Fox Thermal Instruments, Inc.

THERMAL MASS FLOW METER & TEMPERATURE TRANSMITTER

Model FT3

FOX THERMAL INSTRUMENTS, INC.
Fox is ISO 9001 certified

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104488
Rev. C

Notice

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

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Fox FT3 Manuals:

- **Fox FT3 Calibration Validation User's Guide**
- **Fox FT3 RS485 Modbus Manual**
- **Fox FT3 HART Manual**
- **Fox FT3 View™**

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Introduction

Welcome

Thank you for purchasing the Model FT3 Thermal Gas Mass Flow Meter and Temperature Transmitter from Fox Thermal Instruments. The Model FT3 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.

Product Description

Theory of Operation

The Model FT3 is an innovative Thermal Mass Gas Flow Meter and Temperature Transmitter. It is microprocessor-based and field programmable. The FT3 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 FT3 flow meter maintains accurate flow measurement over a large temperature and pressure range.

Mass Flow

Mass Flow

The Model FT3 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 FT3 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

Calibration Validation

Calibration Validation

Fox has developed a method to validate the calibration of the flow meter in the field. This method is called Calibration Validation and it is made up of two distinct tests: CAL-V™ and Zero CAL-CHECK™. The goal of Calibration Validation is to provide operators with the ability to verify that the meter is capturing accurate data at scheduled recalibration times - or at any time - instead of sending the meter back to the factory for recalibration.

By performing CAL-V™ in the field, operators can verify that the meter is running accurately by testing the functionality of the sensor and its associated signal processing circuitry. This test can be done in the pipe and in normal processing conditions. The second test, Zero CAL-CHECK™, ensures the effectiveness and sensibility of the sensor at a "no flow" condition.

Flow Calibration

Flow Calibration

The Fox Calibration Lab maintains instrument calibration records on every flow meter. This data can also be accessed via a computer using FT3 View™ software within the instrument. Computer-generated calibration documents describe specific instrument details that can be sorted by serial number, tag number or customer purchase order.

Calibration files include details on process conditions, calibration fluid, line size and other information. All NIST-traceable equipment utilized for the calibration procedure is identified, as is the calibration history of all reference equipment.

In addition to the Calibration Certificate, a certified flow table that correlates current outputs with scaled units of flow is produced for each calibrated device.

I/O Description

I/O Description

The FT3 features two galvanically isolated 4 to 20mA analog outputs: one isolated digital output that can be used for frequency or alarm, one programmable discrete input and a USB connection for communication with a computer. FT3 View™ is a free Fox PC-based software program that displays flow meter readings and permits flow meter configuration.

The first 4 to 20mA output is for flow rate. The second 4 to 20mA output can be configured either for flow rate or process gas temperature. Both

Introduction

4 to 20mA outputs can be scaled by the user. The frequency output 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.

Industry standard communication options are available including HART or RS485 Modbus. Only one of these options can be provided in a single FT3 flow meter.

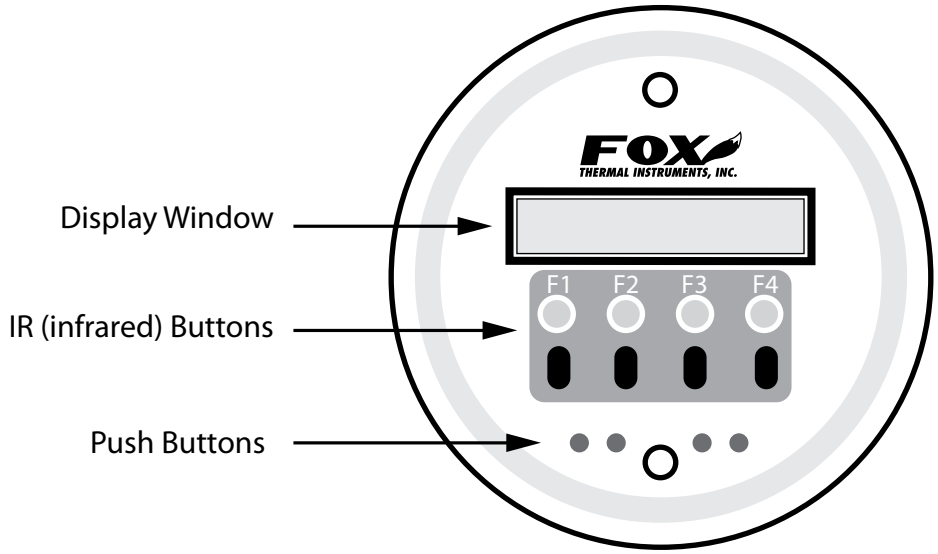
Display

FT3 Optional Display Panel & Configuration Panel

An optional Display and Configuration Panel shows flow rate and flow total in user selectable units, process gas temperature, elapsed time (number of hours since the totalizer was reset) and alarms. The configuration panel allows the user to change a variety of settings including 4 to 20mA scaling, frequency output scaling, flow and temperature units, reference temperature and pressure and many other parameters. The configuration panel's IR (infrared) buttons allow programming without removing the cover.

The FT3 display is a 2 line x 16 character display with 4 mechanical and 4 IR buttons. The IR and mechanical buttons perform the same function but the IR buttons can be used without opening the cover. The IR buttons can be disabled when the meter is used in snow or ice in order to avoid false key detection.

Fig. 1.1: FT3 Optional Display and Configuration Panel



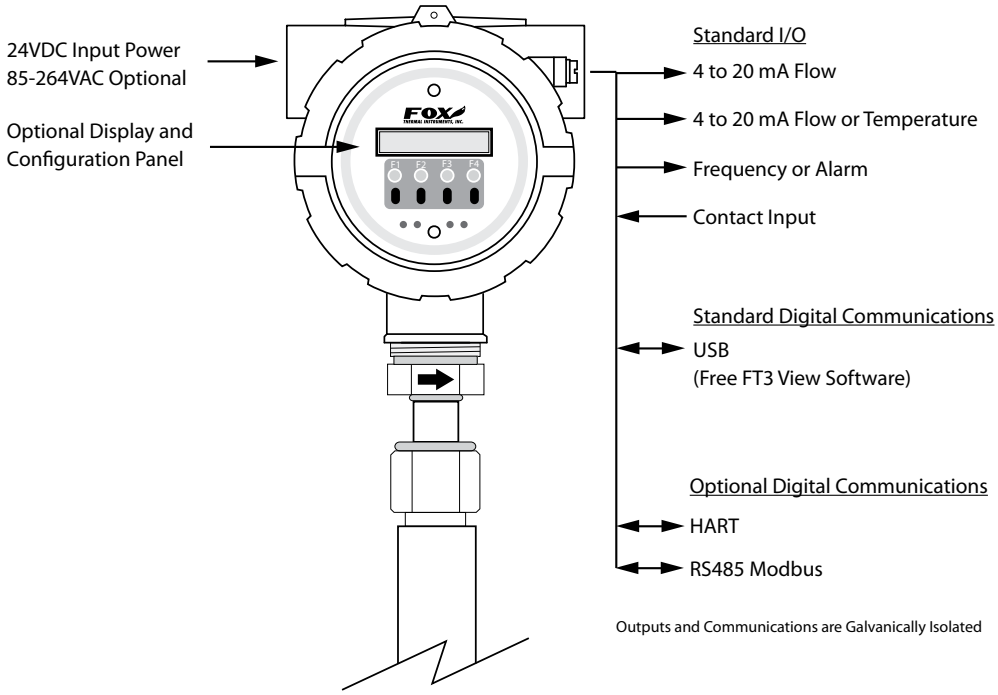
Introduction

FT3 Functional Diagram

FT3 Functional Diagram

The Fox Model FT3 provides two isolated 4 to 20mA outputs: one for flow rate and a second programmable for flow rate or temperature. An optional on-board 2 line x 16 character backlit LCD display is available to view flow rate, total flow, elapsed time, process gas temperature and alarms. The display is also used in conjunction with the Configuration Panel for field configuration of flow meter settings such as 4 to 20mA scaling, pulse output frequency scaling, pipe area, zero flow cutoff, flow filtering or damping, display configurations, diagnostics and alarm limits.

Fig. 1.2: FT3 Functional Diagram



Installation: General

Installation - Model FT3 Flow Meter

Scope

This section describes how to install the Fox Model FT3 Flow Meter and how to get started. Installation methods will vary according to the flow meter type (insertion or inline).

For Insertion Types:

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

For Inline Types:

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

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

General Precautions

The following general precautions should be observed:

1. Exercise care when handling the flow meter to avoid damaging the probe, sensor or enclosure.
2. The enclosure covers must be closed except during installation.
3. Mounting FT3 in direct sunlight can cause the temperature inside the enclosure to increase beyond design limits, resulting in failure of LCD display and reduced component life. It is recommended that a sunshade be installed to avoid direct sunlight.
4. Ensure the flow direction arrow points in the direction of flow.
5. Do not install the FT3 enclosure near an igniter, igniter-controller or switching equipment.
6. Do not install an external power supply in a cabinet containing an igniter controller or switching equipment.
7. Ensure that good engineering practices and applicable industry codes are followed throughout the installation process.
8. For accurate flow measurement: review flow meter placement instructions before installation to ensure a proper flow profile in the pipe.

Installation: Insertion Type

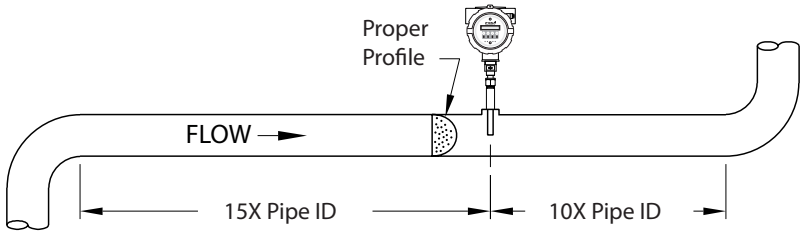
Insertion Flow Meter Lateral Placement

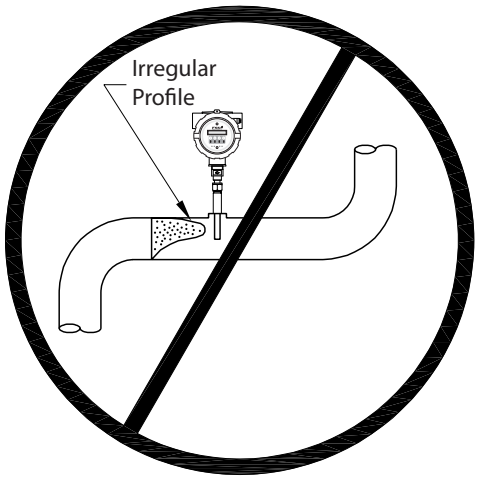
Instructions for Insertion Flow Meter Lateral Placement

Install the Model FT3 Insertion style flow meter so that it is far enough away from bends in the pipe, obstructions, or changes in line sizes to ensure a consistent flow profile. Fifteen diameters of straight pipe upstream and ten downstream are recommended.

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

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





Special Conditions of Use:

- Consult the manufacturer if dimensional information on the flameproof joints is necessary.
- Follow the manufacturer's instructions to reduce the potential of an electrostatic charging hazard.

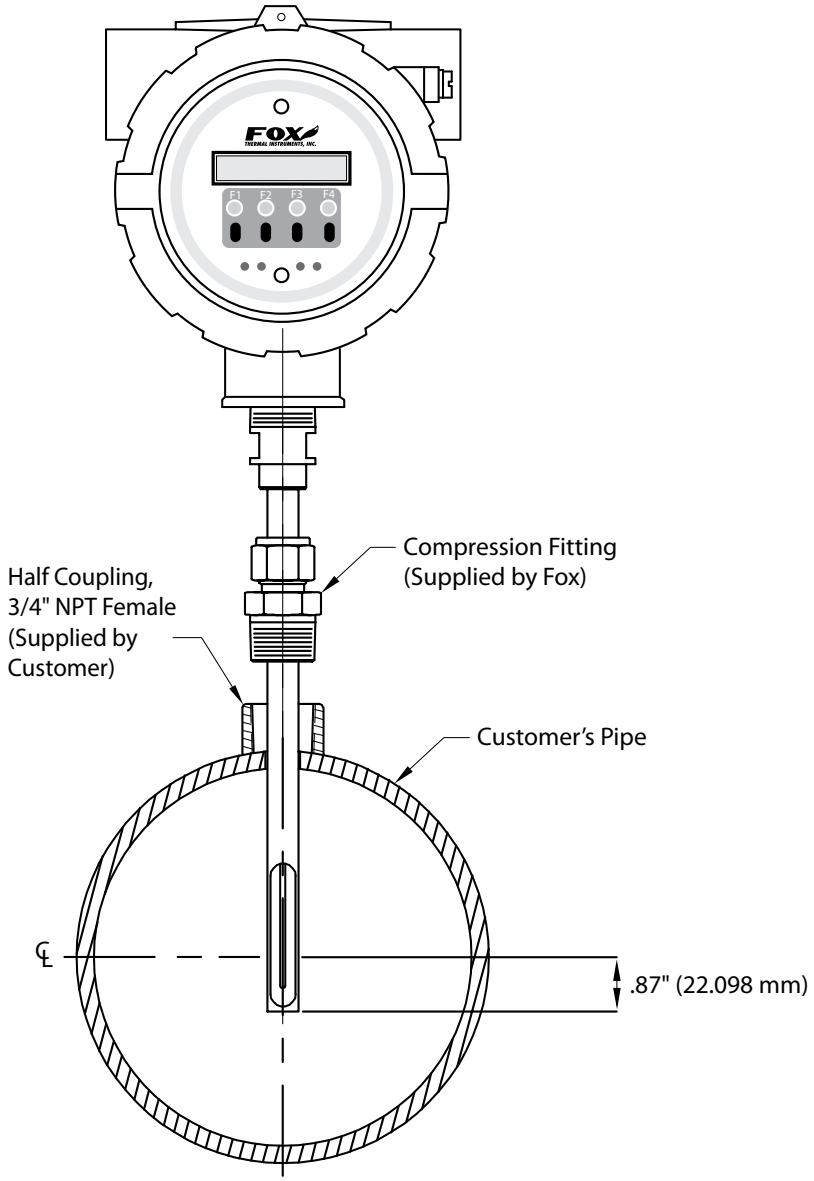
Installation: Insertion Type

Installation Depth

Installation Depth

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

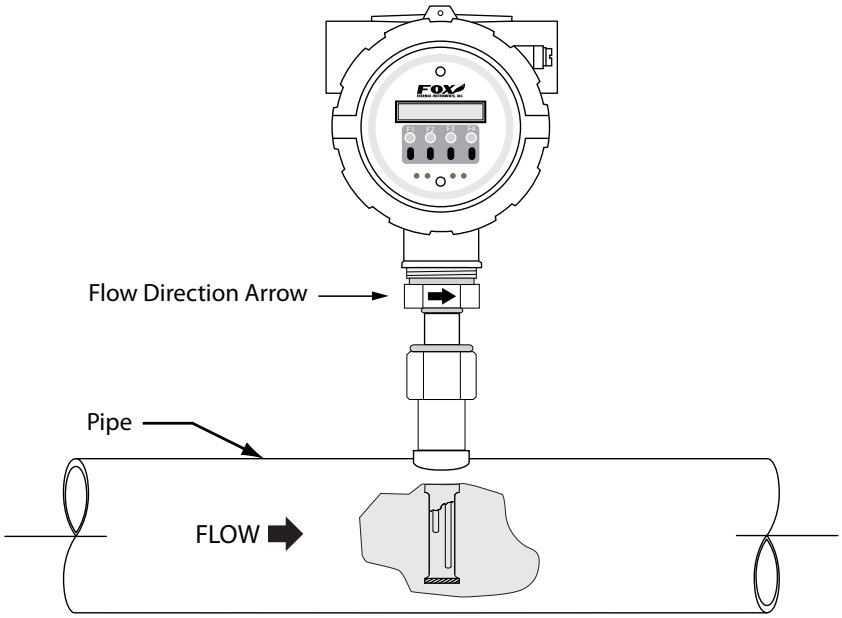
Fig. 2.2: Cross Section of Insertion Sensor Depth in Pipe



Installation: Insertion Type

Sensor Orientation - Direction of Flow

Fig. 2.3: Orientation of Insertion Type Flow Meter



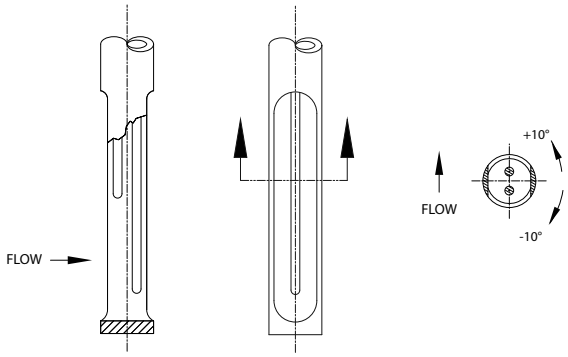
Note: Some flow meters are shipped with the sensor elements that are offset (see figure 2.4). Others are shipped with sensors that have equal length elements (see figure 2.5). The sensor type supplied was selected at the factory to be the best suited for your application. Follow the appropriate sensor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

Sensor Orientation - Unequal Length Sensors

Unequal Length Sensor Elements

Install the shorter sensor element upstream from the longer one.

Fig. 2.4: Unequal Length Sensor Elements

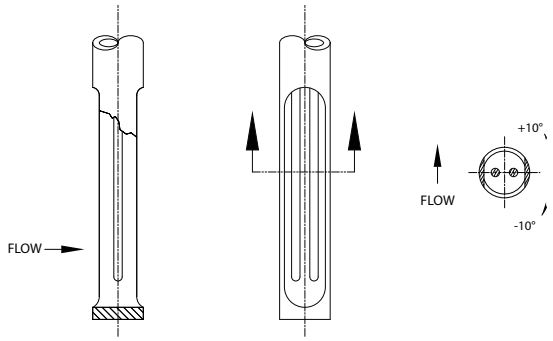


Installation: Insertion Type

Sensor Orientation - Equal Length Sensors

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

Fig. 2.5: Equal Length Sensor Elements



Mounting - Insertion Type

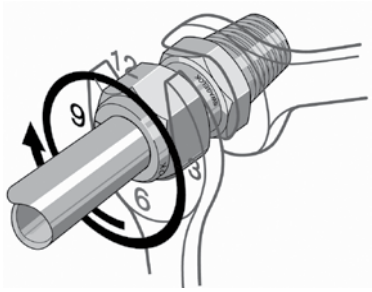
Insertion Mounting Instructions - Compression Fittings
The Model FT3 is mounted through a ¾" hole and a ¾" female NPT half coupling provided in the customer's pipe. Insertion style flow meters are not designed for use in pipes smaller than 1½".

- Install the compression fitting into the ¾-inch female NPT half coupling.
- When installing in a 2" pipe or larger, install the end of the probe 0.87" past the center line of the pipe and tighten the compression fitting nut (refer to figure 2.2 on p. 10).
- 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.

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

Note: Do not overtighten compression fitting.

Fig. 2.6: Proper Tightening of the Compression Fitting Nut



While holding the fitting body steady, tighten the nut one and one-quarter turn to the 9 o'clock position.

Installation: Inline Type

Flow Meter Placement - Inline Type

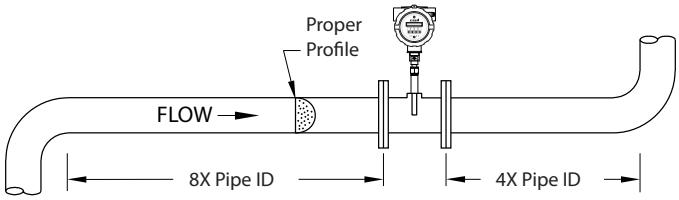
Instructions for Inline Flow Meter Placement
Install the Model FT3 Inline style flow meter so that it is far enough away from bends in the pipe, obstructions, or changes in line sizes to ensure a consistent flow profile. Eight diameters of straight pipe upstream and four downstream are recommended.

