Description

The FS1012 MEMS mass flow sensor module measures the flow rate using the thermo-transfer (calorimetric) principle. The FS1012 is capable of measuring a gas or liquid medium.

The FS1012 offers key advantages over resistor-based flow solutions. The sensor utilizes thermopile sensing, which provides an excellent signal-to-noise ratio. The sensor comprises a “solid” thermal isolation technology and silicon-carbide coating to protect it from abrasive wear and provides robustness and long-term reliability. In comparison, other sensors typically contain a fragile membrane above an etched cavity for the thermal isolation base.

The FS1012 features the sensor fully assembled and wire-bonded out to a 6-pin header. Wetted materials consist of a glass fiber reinforced PA66 resin, epoxy, and silicon carbide.

Features

- Gas or liquid mediums
- Robust “solid” isolation technology
- Resistant to surface contamination
- No cavity to cause clogging
- Resistant to vibration and pressure shock
- Low power application
- Sensitive at low flow rates and differential pressure levels
- Fast response: <5ms
- Millivolt output
- Supply voltage: 3V to 5V
- Module operating temperature range: 0°C to +85°C

Typical Applications

- Process controls and monitoring
- Oil and gas leak detection
- HVAC and air control systems
- CPAP and respiratory devices
- Liquid dispensing system

FS1012 Flow Sensor Module

Basic Application Circuits

Figure 1. Single-Ended Circuit Example

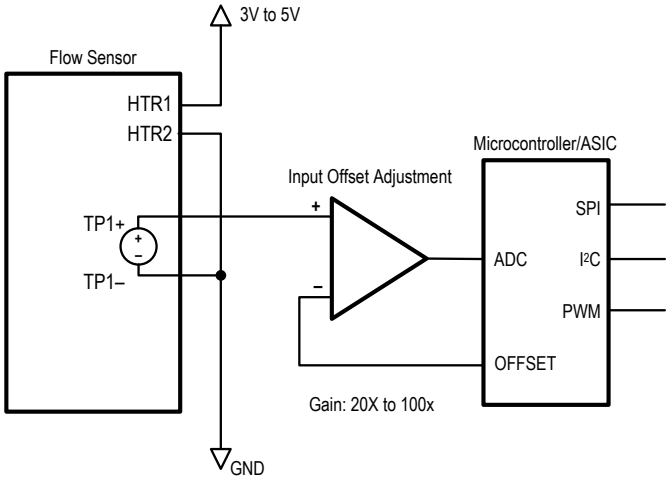
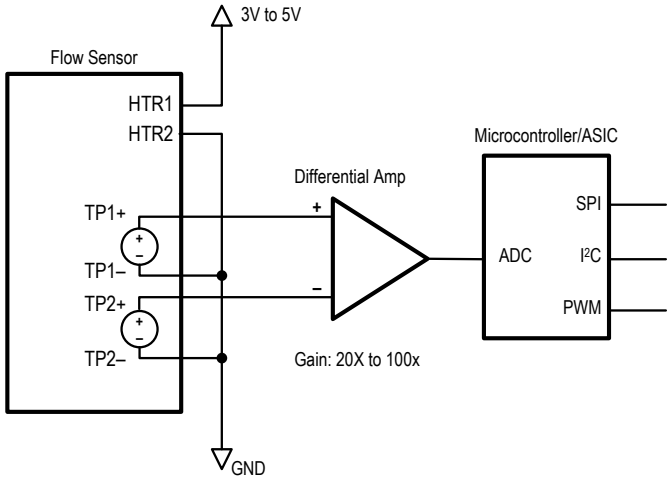
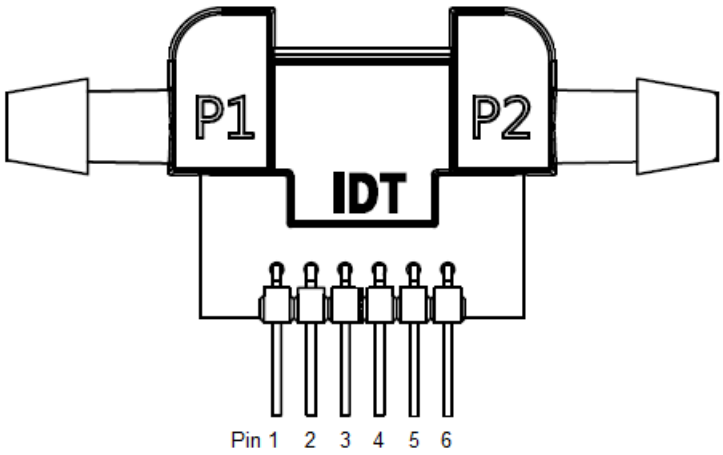


