

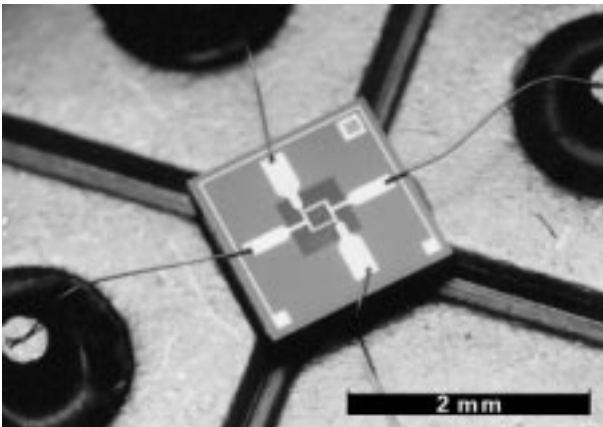


M I C R O S E N S

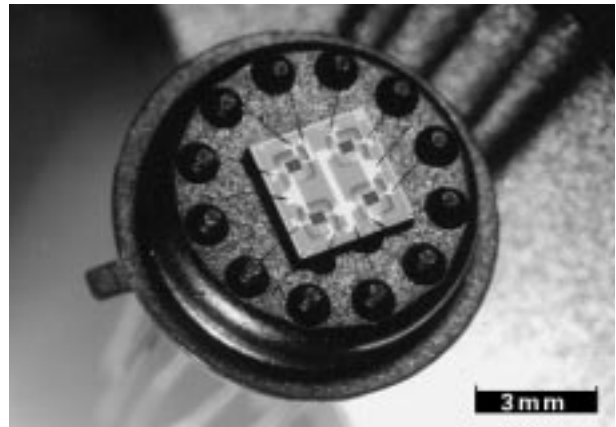
Sensor Description

Microsens Semiconductor Gas Sensor

- MSGS 3000 Monosensor
- MSGS 4000 Multisensor



MSGS 3000 Gas sensor mounted on a standard TO type package



MSGS 4000 Multisensor mounted on a standard TO-5 package

■ Miniaturized semiconductor gas sensor are manufactured using standard microelectronic technology and silicon micromachining techniques (Patent No 8706635)

■ The sensitive element consist of a semiconducting metal oxide layer. The measurement of specific oxidizing or

reducing gases are based on reversible conductivity change of the sensing element at an appropriate working temperature.

■ The thin semiconducting metal oxide layer is deposited on an integrated heater. The sensitive area of the device is thermally insulated from the silicon

substrate to minimize electrical power consumption. The gas selectivity of these sensors has been improved by superficial or bulk doping of the semiconducting metal oxide with metal catalysts, and by selecting an appropriate working temperature.

Main advantages

- Reproducibility
- Small size
- Low power consumption
- Low cost

■ Besides the obvious advantages of producing the gas sensor elements in batch fabrication processes (cost, reproducibility), further advantages of using miniaturized semiconductor gas sensors are related to the ensuing reduction of the required heating power as well as to the good control of the operating temperature. The substrate geometry and the materials used guarantee the necessary

thermomechanical stability and isolating properties.

■ The reproducibility of the gas sensor is mainly due to the technology used and the reproducible deposition of the thin film sensitive layers.

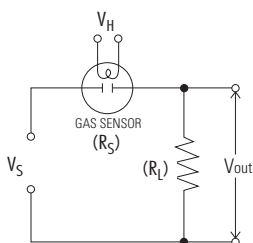
■ The low power consumption of the sensor is an important advantage for portable system application.