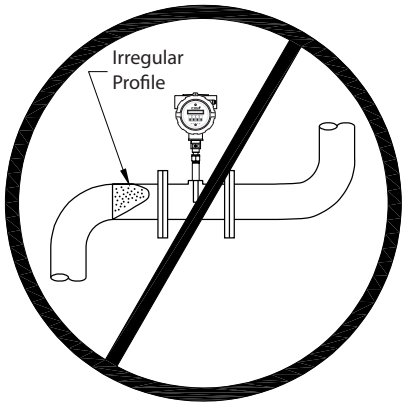
For example, a 2" pipe would require 16" upstream from the edge of the flow body and 8" downstream from the other end of the flow body, whereas a 4" pipe would require 32" upstream and 16" downstream.

The Model FT3 is welded, threaded or flanged to the customer's pipe. Care should be taken to ensure that the diameter of the mating pipe is the same diameter as the Model FT3 flow body or errors in flow readings can occur. The installation procedure should be a combination of the end user's best engineering practices, in compliance with local codes, and the manufacturer's recommendations.

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

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



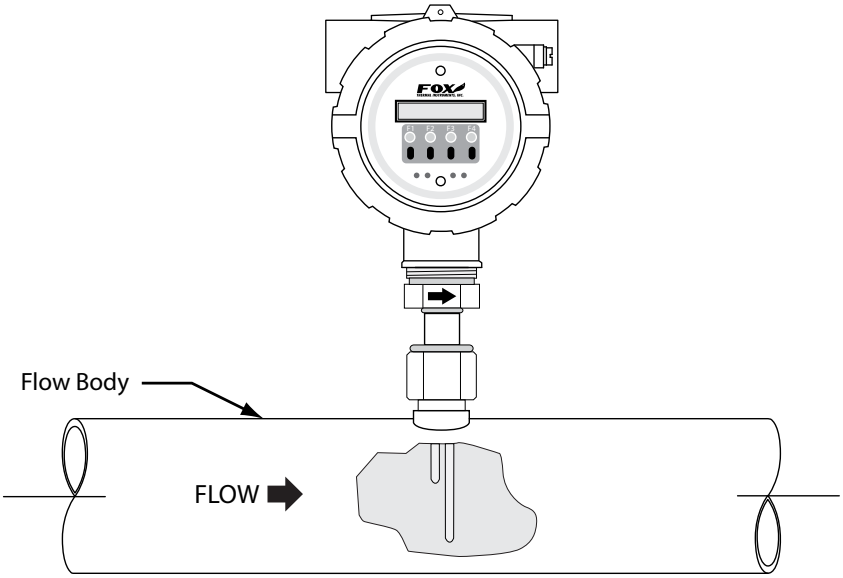


Installation: Inline Type

Flow Body Orientation - Inline Type

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

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



Mounting - Inline Type

Tightening Compression Fittings
The compression fitting has been placed according to the proper depth in the flow body by Fox factory technicians. After the flow body has been correctly fitted to the process pipe, the compression fitting may need to be tightened correctly (see figure 2.6 on p. 12).

Note:
- *Refer to the Fox FT3 Calibration Validation User's Guide for information on setting the field baseline for Zero CAL-CHECK™ tests if you plan to perform these tests in the pipe.*
- *Please save the PVC sensor cover that was shipped with your meter. It will be needed to perform Zero CAL-CHECK™ tests out of pipe.*

Wiring: General

Scope

Wiring Instructions

The FT3 enclosure has two separate conduit entries. The installation must maintain separation between input power and output signal wiring. Wiring is accomplished by removing the wiring compartment cover. Bring customer-supplied wires into the enclosure through the conduit access on the sides of the enclosure. Cut wires for a minimum service loop.

Precautions

Wiring Precautions

- WARNING - DO NOT OPEN WHEN ENERGIZED.
- WARNING - DO NOT OPEN WHEN 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.
- Do not install the FT3 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 entries using suitably certified plugs

Power Wiring

Power Wiring

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

Grounding

Grounding

The enclosure must be properly grounded with a quality earth ground to protect the electronics from static discharges. 16 gauge, stranded wire is recommended.

Signal 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 power and signal wires in the same conduit. Power wires must enter left-hand conduit entry. Signal and remote sensor (where applicable) must enter right-hand conduit entry.

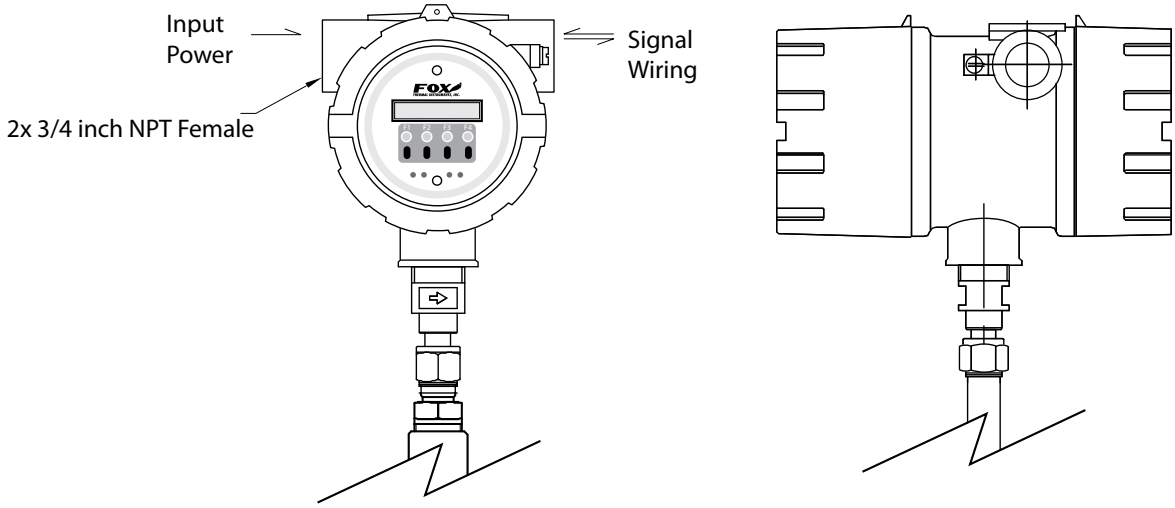
Wiring: Local Sensor

Local Wiring

Local Wiring

Local Wiring will be the same for both insertion and inline type FT3 flow meters.

Fig. 3.1: Local Wiring



Signal Wiring includes:
4 to 20mA, pulse, alarm output, contact input, remote sensor, USB, and communications options. Power input is 24VDC or optional 85-264VAC.

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.

Installation wiring: Obtain the correct length for the FT3 power and signal wires using one of these methods:

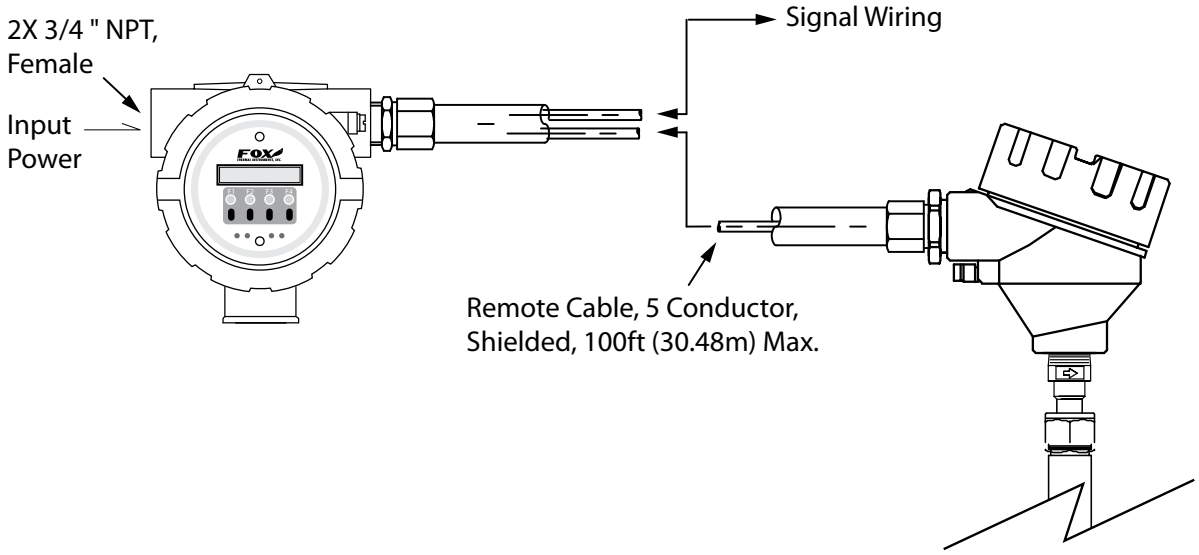
- Trim the wires to extend 2.5 inches out of the enclosure after the conduit and wires are routed to the FT3 (preferred method).
- Trim the wires to extend 6 inches from the end of the conduit before it is attached to the FT3.

Wiring: Remote Sensor Option

Remote Wiring

Remote Wiring
Remote wiring will be the same for both insertion and inline type FT3 flow meters.

Fig. 3.2: Remote Wiring



Signal Wiring includes:
4 to 20mA, pulse, alarm output, contact input, remote switch, USB, and communications options. Power input is 24VDC or optional 85-264VAC.

Helpful Wiring Hints:

1. Identify proper wire routing conduit ports before wiring the meter.
2. Pay close attention to differences in wiring methods between local & remote models.
3. Maximum installation length between the main enclosure and remote enclosure is 100ft (30.48m).
4. Recommended wiring gauges:
   - Power Supply and Earth Ground wires ≤ 16 AWG
   - Signal wires = 18-22 AWG
   - Remote wires = 18 AWG
5. Fox recommends that you use a small standard screwdriver to connect wires in enclosure.
6. Connect Power Source LAST (after all other connections are secured & checked).

Wiring: Remote Sensor

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

Five wire shielded cable required. The shielded cable should be run through a separate grounded steel conduit (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 has a wire resistance that does not exceed one ohm (18 AWG recommended).

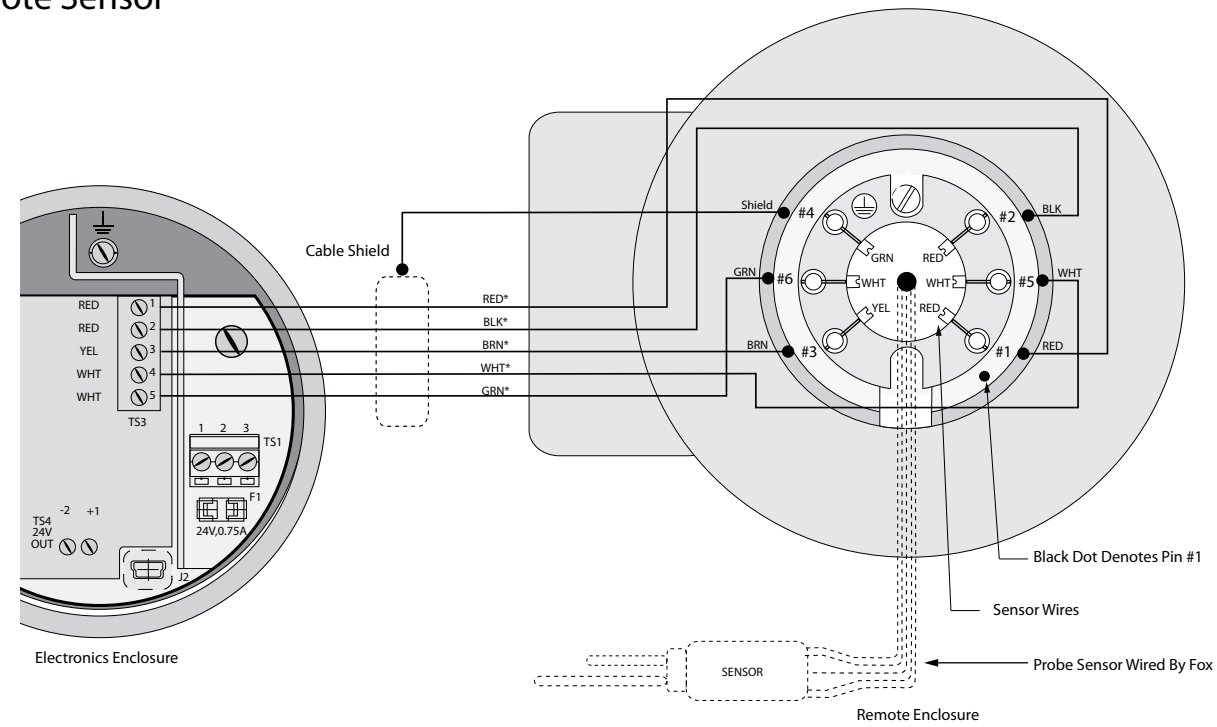
Do not connect the cable shield at the electronics enclosure end.

Use an extension cable to connect the terminals of the remote probe enclosure to connector TS3 of the electronics enclosure as shown in Figures 3.3 (p. 19) and Table 3.1 on the same page.

Wiring: Remote Sensor

Input Wiring Remote Sensor

Fig. 3.3: 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.**

Remote Sensor Cable Wiring

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

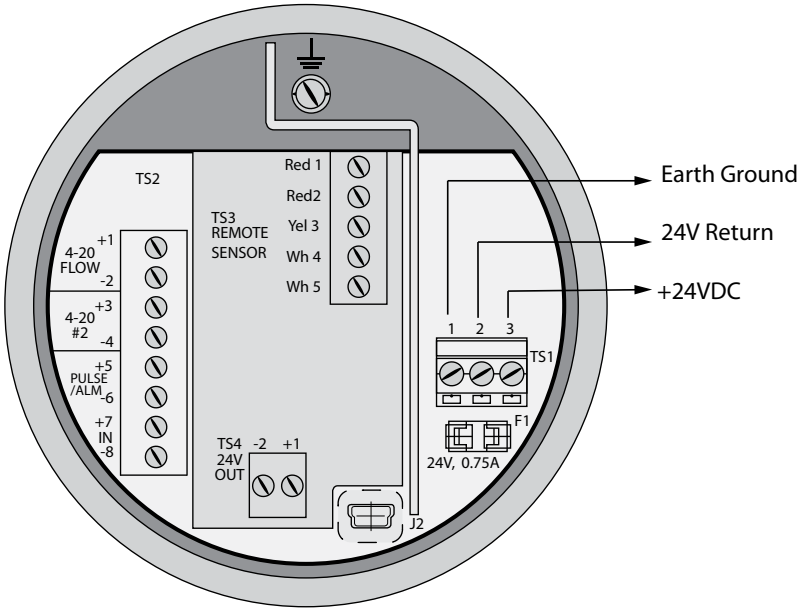
Wiring: Input Power

Power Input Wiring

Power Input Requirements: 24VDC Supply
External DC power supply must provide 24VDC ± 10%, at 750mA 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 24VDC Supply



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

Wiring: Input Power

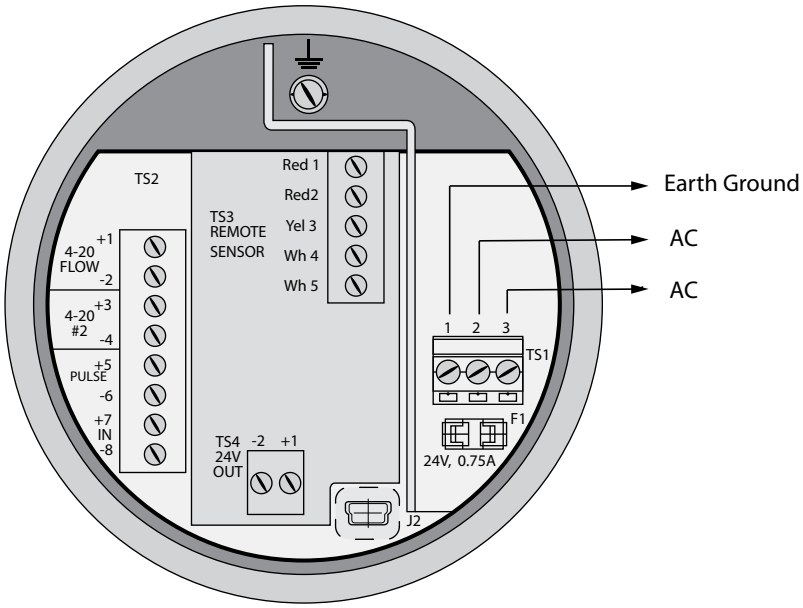
Power Input Wiring

Power Input Requirements: 85 to 264VAC supply

If the optional AC power supply is provided, the input power can be 85 to 264VAC.

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

Fig. 3.5: Connections for optional AC Power



Caution:

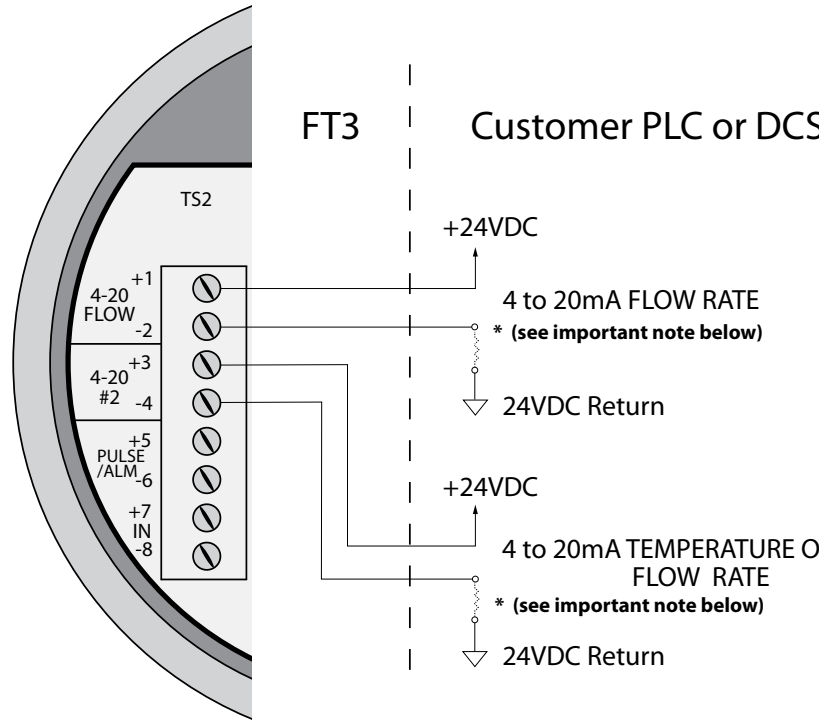
- Supply connection wiring must be rated for at least 90°C.

Wiring: Signal Wiring

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

4 to 20mA Output Wiring: Customer-Supplied Power Source
Bring the 4 to 20mA wiring in through the right-hand conduit hub. Connect FLOW RATE 4 to 20mA wiring to TS2, 1(+) & 2(-). Connect 4 to 20mA output #2 wiring to TS2, 3(+) & 4(-).

Fig. 3.6: 4 to 20mA Output Wiring for Customer-Supplied Power Source



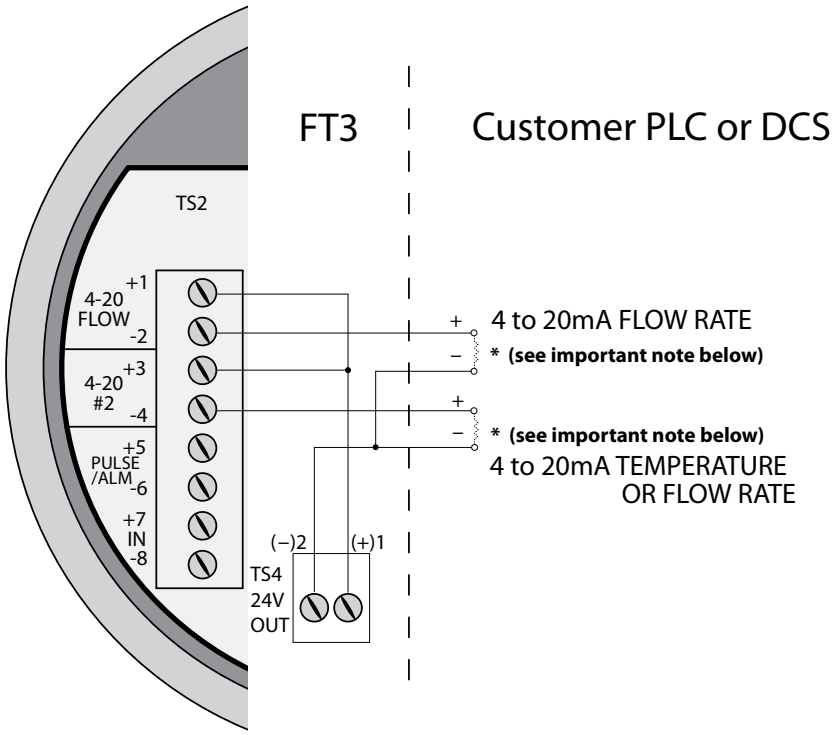
Important Note
The load resistor on the Fox Flow Meter 4 to 20mA signal is typically 250 ohms and is located in or at the customers PLC or DCS. A 250 ohm resistor in the 4 to 20mA line will result in a 1 to 5VDC signal to the PLC or DCS. Some PLC/DCS equipment has the load resistor built in to the unit;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

Wiring: Signal Wiring

4 to 20mA Loop Power Provided by FT3

4 to 20mA Output Wiring: Loop Power Provided by FT3
Bring the 4 to 20mA wiring in through the right-hand conduit hub. Connect the 4 to 20mA wiring to terminal blocks TS2 and TS4 as shown in the diagram below.

