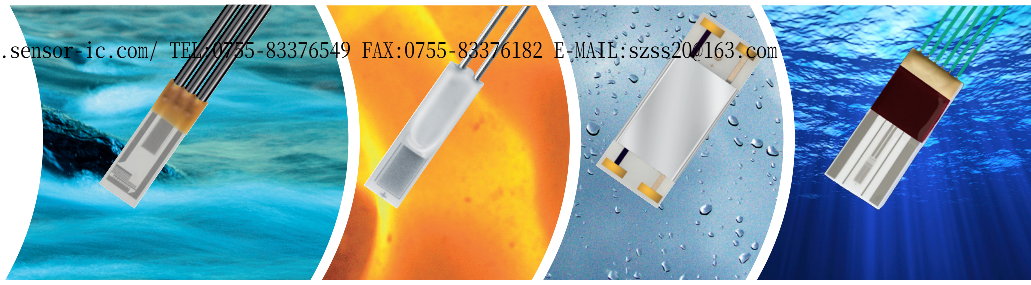
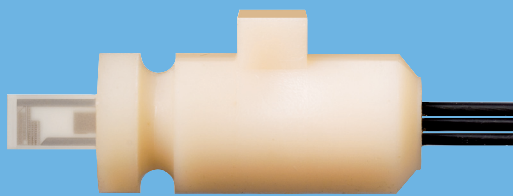
INNOVATIVE SENSOR TECHNOLOGY

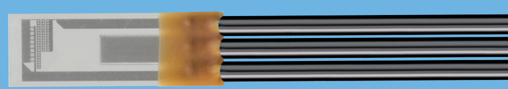


FLOW SENSORS FOR ANEMOMETER APPLICATIONS

Advantages

- Application specific measuring cells
- Robust design
- Simple electronic signal processing
- No moving parts
- Good reproducibility
- Excellent long term stability
- Applicable in both high and low viscosity
- Excellent price-performance ratio
- Operating temperature up to 450 °C
- Customized sensor designs





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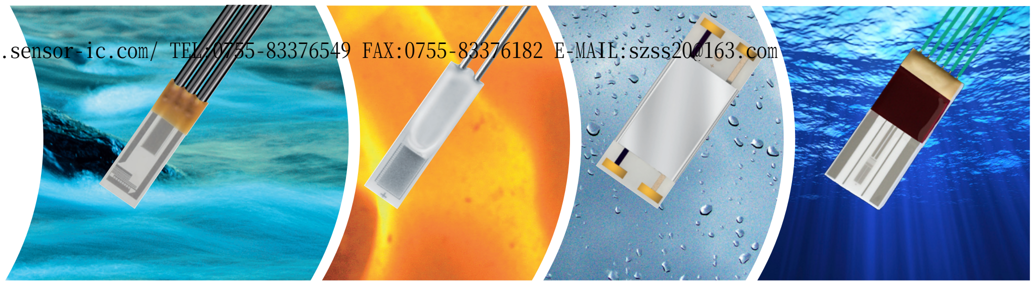


General Description

Thermal mass flow modules and measuring systems are well-known devices that are offered in a wide range of applications by a handful of suppliers in the marketplace. Most of these designs are compact, ready to use systems with an inlet and outlet, and a channel including a passive or active output. These modules are sufficient for many general purpose applications where component price and size are less significant, but they are not well-suited for price-sensitive and space limited flow control solutions. In such cases, IST thermal mass flow sensor elements offer a suitable solution with considerable advantages.

The most popular anemometer is the Constant Temperature Anemometer (CTA). The function is described by King's Law:

$$P_H = I_H^2 \cdot R_H = \left(A + B \cdot \vec{v}^{\,n}\right) \cdot \Delta T \qquad n = 0.3 \ldots 0.5$$

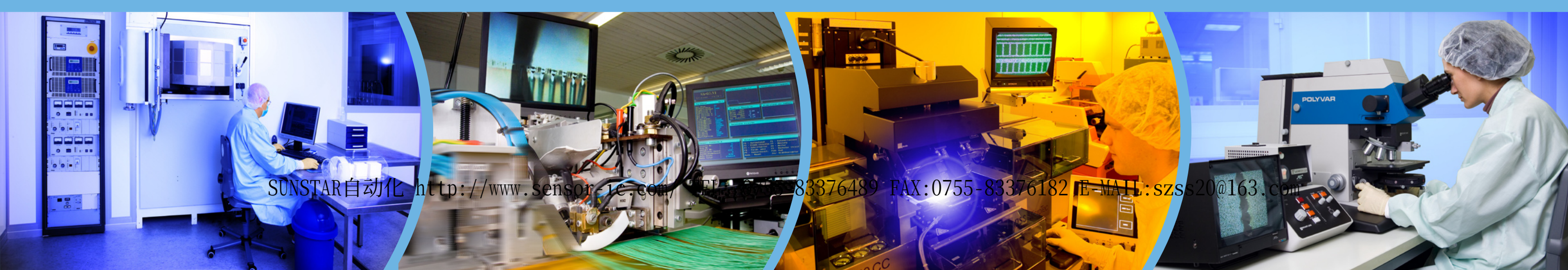
By converting and simplifying this equation the following formular can be obtained:

$$U = U_o \cdot \sqrt{1 + k \cdot \vec{v}^{\,n}}$$

U = CTA-output
U_o = Free convection offset
k = Fluidic dependent constant
$\vec{v}$ = Fluid velocity

Thus, the output is determined by an offset (U_o), an offset dependent slope of the curve, and the fluidic dependent gain value (k).

