## 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**

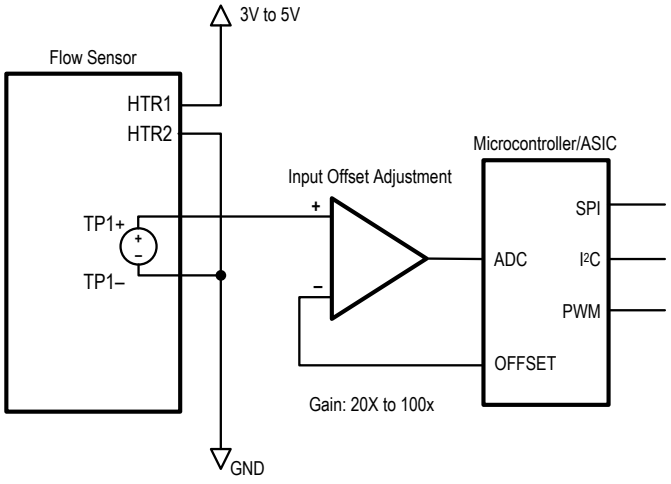
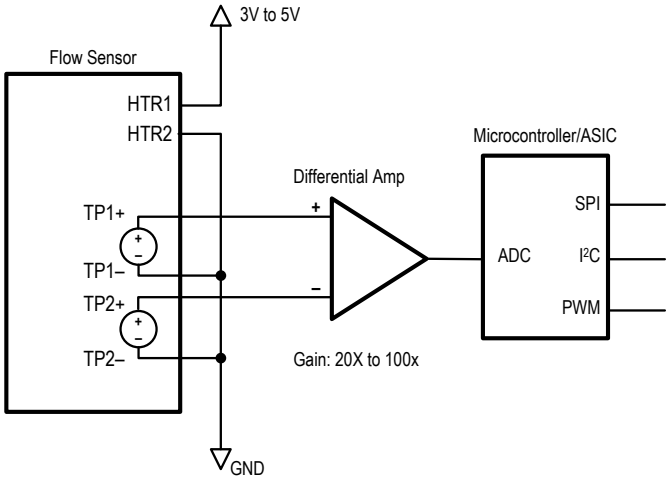
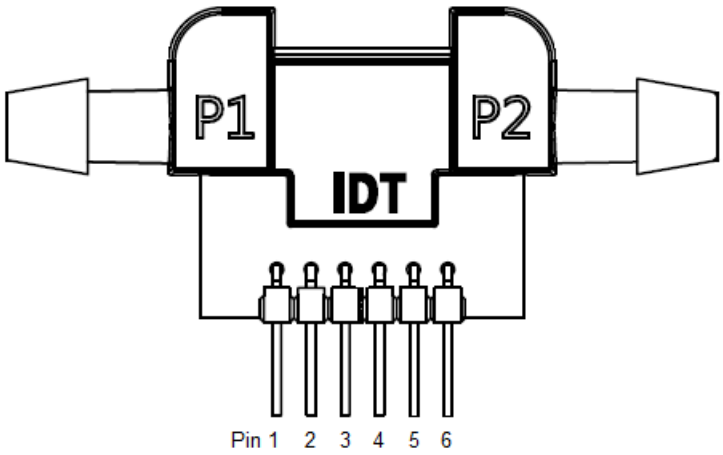