Fig. 3.7: 4 to 20mA Output Wiring for Loop Power Provided by FT3



Note: This wiring option is only available with the isolated 24V ouput power option.

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

Wiring: Frequency/Alarm Wiring

Frequency/Alarm Output Wiring

Frequency/Alarm Output Wiring

Bring frequency/alarm wiring in through the right-hand conduit hub. Connect to TS2, 5(+) & 6(-). The frequency/alarm output is an open collector circuit capable of sinking a maximum of 10mA of current. Frequency or Alarm selection is programmed using the display. Only one option, frequency or alarm, can be active at a time.

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

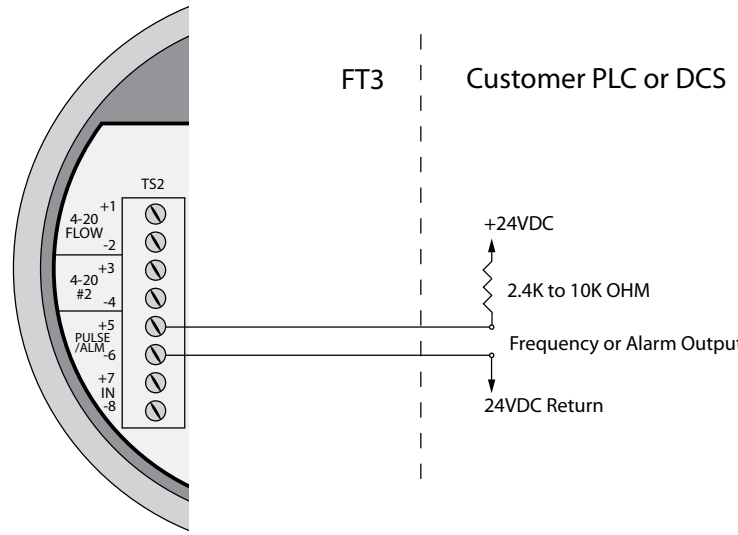
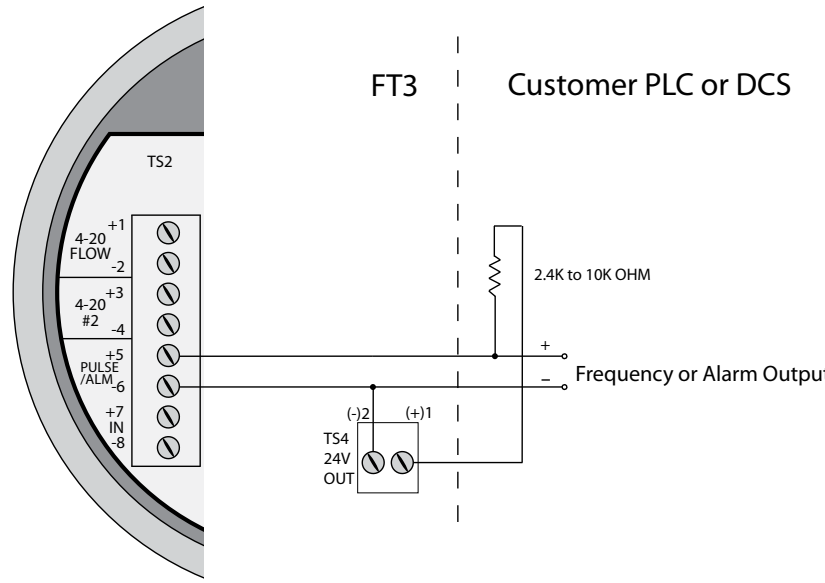


Fig. 3.9: Frequency/Alarm Output Local +24V Power Option



Note:

The FT3 Frequency/ Alarm output is typically used to drive digital circuitry or solid-state relays. The output of a solid state relay may, in turn, operate loads such as electromechanical relays or alarm indicators.

Wiring: Remote Switch

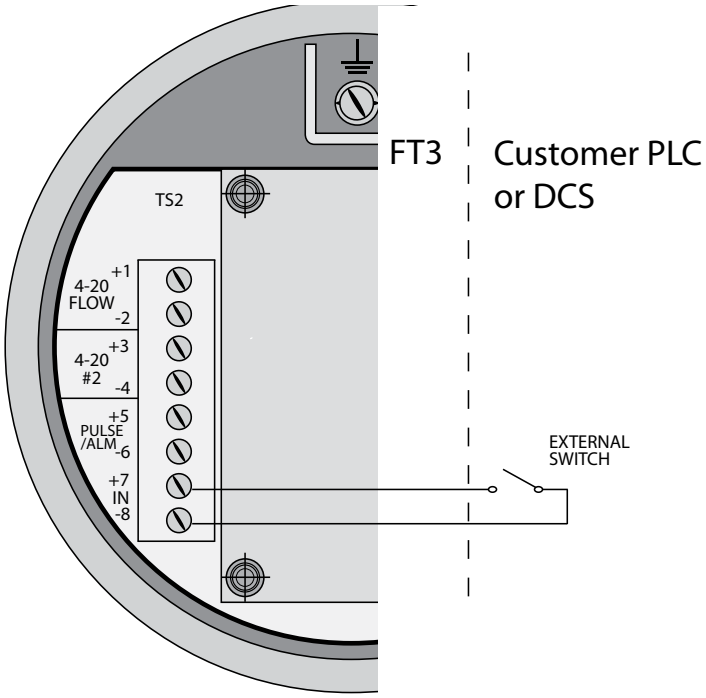
Remote Switch Wiring

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, 7(+) & 8(-).

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

Fig. 3.10: Remote Switch Wiring



If you have purchased RS485 Modbus or HART communications options, please refer to one of the following appropriate Fox Instructions Manuals:

- Fox FT3 RS485 Modbus Manual
- Fox FT3 HART Manual

Operation: Start Up

Start Up Sequence

Start Up Sequence

The program automatically enters the Run/Measure mode after power up. If the Local display is installed, the screen will show the software versions for the FT3 and the display module during power up. Programming of the flow meter can also be accomplished using a Windows-based PC program called FT3View™.

USB Interface

USB Interface

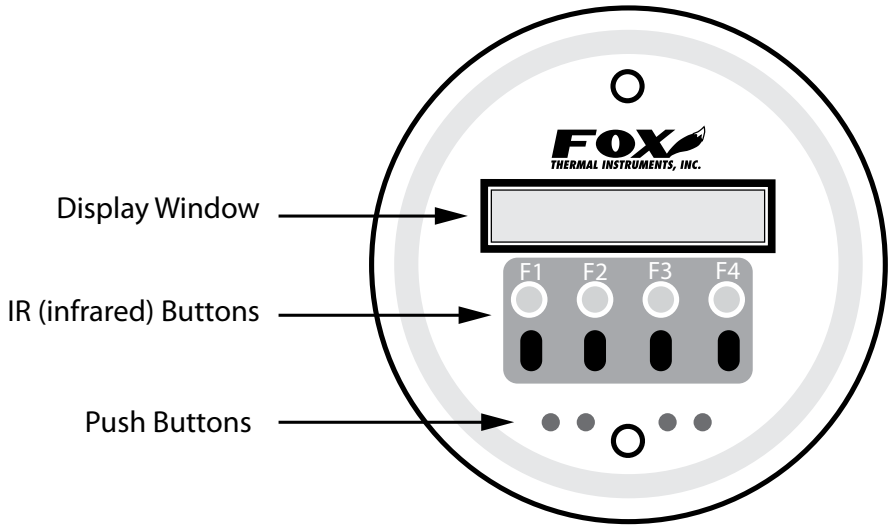
The USB interface is a standard feature which allows communication to a PC in order to monitor readings and configure settings. FT3View™, is a free application program from Fox that connects to the USB interface and allows data monitoring, configuration setting, data logging to Excel, and an option to save and recall FT3 configuration data. A serial communication manual is available for users who want to create their own PC application.

Optional Display

FT3 Optional Display Panel & Configuration Panel

The FT3 display is a 2 line x 16 character display with 4 mechanical and 4 IR (infrared) buttons. The IR and mechanical buttons perform the same function but the IR buttons can be used without opening the cover. The IR buttons can be disabled when the meter is used in snow or ice in order to avoid false key detection.

Fig. 4.1: FT3 Optional Display and Configuration Panel



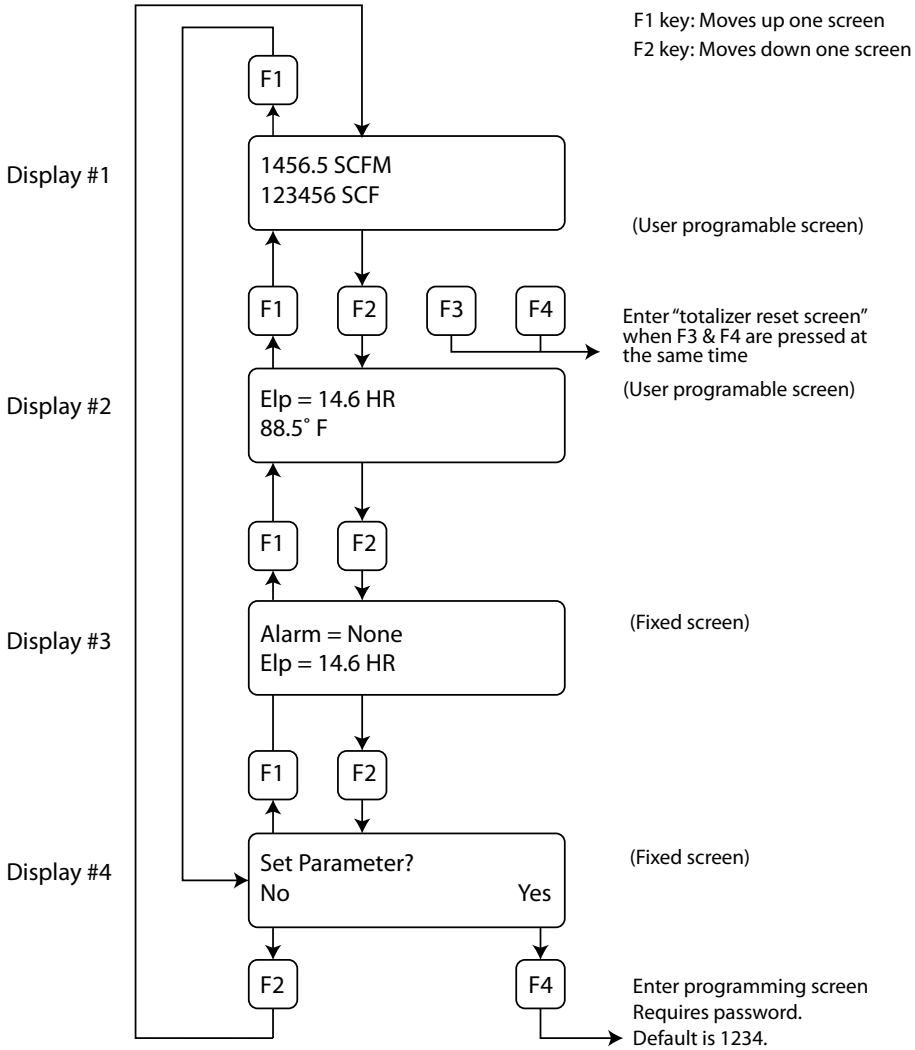
Operation: Display Screens

Local Display Screens

Measurement Mode

In the measurement mode, there are four different display screens (display 1, 2, 3 and a prompt screen to enter the programming mode), two display screens are user programmable (refer to Display Setup p. 37). 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 in order to exit to Display #1. Pressing the F3 and F4 keys at the same time brings up the Reset Total screen (see p. 47) prompt.

Fig. 4.2: FT3 Display Screen Navigation



Operation: Engineering Displays

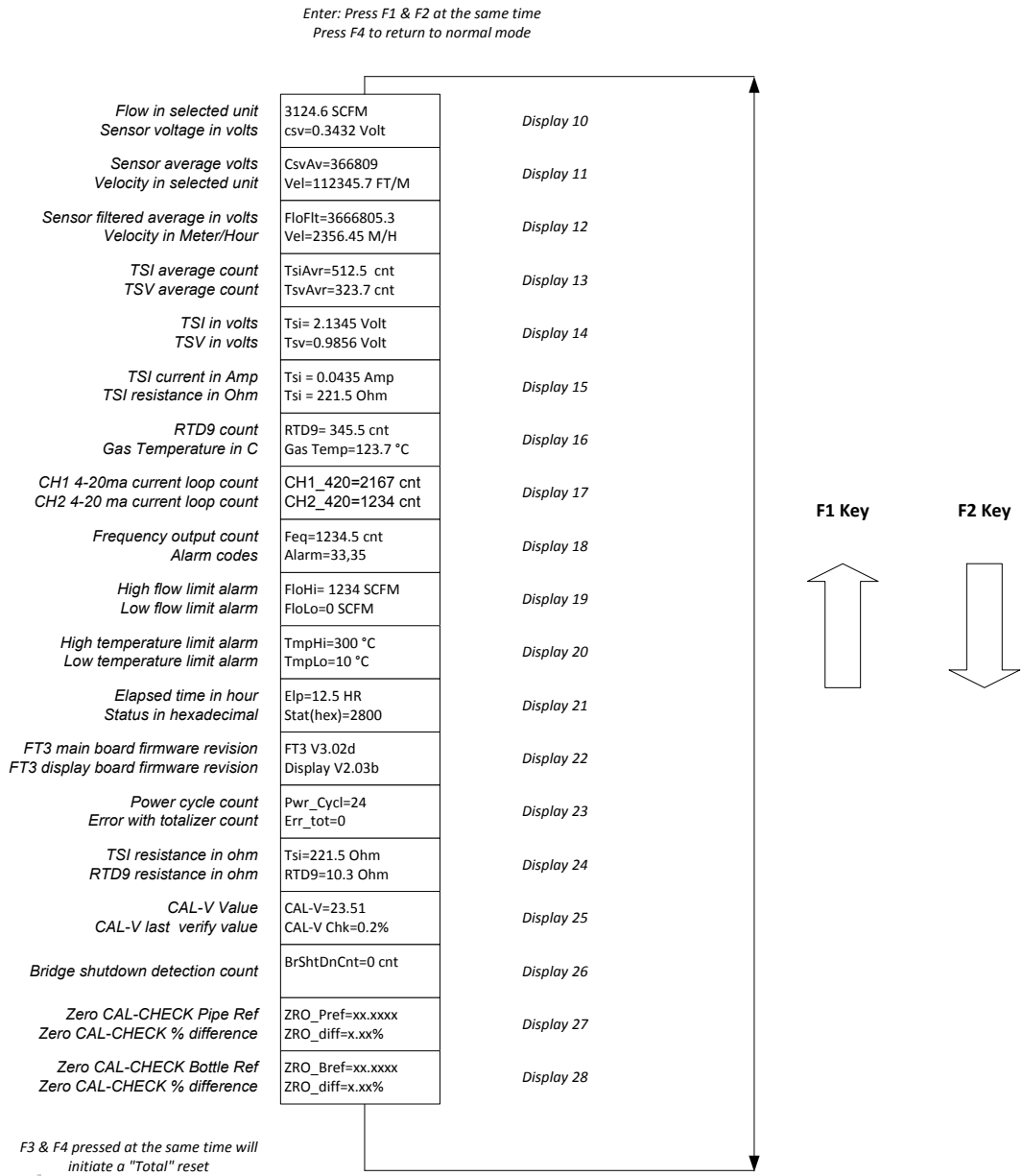
Engineering Display

FT3 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 FT3 which are used by Fox service technicians.

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

Fig. 4.3: FT3 Engineering Displays



Operation: Programming

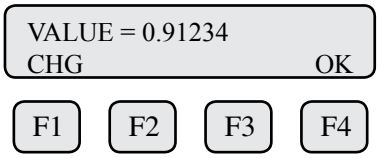
Programming Using the Local Display

Data Entry using the local display module

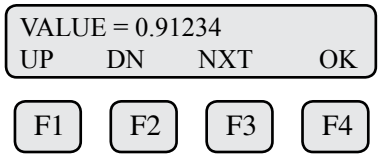
There are 2 basic types of menu entries: one for changing value or string and one for selecting from a selection list.

Value or String

To Change a Value or String :



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

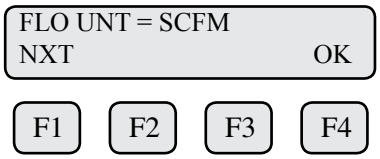


Press the **UP (F1) or DN (F2)** key to select a new digit or character, the cursor points to the selected digit. Press **NXT (F3)** to select the next digit and **OK (F4)** to accept the entry.

Note: If the **UP (F1) or DN (F2)** key is held down for more than 1 second, the program will progressively select new digits at increasing speed as time increases.

Selecting from a List

To Select from a List:



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

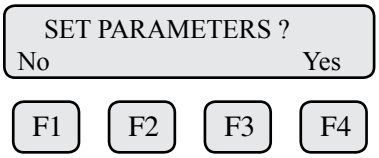
Enter Programming Mode

Entering the Programming Mode

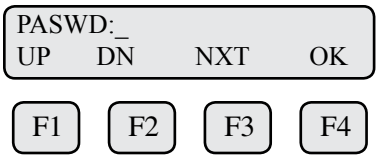
To enter the programming mode, press the **F1** or **F2** key repeatedly in the normal running mode until the following screen is shown:

Operation: Programming

Programming Using the Local Display



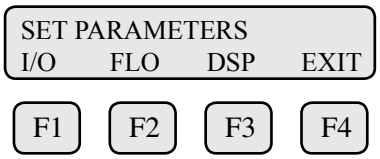
Press **YES (F4)** and the following screen will prompt the user to enter the password if it is active:



Enter the correct password, then follow the instructions for changing a value as specified above. The default Level 1 password is “1234”.

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

If the password is accepted, the base programming screen will be shown:



This is the base screen for the programming mode.

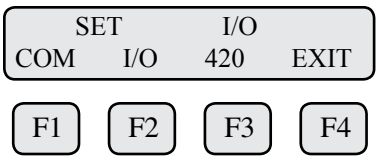
Press **EXIT (F4)** repeatedly until “Normal Mode” is seen briefly to exit the programming mode.

Analog 4 to 20mA Output

Analog 4 to 20mA Output

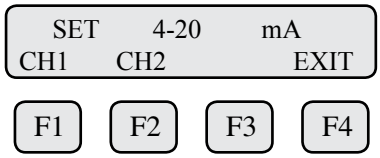
The following menu allows the scaling of the analog 4 to 20mA outputs.

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

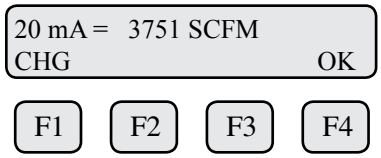


Operation: Programming

Programming Using the Local Display

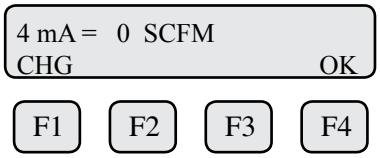


Select **CH1 (F1)** to program channel 1.



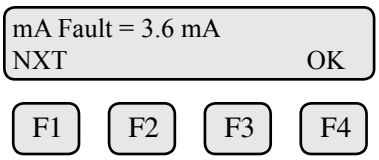
Enter the value for the 20mA and press **OK (F4)** key to accept the setting.

