Fox Thermal
Precision Mass Flow Measurement
An ONICON Brand

Model FT1 Gas Mass Flow Meter For Industrial & Wastewater Applications

- 2nd Generation DDC-Sensor™: Robust, non-cantilevered design
- Gas-SelectX®: menu of field selectable gas compositions
- Zero CAL-CHECK® 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 4 and CE Mark
- 2015 Flow Control Innovation Award Winner
- Processing's 2015 Breakthrough Product Award Winner

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Model FT1
Thermal Mass Flow Meter & Temperature Transmitter

Processing's BREAKTHROUGH PRODUCTS 2015

2015 Innovation AWARDS WINNER Flow Control

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. Available gases: Air, Argon, Butane, Carbon Dioxide, Ethane, Methane, Natural Gas (NAESB composition), Nitrogen, Oxygen, Helium, Hydrogen, Propane, & gas mix (any five gases in this list to create a custom gas composition totalling 100%).

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.

THERMAL MASS TECHNOLOGY

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 FT4X 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.

Theory of Operation

Fox Thermal flow meters use a constant temperature differential (constant Δ 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 Δ 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 Model FT1 flow meter and temperature transmitter is approved for FM/FMc Class I, Division 1, ATEX/IECEx Zone 1. CE Mark.

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.

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
- Zero CAL-CHECK® Calibration Validation
- Rotatable probe: allows ±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

The DDC-Sensor™ allows the user to swivel the probe ±180° into four positions.

Perfect for commercial and industrial applications, the Model FT1 is a superior flow measurement instrument with excellent accuracy!

Zero CAL-CHECK®

For customers that need a quick and easy way to verify the calibration of the meter in the field, the Model FT1 offers the Zero CAL-CHECK® feature. This feature can be initiated through the meter's optional display configuration panel or the FT1 View™ Software. The test takes fewer 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 Zero CAL-CHECK® 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 Zero CAL-CHECK® 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

APPROVALS & SPECIFICATIONS

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

ATEX (FM16ATEX0013X): Approved
  II 2 G Ex db IIB + H2 T4; Gb Ta = -40˚C to 70˚C; IP66/67
  II 2 D Ex tb IIIC T135˚C; Db Ta = -40˚C to 70˚C; IP66/67

IECEx (IECEx FMG 16.0010X): Approved
  Ex d IIB + H2 T4; Gb Ta = -40˚C to 70˚C; IP66/67
  Ex tb IIIC T135˚C; Db Ta = -40˚C to 70˚C; IP66/67

ATEX and IECEx Standards:
  EN 60079-0:2012 + A11:2013   IEC 60079-0:2011
  EN 60079-1:2014   IEC 60079-1:2014
  EN 60079-31:2014   IEC 60079-31:2013
  EN 60529:1991 + A1:2000   IEC 60529:2001

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
  Zero CAL-CHECK®: In-situ, operator-initiated calibration validation

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SPECIFICATIONS

Operating Specs

Gas-SelectX® Gas Selections:
Air, Argon, Butane, Carbon Dioxide, Ethane, Methane, Natural Gas (NAESB gas composition), Nitrogen, Oxygen, Helium, Hydrogen, Propane, 5-gas mix (any five gases in this list equalling 100%). See the Fox Thermal website for more information on current gases.

Gas Pressure (maximum; at 100°F):
Insertion: 740 psig (51 barg)
316 SS inline w/NPT ends: 300 psig (21 barg)
316 SS inline w/150lb flanges: 230 psig (16 barg)
CS inline w/NPT ends: 300 psig (21 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 for temperatures up to 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/H
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. Check Fox Thermal website for velocity calculator.

Flow Ranges - Inline Meters			
Pipe Diameter	SCFM	MSCFD	NM3/H
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, NLPS, NLPM, 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.
A 20 Watt or greater power supply is recommended to power the FT1

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 user's PLC/DCS.

Physical Specs

Probe diameter: ¾″

Sensor Material: 316 stainless steel

Enclosure: NEMA 4, aluminum, dual ¾″ FNPT conduit entries.

Fox Thermal recommends the following probe lengths (assuming no insulation around pipe):

Pipe Diameter	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 equation below for selecting probe length of larger pipe sizes	

Probe Lengths (LL*) 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)
*See dimensional drawings on Fox Thermal website.

Dimensional

Refer to dimensional drawings on Fox Thermal website.

Equation for Selecting Probe Length

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