S P E C I F I C A T I O N S

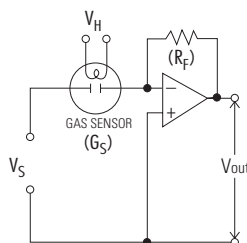
Sensor structure	MSGs 3000 Monosensor	MSGs 4000 Multisensor 4-Sensor Array	MSGs 4000 Multisensor 6-Sensor Array
Insulating membrane <ul style="list-style-type: none"> Membrane material Typical membrane thickness Membrane dimensions Silicon micromachining 	SiNx low stress 0.8 μm 500 x 500 μm KOH	SiNx low stress 0.8 μm 750 x 750 μm Plasma	SiNx low stress 0.8 μm 500 x 500 μm Plasma
Heater <ul style="list-style-type: none"> Heater material Heater thickness Typical resistance value at 22°C Temperature coefficient 	Pt 0.45 μm 42 0.00316/°C	Pt 0.45 μm 45 0.00316/°C	Pt 0.45 μm 41 0.00316/°C
Sensitive layer <ul style="list-style-type: none"> Semiconducting Metal Oxide Deposition Film thickness Sensitive layer dimensions 	Doped and undoped SnO ₂ - Nb ₂ O ₅ PVD-Magnetron Sputtering 100 nm to 400 nm 150 x 150 μm	Doped and undoped SnO ₂ - Nb ₂ O ₅ PVD-Magnetron Sputtering 100 nm to 400 nm 300 x 320 μm	Doped and undoped SnO ₂ - Nb ₂ O ₅ PVD-Magnetron Sputtering 100 nm to 400 nm 150 x 160 μm
Dimensions of the sensor <ul style="list-style-type: none"> Dimensions of the chip Mounted on a TO-5/TO-39 package Number of sensors/4 inch wafer 	1.6 x 1.6 x 0.38 mm Ø 9.13 mm; h=10 mm 1900 sensors	3.0 x 3.0 x 0.38 mm Ø 9.13 mm; h=15 mm 540 sensors	2.0 x 3.0x 0.38 mm Ø 9.13 mm; h=15 mm 810 sensors
Power consumption <ul style="list-style-type: none"> Thermal loss coefficient Typical power consumption at 400°C (isothermal mode) Corresponding operating voltage Corresponding operating current 	0.10 mW/°C 37.8 mW 1.8 V 21.0 mA	0.14 mW/°C 52.9 mW/sensor 2.2 V 24.0 mA/sensor	0.10 mW/°C 37.8 mW/sensor 1.8 V 21.0 mA/sensor
Typical power consumption <ul style="list-style-type: none"> CO/CH₄ sensor General purpose IAQ 	21 mW < 0.5 mW		

Measurement test circuits

Two different basic electric circuits which can be used with the gas sensors are presented on the figure below. The amplifier system (2) presents however the advantage of maintaining a constant voltage V_C on the sensitive layer. A constant-current test circuit can also be used for the gas sensors, considering the recommendation of Table 1 (maximum power sensor dissipation of 1 mW).

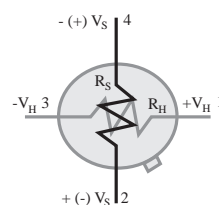


$$R_S = \left(\frac{V_S}{V_{out}} - 1 \right) \cdot (R_L) \quad (1)$$



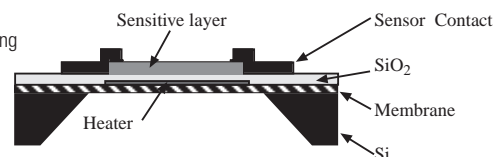
$$G_S = - \frac{1}{V_S \cdot (R_F)} \cdot V_{out} \quad (2)$$

Sensor equivalent circuit (Top View)



PIN NUMBER	
1	Heater Power
2	Sensor Pin
3	Heater Ground
4	Sensor Pin

Schematic drawing



Applications

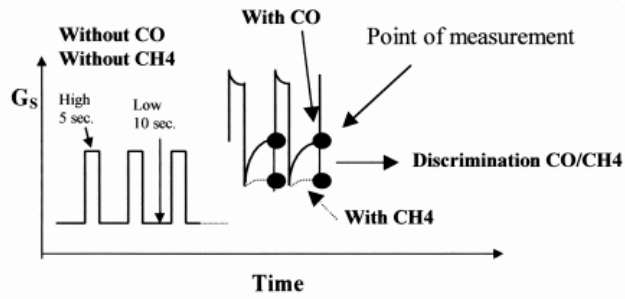
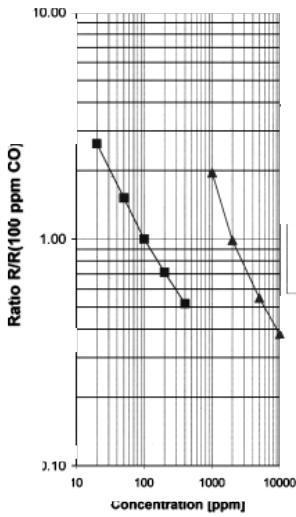
- Security
 - toxic gases
 - explosive gases
- Indoor air quality
- Industrial process control
- Combustion control
- Environnement
- Exhaust gases

In order to use the multisensor device, a specific system and software are available at MICROSENS. This interface is connected to the serial bus RS232, and thus can be easily used on a PC without any additional interface card.

