

LMM-H03

Mass Air Flow Sensor

Product Description

LMM-H03 is a thermodynamic sensing element for the bidirectional measurement of mass air flow in a well defined channel. It is dedicated for applications with high reliability requirements such as medical or industrial gas flow applications. Mounted directly within the flowing media the LMM-H03 is sensitive against the heat transfer on a micrometer scale. This heat transfer is detected by a micro-machined silicon device which is mounted on ceramic substrate defining the geometry of the sensing element.

The functional principle of the LMM-H03 is a hot film anemometer, which is the thin film version of the hot wire anemometer. A thin film heating element (heater) is heated to a defined temperature difference with respect to the air. At zero flow there is heat dissipation due to the thermal conductivity of the air. With applied flow the heat dissipation increases steadily with the flow rate.

The sensing element can be operated at Constant Power and Constant Voltage mode. However, it is recommended to operate LMM-H03 in the described Constant Temperature Difference (CTD) mode. In the CTD mode the electronics detects any change of the thermal equilibrium very quickly and compensates it by adjusting the power settings through the heaters. This allows a very reliable mass flow measurement with a very short time constant which is in the order of milliseconds.

Features

- ◆ Highly reliable and long term stable
- ◆ Fast reaction time
- ◆ Can be adapted to various flow channel geometries
- ◆ Can be used for almost all kind of gases and volatile substances

Applications

- ◆ Engine Control
- ◆ Industrial gas flow measurement
- ◆ Leak detection in pressurized air systems
- ◆ Spirometer

- ◆ Hot Film Anemometer Component
- ◆ Highly reliable and long term stable
- ◆ Bi-directional airflow measurement
- ◆ Fast reaction time
- ◆ Manufactured according ISO TS16949
- ◆ Can be adapted to various flow channel geometries
- ◆ Can be used for almost all kind of gases and volatile substances

Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Storage Temperature	T_{Store}	after bonding, with protected bond pads	-40	+25	+125	°C
Storage Temperature	T_{Store}	before bonding, unprotected bond pads	+10	+25	+40	°C
Maximum Current	I_{max}	at now flow, +25 °C ambient	–	–	20	mA

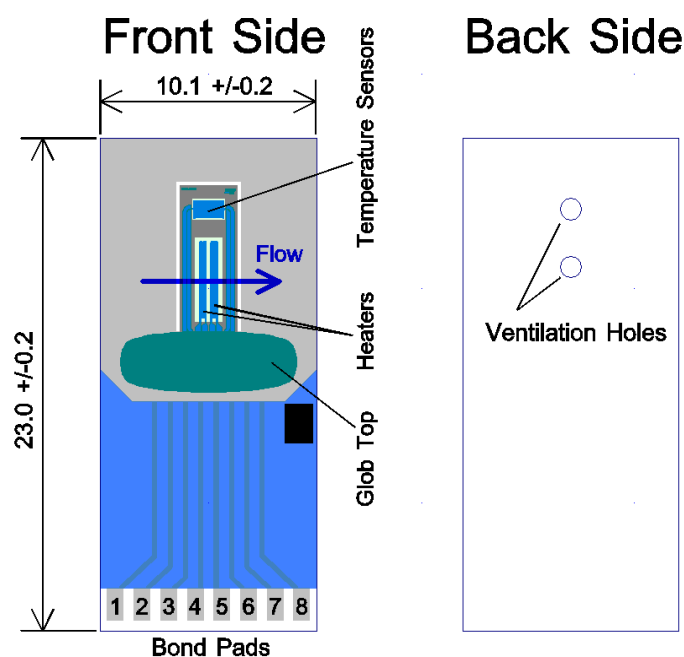
Operation Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operation Temperature	T_{Store}	after bonding, with protected bond pads	-40	+25	+125	°C
Heater Overtemperature	ΔT_{Heater}	$\Delta T_{Heater} = T_{Heater} - T_{air}$		100	120	K

