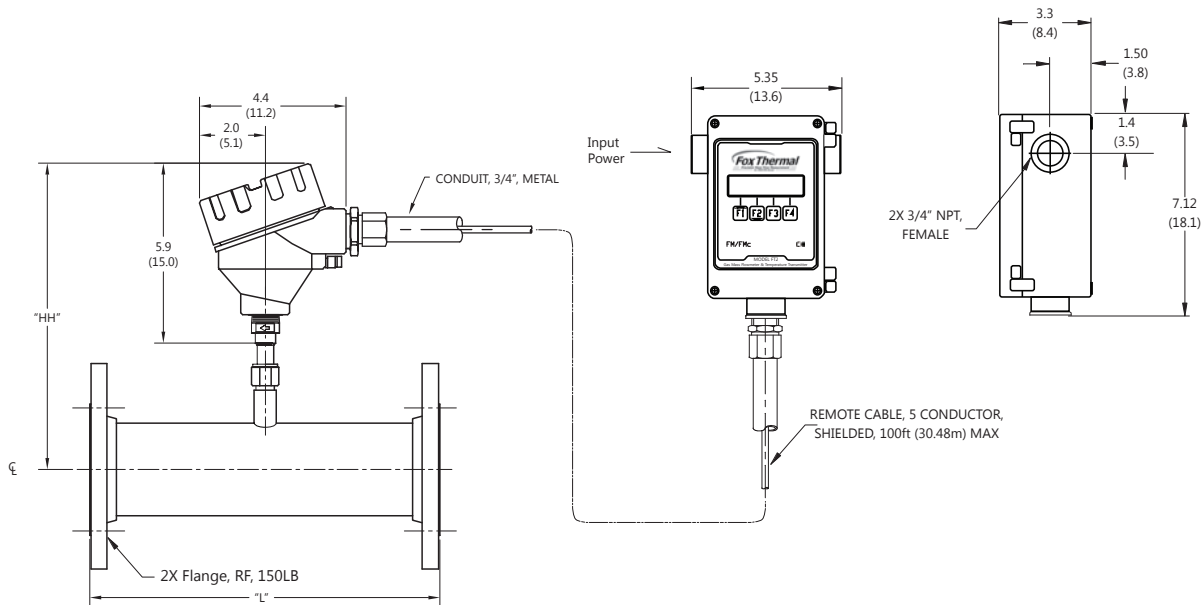*Table 7.5  Inline Meter with 316 stainless steel flow body and NPT End Connections*

| Body Size [model code] | Body Size [inches] | Dimension "L" ± .10 [inches] | Dimension "H" ± .25 [inches / centimeters] |
|---|---|---|---|
| 025P | 0.25" | 5.8" | 12.5" (31.8cm) |
| 05P | 0.50" | 12" | 12.5" (31.8cm) |
| 075P | 0.75" | 12" | 12.5" (31.8cm) |
| 10P | 1.00" | 12" | 12.5" (31.8cm) |
| 125P | 1.25" | 12" | 12.5" (31.8cm) |
| 15P | 1.50" | 12" | 12.5" (31.8cm) |
| 20P * | 2.00" | 12" | 12.5" (31.8cm) |
| 25P * | 2.50" | 18" | 12.6" (32.0cm) |
| 30P * | 3.00" | 18" | 12.6" (32.0cm) |
| 40P * | 4.00" | 18" | 13.1" (33.3cm) |

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

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*Fig. 7.6: Inline Remote Meter with 316 Stainless Steel Flow Body and NPT End Connections Dimensions*



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

| Body Size | Body Size | Dimension "L" ± .10 | Dimension "HH" ± .25 |
|---|---|---|---|
| [model code] | [inches] | [inches] | [inches / centimeters] |
| 025P | 0.25" | 5.8 | 9.9" (25.1cm) |
| 05P | 0.50" | 12" | 9.9" (25.1cm) |
| 075P | 0.75" | 12" | 9.9" (25.1cm) |
| 10P | 1.00" | 12" | 9.9" (25.1cm) |
| 125P | 1.25" | 12" | 9.9" (25.1cm) |
| 15P | 1.50" | 12" | 9.9" (25.1cm) |
| 20P * | 2.00" | 12" | 9.9" (25.1cm) |
| 25P * | 2.25" | 18" | 10.0" (25.4cm) |
| 30P * | 3.00" | 18" | 10.0" (25.4cm) |
| 40P * | 4.00" | 18" | 10.5" (26.7cm) |

