

MODEL

FT1

TEESING

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## Fox Thermal Gas Mass Flow Meter

### HIGHLIGHTS

- DDC-Sensor™: Robust, non-cantilevered design
- Gas-SelectX®: menu of field selectable gas compositions
- CAL-V™ Calibration Validation
- Insertion and Inline styles
- Measures gas flow rate in SCFM, MSCFD, KG/HR, & many more
- Wide measurement range: up to 1000:1 turndown; 100:1 typical
- 4-20mA for flow rate or temperature; HART communication option
- Choice of second output: pulse output for flow/total, Modbus RTU (RS485), or BACnet MS/TP (RS485)
- USB port to connect to a PC, standard
- Free FT1 View™ Software available
- Welded, 316 SS sensor and flow body construction, carbon steel flow body optional
- Microprocessor based, field-programmable electronics
- Optional on-board 2 line x 16 character, backlit display with configuration panel
- NIST traceable calibration
- Low-end sensitivity for leak detection
- Negligible pressure drop
- FM (U.S.) & FMc (CANADA) approved for Class I, Div 1; ATEX/IECEx approved for Zone 1
- NEMA 4X and CE Mark
- Flow Control Innovation Award Winner
- Processing's Breakthrough Product Award Winner



## FAST AND FLEXIBLE GAS FLOW MEASUREMENT

The Model FT1 thermal mass flow meter and temperature transmitter can be used in a large variety of industrial and commercial gas flow measurement applications. The FT1 offers the flexibility to monitor multiple gas types at the push of a button, rotate the housing as needed for tight installations, and configure meter settings from advanced software.

## MODEL FT1

### FOX THERMAL MODEL FT1 THERMAL GAS MASS FLOW METER FEATURES

The Fox Thermal Model FT1 measures gas flow rate in standard units without the need for temperature or pressure compensation. It provides an isolated 4-20mA output (with a HART option) and a selection of pulse, Modbus RTU (RS485), or BACnet MS/TP (RS485) for a second output.

With an optional on-board 2-line x 16-character backlit display, operators can view flow rate, total, elapsed time, process gas temperature, and alarms. The display is also used in conjunction with the Configuration Panel to access flow meter settings, such as 4-20mA and pulse output scaling, pipe diameter, zero flow cutoff, flow filtering (damping), display options, and high or low alarm limits.

The Model FT1 is available in insertion and inline styles. The insertion style FT1 has a robust stainless steel probe and is easily installed by drilling a hole in the pipe and welding on a 1" NPT coupling. A Fox Thermal-supplied compression fitting secures the probe in place. It is supplied with 316 stainless steel wetted materials standard. Inline styles of the FT1 are available in both stainless steel and carbon steel with NPT and 150lb flange options. See Specification section for details on sizing. A USB port to connect to a computer or laptop is standard; interface options include HART, Modbus RTU (RS485) and BACnet MS/TP (RS485).

Fox Thermal has certified cleaning and bagging procedures for flow meters to be used in oxygen applications.

## THEORY OF OPERATION

Fox Thermal flow meters use a constant temperature differential (constant  $\Delta T$ ) technology to measure the mass flow rate of gases. The thermal mass flow sensor consists of 2 Resistance Temperature Detectors (RTD's). The Reference RTD measures the gas temperature. Meanwhile, the instrument electronics heat the mass flow sensor, or heated element, to a constant temperature differential (constant  $\Delta T$ ) above the gas temperature and measures the cooling effect of the gas flow. The electrical power required to maintain a constant temperature differential is directly proportional to the mass flow rate of the gas.