Then the following screen will display:



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

Note: 4mA is normally set to 0.



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

The options are:

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

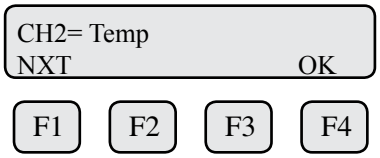
Press **(F4)** repeatedly until “Normal Mode” is seen briefly to exit the programming mode.

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

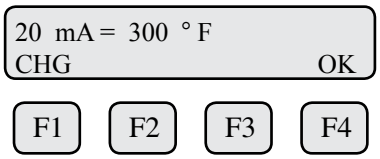
Operation: Programming

Programming Using the Local Display

Select **CH2 (F2)** to program channel 2.
Channel 2 is programmable for flow (CH2=Flow)or temperature (CH2=Temp).

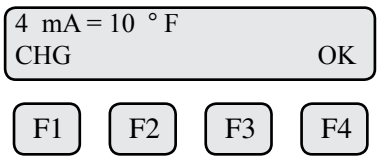


Press **NXT (F1)** to select Flow or Temperature and then press **OK (F4).**



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

Then the following screen will show:



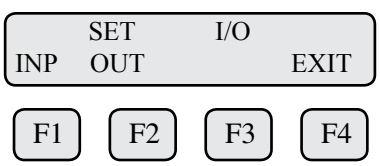
Enter the value for the 4mA and press **OK (F4).**

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

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

Frequency Output

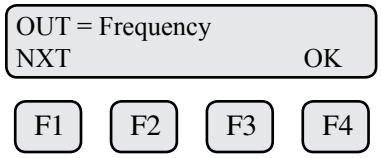
Frequency Output
From the main menu, press **I/O (F1), I/O (F2)** and then **OUT (F2)**



Operation: Programming

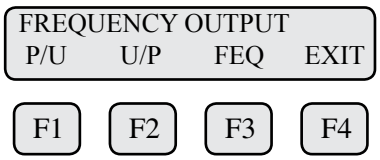
Programming Using the Local Display

Press **OUT (F2)** to select output and the following screen may show:



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

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

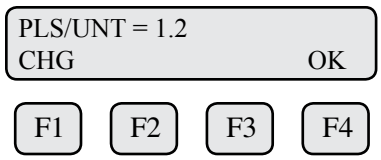


Use **P/U (F1)** to enter pulse per unit, **U/P (F2)** for Unit per pulse or **FEQ (F3)** to enter the flow and maximum frequency to scale the frequency output.

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

Pulse per Unit

Entering data in Pulse per Unit:
Press **P/U (F1)** and the following screen will show:



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

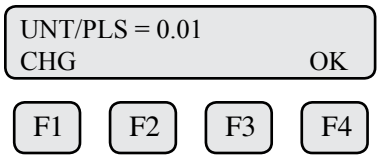
The value entered is in pulse per selected flow unit total (i.e., 10 pulses per SCF)

Operation: Programming

Programming Using the Local Display

Unit per Pulse

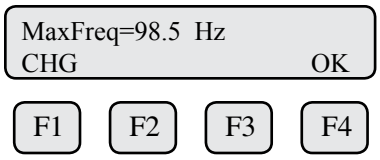
Entering data in Unit per Pulse:
Press **U/P (F2)** and the following screen will show:



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

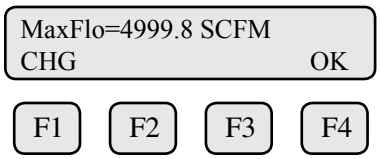
Max Flow and Frequency

Entering data with flow and maximum frequency:
Press **FEQ (F3)** and the following screen will show:



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

The next screen will show:

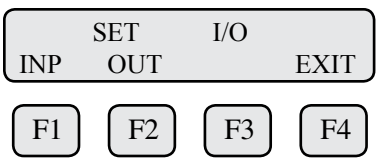


Note: When the flow rate exceeds the maximum frequency set point, the output will stay at that maximum frequency but the FT3 will issue an alarm code.

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

Alarm Output

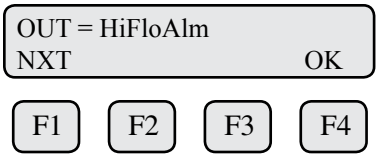
Alarm Output
To program the Alarm output, press **I/O (F1)** key from the "SET PARAMETERS" menu screen, then select **I/O (F2)** and the screen will show:.



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

Operation: Programming

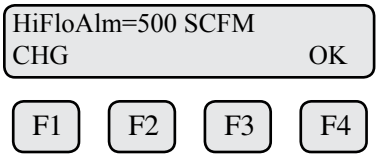
Programming Using the Local Display



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

Selections are:

HiFloAlm =	High Flow Alarm
LoFloAlm =	Low Flow Alarm
HiTempAlm =	High Temperature Alarm
LoTempAlm =	Low Temperature Alarm
Not used	
Frequency	

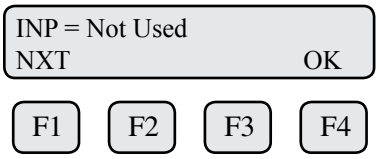


Enter the value for the limit by pressing **CHG (F1)** and then **OK (F4).**

Note: There is only one output to operate as a frequency output or an alarm output. Both cannot operate at the same time.

Discrete Input

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



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

Selections are:

Not used	
Tot Reset	Reset the totalizer
Switch Crv	Switch between calibration curve 1 and curve 2 (only if 2 gas curve ordered)

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

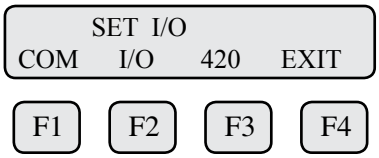
Operation: Programming

Programming Using the Local Display

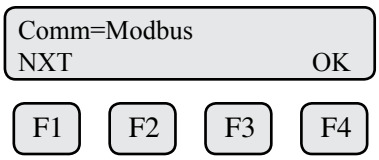
Serial Communication

Serial Communication Settings

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



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



Options for serial communication are:

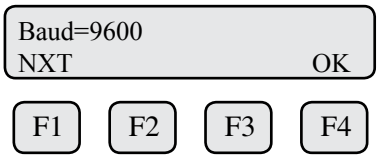
- Not Used
- HART
- Modbus

Any selection other than “Not Used” requires installation of an option board for the selected communication type.

If RS485 Modbus is selected, you will be asked to enter Baud rate, parity, stop bit and address (see below):

Baud Rate

Baud rate (for Modbus selection only):



Press **NXT (F1)** to select the baud rate and press **OK (F4)**

Selections are:

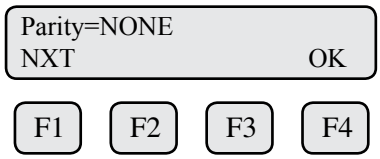
- 19200
- 9600
- 4800
- 2400
- 1200

Operation: Programming

Programming Using the Local Display

Parity

Parity (for Modbus selection only):



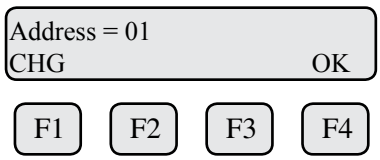
Press **NXT (F1)** to select the parity and press **OK (F4)**

Selections are:

- NONE
- ODD
- EVEN

Address

Address: For Modbus selection only



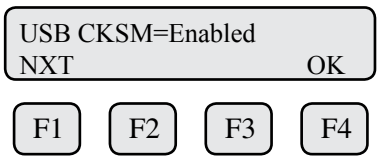
Press **CHG (F1)** to change the Modbus address and then press **OK (F4)**. To avoid conflicts on the Modbus this must be a unique address.

USB Checksum

Enabling/Disabling USB Serial communication checksum

The USB serial communication checksum may be enabled or disabled using the display keypad.

Disabling the communication checksum is sometimes useful in order to use a simple serial communication program such as HyperTerminal to communicate with the meter.



Press **NXT (F1)** to enable or disable the USB checksum and press OK (F4).

Display Setup

Display Setup

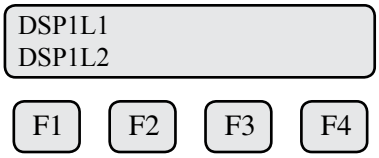
Remember, there are four display screens that you can cycle through in normal operating mode (see Figure 4.2 on p. 27). Two of the four display screens are fixed and cannot be changed (displays #3 & 4). The other two screens

Operation: Programming

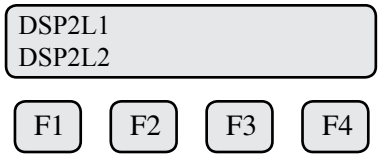
Programming Using the Local Display

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

Display #1



Display #2



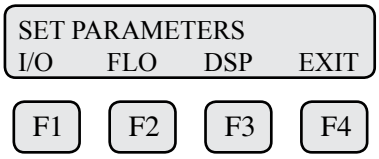
Selections are:

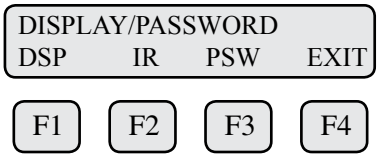
DSP1L1	Display 1, Line 1
DSP1L2	Display 1, Line 2
DSP2L1	Display 2, Line 1
DSP2L2	Display 2, Line 2

Programming Display Screens #1 & 2

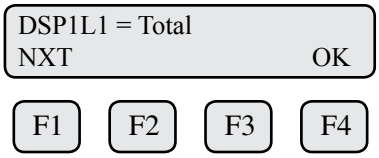
To Program Display Screens #1 & 2:

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





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



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

Selections are:

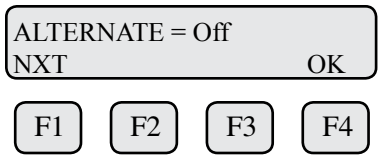
Flo rate	Flow rate
Total	Total mass
Elps	Elapsed time
Temp	Temperature
Alarm	Error codes

Operation: Programming

Programming Using the Local Display

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

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



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

Selections are: On or Off

Press **OK (F4)** to accept selection.

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

Password

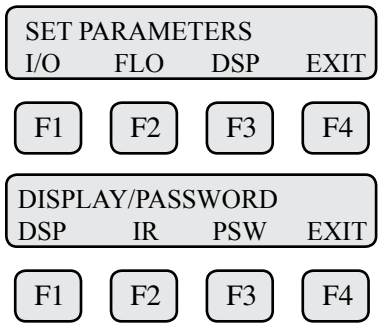
Password

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:



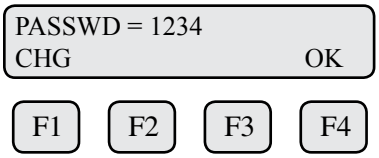
Operation: Programming

Programming Using the Local Display

Programming Password

To Program the Password:

Press **PSW (F2)** key to select password.



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

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

Note: Password can be number or letter characters up to 4 digits.

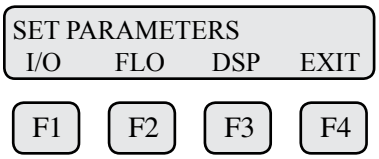
Units Settings

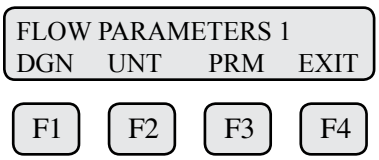
Units Settings

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 by pressing **FLO (F2)**:

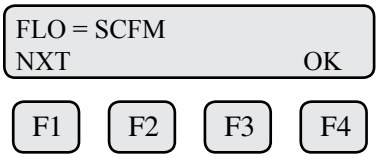




Operation: Programming

Programming Using the Local Display

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



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

Selections for Flow unit are:

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

Note: The totalizer will roll over when reaching a certain value. The maximum value is dependent on the unit selected.

Maximum Total Rollover Value:

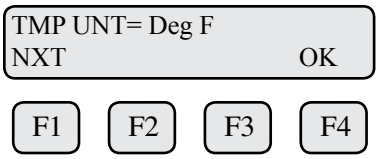
Most flow units:	99,999,999,999
MSCFD:	999,999,999
MMSCFM:	9,999,999
MMSCFD:	999,999

WARNING:
The FT3 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 FT3 will not recalculate these values and these values must be re-entered manually.

Operation: Programming

Programming Using the Local Display

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

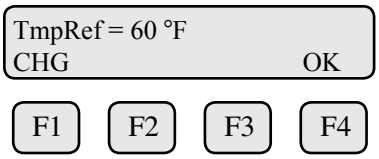


Press **NXT (F1)** to change selection and **OK (F4)** to accept.

Selections for Temperature unit are:

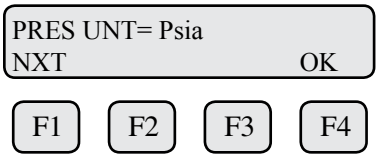
- Deg C
- Deg F

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



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

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

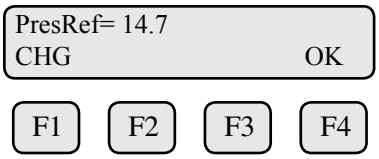


Press **NXT (F1)** to select next entry and OK (F4) to accept.

Selections are:

mmHG	Millimeters of mercury
Psia	Pounds per square inch atmosphere
bara	Bar atmosphere

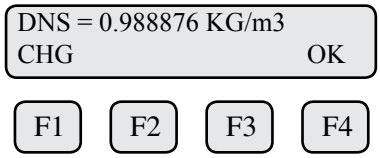
After the pressure unit selection is made, the display will show a menu to enter the pressure reference:



Operation: Programming

Programming Using the Local Display

Press **CHG (F1)** to change it and **OK (F4)** to accept.
After the pressure reference is accepted, the display will prompt for the gas density if LBS or KG was selected for flow unit:



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

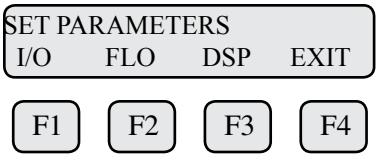
Note: The density entry is only used when KG/time or LBS/time is selected for flow rate units.

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

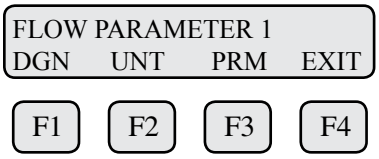
Flow Parameters

Flow Parameters

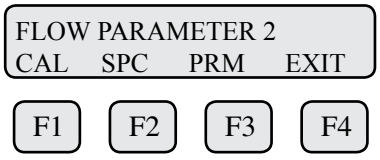
This is the menu used to set various flow parameter values. They are:
Flow cutoff, pipe area, filter, high and low alarm for flow and temperature.



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



Then press **PRM (F3)**:



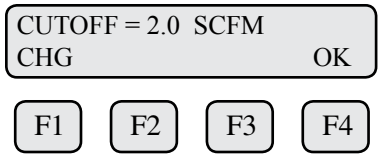
Note: The CAL and SPC function key will only appear and be accessible from a **Level 2** password.

Operation: Programming

Programming Using the Local Display

Flow Cutoff

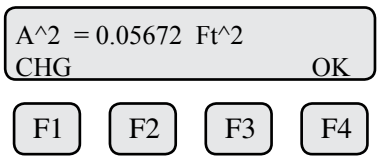
Then press **PRM (F3)**:



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.

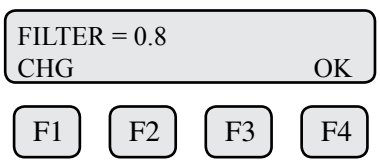
Pipe Area



Enter the pipe area in **square meters** or **square feet** and then press **OK (F4)**.

Use square meter for metric flow unit selection and square feet for English flow unit selection.

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 new average is:

New average = (80% new sample) + (20% last average)

Filter range is 0.01 to 1.0, 0.01 being a high filter value and 1.0 = no filter.

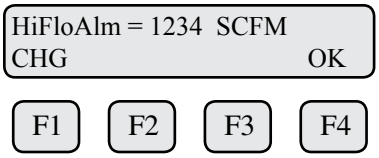
Enter the filter value and then press **OK (F4)**.

Operation: Programming

Programming Using the Local Display

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

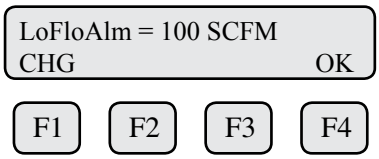
High Flow Rate Alarm



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

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

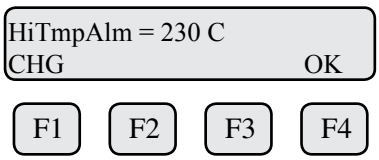
Low Flow Rate Alarm



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 Temp Alarm



This is the upper temperature limit alarm value that can be associated with a

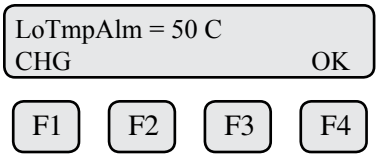
Operation: Programming

Programming Using the Local Display

discrete output. An alarm code is generated when the temperature value exceeds this limit. If no checking is needed, this value should be set to zero.

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

Low Temp Alarm



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 that deal with factory set parameters that should not be changed.

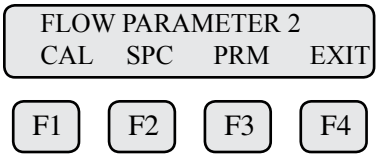
Calibration Parameters

Calibration Parameters

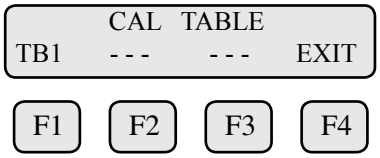
This menu allows changing the factory calibrated setting of the flow meter and is accessible with a **Level 2** password. Calibration parameter values are set for temperature and pressure at 0 degree C and 760 mmHg.

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.**



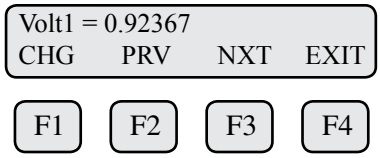
Press **CAL (F1)** then the display will show:



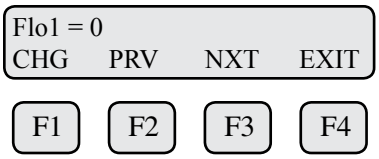
Operation: Programming

Programming Using the Local Display

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



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



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

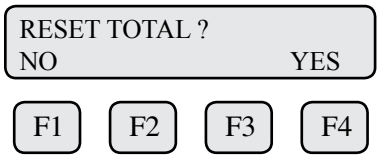
Pressing the **NXT (F3)** key will show the data point voltage and then mass velocity and then go to the next data point. The number after Volt (i.e., Volt1) or Flo (i.e., Flo1) indicated the data point number.

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

Reset Total and Elapsed Time

The resetting of the totalizer and elapsed time is accomplished by pressing the **F3** and **F4** keys at the same time in the normal running mode.



Press **YES (F4)** to reset total and **NO (F1)** to cancel.

Note: This feature is not available on non-resettable units.

Totalizer Rollover

Totalizer Rollover: The FT3 has an automatic roll-over function. The unit will begin roll-over as follows:

Operation: Programming

Programming Using the Local Display

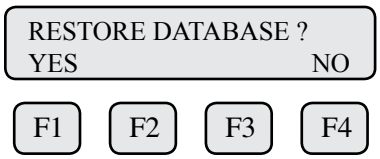
Most flow units:	99,999,999,999
MSCFD:	999,999,999
MMSCFM:	9,999,999
MMSCFD:	999,999

Restore Database

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**).

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

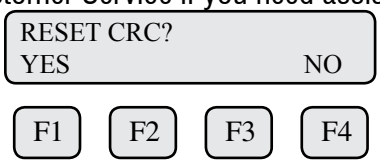


Press **YES (F1) ONLY** if you want to restore your database to the initial factory setting that the meter was shipped with. All current user-entered settings will be overwritten.

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

Reset CRC

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



Operation: Programming

Programming Using the Local Display

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

Reset CRC

Simulation

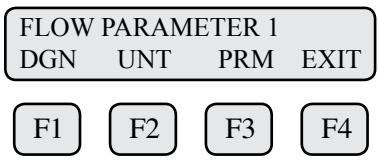
This menu allows for the simulation of flow rate, temperature and flow input voltage. It should only be used for testing and demonstration purposes. **Make sure to return all of these simulation values to zero, before returning to the normal mode of operation.**

Note: Simulated values are only enabled when not set to zero.