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

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



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

| Body Size [model code] | Body Size [inches] | Dimension "L" ± .10 [inches] | Dimension "H" ± .25 [inches / centimeters] |
|---|---|---|---|
| 05F | 0.50" | 12" | 12.5" (31.8cm) |
| 075F | 0.75" | 12" | 12.5" (31.8cm) |
| 10F | 1.00" | 12" | 12.5" (31.8cm) |
| 125F | 1.25" | 12" | 12.5" (31.8cm) |
| 15F | 1.50" | 12" | 12.5" (31.8cm) |
| 20F * | 2.00" | 12" | 12.5" (31.8cm) |
| 25F * | 2.50" | 18" | 12.6" (32.0cm) |
| 30F * | 3.00" | 18" | 12.6" (32.0cm) |
| 40F * | 4.00" | 18" | 13.1" (33.3cm) |
| 60F | 6.00" | 24" | 14.2" (36.1cm) |

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

# Appendices

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



*Table 7.8 Inline Remote Meter with stainless steel flow body and 150lb. RF Flange End Connections*

| Body Size | Body Size | Dimension "L" ± .10 | Dimension "HH" ± .25 |
|---|---|---|---|
| [model code] | [inches] | [inches] | [inches / centimeters] |
| 05F | 0.50" | 12" | 9.9" (25.1cm) |
| 075F | 0.75" | 12" | 9.9" (25.1cm) |
| 10F | 1.00" | 12" | 9.9" (25.1cm) |
| 125F | 1.25" | 12" | 9.9" (25.1cm) |
| 15F | 1.50" | 12" | 9.9" (25.1cm) |
| 20F * | 2.00" | 12" | 9.9" (25.1cm) |
| 25F * | 2.50" | 18" | 10.0" (25.4cm) |
| 30F * | 3.00" | 18" | 10.0" (25.4cm) |
| 40F * | 4.00" | 18" | 10.5" (26.7cm) |
| 60F | 6.00" | 24" | 11.6" (29.5cm) |

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

**APPENDICES**

Model FT2A — top-left header banner

## Appendices

**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

**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**

(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.

(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.

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# Appendices

**Returning Your Meter**

The Fox Thermal 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
   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.foxthermal.com and you will hear from a Customer Service Rep within 1 business day of your requested update.

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

**DEFINITIONS**

**Glossary of Terms and Definitions**

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

# Definitions

| | |
|---|---|
| NPT | National Pipe Thread |
| PDA | Personal hand held computer |
| UNT | Unit |
| U/P | Unit per Pulse |
| PC | Personal Computer |
| P/U | Pulse per Unit |
| PIP A^2 | Pipe Area |
| PLC | Programmable Logic Controller |
| PRM | Parameters |
| PRS | Pressure |
| PSIA | Pounds per Square Inch Absolute |
| Pt | Point |
| PSW | Password |
| SIM | Simulation |
| SCF | Standard Cubic Feet |
| SCFM | Standard Cubic Feet per Minute |
| SCFH | Standard Cubic Feet per Hour |
| SCFD | Standard Cubic Feet per Day |
| SPC | Special Control |
| STP | Standard Temperature and Pressure |
| TMP | Temperature |
| TSI | Internal Variable |
| TSV | Internal Variable |
| 420 | 4-20mA output |

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**Wiring**

**Definition of Terms**

**Troubleshooting Tips**

**Information**

**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.**

**Indicates compliance with the applicable European Union Directives for Safety LVD (Low Voltage Directive 2006/95/EC), EMC (Electromagnetic Compatibility Directive 2004/108/EC), and PED (Pressure Equipment Directive 97/23/EC).**

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