Figure 2. Differential Circuit Example



Pin Assignments

Figure 3. Pin Assignments for Module – Top View



Pin Descriptions

Table 1. Pin Descriptions

Pin Number	Pad Name	Type	Description
1	TP1+	Output	Thermopile 1 (+)
2	TP1–	Output	Thermopile 1 (–)
3	HTR1	Input	Heater
4	HTR2	Input	Heater
5	TP2–	Output	Thermopile 2 (–)
6	TP2+	Output	Thermopile 2 (+)

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Absolute Maximum Ratings

The absolute maximum ratings are stress ratings only. Stresses greater than those listed below can cause permanent damage to the device. Functional operation of the FS1012 at absolute maximum ratings is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Table 2. Absolute Maximum Ratings

Symbol	Parameter	Conditions	Minimum	Maximum	Units
V_H	Heater Voltage Supply			5.6	V
T_{STOR}	Storage Temperature		-50	130	°C
P_{BURST}	Burst Pressure			10	bar

Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Units
T_{AMB}	Ambient Operating Temperature [a]	0		85	°C
I_{HTR_CC}	Heater Driving Current – Constant Current [a]		10	20	mA
V_{HTR_CV}	Heater Driving Voltage – Constant Voltage [a]		3	5.6	V

[a] Sensor specifications are tested at the wafer die level.

Electrical Characteristics

Table 4. Electrical Characteristics

Note: See important notes at the end of the table.

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
R_H	Heater Resistor [a]		230	290	400	Ω
$\propto_{_HTR}$	Heater Temperature Coefficient of Resistance [a]			300		ppm/°C
V_{TP_OUT}	Thermopile Output [a]	3V driving voltage, in air, 20°C, no flow	30	35	60	mV
R_{TP}	Thermopile Resistance [a]	20°C	100	210	300	KΩ
$V_{TP_OUTDIFF}$	Thermopile Differential Output [a]	3V driving voltage, in air, 20°C, no flow	-1	0	1	mV
t_{RESP}	Response Time			5		ms

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Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
Standard Gas Flow Range [b], [c]						
	Gas Flow	FS1012-1020-NG	0		2 (2000)	SLPM (SCCM)
		FS1012-1100-NG	0		10 (10000)	SLPM (SCCM)
Standard Liquid Flow Range [b], [c]						
	Liquid Flow	FS1012-1001-LQ	0		0.5 (500)	SLPM (SCCM)
		FS1012-1002-LQ	0		1.0 (1000)	SLPM (SCCM)

[a] Sensor specifications are tested at the wafer die level.

[b] SLPM: Standard liter per minute.

[c] SCCM: Standard cubic centimeter per minute.

Flow Curves

The flow output curves are typical values at room conditions. The heater voltage is set at 5VDC. Flow input is from P1 to P2 out.

In general, use TP1 to measure gas flow and TP2 for liquid flow.