**Figure 2. Differential Circuit Example**



# 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 (+) |

# 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 |

| 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**

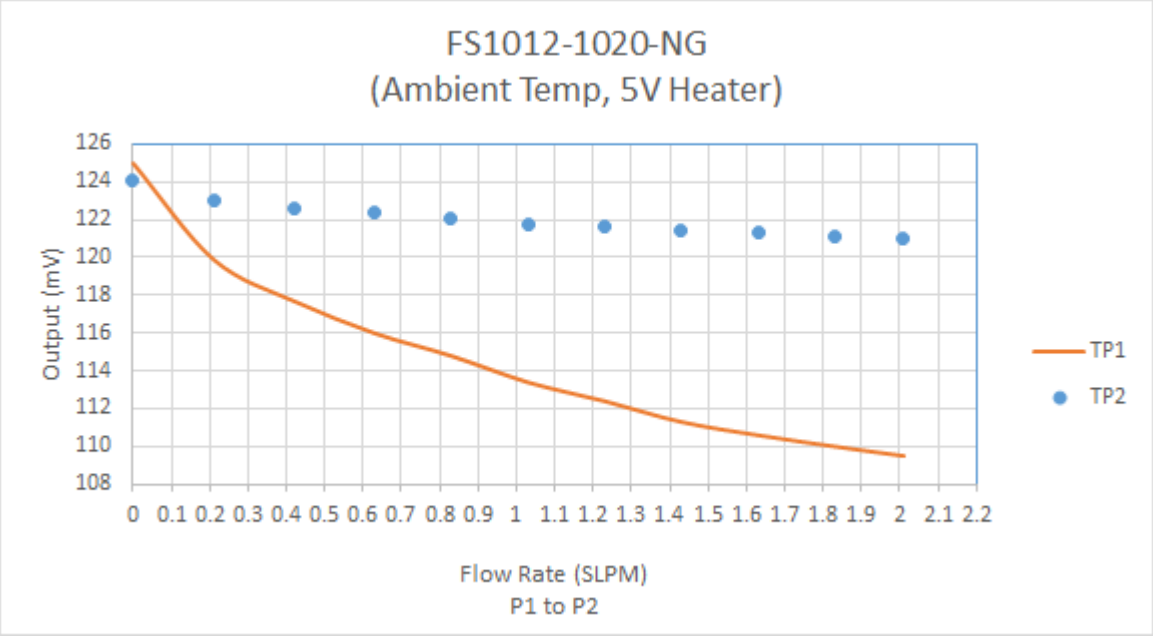