G A S R E S P O N S E O F T H E S E N S O R S

CO/CH4 Sensitivity; RH=50%; Ta=23°C

CO/CH4

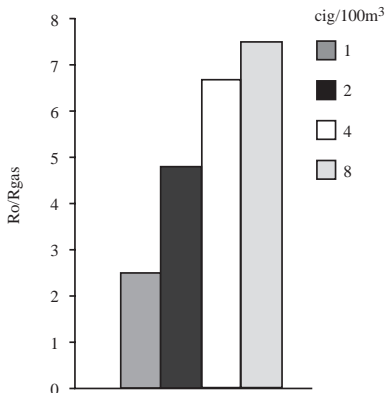


Principle of the operating mode
GS = Conductance of the Gas Sensor



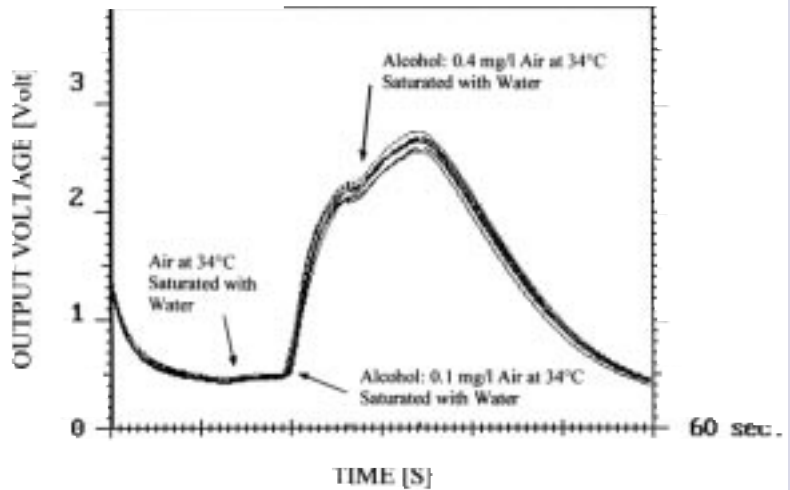
VOC

test cigarette: caballero
Ro is the average sensor resistance over the first five minutes without any tobacco smoke

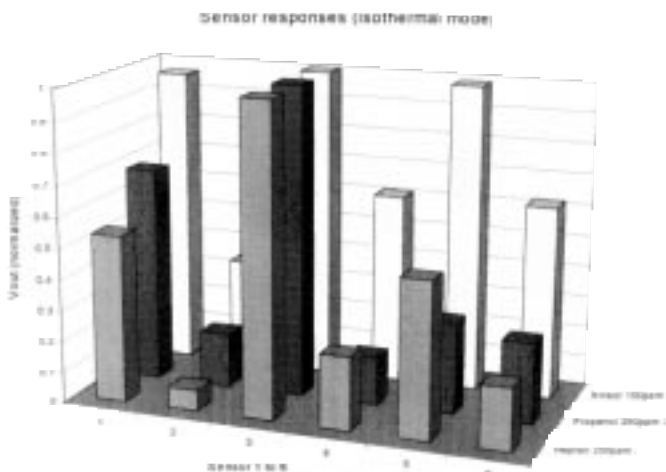


Microsens single sensor
heat drive: voltage control
pulse mode heater temperature 200°C/500°C (10"/5")

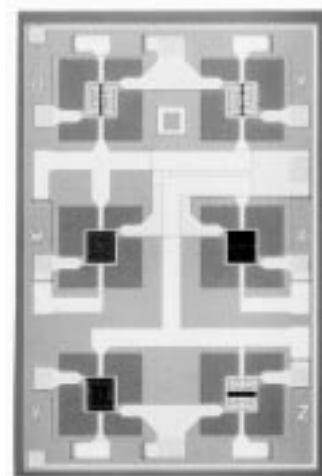
Alcohol



Multisensor application



Discrimination of different organic compounds based on a 6-sensors array.
Normalization based upon the maximum value of sensor 3.