*The DDC-Sensor™ allows the user to swivel the probe  $\pm 180^\circ$  into four positions.*

## ADVANCED FEATURES

Suitable for harsh and hazardous environments, the instrument features:

- Robust DDC-Sensor™ Design
- Gas-SelectX® with a selection of pure gases or a gas mix (up to five gases)
- CAL-V™ Calibration Validation
- Rotatable probe: allows  $\pm 180$  degree swivel
- FM/FMc, ATEX, IECEx approvals. CE mark.
- 10-30VDC power input, standard
- NIST-traceable calibration
- Free FT1 View™ Software
- High and low alarm limits
- Wetted materials are all welded, 316 stainless steel

## DIGITAL TECHNOLOGY PLATFORM

### DDC-SENSOR™ TECHNOLOGY

The Fox Thermal DDC-Sensor™ is a state-of-the-art sensor technology used in the Fox Thermal Model FT1 Thermal Gas Flow Meter. The DDC-Sensor™, a Direct Digitally Controlled sensor, is unlike other thermal flow sensors available on the market. Instead of using traditional analog circuitry, the DDC-Sensor™ is interfaced directly to the FT1 microprocessor for more speed and programmability. The DDC-Sensor™ accurately responds to changes in process variables (gas flow rate, pressure, and temperature) to determine mass flow rate, totalized flow, and temperature.

Fox Thermal's DDC-Sensor™ provides a technology platform for calculating accurate gas correlations. The FT1 correlation algorithms allow the meter to be calibrated on a single gas in the factory while providing the user the ability to select other gases in the Gas-SelectX® menu. With its DDC-Sensor™ and advanced correlation algorithm, the FT1 is a precision, multi-gas-capable thermal gas flow meter.

### GAS-SELECTX® GAS SELECTION MENU

Process Engineers need a fast solution to their monitoring needs. For these cases, Fox Thermal has developed the Gas-SelectX® gas menu feature for the Model FT1 flow meter. Gas-SelectX® allows the user to choose from a menu of several common gases or gas mixtures for their application. Visit the [Fox Thermal website](#) to view the gases available in the gas menu for the FT1.

The meter's proprietary algorithms allow the user to switch gases or gas mixes in the field, as needed. This makes the FT1 ideal for measurement of Digester Gas, Liquefied Petroleum Gas (LPG) and a variety of other biogases. Whether you need to measure natural gas or air, CO2 or digester gas, the FT1 brings these options and more to the user with a push of a button.

### CAL-V™

For customers that need a quick and easy way to verify the calibration of the meter in the field, the Model FT1 offers the CAL-V™ feature. This feature can be initiated through the meter's optional display configuration panel or the FT1 View™ Software. The test takes less than 5 minutes to run and produces a pass/fail result at the conclusion of the test. A fail result may indicate either a dirty sensor or the need to recalibrate.

If the CAL-V™ test is performed using the FT1 View™ software, a Calibration Validation Certificate can be produced at the conclusion of the test. The certificate will show the date and time of the test along with meter data such as firmware version, and meter serial number. This in-situ calibration validation helps operators comply with environmental mandates and eliminates the cost and inconvenience of annual factory calibration.

### FT1 VIEW™ SOFTWARE

Fox Thermal has developed advanced software - FT1 View™ - a free PC-compatible application available for download from the Fox Thermal website. Connect your laptop, PC, or control station to the meter using the USB port interface to access the meter's data and configure the meter's settings.

FT1 View™ allows:

- Quick access to all configuration parameters with pop-up windows and pull down menus
- Selection of measurement units, flow and temperature ranges, alarm settings and more
- Print or save a CAL-V™ Calibration Validation Certificate
- Set alarms; display alarm codes
- Storage of meter configurations to a file that can be archived
- Simulation mode used to align 4-20mA output with the input to customer's PLC/DCS
- Raw data to be viewed in order to diagnose or troubleshoot your meter
- Data logging to an Excel® spreadsheet

## DIMENSIONS

### INSERTION STYLES

Assuming there is no insulation or retractor, Fox recommends the following probe lengths:

Pipe Size	Probe Length
1.5" (40mm) to 6" (150mm)	6-inch
8" (200mm) to 12" (300mm)	9-inch
14" (350mm) to 18" (450mm)	12-inch

Use the equation below for larger pipe sizes

Probe Lengths in inches (cm) =	
6.0 (15.2)	9.0 (22.9)
12.0 (30.5)	15.0 (38.1)
18.0 (45.7)	24.0 (61.0)
30.0 (76.2)	36.0 (91.4)

### EQUATION

Equation for selecting insertion flow meter probe length:

Probe length = ½ pipe ID (in inches) + 3" + thickness of insulation (if any) + 10" (for retractor if supplied). Round up to the next standard probe length available.