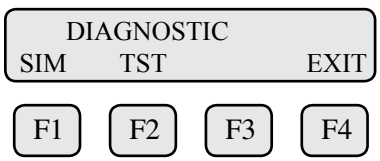
Simulation

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

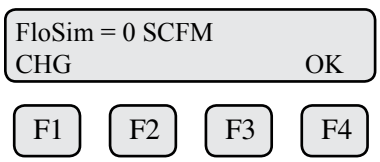
The menu is accessible from the main programming menu by pressing **FLO**, and **DGN (F1)**:



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



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

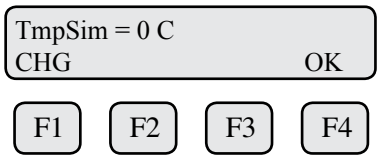


Enter the value and then press **OK (F4)**.

Operation: Programming

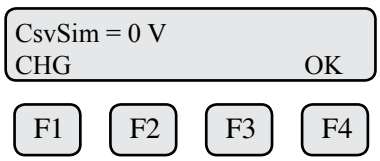
Programming Using the Local Display

Note: Enter zero to disable this feature.



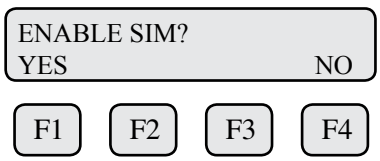
Enter the value and then press **OK (F4)**.

Note: Enter zero to disable this feature.



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.



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.

Note:

- *Refer to the Fox FT3 Calibration Validation User's Guide for information on setting the field baseline for Zero CAL-CHECK™ tests if you plan to perform these tests in the pipe.*
- *Please save the PVC sensor cover that was shipped with your meter. It will be needed to perform Zero CAL-CHECK™ tests out of pipe.*

Operation: Programming

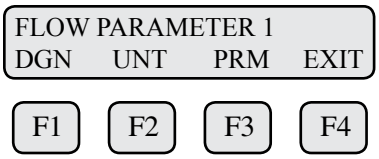
Programming Using the Local Display

CAL-V™

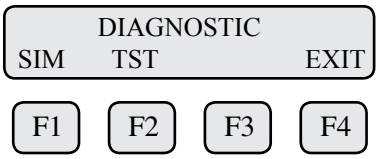
CAL-V™ - Calibration Validation Test 1

This menu allows the user to confirm the calibration of the FT3 by verifying the functionality of the sensor and sensor signal processing circuitry. During the CAL-V™ calibration validation test, the microprocessor adjusts current to the sensor elements and determines the resulting electrical characteristics. These site characteristics are compared with the data that was collected at the factory during the original meter calibration. Matching data within established tolerances confirms the meter is accurate. This test can be performed under no flow or normal flow conditions. The test takes up to four minutes to complete. At the conclusion of the test, a Pass or Fail message will be displayed. Press **F4** at the conclusion of the test to return to normal measuring mode or to terminate the test.

Press **FLO (F2)** from the main menu. The display will show:



Press **DGN (F1).** The display will show:



Press **TST (F2).**

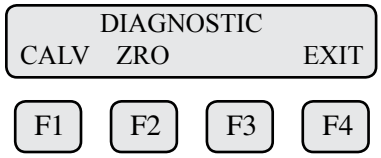
Caution:

- The CAL-V™ test is valid for checking the calibration accuracy of flow meters installed in the applications for which it was calibrated including the gas/gas mixture, calibration range and pipe size shown on the calibration certificate.
- For applications with temperature exceeding 250°F (121°C), CAL-V™ test results may vary.
- Periodic inspection for damage and cleaning of the sensor elements is required.

Operation: Programming

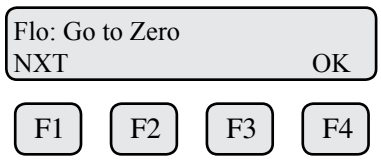
Programming Using the Local Display

The display will show:



Press **CALV (F1)** to perform the CAL-V™ verification test.

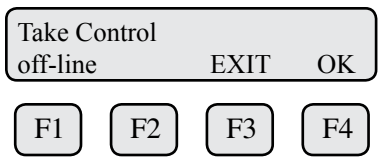
Note: The FT3 will stop measuring flow when performing this test. **Press EXIT (F4)** to exit if you do not wish to continue.



To select what the flow output will do during a CAL-V, choose from these options:

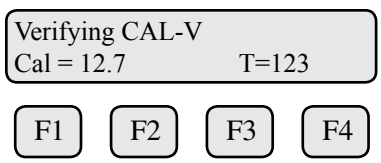
Go To Zero: Flow output will be zero during the test (i.e. 4mA)
Hold Value: Flow will hold last value during the test

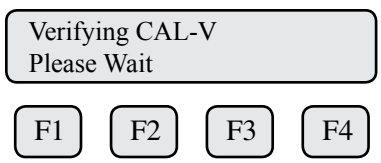
Select the option and press **OK (F4)**.



WARNING: If you are using a closed loop control, the system needs to be taken off-line during the test.

Press **OK (F4)** to start CAL-V™. CAL-V™ test screen:





This test will take up to 4 minutes (less time if there is flow) and will show the Cal value changing as the power to the sensor is adjusted. The T=xxx is a count down timer indicating how much time is left to finish the test. A “Please Wait” message will be flashing on and off on line 2 during this test.

Operation: Programming

Programming Using the Local Display

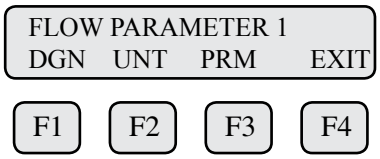
Upon test completion, the final CAL-V™ value will be displayed along with a Pass/Fail message.

Zero CAL-CHECK™

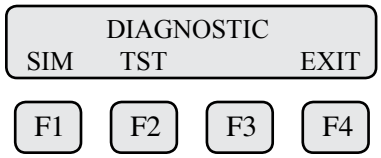
Zero CAL-CHECK™ - Calibration Validation Test 2

The Zero CAL-CHECK™ test is a companion test to CAL-V™. Unlike CAL-V™, which may be performed in the pipe and at process conditions, Zero CAL-CHECK™ must be performed at zero flow to ensure a valid test result. This test is used to confirm that the flow meter still retains its original NIST-traceable calibration at zero flow and that the sensor is free of film or residue that may affect readings. The test takes less than 5 minutes to complete. At the conclusion of the test, a Pass or Fail message will be displayed. Press **F4** at the conclusion of the test to return to normal measuring mode or to terminate the test. See Calibration Validation User's Guide for more details.

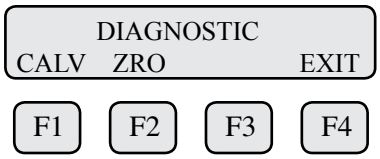
Press **FLO (F2)** from the main menu. The display will show:



Press **DGN (F1).** The display will show:



Press **TST (F2).** The display will show:



Press **ZRO (F2)** to enter the Zero CAL-CHECK™ menu.

If performing the test in the pipe, a "no flow" condition must be met. If performing out of the pipe, the meter must be removed and the sensor

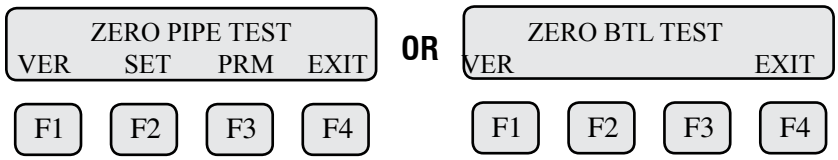
Operation: Programming

Programming Using the Local Display

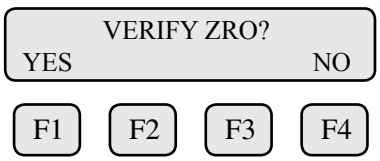
protected by the PVC sensor cover originally shipped with the meter from the factory.

Press **PIP (F1)** to choose to perform the test in the pipe. Press **BTL (F2)** to choose to perform the test out of the pipe.

The display will show:



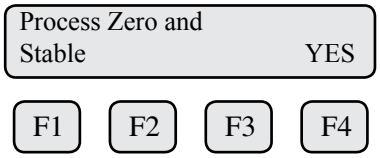
Press **VER (F1)** key to verify the Zero CAL-CHECK™.



Press **YES (F1)** key to verify the Zero CAL-CHECK™.

Note:

- *The field baseline for a Zero CAL-CHECK™ test performed in the pipe ("ZERO PIPE TEST") must be set before performing the test.*
- *See the Fox Calibration Validation User's Guide for details on performing all diagnostic tests.*
- *Please use the PVC sensor cover that was shipped with your meter perform Zero CAL-CHECK™ tests out of pipe ("ZERO BTL TEST").*

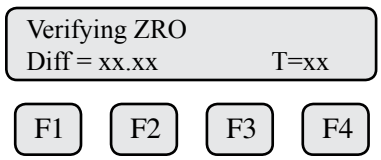


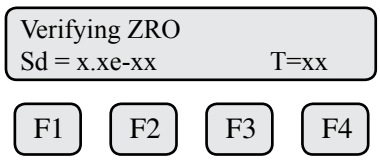
Operation: Programming

Programming Using the Local Display

WARNING: If you are doing a "Pipe" test, you must verify that there is a no flow condition before proceeding. If you are performing the test in a bottle, be sure to isolate the sensor in a bottle - any air movement (even from a fan) can result in a false "fail" result.

Once process is stable, press **YES (F4)** key to begin the Zero CAL-CHECK™.





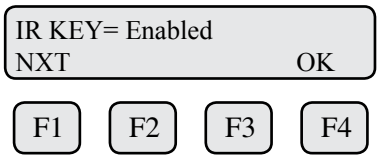
This test will take less than 5 minutes. The T=xx is a count down timer indicating how much time is left to finish the test.

Upon test completion, the final percentage value will be displayed along with a Pass/Fail message.

Enable/Disable IR Buttons

Enabling/Disabling the Infrared Keypad (IR Buttons)

The IR buttons may be disabled from the menu to avoid being triggered by frost or snow on the window. This menu is accessed by pressing **DSP (F3)** from the main menu then **IR (F2)**:



Press **NXT (F1)** key to enable or disable the IR buttons.

Note: After selecting “Disable” and pressing **OK (F4)**, the IR buttons will no longer operate. It will be necessary from now on to open the cover and operate the configuration panel using the mechanical push buttons. To return to the normal display mode, use mechanical buttons or wait for the programming mode timeout.

Operation: Programming

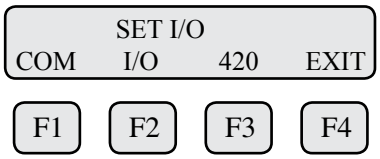
Programming Using the Local Display

Enable/Disable USB Checksum

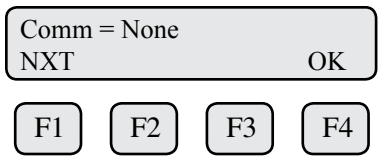
Enabling/Disabling USB Serial Communication Checksum

The USB serial communication checksum may be enabled or disabled using the display keypad. Disabling the communication checksum is sometimes useful in order to use a simple serial communication program such as HyperTerminal to communicate with the meter.

This menu is accessed by pressing **I/O (F1)** from the main menu.



Press **COM (F1)** to select a communication type.



Press **NXT (F1)** to select the bus type, then press **OK (F4)**:

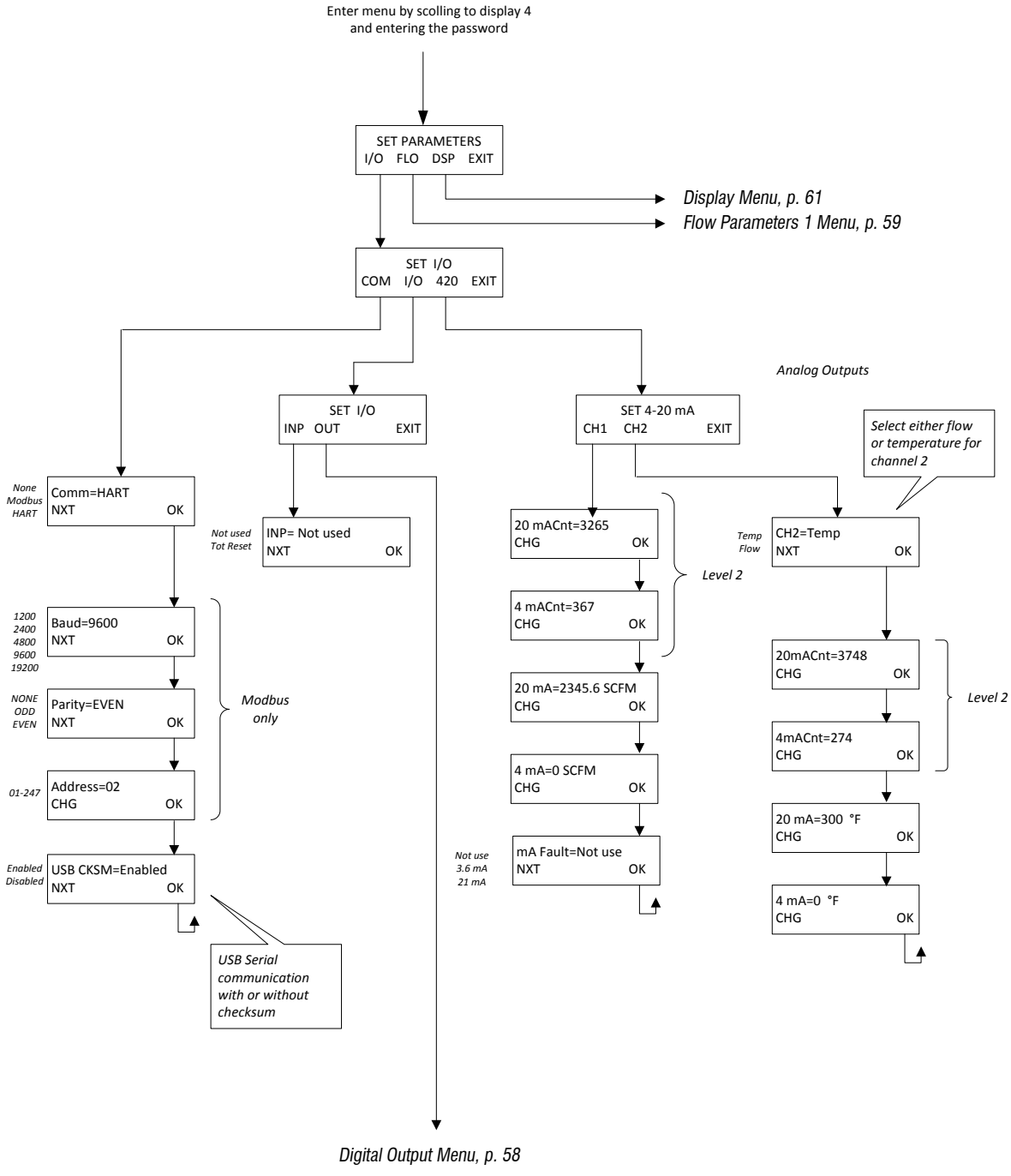
Comm selections are:
- None
- HART
- MODBUS

Any selection other than “None” requires installation of an option board for the selected communication type. If Modbus (RS485 Modbus) is selected, you will be asked to enter Baud rate, parity and address. After enabling HART, you must configure HART settings using a HART communicator (see Fox HART Manual).

Operation: Menu Tree

Main Menu

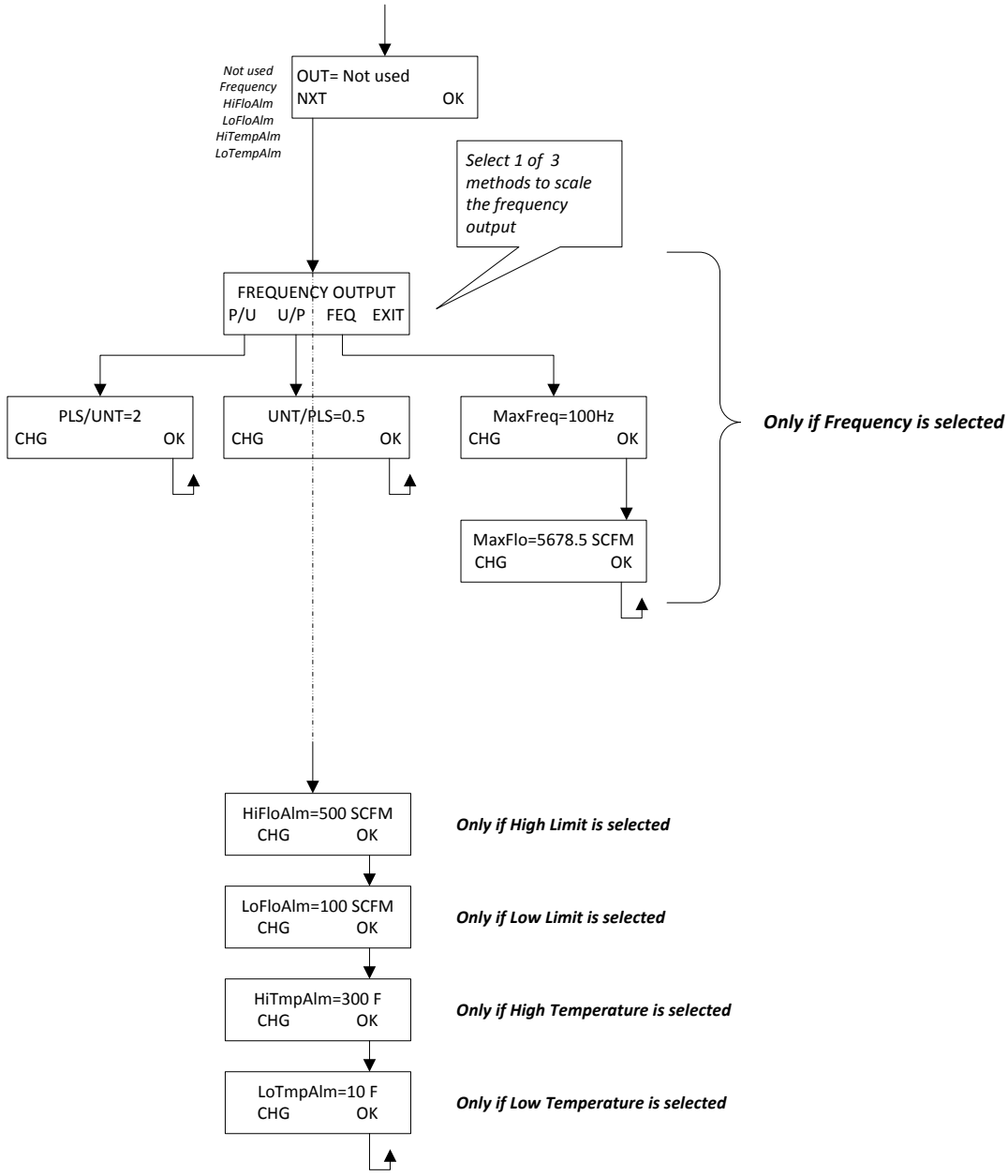
Fig. 4.4: FT3 Menu Tree - Main Menu



Operation: Menu Tree

Digital Output

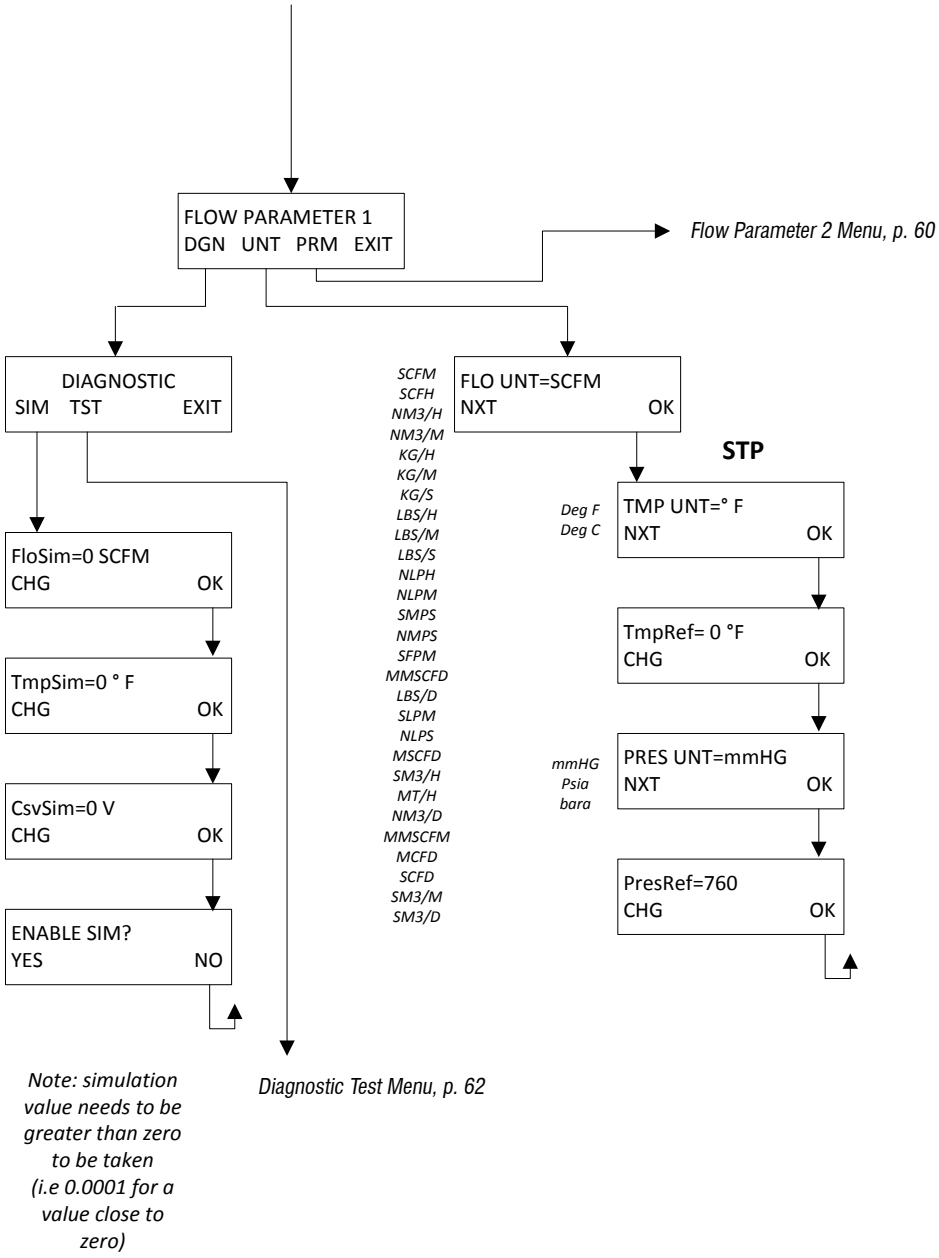
Fig. 4.5: FT3 Menu Tree - Digital Output