6-sensors array (with different geometries of sensitive layer)
Pd-doped SnO2 sensitive layer. Size of the die: 2mm x 3mm

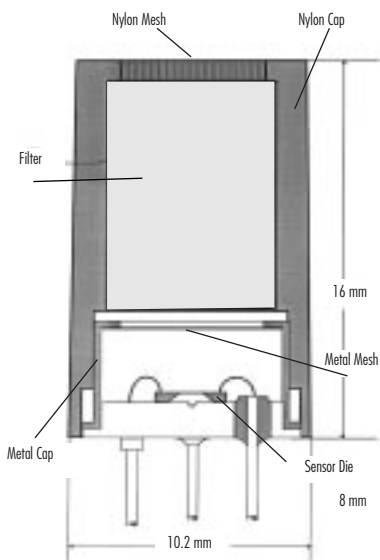
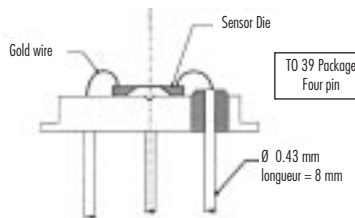
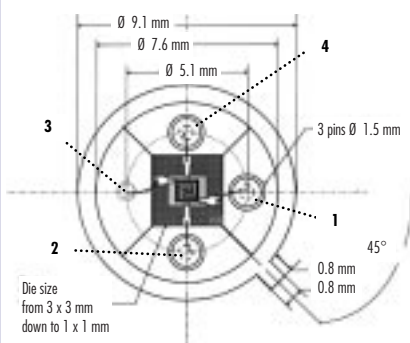


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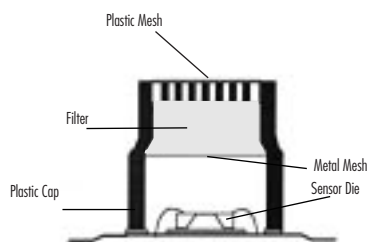
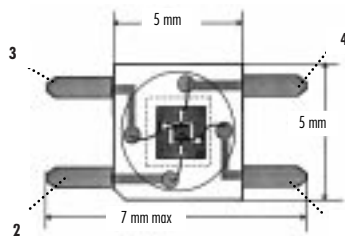
Packaging characteristics

■ For the monosensor, the standard packaging uses a TO-39 support. For some applications as CO/CH₄ measurement, a charcoal filter placed in a nylon casing reduces the effects of interfering gases. For the multisensor, a standard TO-5 packaging 12 leads is used.

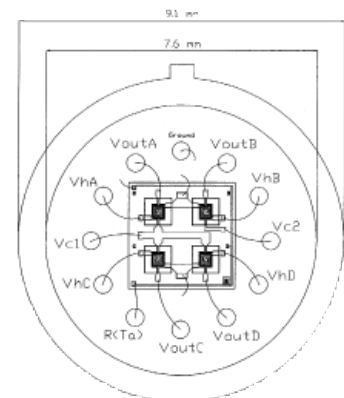
MSGs-3000 TO-39 PACKAGE



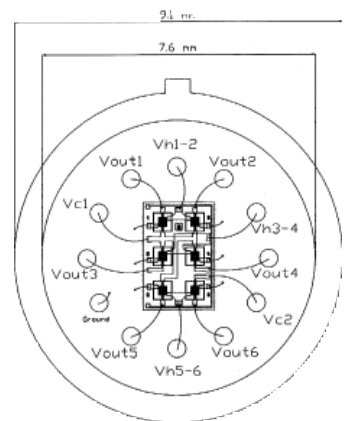
MSGs-3000 PLASTIC PACKAGE



MSGs-4000 TO-5 12 LEADS PACKAGE



4- sensor array. Die size: 3 x 3 mm



6- sensor array. Die size: 2 x 3 mm