Figure 4. FS1012-1020-NG Flow Curve

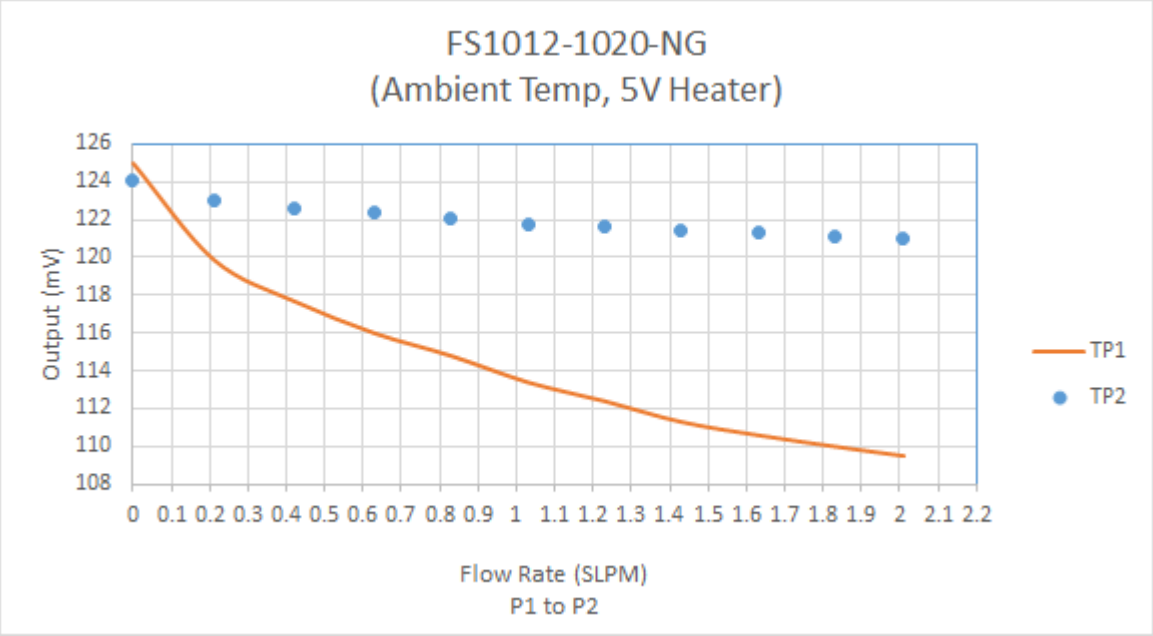


Figure 5. FS1012-1100-NG Flow Curve

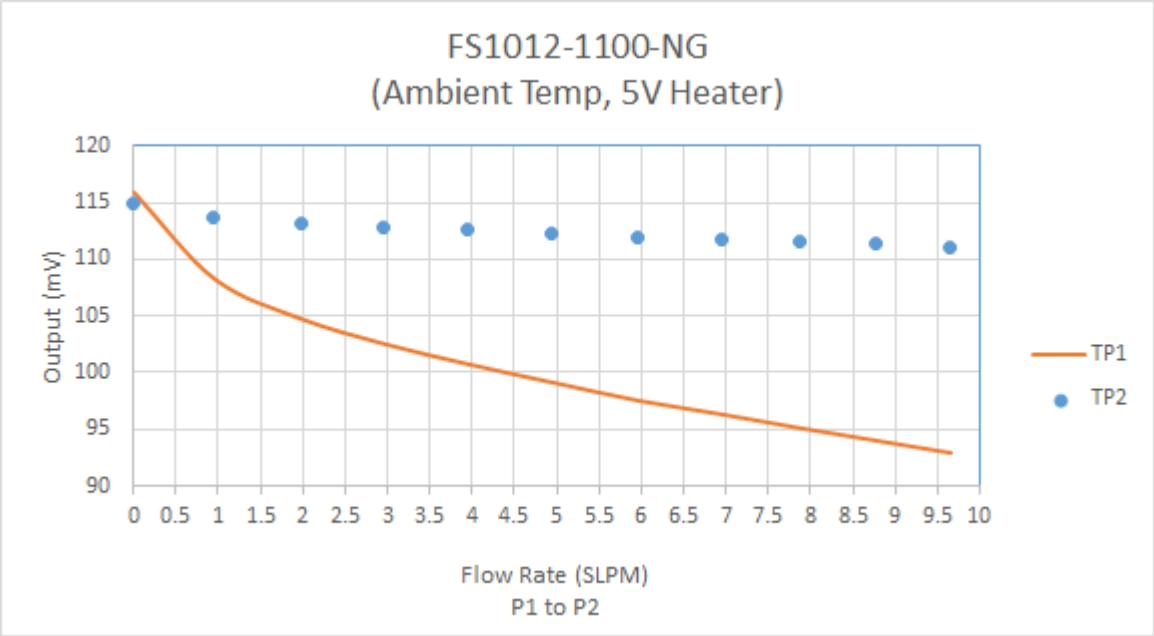


