MEMS Gas Flow Sensor Module

MFA1100R

Features

- **Wide measuring range (0.27 – 100 SLM)**
- **Large turndown ratio (> 350)**
- **High measuring accuracy**
  - **< 3% for 0.27 – 10 SLM**
  - **< 1.5% for 10 - 100 SLM**
- **Outstanding hysteresis and repeatability (< 1%)**
- **Low power consumption**
  - **70 µA on average in operating mode**
  - **0.1 µA in sleep mode**
- **Single 2.7 - 5.5V supply**
- **RoHS compliant**

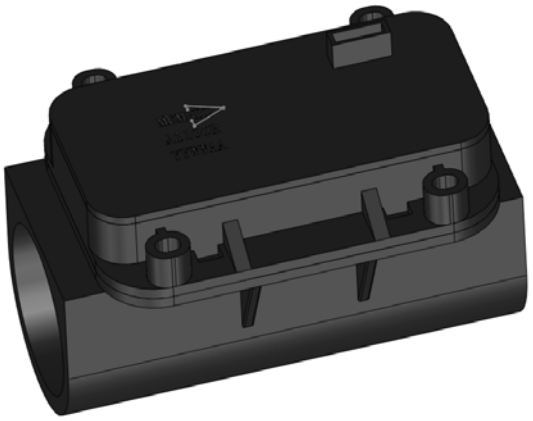


Fig.1 illustration of MFA1100R

Applications

- **Residential gas meter**
- **Medical flow measurement and control**
- **Industrial flow measurement and control**

General Description

MFA1100R is a gas flow sensing module based on our proprietary CMOS technology for thermal mass flow sensing. It can measure up to 100SLM flow rate with +/-1.5% accuracy (after external calibration), and achieves a turndown ratio greater than 350:1. The sensing element is monolithically integrated with CMOS signal processing circuitry and embedded software capable of converting gas flow rates to a differential analog voltage with very high (better than 1%) repeatability. The module runs from a single cell battery, and has a low power sleep mode for optimal power management.

MFA1100R is a true thermal mass flow sensing module, and can easily be configured in a smart metering solution. Customized versions are available, contact us for more information at sales@quatronix-cn.com.

MFA1100R Specifications [1] (Measurements are done with air as medium, at 25°C±2°C temperature, 1atm pressure, using a 3.3V DC power supply, unless otherwise specified)

Parameter	Condition	Min	Typical	Max	Unit
Measurement Range	ϕ30mm tube size	0.27		100	SLM
Supply DC Voltage		2.7	3.3	5.5	V
Operating Temperature		-20		60	°C
Storage Temperature		-40		85	°C
Sensor Output Range	Full scale flow range	0		600	mV
Power Consumption	Average		70		μA
Power Down Consumption	Sleep mode			0.1	μA
Zero Flow Rate Output	25°C	-0.2		0.2	mV
	-20°C ~60°C		±0.02		mV/°C
Accuracy[2]	0.27 SLM ≤ Q1 < 10 SLM			3.0	%
	10 SLM ≤ Q2 ≤ 100 SLM			1.5	
Repeatability and Hysteresis	Full scale flow range		±1.0		%
Output Temperature Sensitivity	10 SLM, -20°C~60°C		-0.19		%/°C
Pressure Drop	100 SLM		100		Pa
Response Time [3]	100 SLM		40	100	ms

Note 1: All data are measured with a specific housing with ϕ30mm tube size in the medium of air, other kinds of media or higher requirements upon request.

Note 2: Measured after 9 points piecewise linear calibration at meter level (Qmin, 3Qmin, 5Qmin, 10Qmin, 0.1Qmax, 0.2Qmax, 0.4Qmax, 0.7Qmax, Qmax).

Note 3: Response time is measured from the moment of wakeup from sleep mode, to output reaching 90% of its final value, assuming no longer than 2 seconds sleep time. The typical wakeup time will increase to 75ms for longer sleep times.