**Figure 5. FS1012-1100-NG Flow Curve**

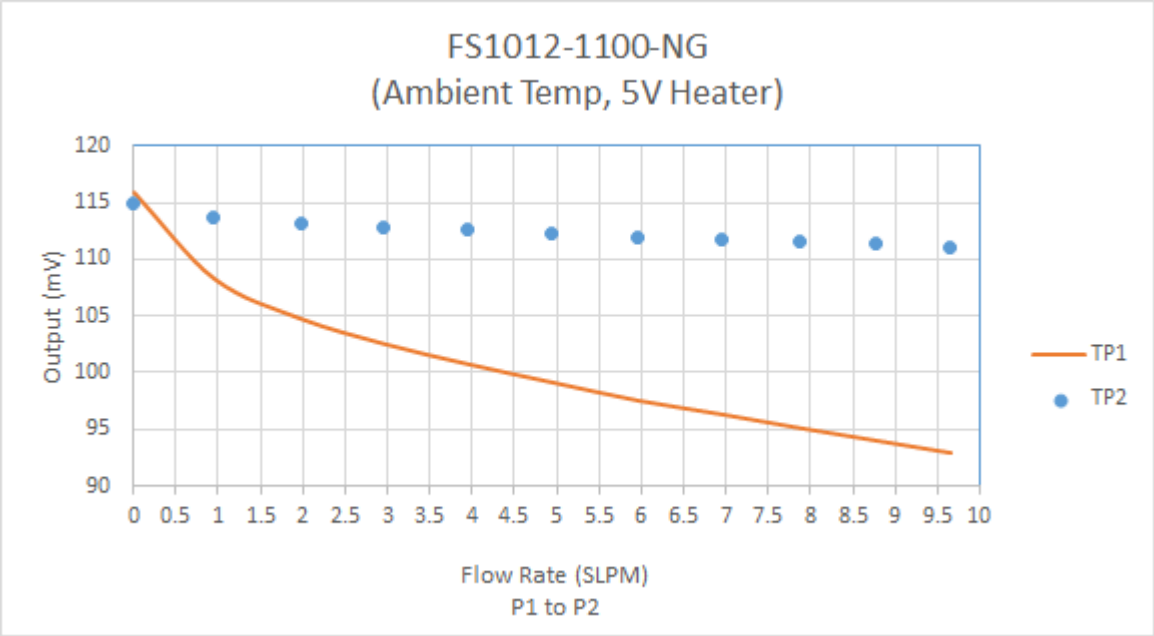



**Figure 6. FS1012-1001-LQ Flow Curve**

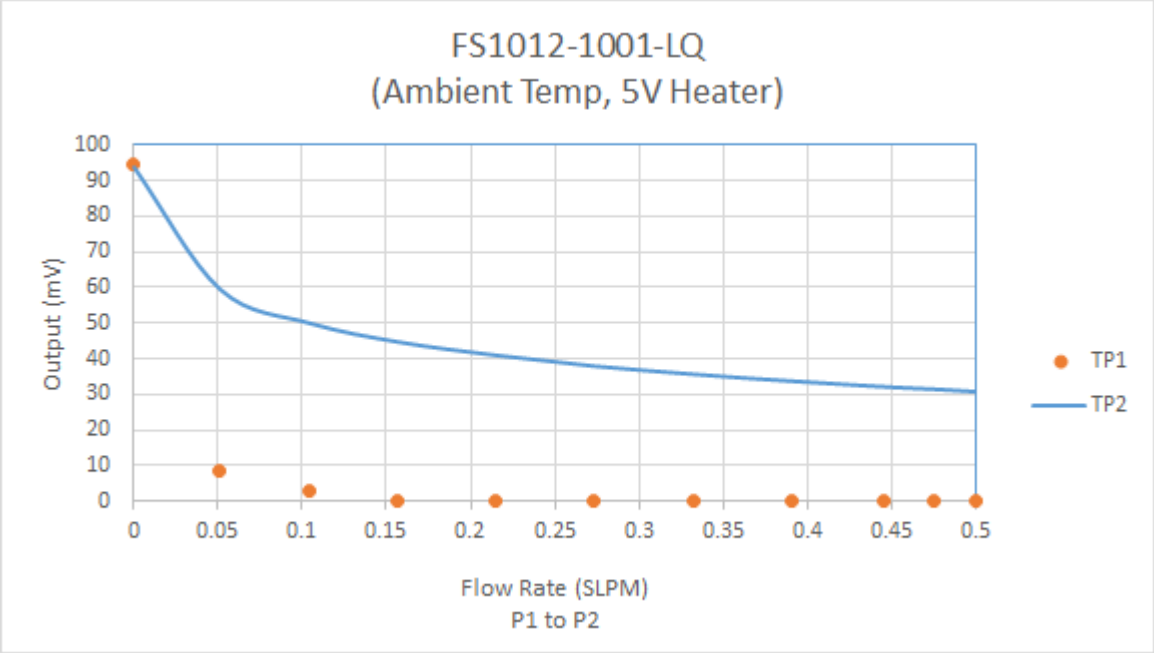
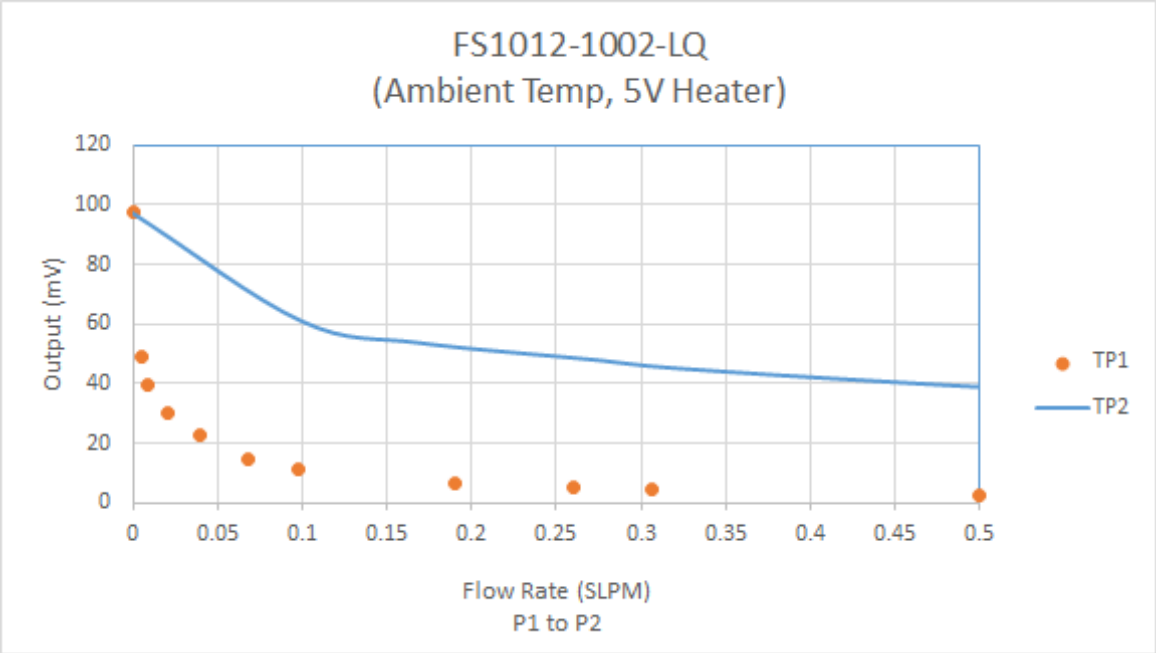
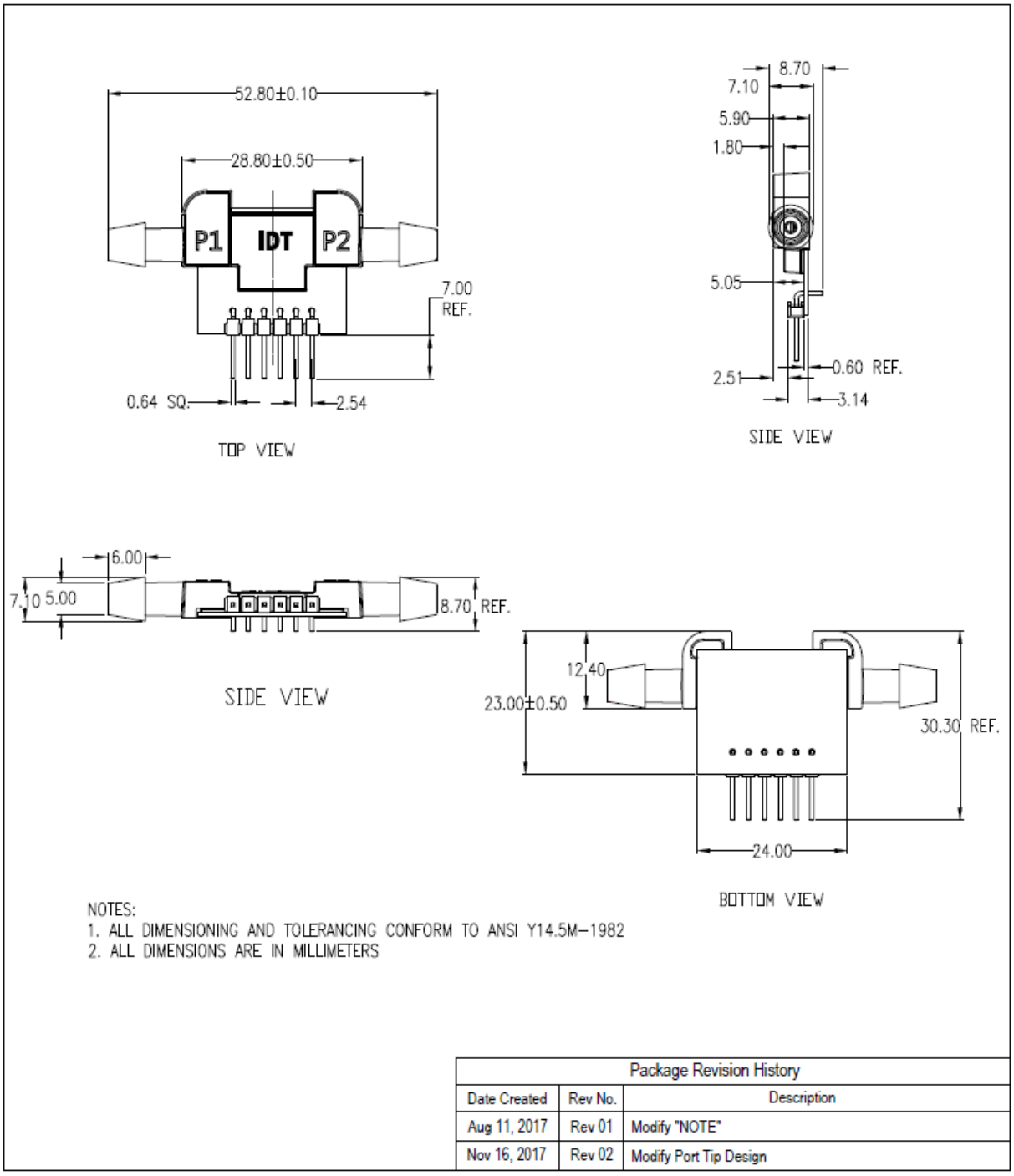


**Figure 7. FS1012-1002-LQ Flow Curve**



# 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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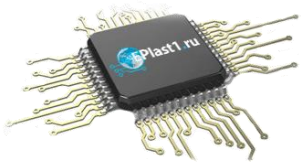
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

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