Sensing Properties

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Resistance Ambient Temperature Sensor 1	R_{ATS1}	Pad 1+2, $T_{Amb} = +25\text{ °C}$	1300	1700	2100	Ω
Resistance Heater 1	$R_{Heater1}$	Pad 3+4, $T_{Amb} = +25\text{ °C}$	40.0	45.0	50.0	Ω
Resistance Heater 2	$R_{Heater2}$	Pad 5+6, $T_{Amb} = +25\text{ °C}$	40.0	45.0	50.0	Ω
Resistance Ambient Temperature Sensor 2	R_{ATS2}	Pad 7+8, $T_{Amb} = +25\text{ °C}$	1300	1700	2100	Ω
Temperature Coefficient R_{ATS} and R_{Heater}	\Rightarrow	measurement at $T_1 = 0\text{ °C}$ and $T_2 = +100\text{ °C}$	5500	6000	6500	ppm/K
TCR Match	\Leftrightarrow	measurement at $T_1 = 0\text{ °C}$ and $T_2 = +100\text{ °C}$	–	–	100	ppm/K

Mechanical Dimensions



Mechanical dimensions and connections of LMM-H03

The sensor membrane has a thickness of about ~2 μm. Therefore it should not be exposed to any mechanical stress. One has to take care of a filter unit around the measurement device. High speed particles coming direct to the surface of the membrane can result in damages or shortage of the life time. The ventilation holes shall be kept open to release air pressure built up due to heating.

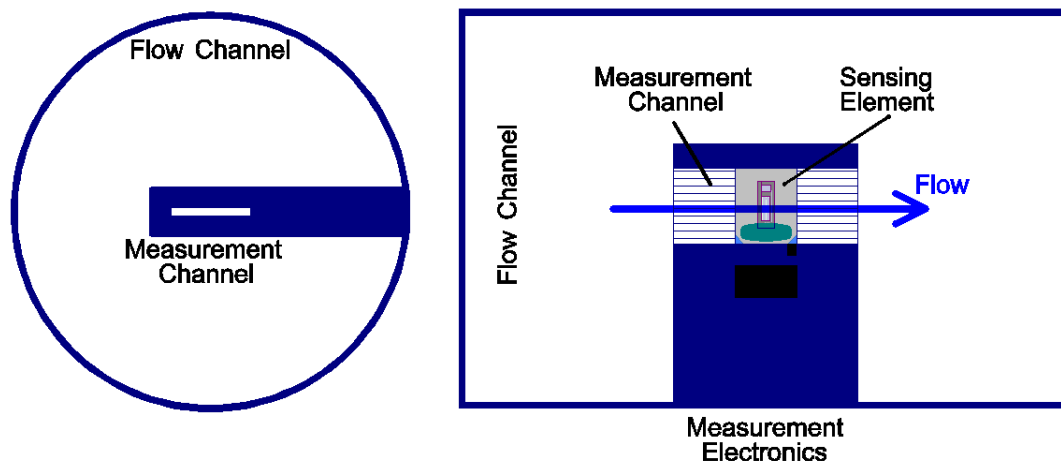
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Length	L	+25 °C	22.8	23.0	23.2	mm
Width	W	+25 °C	9.95	10.15	10.35	mm
Height Ceramics	$H_{ceramics}$	+25 °C	0.48	0.63	0.78	mm
Height Ceramics + Metall	H_{Flow}	+25 °C	0.9	1.1	1.2	mm
Height max. Overall	H_{Total}	+25 °C	–	–	1.8	mm
Bond Pad Width	W_{Pad}	+25 °C	–	0.5	–	mm
Bond Pad Length	L_{Pad}	+25 °C	–	1.5	–	mm