Absolute Maximum Rates*

Supply Voltage (V_{DD}) ..... -0.5 to +5.5V
Storage Temperature ..... -40°C to +85°C
Maximum Exposed Flow ..... 300 SLM
Maximum Pressure ..... 3 Bar
Shock 1000g, 0.5ms
Vibration ..... 1g, 5 to 200 Hz

*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; the functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

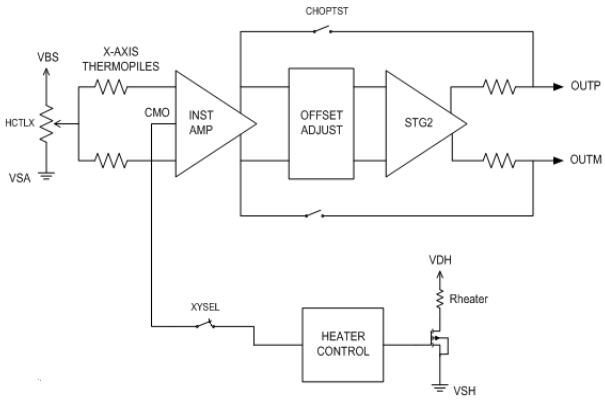
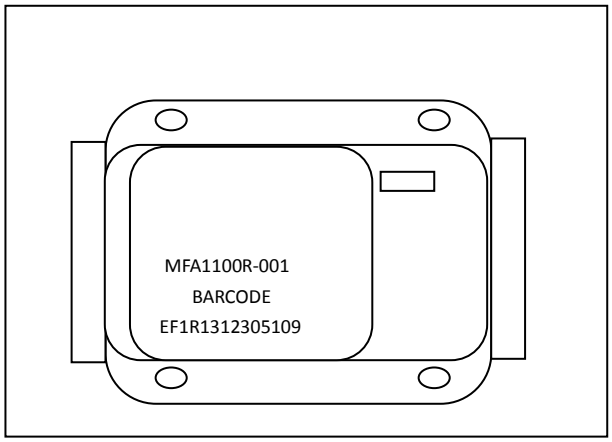


Fig.2 MFA1100R functional block diagram



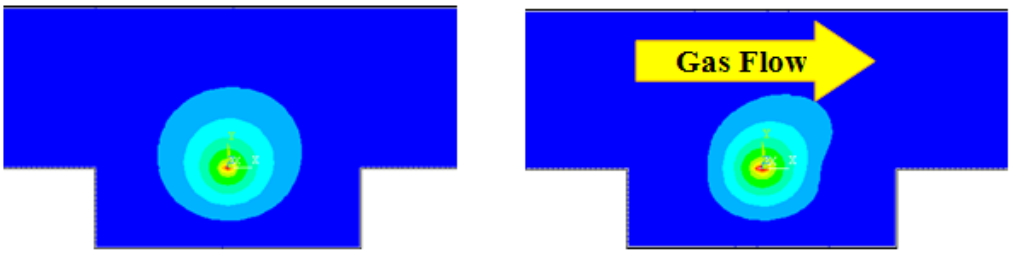
Tag Descriptions

Line 1: Model name
Line 2: Barcode
Line 3: Lot number

Fig. 3 Tag illustration for MFA1100R

Measurement Principle

The flow rate is detected by the MEMS thermal mass flow sensor. The sensor chip, produced in our proprietary CMOS compatible technology, is composed of a central heater source (micro heater) and two temperature sensors (thermopiles), which are placed symmetrically upstream and downstream of the micro-heater. If no gas flows over the sensor surface, the symmetric thermopiles measure the same rise in temperature (Fig.4a), resulting in the same output voltage of the two thermopiles. If a non-zero gas flows from the inlet to the outlet of the meter, the velocity of a fully-developed laminar air flow unbalances the temperature profile around the heater (Fig.4b) and heat is transferred from upstream thermopiles to the downstream thermopiles, causing a change in the voltages of the thermopiles. Larger gas flow rates result in larger asymmetry in the temperature profile (Fig.5). Precision analog circuitry in the ASIC converts the temperature difference to a differential analog voltage at the output pins.