Figure 6. FS1012-1001-LQ Flow Curve

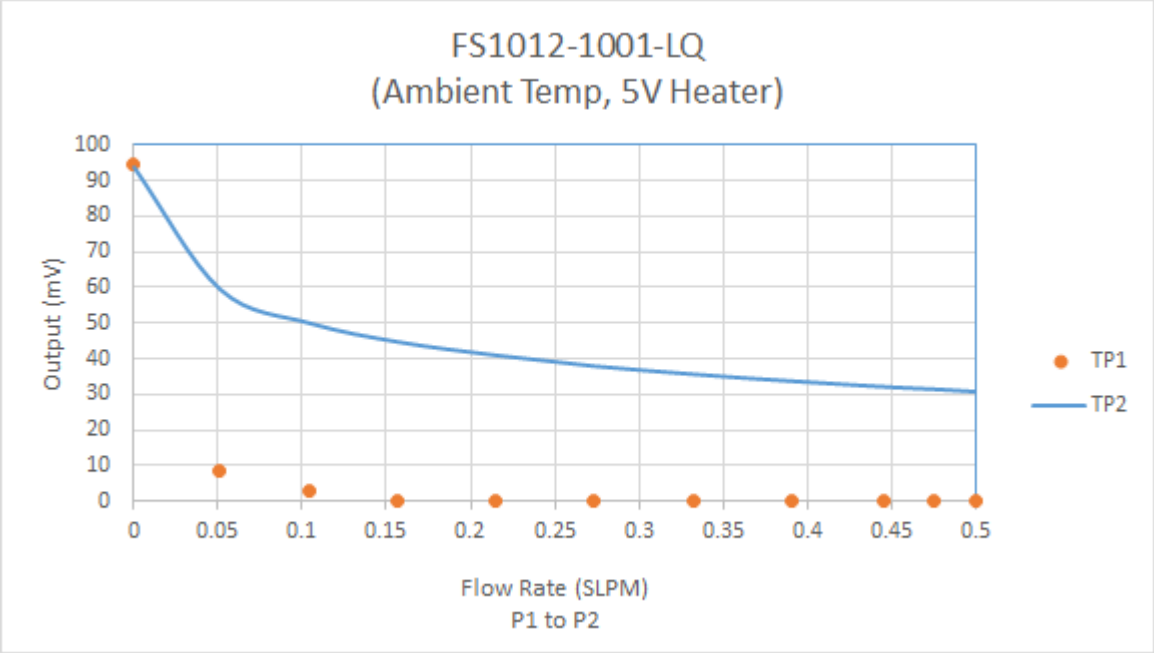
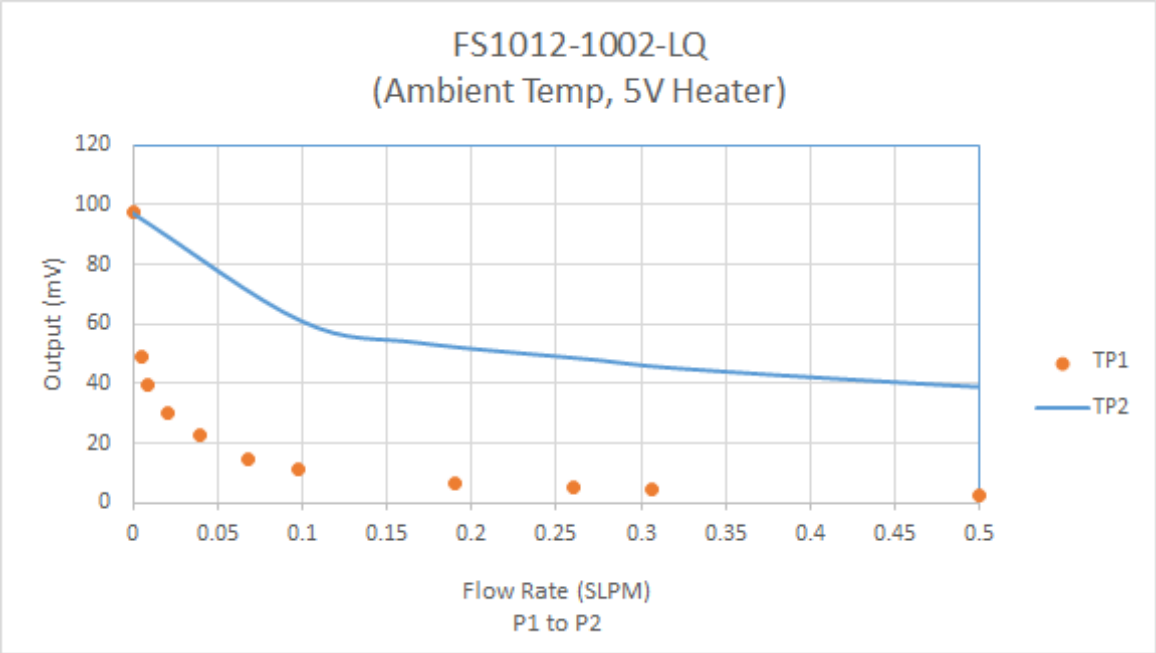
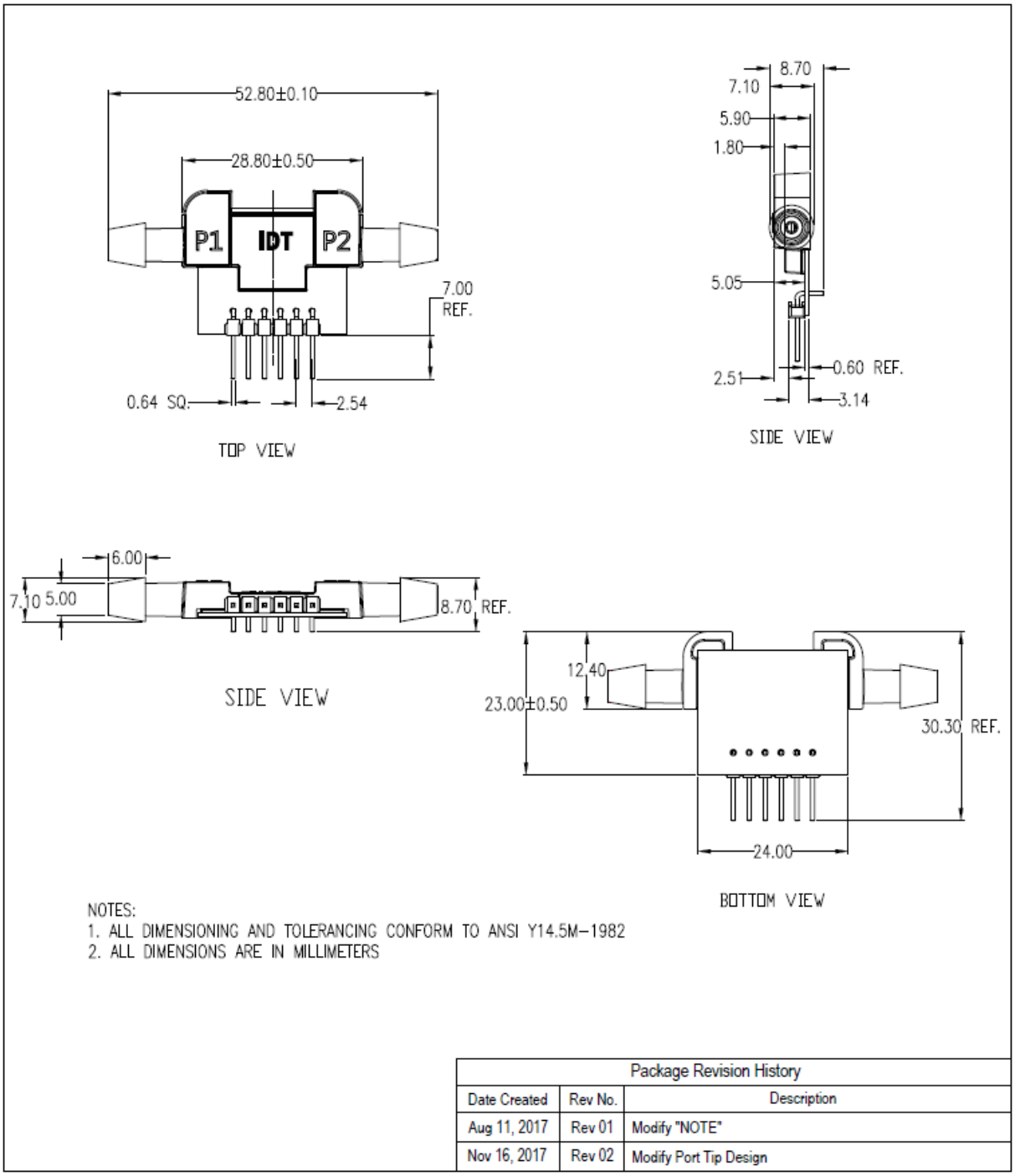