Operation: Menu Tree

Parameter Menu 1

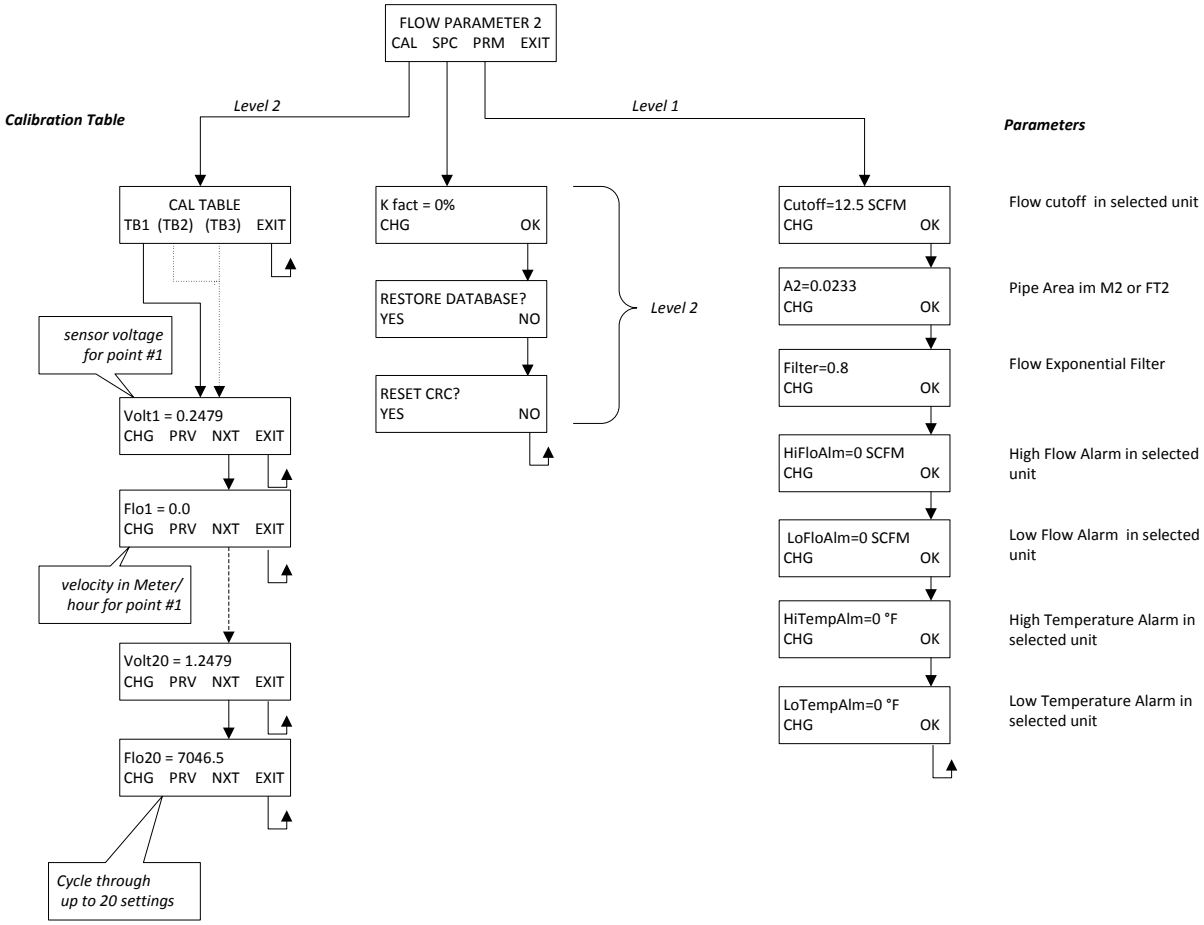
Fig. 4.6: FT3 Menu Tree - Parameter Menu 1



Operation: Menu Tree

Parameter Menu 2

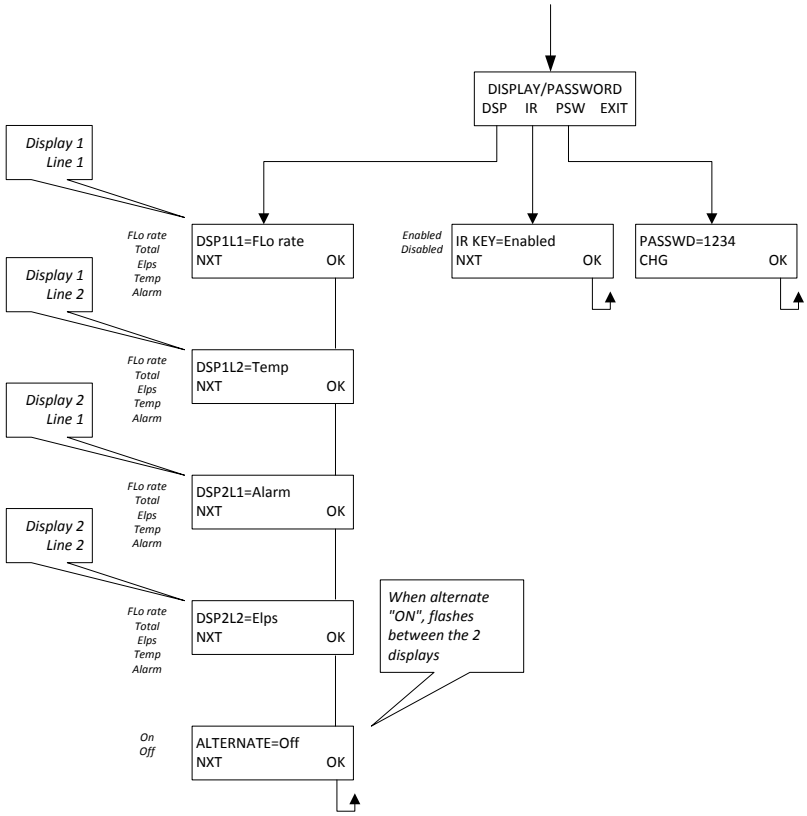
Fig. 4.7: FT3 Menu Tree - Parameter Menu 2



Operation: Menu Tree

Display Menu

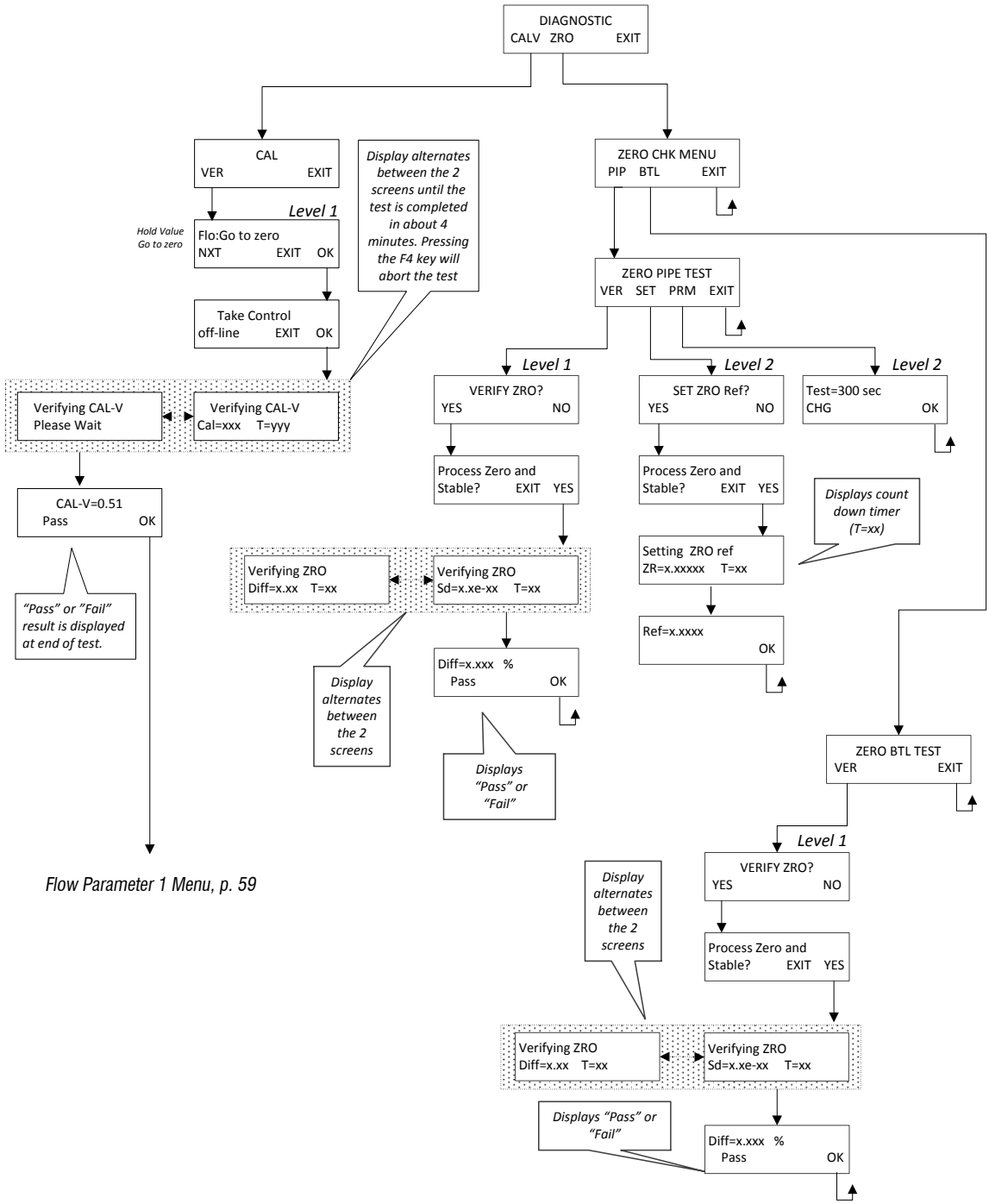
Fig. 4.8: FT3 Menu Tree - Display Menu



Operation: Menu Tree

Diagnostic Tests Menu

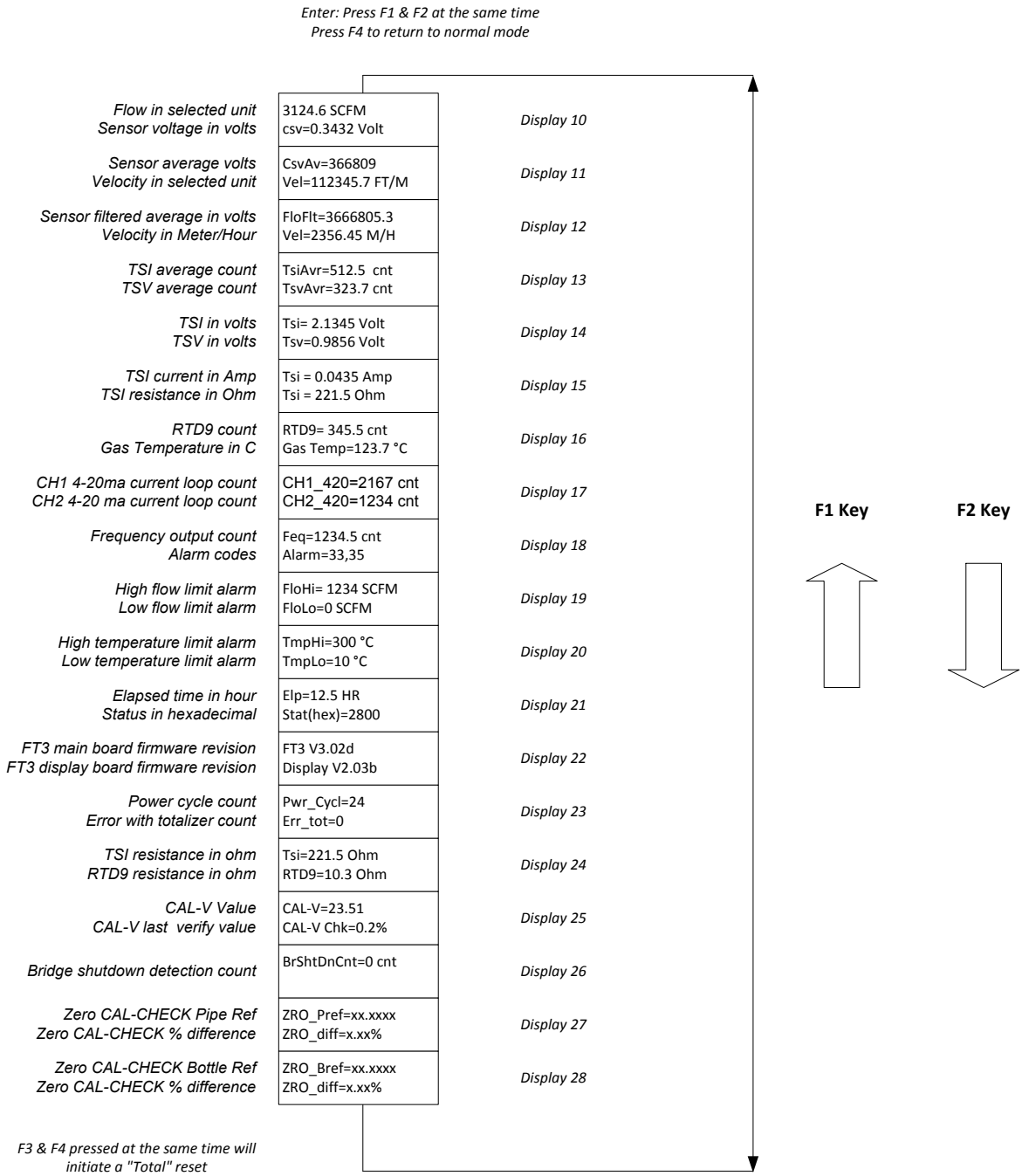
Fig. 4.9: FT3 Menu Tree - Diagnostic Tests Menu



Operation: Menu Tree

Engineering Display

Fig. 4.10: FT3 Menu Tree - Engineering Display



Maintenance: General

Precautions

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

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

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

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

Access to Electronics

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

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

Broken or Damaged Probe

If the sensor is broken or damaged, the probe and electronics must be returned to the factory. A new sensor will be installed and calibrated. Refer to "Returning Your Meter" on p. 94.

Flow Calibration and Calibration Validation

To ensure continued high accuracy of your Model FT3 Flow Meter, Fox Thermal Instruments Inc. provides a full NIST traceable calibration. It is recommended that the meter be returned to Fox for a calibration check in our NIST traceable labs after three years of operation. The CAL-V™ and Zero CAL-CHECK™ (see p. 5, p. 51 & p. 53) tests should be performed annually or as required by federal, state and local agencies, if applicable.

Maintenance: General

Fuse Replacement

Warning! Turn input power OFF before removing or installing a fuse. Use only recommended fuse replacements.
Verify the fuse is defective by measuring it with an Ohm Meter (Two replacement fuses are provided with each unit).

To replace the fuse:
The fuse F1 is located near the power terminal block and can be removed by using tweezers or needle-nose pliers.

Sensor Wiring

Note: Sensor terminations are performed at the factory except when the Remote Electronics option is used or ordered.

Preventive Maintenance

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 and breakage resistant, avoid touching them with any solid object and use a light touch while cleaning them.

Troubleshooting: General

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 impair the accuracy of the flow meter. If you experience any problem with your Model FT3 Flow meter, call Fox Customer Service Department, Technical Assistance at (831) 384-4300.

Problem	Possible Cause	Action
Display-Main Bd Comm. Error	Display and main board not communicating	Check status of LP1 on the Main Board and LP6 on the display board. Are green LEDs blinking once per second? If LEDs are not blinking, cycle power to reset meter. Call Fox Tech Support.
Meter does not read up to full scale	Calibration table may be corrupted	•Check the calibration table for a corrupted location. •Enter the password 9111. •Start on p. 43 of the FT3 manual and follow the steps to get to Flow Parameters 2 menu screen. •Select CAL (F1) •Select NXT (F1) to cycle through calibration table to verify entries match calibration certificate. •Check for CRC error code
Velocity measurement seems low	1.Probe not oriented properly 2.Sensor dirty	1.Orient probe per installation sections: Insertion (p. 9), Inline (p. 13). 2.Clean sensor (p. 65)

Troubleshooting: General

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

Troubleshooting: General

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. 43)
	2.Sensor dirty	2.Clean sensor (Refer to Maintenance section, p. 65)
	3.Sensor broken	3.Return flow meter to Fox for repair (Refer to p. 94 for shipping instructions)
	4.Probe not mounted securely	4.Remount probe (see Installation section, p. 9 and p. 13); must be mounted securely without vibration. If vibration persists, choose a new mounting location without location.
	5.Malfunction in flow meter	5.Return flow meter to Fox for repair (Refer to p. 94 for shipping instructions)
	6.Meter installed incorrectly	6.Re-install meter according to instructions (Refer to installation section, p. 9 and p. 13)

Troubleshooting: Installation Problems

Problem Summary

Installation Problems

The following is a summary listing of problems that may be encountered with the installation of the FT3 Thermal Mass Flow Meter.

1. *Improper wiring connections for power and/or 4 to 20mA output signal.*

   The FT3 requires a separate power source for the main board and the two 4 to 20mA output signals. Two wires supply 24VDC power to the main board. Two wires are used for each of the 4 to 20mA output signals. Refer to Figure 3.4 and Figure 3.5 (p. 20). Also refer to "Wiring Precautions" and "Helpful Hints" in Wiring section (p. 15) for further guidance.

2. *Inadequate power source.*

   For those models that are powered by 24VDC, a 24VDC ±10%, 0.75 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 23 to 25VDC as measured at the power input terminals of the flow meter electronics.