a. Zero gas flow **b. Non-Zero gas flow**

Fig. 4 Operation principle of thermal flow sensor

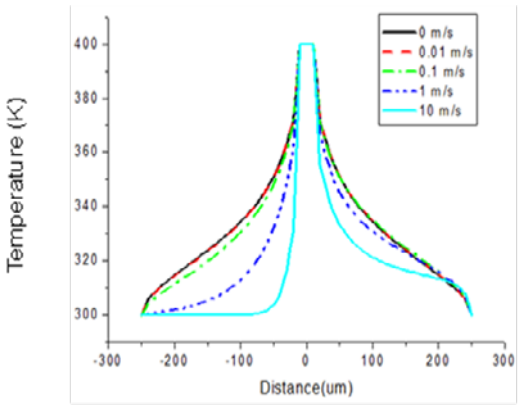
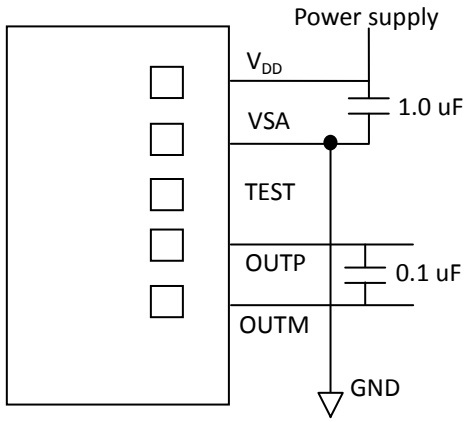


Fig. 5 Temperature profiles versus distances and gas velocities

External Circuitry



Pin Description

Pin	Name	Description	I/O
1	VDD	Power supply, 3.3V is recommended	P
2	VSA	Ground	P
3	TEST	Factory internal test use	N/A
4	OUTP	Positive analog output	O
5	OUTM	Negative analog output	O

Applications Information (Using Sleep Mode)

The low power consumption of the MFA1100R is achieved by enabling sleep mode between measurements. When sleep mode is enabled, under maximum flow conditions, a wake up time of 100ms is required to achieve the specified accuracy (see Fig. 6). However, under low flow conditions, the device settles to its specified accuracy very quickly (see Fig. 7).

