MTCS 2200 - Gas

Micro Thermal Conductivity Sensor for Gas

Applications

Industry

• Determining gas concentration by measuring the thermal conductivity in binary mixture (Ar, H_2 in N_2) or quasi-binary mixture (H_2, He or CO_2 in air)

• Combustion control

• Monitoring of CH_4 concentration in Natural Gas for gas engine control

• Detection of refrigerant gases such as Freons (R-11; R-12, R-21, R-22), CFC or CF_3CH_2F Fluoroethane (R-134 or R-404) for leakage monitoring of cooling systems

• Measurement of Hydrogen (0 to 5% or higher), Helium (0 – 5000 ppm) or Xenon in air

• Security

• Industrial process control, horticulture, food storage, fermentation process control

• Micro vacuum device as miniature Pirani gauge

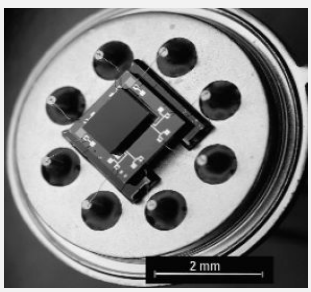
• Micro absolute humidity sensor in air based on thermal conductivity

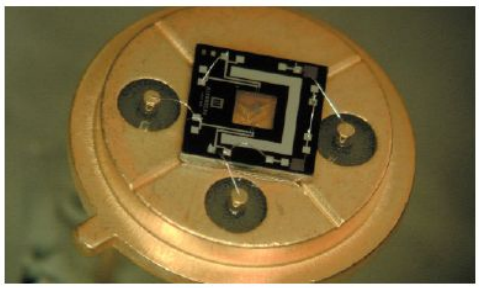
• Beverage industry (CO_2 concentration)

Domestic use

• CO_2 safety monitoring (0-4%) for Security, Fire Alarms or Indoor Air Quality

• Detection of cooking point in microwave owens





General description

The thermal conductivity gas sensor is manufactured on silicon with thin film deposition and silicon micro-machining techniques. This device determines gas concentrations of binary or ternary gas mixtures.

The sensor structure consists of an integrated heater located on a thin electrical and thermal insulating membrane. Two thin film resistors are used for heating and measuring the temperature [T_m] of the membrane. Two reference resistors are integrated on the silicon beside the membrane area for the compensation of the ambient temperature changes. The four resistors are passivated to protect them from the effects of the gas and are electrically connected to a TO8 or TO5 base by gold wire bonding.

The sensor is attached to a silicon support which also permits gas exchange to the lower side of the membrane. The upper side or the lower side of the membrane is a micro-structure consisting of a cavity anisotropically etched in silicon. The hollow space thus formed between the membrane and the colder part is the gas thermal conductivity measuring section. The measured gas diffuses into the cavity above the heated membrane through the lateral opening, preventing flow perturbation. The thermal heat transfert of the sensor will depend on the thermal conductivity of the gas surrounding the membrane. A constant current circuit is generally used with such sensors for gas measurement. The gas concentration directly depends on the temperature difference [$\delta T=T_m - T_{amb}$] which is measured using the electrical power variation.

Neroxis has been developed Thermal Conductivity Gas Sensor integrated on silicon

Sensor Structure

		Typ.	Min.	Max.	Unit
Insulating membrane • Membrane material: LPCVD silicon nitride • Film thickness: 0.3 µm • Membrane dimensions: 1.0 x 1.0 mm	• Resistances, Rm_1, Rm_2	120	110	135	Ω
	• Resistances, Rt_1, Rt_2	270	240	300	Ω
Heater • Heater material: Evaporated nickel • Film thickness: 0.25 µm	• $(Rt_1 + Rt_2) / (Rm_1 + Rm_2)$	2.24	2.12	2.36	
	• $\|Rm_1 - Rm_2\|$	< 1.5			Ω
Dimensions of the sensor • Chip dimensions: 3.5 mm x 3.5 mm x 0.76 mm • Including TO8 base: ø = 13 mm; h = 15.4 mm • Including TO5 base: ø = 9.2 mm; h = 4.6 mm	• $\|Rt_1 - Rt_2\|$	< 5.5			Ω
	• Temp. coeff. 20-100, α	0.0045	0.0050	0.0055	K^{-1}

Structural properties

- Typical heating power: < 6 mW
- Membrane excess temperature: 50 - 70 °C
- Geometry factor, G: 3.9 x 10^{-3}
- Thermal time constant: < 100 ms
- Gas/Humidity responsel time: < 10 s

Main advantages

- Silicon micromachined sensor with very small dimensions (3.5 x 3.5 mm^2) and for miniature gas volume (20 mm^3)
- Short time constant (membrane time constant <5 ms)
- Low power, highly sensitive with a minimal heating power (< 6 mW)
- Independent of flow
- Integrated sensing resistance on membrane as well as temperature compensation resistors
- Reliable and reproductible sensitivity performances
- Small dispersion of the sensor specifications due to batch fabrication processes
- Linear output signal versus target gas concentration
- Very stable long term operation
- High mechanical resistance
- No field maintenance

Ordering information

Part number: MTCS 220X – Y - Z

X	Y	Z
1: Binary mixture **2:** CH_4 **3:** CO_2 **4:** H_2, He **5:** CFC, Freon **6:** Ar, Ne, N_2, O_2 **7:** Binary mixture **8:** CH_4, H_2, He	**1:** TO5-4 **2:** TO8 **3:** TO5-(6+2)	**1:** Aluminium metallization and wire bonding **2:** Gold metallization and wire bonding

ENVIRONMENTAL SENSORS

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