Specification further

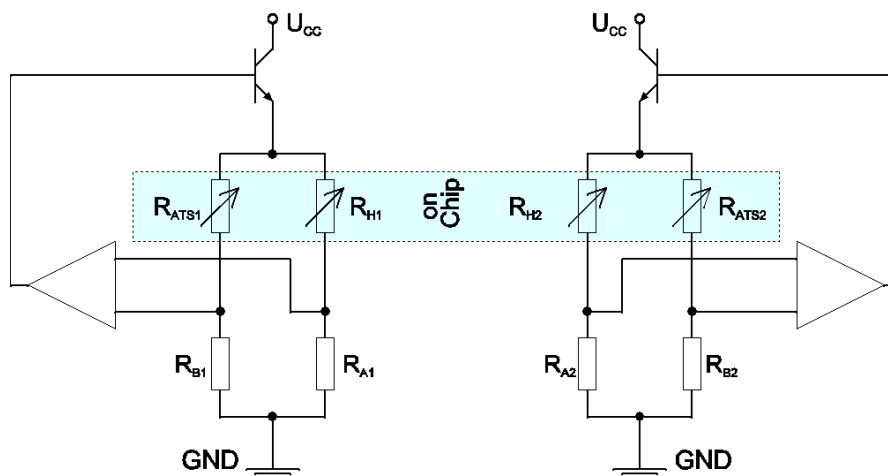
Parameter	Specification
Package Type	Hybride Ceramics
Pad Material	AgPt bondable with 150 μm Al-wire, also solderable

Application Example

One application of the LMM-H03 is to measure the amount of air coming into an engine. The actual mass air flow sensor module consists of a flow channel and a measurement channel, the so called Venturi channel. The measurement channel with the LMM-H03 should be placed in the center of the flow channel because at this place the flow is almost laminar and the flow velocity reaches its maximum. The cross sections of both channels can be adjusted to the amount of air which is supposed to be measured. For reproducible measurement results it is strictly required to avoid any turbulence at the surface of the sensing element.



Flow channel of application example of a mass air flow sensor

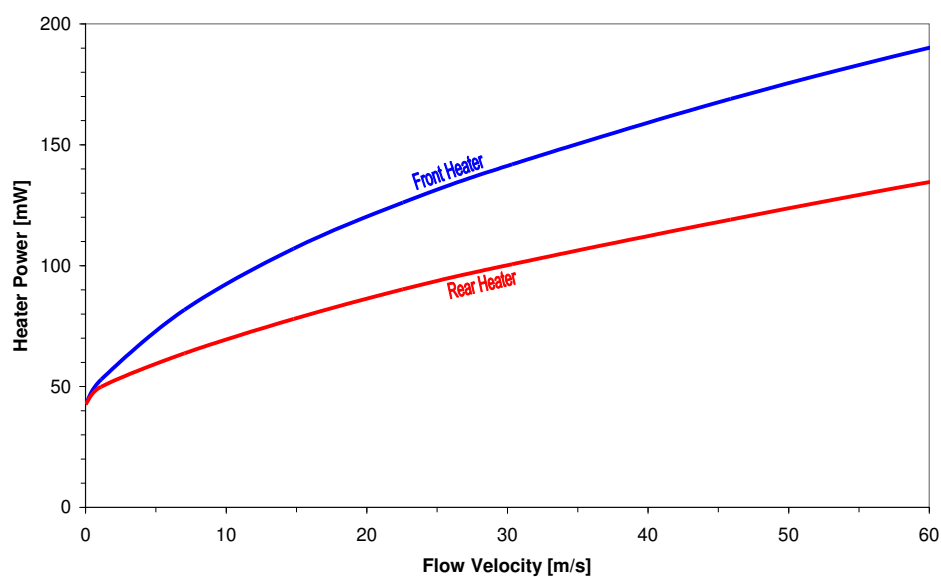


Above is shown an example of a measurement electronics using a Wheatstone-bridge. The resistors R_{Ax} and R_{Bx} need to be trimmed to operate the heater at a defined over-temperature

NOTE: This drawing shows only the basic functionality. This is not a ready to use circuit diagram!

As an example the graphs below show the heater power as a function of flow velocity. The configuration used the following parameters:

- ◆ Flow Channel Ø: 55-70 mm
- ◆ Measurement Channel:
 - Height: 1-2 mm
 - Width: 10-15 mm
 - Length: >20×Height (bidirectional)



Example of a Power-Flow-Response of the LMM-H03

With a given electronics and measurement channel the measurement range can be easily adjusted by modifying the size of the flow channel. For higher or lower flow ranges the flow channel needs to be made larger or smaller, respectively.

Ordering Information

Description	Part Number
LMM-H03	G-MAFCO-005