3. *Flow measurement seems inaccurate.*

   - Check to ensure that the flow meter is installed so that the Flow Direction Arrow engraved on the flat surface of the fitting below the electronics housing is properly pointing in the direction of flow. Refer to Figure 2.7 (p. 14). 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. 10).
   - For inline meter types, ensure that there are a minimum of ten diameters of straight pipe upstream of the sensor and five diameters downstream. For insertion meter types, ensure that there are a minimum of fifteen diameters of straight pipe upstream of the sensor and ten diameters downstream. If complex flow disturbances are upstream of the sensor, extension of the straight pipe may be required to ensure accurate flow measurement. Contact Fox for assistance.
   - Ensure that pipe area data in the meter matches data on the Fox Calibration Certificate. The pipe internal cross sectional area is

Troubleshooting: Installation Problems

Installation Problems

programmed into the flow meter through the front panel (see Flow Parameters, p. 43). This area is programmed in square feet or square meters. The Calibration Certificate delivered with the flow meter contains the area that was programmed into the flow meter at the Fox factory. Check to ensure that this area is correct.

4. *Erratic flow reading especially a flow reading spiking high.*

   This may be a symptom of moisture in the flow stream. Fox flow meters are designed to work in relatively dry gas applications only. Contact Fox to discuss resolutions to this problem.

5. *Flow meter is not responding to flow.*

   This problem could be caused by a number of reasons:

   - Check to ensure adequate power is supplied to the flow meter as described above. If things appear to be correct, an easy functional test can be performed. 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. 46). Check meter data for any non-whole numbers and call customer service for assistance.

6. *Display and/or 4 to 20mA signal reading above zero flow when no flow is occurring in the pipe.*

   If the reading is less than 5% of full scale, it is likely this is a normal condition caused by convection flow created by the heated sensor. It does not mean that the zero of the instrument is improperly set. The Fox sensor is extremely sensitive to gas flow and can even read the small flow caused by convection. If this is an unacceptable condition, please contact Fox Customer Service for alternatives.

Troubleshooting: Installation Problems

Installation Problems

7. *Mismatched serial numbers*

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

Troubleshooting: Alarm Codes

Alarm Codes

Alarm Codes

Information to diagnose and clear alarm codes is on p. 60 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. 43 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. 43 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. 43 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. 43 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. 63 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. 63 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. 49 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. 58 of this Manual. Verify the Frequency Output settings are within limits.

Troubleshooting: Alarm Codes

Alarm Codes

Alarm Code	Reason	Action
32	4 to 20mA for flow rate is out of range	Refer to the MAIN MENU on p. 57 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4 to 20mA.
33	4 to 20mA for temperature is out of range	Refer to p. 45 of this Manual. Use the Set I/O section to verify range limits under FLO Set 4 to 20mA. Channel #2 can be set for flow or temperature.
34	Busy	Meter is recalculating new parameters.
35	Sensor Bridge Shutdown	The FT3 probe is getting too hot. Open sensor circuit and check sensor wiring.
36	Database CRC Error	Refer to the PARAMETER MENU 2 section on p. 43 of this Manual to reset CRC. Use SPC section of menu to reset CRC. Contact Fox Service Department for possible causes.
37	Totalizer Error Detected	See "Reset the Total and Elapsed Time" on p. 47 for steps to clear Error Code. Contact Fox for possible causes.
38	CAL-V in progress	Wait until the CAL-V or Cal Set is finished.
39	ADC12 versus ADC24 too far	The tolerance between the 2 ADC is out of specification. Recalling manufacture default may correct the problem.
40	CAL-V Diff Fail	The CAL-V Diff Failed. Check sensor wiring and verify that the sensor's resistance is correct. Call Tech Support.
41	Zero CAL-CHECK Fail	Allow meter to stabilize for 15 minutes and perform the test again. If another "Fail" test results, call Tech Support.

Appendices: Specifications

Performance & Operating Specs

Performance Specs

Flow Accuracy:

Inline Meter: ± 1% of reading ± 0.2 % of full scale. 8 diameters of straight, unobstructed pipe upstream and 4 downstream required.
Insertion Meter: ± 1% of reading ± 0.4 % 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) -40 to 250° F (-40 to 121° C); ± 3.6° F (± 2.0° C), 250 to 650° F (121 to 343° C); 60 SFPM minimum.

Calibration:

Factory Calibration to NIST traceable standards
CAL-V™ & Zero CAL-CHECK™: In situ, operator-initiated calibration validation

Operating Specs

Units of Measurement (field selectable):

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

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	NM^3/hr
1.5" (40mm)	0-840	0-1,320
2" (50mm)	0-1,400	0-2,200
3" (80mm)	0-3,080	0-4,860
4" (100mm)	0-5,300	0-8,360
6" (150mm)	0-12,000	0-18,900
8" (200mm)	0-20,800	0-32,800
12" (300mm)	0-46,600	0-73,500

Appendices: Specifications

Operating Specs

Full Scale Flow Ranges for In-Line Flow meters:

Size	SCFM	NM^3/hr
0.25"	0-20	0-32
0.5"	0-90	0-140
0.75"	0-180	0-280
1"	0-320	0-500
1.25"	0-580	0-910
1.5"	0-840	0-1,320
2"	0-1,400	0-2,200
2.5"	0-2,000	0-3,150
3"	0-3,080	0-4,860
4"	0-5,300	0-8,360
6"	0-12,000	0-18,900

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

Gas Pressure (maximum):

Insertion: 500 psig (34.5 barg)

Inline (1/4" through 6"): NPT 500 psig (34.5 barg); 150# flange 230 psig (16 barg)

Check with factory for higher pressure options.

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: 32 to 650°F (0 to 343°C)

Enclosure:

Without display or AC power supply: -40 to 158°F (-40 to 70°C)

With display and/or AC power supply: -4 to 158°F, (-20 to 70°C)

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

Input Power:

24 VDC, ± 10%, 0.75 amp standard; 85 to 264VAC 47-63Hz, 20 watts optional.

Appendices: Specifications

Operating & Physical Specs

Inputs/Outputs:

All outputs and communication circuits are galvanically isolated.

4 to 20 mA output one is proportional to the measured flow rate. Fault indication per NAMUR NE43.

4 to 20 mA output two is programmable for temperature or flow rate.

Digital output one is programmable for either frequency or alarm output. Output is open collector type, operating voltage 5V to 24V, maximum sinking current: 10 mA. The frequency output is proportional to flow rate with a range of 0 to 100Hz. When configured for alarm, the digital output generates an on or off signal.

Remote switch input can be configured to reset elapsed time, flow totalizer and switch between gas curves when the 2 gas curve option is ordered.

USB communication port is standard. The free PC-based software tool - FT3 View™ - provides complete configuration, remote process monitoring, and data logging functions.

Optional serial communication: HART and RS485 Modbus.

4 to 20mA Loop Verification:

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

Physical Specs

Sensor material:

316 stainless steel standard; Hastelloy C276 optional

Enclosure:

NEMA 4X (IP68), aluminum, dual conduit entries with ¾" NPT or optional M20 x 1.5mm. Cabling to remote enclosure: 5-conductor, 18 AWG, twisted, shielded, 100 feet maximum.

Retractor Assemblies:

Packing gland assembly: 125 psig (8.6 barg) max.

High pressure (crank) retractor: NPT 600 psig (41.4 barg), ANSI 150 flange & ANSI 300 flange, no valve supplied.

Insertion Flow Meter Installation:

Fox-supplied compression fitting connects to customer-supplied ¾" female coupling welded to pipe.

Appendices: Agency Approvals

Agency Approvals

Agency Approvals

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

FM and FMc: Approved
Class I, Div. 1, Gps B, C, D; Class II, Div. 1, Gps E, F, G; Class III, Div. 1; T3C, Ta = -40°C to 70°C; Class I, Zone 1, AEx/Ex d IIB+H2 (T6, T4, or T1*); Ta = -20°C to 70°C; Type 4X, IP67

ATEX (FM12ATEX0034X): Approved
II 2 G Ex d IIB+H2 (T6, T4, or T1*) Gb Ta = -20°C to 70°C; IP67
II 2 D Ex tb IIIC (T85°C, T135°C, or T450°C*) Db Ta = -20°C to 70°C; IP67

IECEx (IECEx FMG 12.0010X): Approved
Ex d IIB+H2 (T6, T4, or T1*) Gb Ta = -20°C to 70°C; IP67
Ex tb IIIC (T85°C or T135°C*) Db Ta = -20°C to 70°C; IP67**

ATEX and IECEx Standards:

EN 60079-0: 2009	IEC 60079-0: 2011
EN 60079-1: 2007	IEC 60079-1: 2007
EN 60079-31: 2009	IEC 60079-31: 2008
EN 60529: 1991, +A1: 2000	IEC 60529: 2001

Model Code		Temperature Code Marking (Gas)		Temperature Code Marking (Dust)	
Enclosure	**Sensor Type**	**Main Enclosure**	**Remote Enclosure**	**Main Enclosure**	**Remote Enclosure****
E1	*ST*	*T4*	*N/A*	*135°C*	*N/A*
E2	*ST*	*T4*	*N/A*	*135°C*	*N/A*
E3	*ST*	*T6*	*T4*	*85°C*	*135°C***
E4	*ST*	*T6*	*T4*	*85°C*	*135°C***
E3	*HT*	*T6*	*T1*	*85°C*	*450°C***
E4	*HT*	*T6*	*T1*	*85°C*	*450°C***

*Temperature code ratings for Zones are dependent on external process temperature factors and equipment enclosure configuration. See the table above for specific temperature code ratings.

**The IECEx dust rating does not apply to the Remote Enclosure.

Appendices: FT3 with 2 Gas Curves

Scope

Scope

This section describes added features to the standard FT3 flow meter when using the 2 gas curves firmware option.

FT3 2 Gas Curves

FT3 2 Gas Curves

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

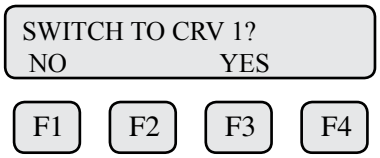
1) Use of Contact Input:

When the contact input is programmed for curve switching, an open contact will select curve #1 and a contact closure will select curve #2.

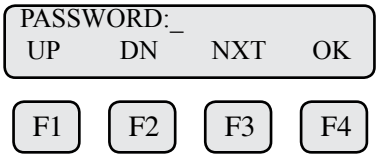
2) Use of the Keypad:

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

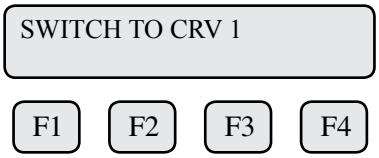
Pressing F2 & F3 simultaneously:



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



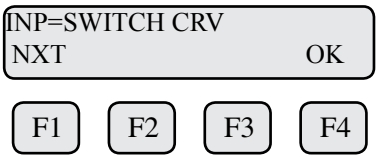
After entering a valid password, a brief confirmation message will be displayed for 1 second:



Appendices: FT3 with 2 Gas Curves

FT3 2 Gas Curves

3) Programming Contact Input for Curve Switching:
Enter the menu using steps outlined in "Discrete Input Settings" section (p. 35) and select "Switch CRV". Please note that the flow meter needs to be programmed for 2 gas curves at the Fox factory before you can select this function. Flow meters are shipped with pre-programmed user requested settings.



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

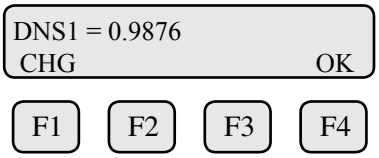
Helpful Hint:
From normal display mode, press F4 to view the current gas curve selection.

Appendices: FT3 with 2 Gas Curves

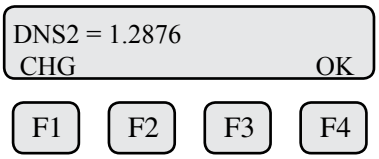
FT3 2 Gas Curves

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

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



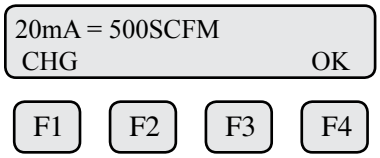
DNS1 is the density associated with curve 1. Change it as needed and press OK.



DNS2 is the density associated with curve 1. Change it as needed and press OK.

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

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

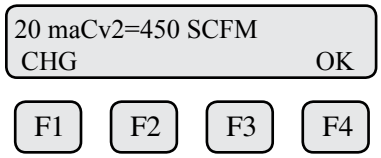


20mA is the upper limit associated with curve 1. Change it as needed and press OK.

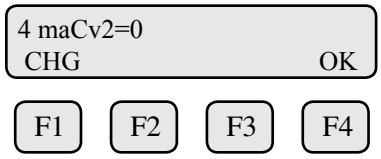
4mA is the lower limit associated with curve 1. Change it as needed and press OK.

Appendices: FT3 with 2 Gas Curves

FT3 2 Gas Curves



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



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

6) Operation:

- 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 FT3 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 order with 2 gas curves will identify which gas is Gas 1 and Gas 2.
- When measuring in mass units, a density value must be entered for each gas curve.

Appendices: Dimensions

Local with Retractor

Fig. 7.1 Local Insertion Meter with Retractor Dimensions

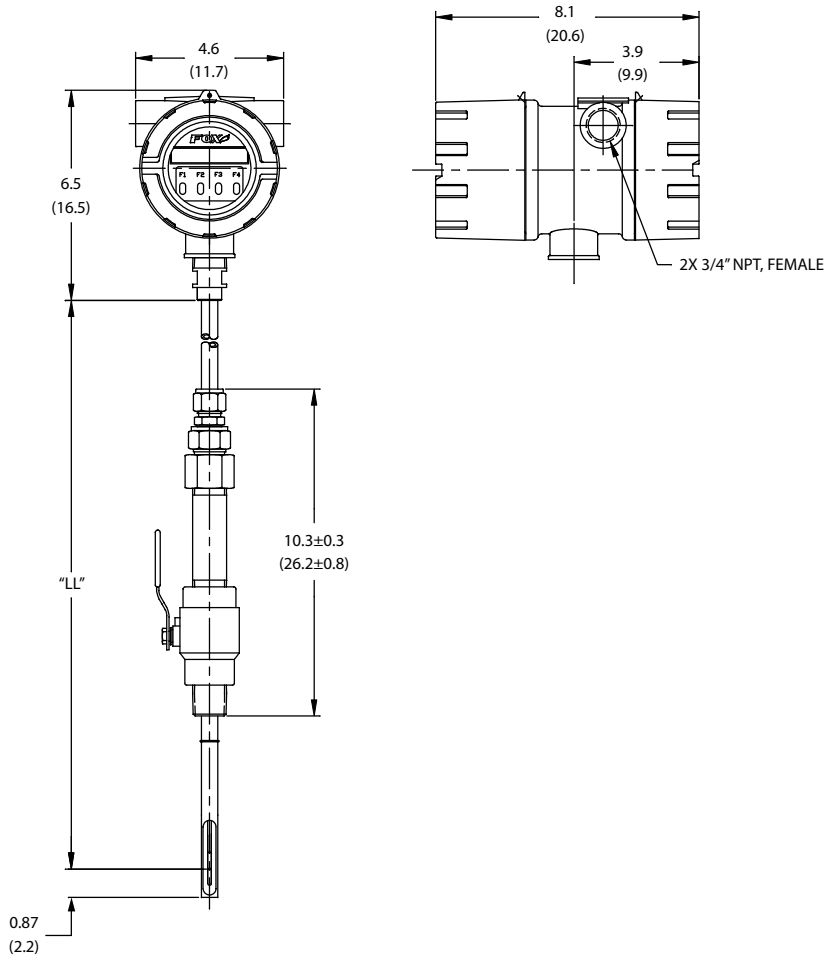


Table 7.1 Local Insertion Meter with Retractor

Probe Size	Probe Size	Dimension "LL" ± .01
[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: Dimensions

Remote with Retractor

Fig. 7.2 Remote Insertion Meter with Retractor Dimensions

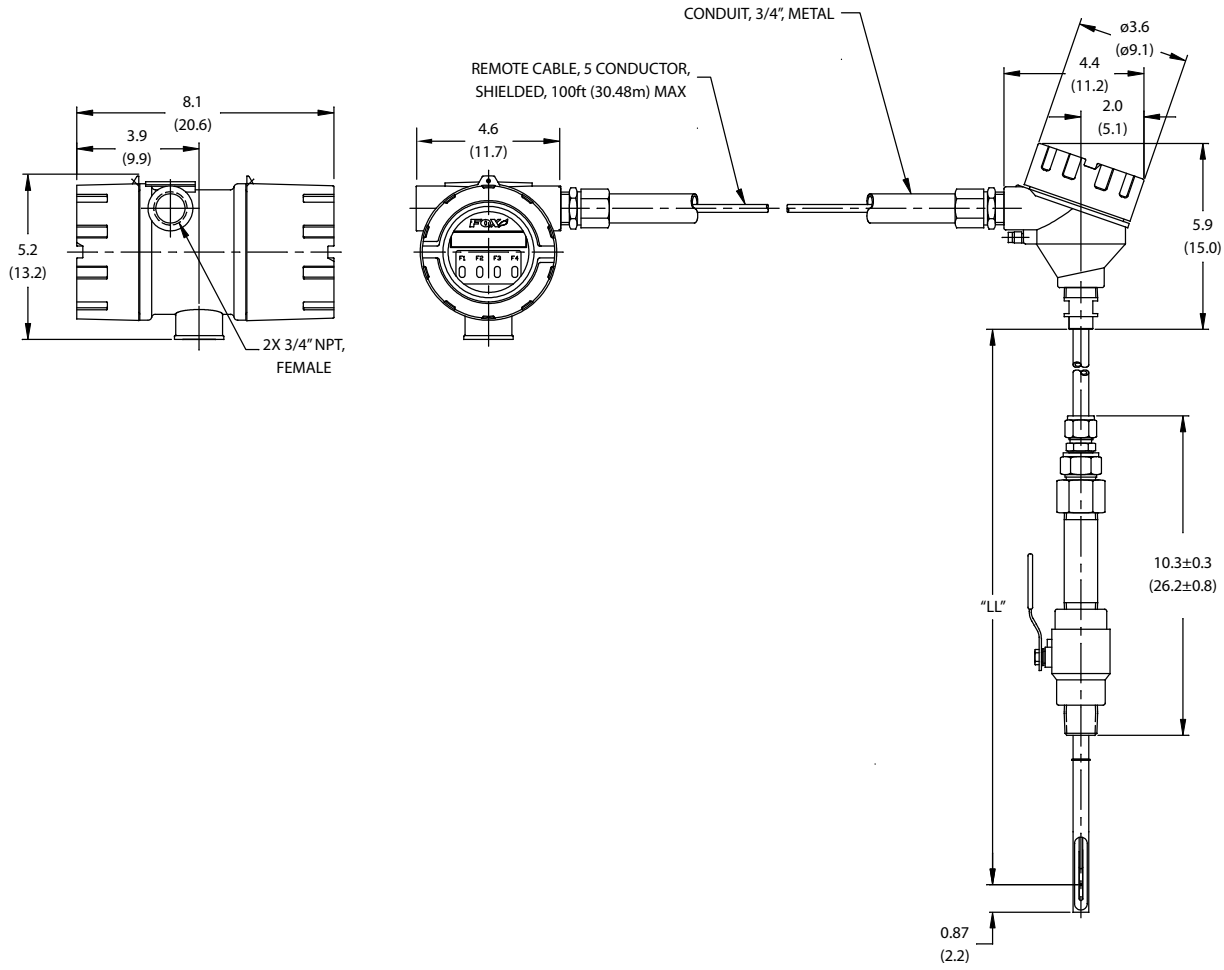


Table 7.2 Remote Insertion Meter with Retractor

Probe Size	Probe Size	Dimension "LL" ± .01
[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: Dimensions