**Note:** Contact Fox for longer probes.

## APPROVALS

**CE Mark: Approved**

EMC Directive: 2014/30/EU

Electrical Equipment for Measurement, Control and Lab Use:  
EN61326-1:2013

EU Directive: 2014/68/EU

Weld Testing: EN ISO 15614-1 and EN ISO 9606-1, ASME B31.3

**FM (FM16US0005X) & FMc (FM16CA0005X): Approved**

Class I, Division 1, Groups B, C, D;

Class II, Division 1, Groups E, F, G;

Class III, Division 1; T4, Ta = -40° to 70°C;

Class I, Zone 1, AEx/Ex db IIB + H2 T4; Gb Ta = -40°C to 70°C;

Type 4X, IP66/67

### INLINE STYLES

Inline pipe sizes, materials, and end connections are listed in the table below.

Inline pipe sizes in inches =														
0.75	○	●	◐	◑	1.00	○	●	◐	◑	1.25	○	●	◐	◑
1.50	○	●	◐	◑	2.00	○	●	◐	◑	2.50	○	●	◐	◑
3.00	○	●	◐	◑	4.00	○	●	◐	◑	6.00	○	●	◐	◑

○= SS ●= CS ◐= NPT Ends ◑= 150lb flanges

**Note:** See [FT1 Model Codes](#) document for more information.

**Note:** Inline flow bodies include built-in flow conditioners. [FC20 Flow Conditioners](#) are available as an option for insertion flow meters..

### PROBE DIAMETER

Insertion and inline flow Meters: Probe diameter: ¾"

### DRAWINGS

See [FT1 Dimensional Drawings](#) on Fox Thermal website.



FT1 meters installed for natural gas sub-metering at a major hotel/casino in Las Vegas, NV.

## PERFORMANCE SPECS

### Flow Accuracy:

- Air: ±1% of reading ±0.2% of full scale
- Other gases: ±1.5% of reading ±0.5% of full scale
- Accuracy specification applies to customer's selected flow range
- Maximum range: 15 to 25,000 SFPM (0.07 to 120 NMPS)
- Minimum range: 15 to 500 SFPM (0.07 to 2.4 NMPS)
- Straight, unobstructed pipe requirement:
  - Insertion: 15 diameters upstream 10 downstream
  - Inline: 8 diameters upstream, 4 downstream

### Flow Repeatability: ±0.2% of full scale

### Flow Response Time: 0.8 seconds (one time constant)

### Temperature Accuracy: ±1° F (±0.6° C)

### Calibration:

Factory Calibration to NIST traceable standards

### CAL-V™:

In-situ, operator-initiated calibration validation

## OPERATING SPECS

### Gas-SelectX® Gas Selections:

Pure Gas menu and a 5-gas mix to suit any application. See the Fox Thermal website for more information on current [availability of gases](#).

### Gas Pressure (maximum; at 100°F):

- Insertion: 740 psig (51 barg)
- 316 SS inline w/NPT ends: 500 psig (34 barg)
- 316 SS inline w/150lb flanges: 230 psig (16 barg)
- CS inline w/NPT ends: 500 psig (34 barg)
- CS inline w/150lb flanges: 285 psig (20 barg)
- Retractor: 150 psig (10.3 barg)
- Notes:
  - Check with factory for higher pressure options.
  - With Teflon Ferrule option (P/N 106415), maximum gas pressure is 60 psig (4.1 barg).
  - Pressure ratings stated for temperature of 100°F (38°C).