U_o represents the value of a constant temperature difference (ΔT) between the heater and the fluid. Generally the controller of a CTA keeps the resistive structure at a constant temperature. Different passivation thicknesses and flow element surfaces impact the CTA characteristics. The characteristics is dependent not only on the sensor alignment / orientation and fluid type, but also on the fluid temperature and sensor contamination such as dust and other particles.



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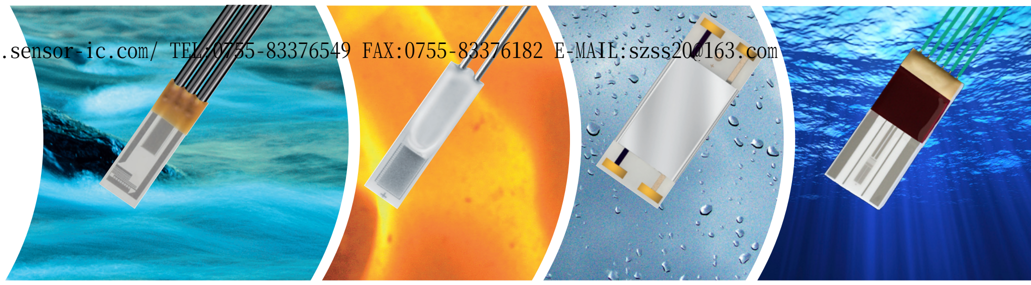
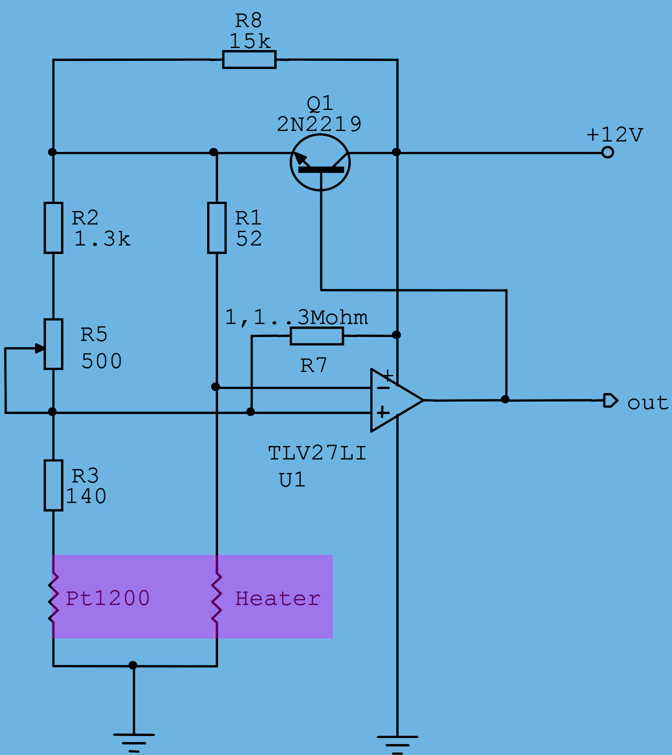
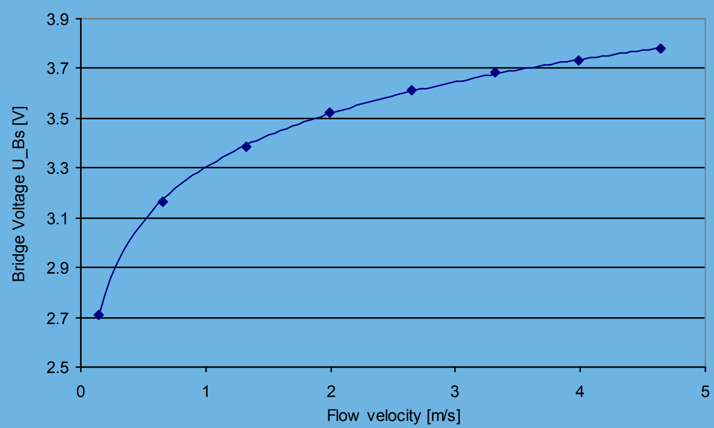


Circuit

The schematic below shows a simple feedback circuit for the temperature regulation of the heater on the flow sensor. The temperature sensor on chip (pt1200) is for compensation of the medium temperature variation.