Figure 7. FS1012-1002-LQ Flow Curve



Package Outline Drawings

Figure 8. FS1012 Module Outline Drawings



Package Revision History		
Date Created	Rev No.	Description
Aug 11, 2017	Rev 01	Modify "NOTE"
Nov 16, 2017	Rev 02	Modify Port Tip Design

Ordering Information

Note: The part code depends on the application. In the part code, NG refers to “non-corrosive gas” and LQ refers to “liquid.”

Orderable Part Number	Description and Package	Shipping Packaging	Temperature
FS1012-1020-NG	0 to 2 SLPM gas flow sensor mounted on a circuit board with a flow housing	Box	0°C to +85°C
FS1012-1100-NG	0 to 10 SLPM gas flow sensor mounted on a circuit board with a flow housing	Box	0°C to +85°C
FS1012-1001-LQ	0 to 0.5 SLPM (500 SCCM) liquid flow sensor mounted on a circuit board with a flow housing	Box	0°C to +85°C
FS1012-1002-LQ	0 to 1.0 SLPM (1000 SCCM) liquid flow sensor mounted on a circuit board with a flow housing	Box	0°C to +85°C

Revision History

Revision Date	Description of Change
November 19, 2018	Update module dimensions drawing, change Table 2 spec, added flow curves.
September 8, 2017	Updated module dimensions drawing.
July 20, 2017	Initial release of the datasheet.

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