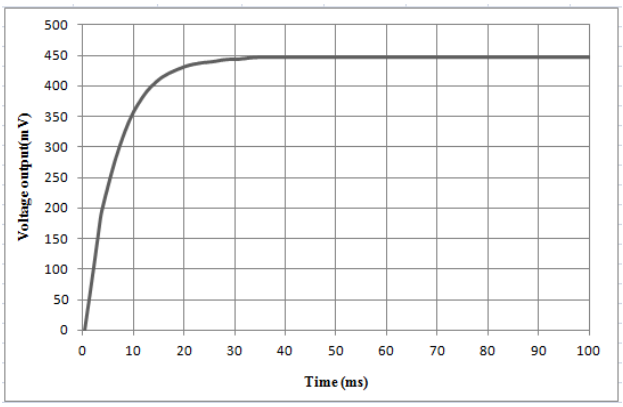


Fig. 6 Power-on time at flow rate of 100 SLM

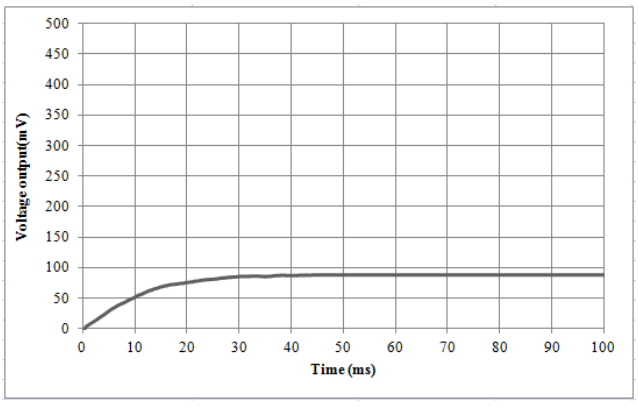


Fig. 7 Power-on time at flow rate of 10 SLM

Performance Characteristics

V_{DD} = 3.3 VDC, Temperature 20°C

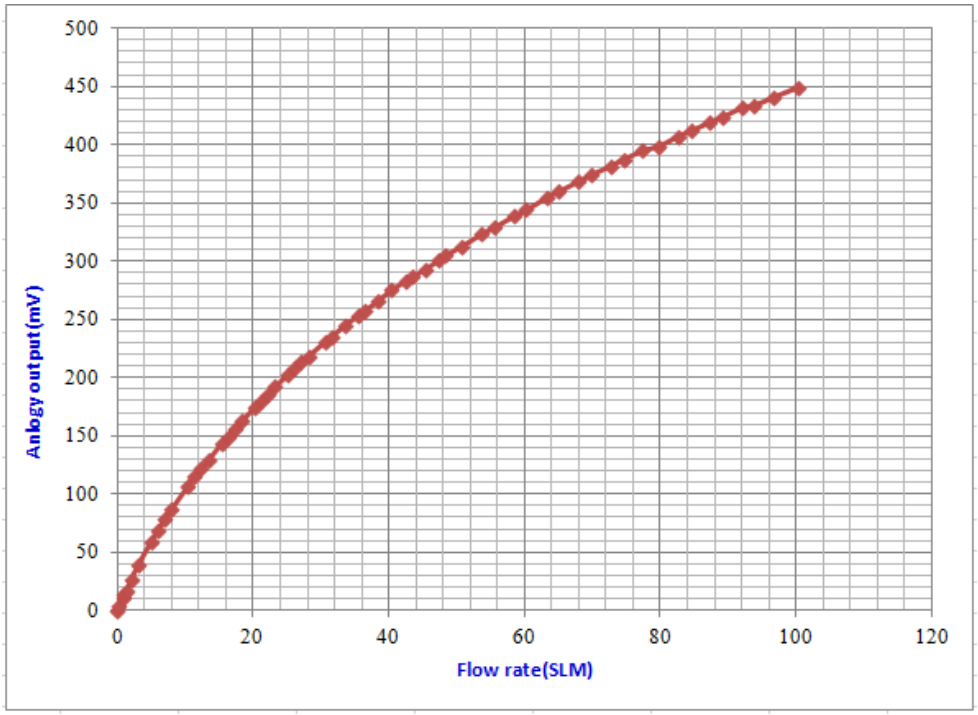


Fig. 8 Voltage output versus gas flow rate (measured with air)