Example of a flow measuring curve



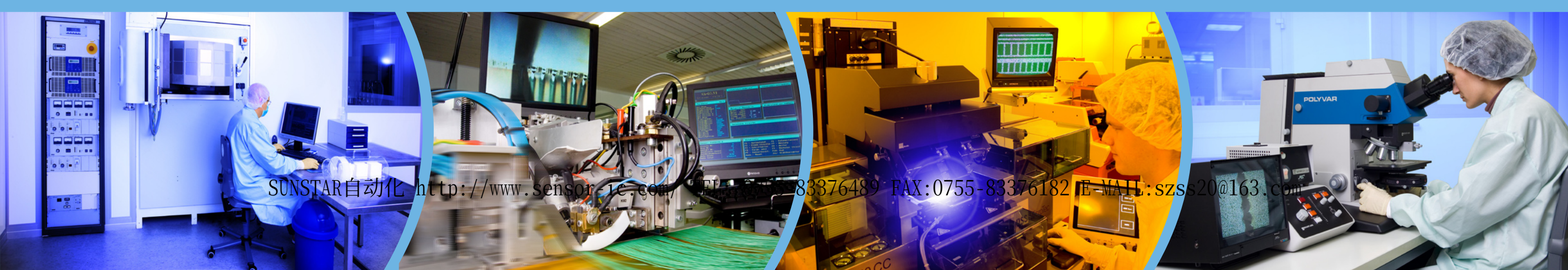
In each case it is necessary to perform tests in order to determine the best resistor solution for the flow sensor. For gas applications, a medium temperature difference of about 30 K on the heater is recommended. For liquids, a medium temperature difference of about 10 K will be sufficient. This temperature difference, R3, is determined by the following equation:

$$R_3 = \alpha \cdot R_o \cdot \Delta T$$

α = 0.003902 K^{-1}

R_o = 1200 Ohm

The R7 resistor is applied for the stability of the anemometer circuit. The R7 is dependent on the used OpAmp and it should be valued from 1.1 to 3 Mohms. The OpAmp should be a low input bias current (about some pA).



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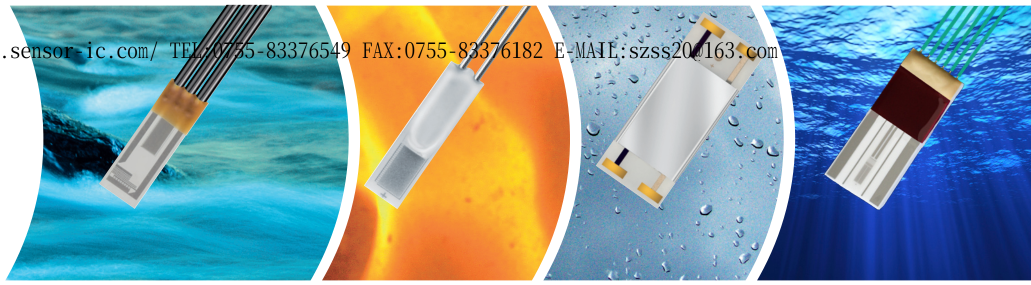
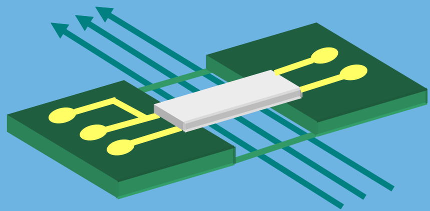
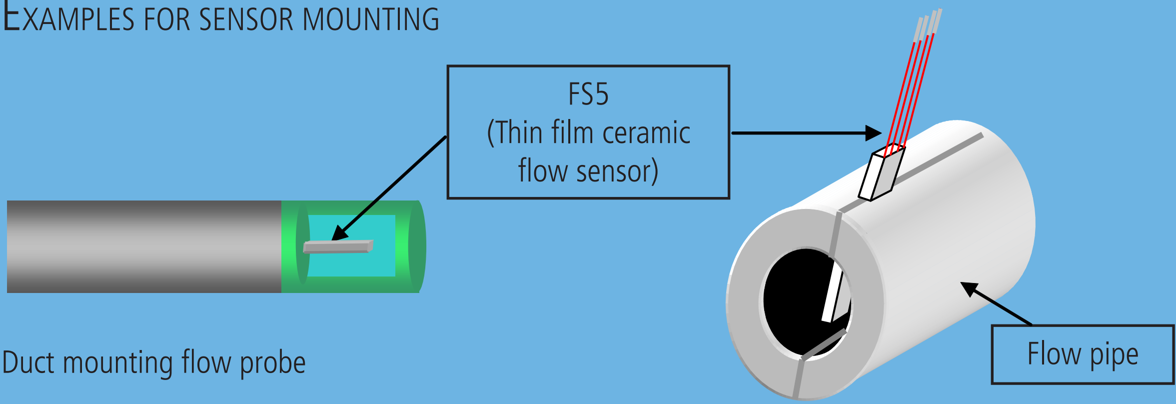


Flow channel design



Examples for sensor mounting



Duct mounting flow probe

Customized channel / pipe with flow sensor

Applications

- Air flow in channels
- Compressed air billing
- HVAC, building automation
- Automotive
- Open channel flow measurement
- Medical applications
- Device monitoring
- Coolant monitoring
- Food processing

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