### Temperature:

DDC-Sensor™: -40 to 250°F (-40 to 121°C)  
 Enclosure: -40 to 158°F (-40 to 70°C)\*  
 \*NOTE! Display dims below -4°F (-20°C); function returns once temperature rises again.

### Flow Velocity Range:

15 to 25,000 SFPM at 70°F (0.07 to 120 NMPS at 0°C)  
 Turndown: up to 1000:1; 100:1 typical

Flow Ranges - Insertion Meters			
Pipe Diameter	SCFM	MSCFD	NM3/Hr
1.5" (40mm)	0 - 354	0 - 510	0 - 558
2" (50mm)	0 - 583	0 - 840	0 - 920
2.5" (63mm)	0 - 830	0 - 1,310	0 - 1,200
3" (80mm)	0 - 1,280	0 - 1,840	0 - 2,020
4" (100mm)	0 - 2,210	0 - 3,180	0 - 3,480
6" (150mm)	0 - 5,010	0 - 7,210	0 - 7,910
8" (200mm)	0 - 8,680	0 - 12,500	0 - 13,700
10" (250mm)	0 - 13,600	0 - 19,600	0 - 21,450
12" (300mm)	0 - 19,400	0 - 27,900	0 - 30,600

NOTE! To determine if the FT1 will operate accurately in other pipe sizes, divide the maximum flow rate by the pipe area. The application is acceptable if the resulting velocity is within the velocity range above.

Flow Ranges - Inline Meters			
Pipe Diameter	SCFM	MSCFD	NM3/Hr
0.75"	0 - 93	0 - 134	0 - 146
1"	0 - 150	0 - 216	0 - 237
1.25"	0 - 260	0 - 374	0 - 410
1.5"	0 - 354	0 - 510	0 - 558
2"	0 - 583	0 - 840	0 - 920
2.5"	0 - 830	0 - 1,310	0 - 1,200
3"	0 - 1,280	0 - 1,840	0 - 2,020
4"	0 - 2,210	0 - 3,180	0 - 3,480
6"	0 - 2,500	0 - 3,600	0 - 3,950

NOTE! Consult factory for flow ranges above those listed. Inline meters above 2,500 SCFM (3,950 NM3/H) may require third party calibration. Contact Fox Thermal.

### Relative Humidity:

90% RH maximum; non-condensing

### Units of Measurement (field-selectable):

SCFM, SCFH, NM3/M, NM3/H, NM3/D, NLP, NLPH, MCFD, MSCFD, SCFD, MMSCFD, MMSCFM, SM3/D, SM3/H, SM3/M, LB/S, LB/M, LB/H, LB/D, KG/S, KG/M, KG/H, SLPM, MT/H

### Input Power: 12 to 28 VDC, 6 watts max.

Full input power range: 10 to 30 VDC.  
 20 Watt or greater power supply is recommended

### Outputs:

Channel 1: Standard isolated 4-20mA output for flow or temperature; fault indication per NAMUR NE43; HART communication option.  
 Channel 2: Option of a) pulse output or b) Serial Communication (Modbus RTU (RS485) or BACnet MS/TP (RS485))  
 Isolated pulse output: 5 to 24VDC, 20mA max., 0 to 100Hz for flow (the pulse output can be used as an isolated solid state output for alarms).

### Serial Communication:

USB connector for connecting to a laptop or computer is standard.  
 Optional isolated communication outputs: Modbus RTU (RS485), BACnet MS/TP (RS485).  
 Free PC-based software tool - FT1 View™ - provides complete configuration, remote process monitoring, and data logging functions.

### 4-20mA and Pulse Verification:

Simulation mode used to align 4-20mA output and pulse output (if ordered) with the input to customer's PLC/DCS.

## PHYSICAL SPECS

### Probe diameter:

¾"

### Sensor Material:

316 stainless steel

### Enclosure:

NEMA 4X, aluminum, dual ¾" FNPT conduit entries.