Mechanical Dimensions

Unit: mm, Tolerance:± 0.2 mm

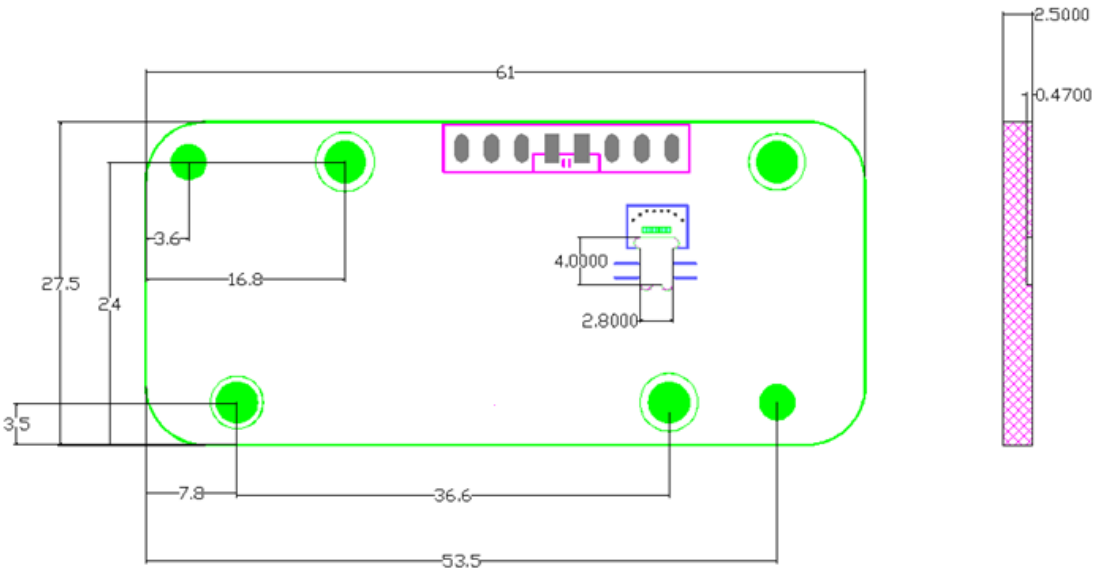


Fig. 9 MFA1100R PCB mechanical dimensions

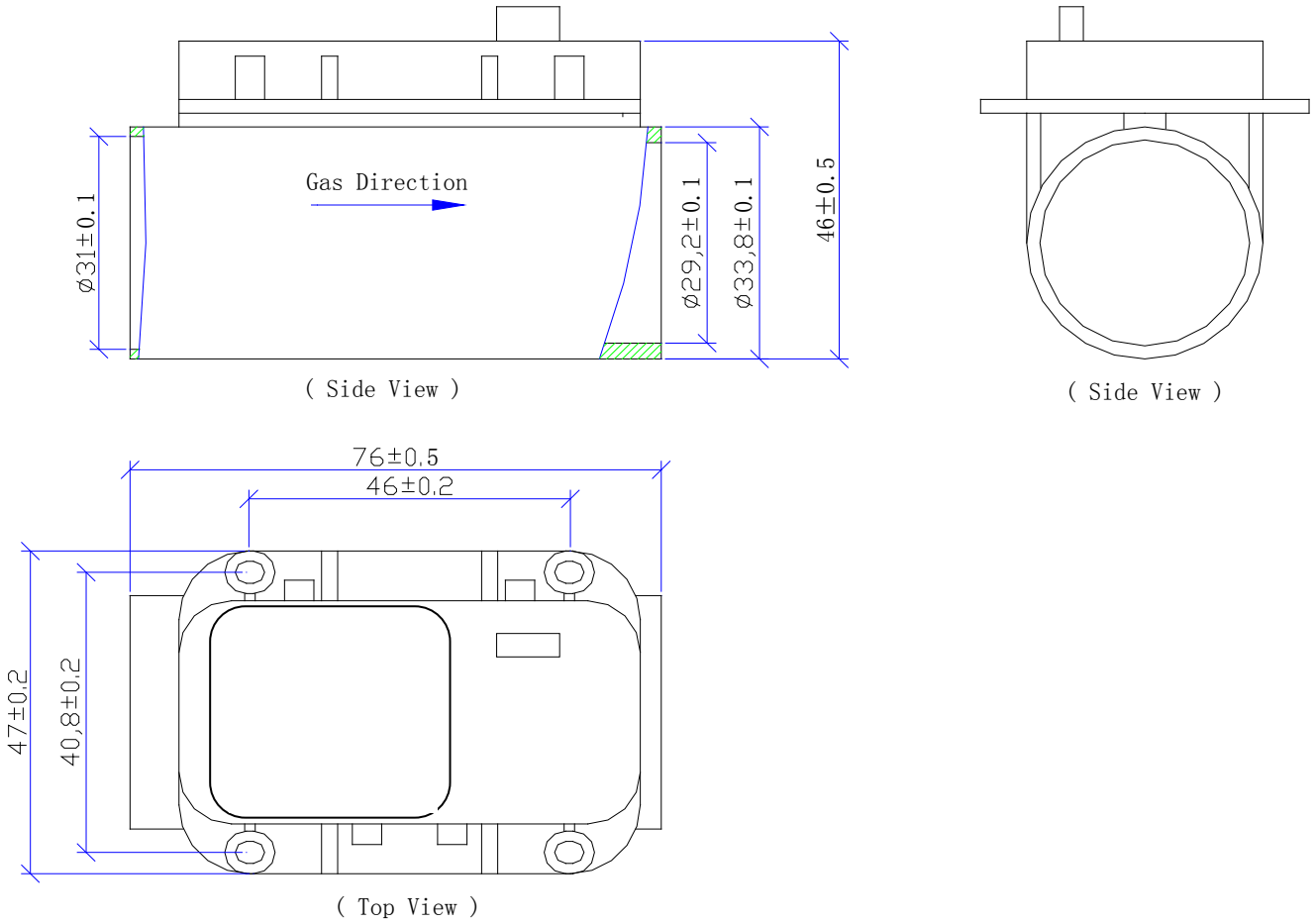


Fig. 10 MFA1100R module mechanical dimensions

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