Microsens Catalytic Gas Sensor

MCGS-2102, Methane Gas Sensor (CH_4)

General description

Operating principle

■ The measurement of combustible gases with catalytic gas sensors is based on the temperature change occuring with the exothermic reaction at the catalytic sensing surface, heated between 450°C and 550°C. The oxidation of the gas causes a rise of the temperature of the sensitive heating element (R_S) compared with the temperature of the reference element (R_R). The temperature difference gives rise to a difference in electrical resistance of the elements, which is detected by variation in the voltage (V_S) across the sensitive resistance. This voltage shift is a direct measure of the combustible gas concentration.

Sensor description

■ The MCGS-2102 sensor is designed for detecting methane (CH_4).

■ The sensitive element and the reference element of this type of sensor are two identical heaters in the form of thin platinum layers. These two heaters are deposited on a thin silicon nitride membrane providing good thermal and electrical insulation from each other and from the silicon substrate. The catalyst is a precious metal such as palladium deposited on the sensitive heating resistance, see Figure 1.

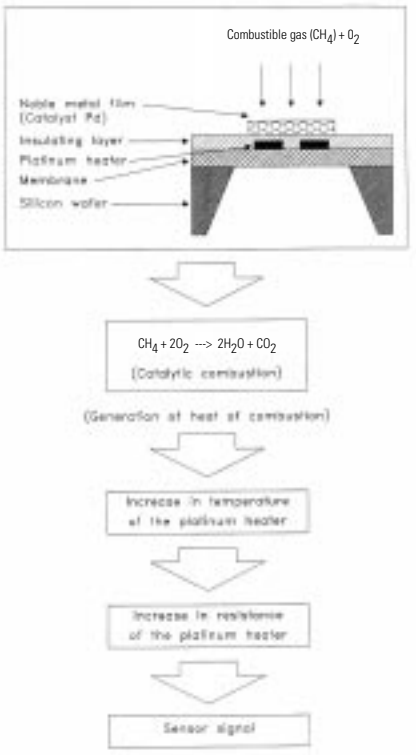


Figure 1: Schematic drawing

■ The sensor chip is electrically connected to a TO39 package by gold wire bonding as indicated on Figure 2.

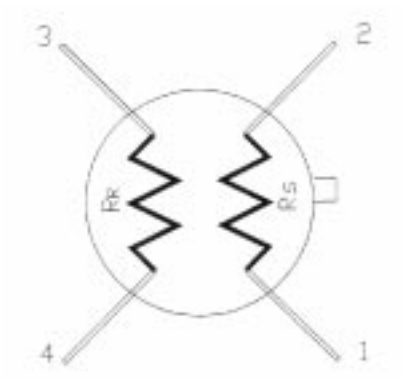


Figure 2: Sensor equivalent circuit (Top View)

Features

- Sensitivity range: 0 - 100% LEL (100 ppm to 5% Vol. CH4 in air)
- High selectivity obtained with a specific filter
- Low power consumption
- Small size

Application examples

- Security control
  - Explosive or combustible gas leakage control
- Portable explosive gas detection
  - Domestic natural gas leakage control

Device specifications [1]

- Chip Dimensions:
  2.84 mm x 2.46 mm x 0.38 mm
- Sensor Dimensions mounted on a TO-39 package with a filter:
  Ø = 10.3 mm; h = 24 mm
- Typical thermal loss coefficient:
  ß = 0.15 mW / °C

MCGS-2102 Sensor specifications[1]

Table 1: Sensor Specification

Characteristics	Symbol	Typ. value	Unit
Sensitive Resistance (25°C)	R_S	50 ± 5	Ω
Reference Resistance (25°C)	R_R	50 ± 5	Ω
Temp coeff	α	3 x10^{-3}	K^{-1}

Table 2: Recommended Electrical Operating Conditions[2]

Characteristics (in continuous constant current mode)	Symbol	Typ. value	Unit
Current power supply	I	27	mA
Sensitive element Voltage (pins1&2)	V_S	3.0 ± 0.3	V
Reference element Voltage (pins 3&4)	V_R	2.2 ± 0.2	V
Sensitive element Power	P_S	84	mW
Reference element Power	P_R	62	mW

Table 3: Performance Characteristics

Characteristics	Symbol	Value	Unit
Measuring concentration range	C	0 - 100%	LEL(Lower Explosive Limit)
Output signal, CH_4 (linear)	ΔV	3.75	mV / %LEL
Response time (to 90% LEL) (without charcoal filter)	τ_{90}	< 10	secs

Notes:

1. The following specification is subject to change without prior notice.

2. The heating conditions must be observed as described in Table 2. Permanent damage may occur if the power is exceeded.

Measurement test circuits

■ A constant current is applied to the series network of the sensitive resistance, R_S (pins 1&2) and the reference resistance, R_R (pins 3&4), see Figure 3. In the presence of CH_4, the voltage across R_S increases, R_R is unaffected. This results in an electrical unbalance in the measurement circuit and the output signal is proportional with the methane concentration, see Figure 4.

A trimming resistor is connected in the circuit as shown in Figure 3.