Local Insertion Meter

Fig. 7.3 Insertion Meter Dimensions

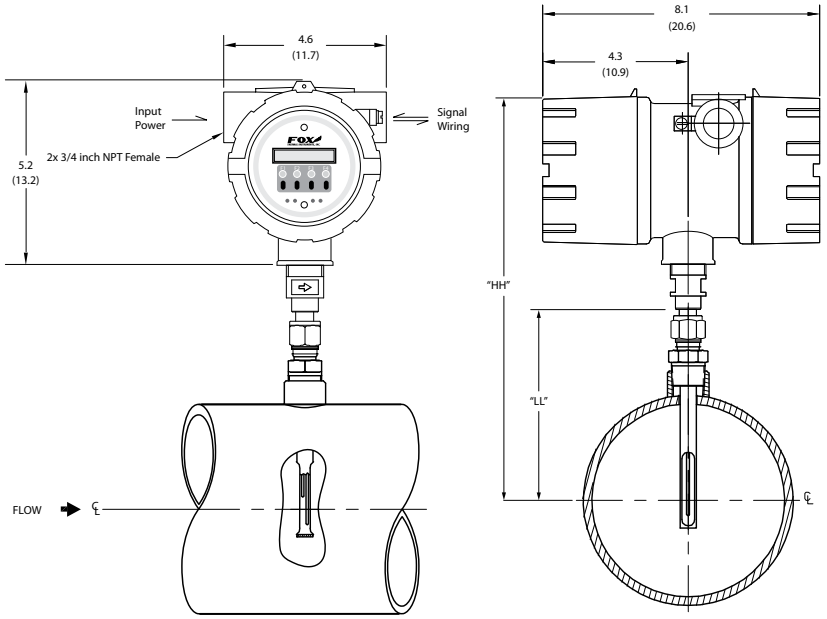


Table 7.3 Insertion Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension "LL" ± .01	Dimension "HH" ± .01
[model code]	[inches]	[inches / centimeters]	[inches / centimeters]
06I	6"	6.0" (15.2cm)	12.5" (31.8cm)
09I	9"	9.0" (22.9cm)	15.5" (39.4cm)
12I	12"	12.0" (15.0cm)	18.5" (47.0cm)
15I	15"	15.0" (38.1cm)	21.5" (54.6cm)
18I	18"	18.0" (45.7cm)	24.5" (62.2cm)
24I	24"	24.0" (61.0cm)	30.5" (77.5cm)
30I	30"	30.0" (76.2cm)	36.5" (92.7cm)
36I	36"	36.0 " (91.4cm)	42.5 " (108.0cm)

Appendices: Dimensions

Remote Insertion Meter

Fig 7.4: Insertion Remote Meter Dimensions

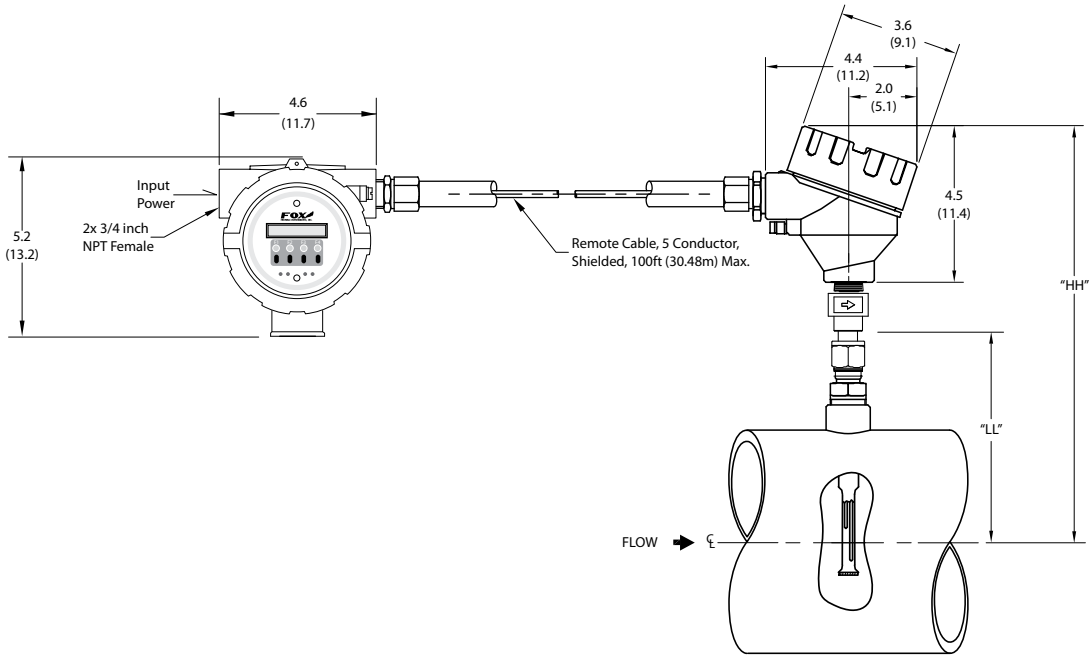


Table 7.4 Insertion Remote Meter with 316 stainless steel probe

Probe Size	Probe Size	Dimension "LL" ± .01	Dimension "HH" ± .01
[model code]	[inches]	[inches / centimeters]	[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" (15.0cm)	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)

Appendices: Dimensions

Local Inline NPT Meter

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

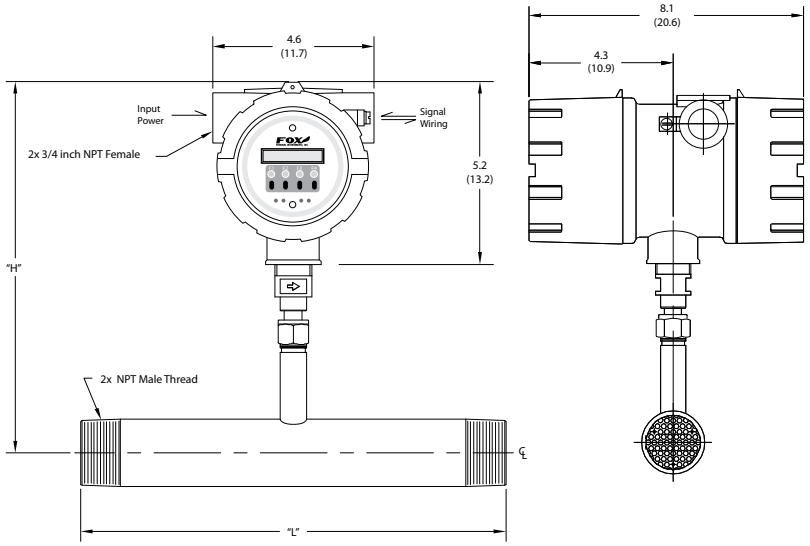


Table 7.5 Inline Meter with 316 stainless steel flow body and NPT End Connections

Body Size [model code]	Body Size [inches]	Dimension "L" [inches]	Dimension "H" [inches / centimeters]
025P	0.25"	5.8"	10.5" (26.7cm)
05P	0.50"	12"	10.5" (26.7cm)
075P	0.75"	12"	10.5" (26.7cm)
10P	1.00"	12"	10.5" (26.7cm)
125P	1.25"	12"	10.5" (26.7cm)
15P	1.50"	12"	10.5" (26.7cm)
20P *	2.00"	12"	10.5" (26.7cm)
25P *	2.25"	18"	10.6" (26.9cm)
30P *	3.00"	18"	10.6" (26.9cm)
40P *	4.00"	18"	11.1" (28.2cm)

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

Appendices: Dimensions

Remote Inline NPT

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

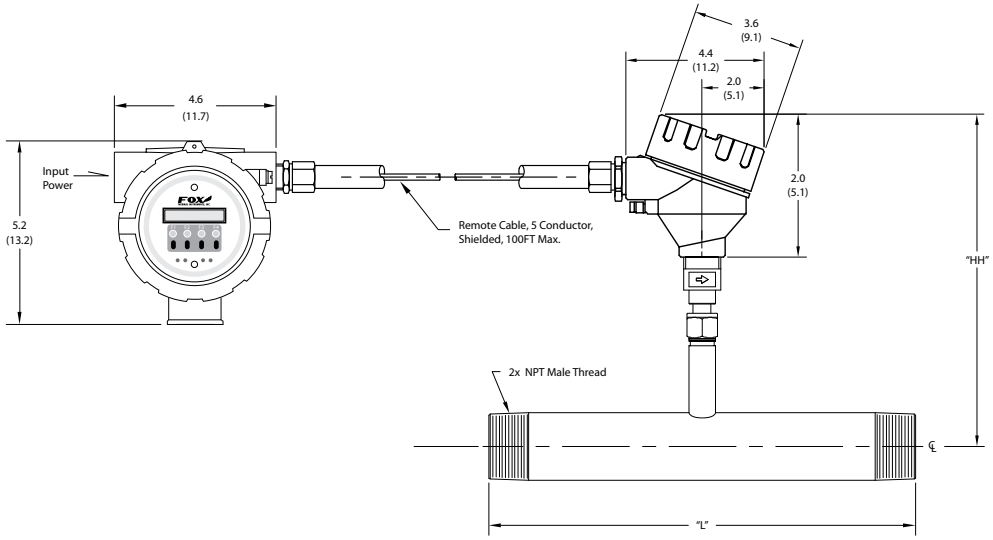


Table 7.6 Inline Remote Meter with 316 stainless steel flow body and NPT End Connections

Body Size [model code]	Body Size [inches]	Dimension "L" [inches]	Dimension "HH" [inches / centimeters]
05P	0.50"	12"	10.5" (26.7cm)
075P	0.75"	12"	10.5" (26.7cm)
10P	1.00"	12"	10.5" (26.7cm)
125P	1.25"	12"	10.5" (26.7cm)
15P	1.50"	12"	10.5" (26.7cm)
20P *	2.00"	12"	10.5" (26.7cm)
25P *	2.25"	18"	10.6" (26.9cm)
30P *	3.00"	18"	10.6" (26.9cm)
40P *	4.00"	18"	11.1" (28.2cm)

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

Appendices: Dimensions

Local Inline Flange Meter

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

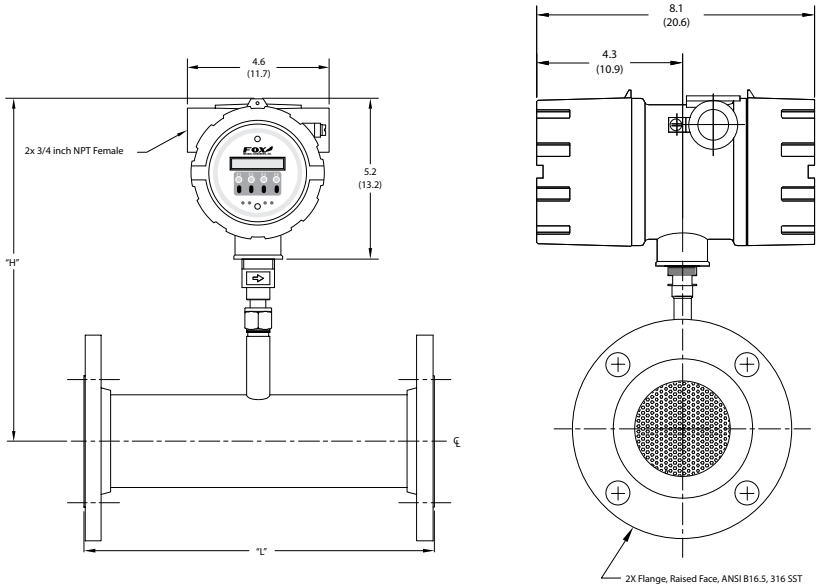


Table 7.7 Inline Meter with 316 stainless steel flow body and 150# RF Flange End Connections

Body Size [model code]	Body Size [inches]	Dimension "L" [inches]	Dimension "H" [inches / centimeters]
05F	0.50"	12"	10.5" (26.7cm)
075F	0.75"	12"	10.5" (26.7cm)
10F	1.00"	12"	10.5" (26.7cm)
125F	1.25"	12"	10.5" (26.7cm)
15F	1.50"	12"	10.5" (26.7cm)
20F *	2.00"	12"	10.5" (26.7cm)
25F *	2.25"	18"	10.6" (26.9cm)
30F *	3.00"	18"	10.6" (26.9cm)
40F *	4.00"	18"	11.1" (28.2cm)
60F	6.00"	24"	12.2" (31.0cm)

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

Appendices: Dimensions

Remote Inline Flange Meter

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

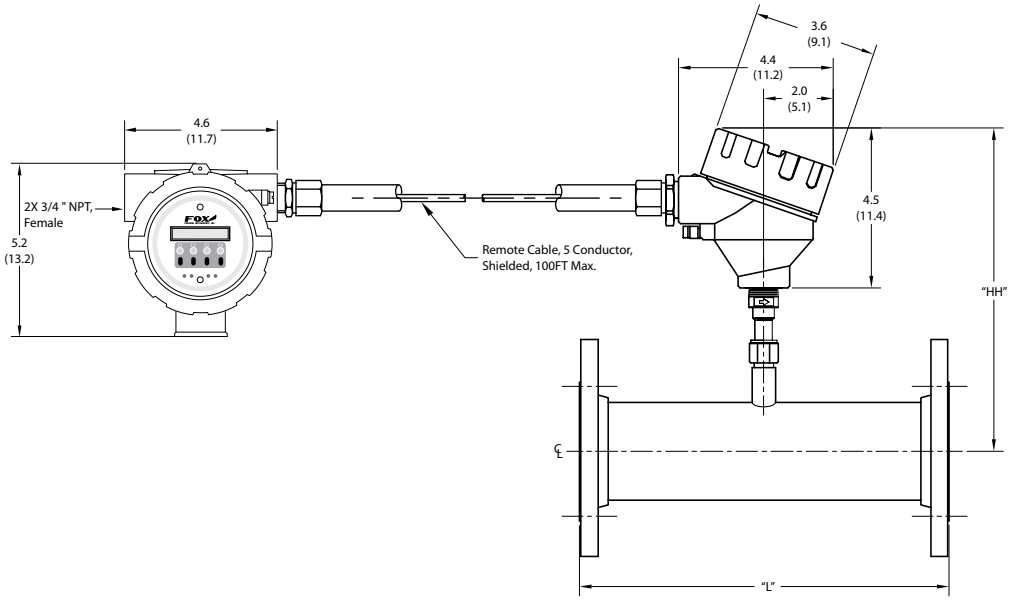


Table 7.8 Inline Remote Meter with stainless steel flow body and 150# RF Flange End Connections

Body Size [model code]	Body Size [inches]	Dimension "L" [inches]	Dimension "HH" [inches / centimeters]
05F	0.50"	12"	10.5" (26.7cm)
075F	0.75"	12"	10.5" (26.7cm)
10F	1.00"	12"	10.5" (26.7cm)
125F	1.25"	12"	10.5" (26.7cm)
15F	1.50"	12"	10.5" (26.7cm)
20F *	2.00"	12"	10.5" (26.7cm)
25F *	2.25"	18"	10.6" (26.9cm)
30F *	3.00"	18"	10.6" (26.9cm)
40F *	4.00"	18"	11.1" (28.2cm)
60F	6.00"	24"	12.2" (31.0cm)

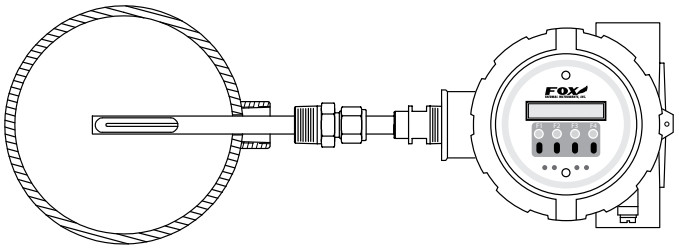
* Also available in A106 Grade B carbon steel pipe with A105 flanges (20FC, 25FC, 30FC, and 40FC model codes)

Appendices: Installation Variations (moisture)

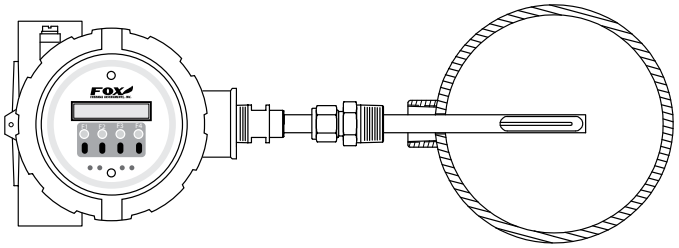
Tilt Installations

Tilt Installations
These variations on installations help prevent moisture and condensation from forming on the sensor and disrupting accurate flow measurement. Fox recommends 180° installation, if possible.

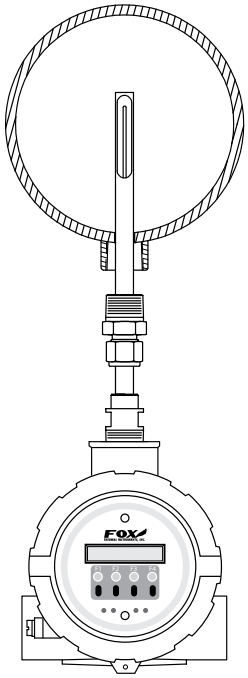
Tilt Installation at 90°, CW



Tilt Installation at 90°, CCW



Tilt Installation at 180°



Appendices: Installation Variations (limited space)

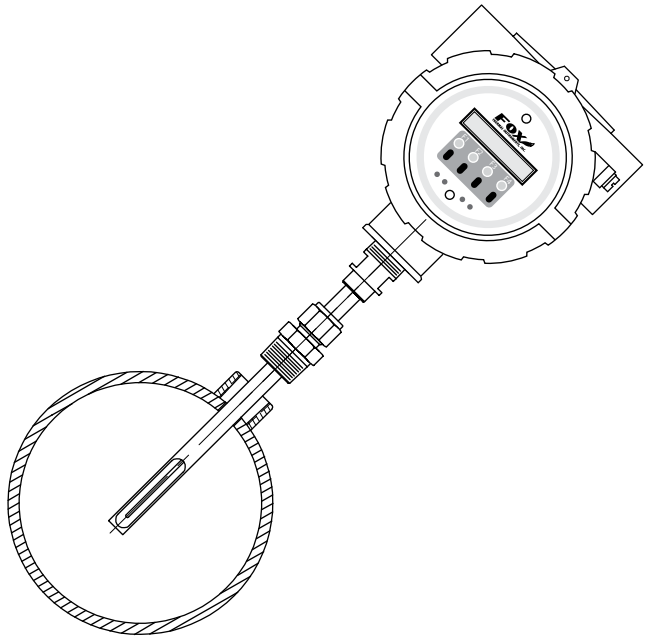
Tilt Installation at 45°, CW

Tilt Installation at 45°

When restricted physical installation space exists, the FT3 can also be installed at a 45° angle. Please note that the display's orientation will remain aligned with the top of the meter.

Note: Displays are rotatable only in 90° angle increments.

For more information about display configurations, visit www.foxthermalinstruments.com to view other display configurations.



Appendices: Warranty

Warranty

Warranty

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

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

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

(d) The liability of FOX shall be limited to replacing or repairing, at its option, any defective parts which are returned. Labor and related expenses incurred to install replacement parts are not covered by this warranty.
(e) As to replacement parts supplied or repairs made during the original warranty period, the warranty period for the replacement or repaired part shall terminate with the termination of the warranty period of the original product or part.

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

Appendices: Warranty

Warranty

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

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

Appendices: Returning Your Meter

Returning Your Meter

Returning Your Meter

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

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

1. Please have your meter's serial number(s) ready so that we can find the records for your meter(s) quickly.
2. Obtain a Return Material Authorization (RMA) Number from the Fox Customer Service Department.
3. Read the Fox RMA Customer Information Form carefully for detailed instructions on the RMA process.
4. Fill out the Fox RMA Customer Information Form. (Be sure to include the RMA number and initial the decontamination statement.)
5. Unless specifically instructed to do otherwise, the entire flow meter must be returned, including all electronics. (For remote units or flow bodies, ALL serial numbers must match their corresponding meters.)
6. Clean and decontaminate all wetted parts before returning to Fox.
7. On the Fox RMA Customer Information Form, please include information describing the difficulties experienced, and a contact name and phone number.
8. Be sure to include complete return shipping instructions. We cannot deliver to post office boxes.
9. Ship the meter to the following address:

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

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

What to Expect During Servicing

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

If you have already shipped your meter to Fox for servicing and would like to check the status of your meter, please fill out our online Service Order Status form located at www.foxthermalinstruments.com and you will hear from a Customer Service Rep within 24 hours of your requested update.

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

Definitions

Glossary of Terms and 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

Definitions

Glossary of Terms and Definitions

NM3/H	Normal cubic Meter per Hour
NM3/M	Normal cubic Meter per Minute
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 to 20mA output

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