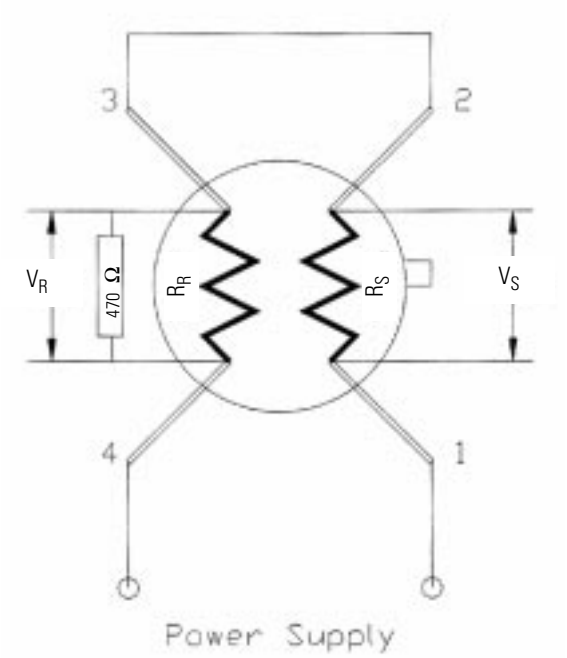


Figure 3: Test circuit

Mode of operation

■ The MCGS-2102 sensor can be operated in two different modes:

Continuous mode

■ A constant current is passed through the sensitive resistance heating the catalyst to a sufficient temperature for total oxidation of the methane reaching the surface of the catalyst. The current flowing through the sensitive resistance should be high enough to ensure the output to be reasonably independant of small changes in temperature. The sensitive resistance is powered to provide a catalyst temperature of 550°C. Typically this requires dissipation of electrical power of 84 mW, see Table 2.

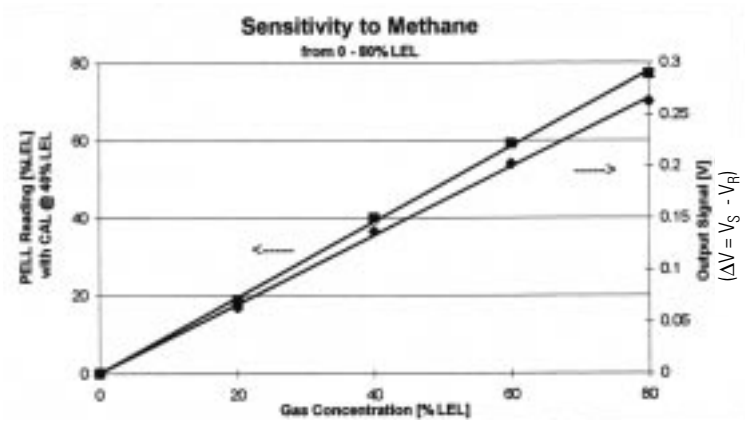


Figure 4: Sensor output signal

Cycling temperature mode

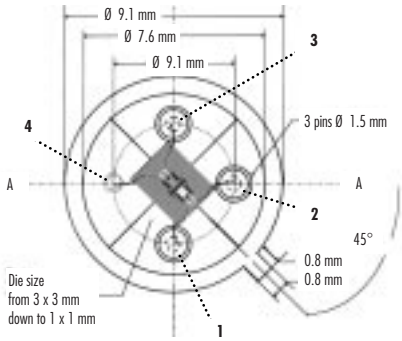
■ A temperature cycling operating mode can be used to drive the sensor. This operation mode has the advantage of reducing the power consumption for portable instruments.

Packaging Characteristic

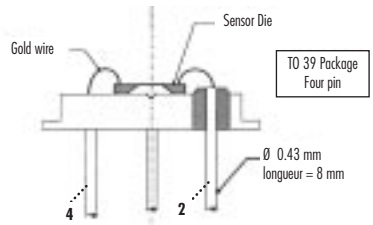
■ The standard packaging used a TO-39 support with a charcoal filter on top.

MCGS-2102
TO-39 PACKAGE

Top view



Side view (A-A)



Side view (A-A)
complete package

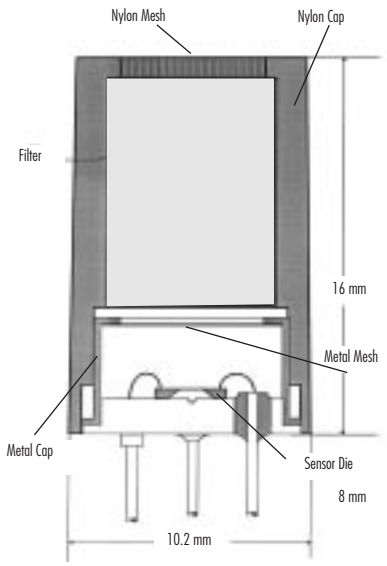


Figure 5: Schematic drawing of the packaging

MICROSENS SA
Rue Jaquet-Droz 1, CH-2007 Neuchâtel/Switzerland
Tél.: ++41-32-720 51 51, Fax: ++41-32-720 57 12
e-mail: info@microsens.ch
web site : www.microsens.ch