MiCS – 5131

Ethanol Gas Sensor

This datasheet describes the use of the MiCS-5131 in breathalyzer applications. The package and the mode of operation illustrated in this document target the detection of ethanol in the human breath.

Features:

- Low heater current
- Wide detection range
- High sensitivity
- Fast thermal response
- Electro-Static Discharge protected
- Miniature dimensions
- High resistance to shocks and vibrations

For this and other quality MiCS products, send an e-mail to info@microchemical.com or contact MicroChemical Systems at:

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Sensor Characteristics

Important Precautions:

Please read the following instructions carefully before using the MiCS-5131 sensor described in this document to avoid erroneous readings and to prevent the device from permanent damage.

- The sensor must not be wave soldered without protection or exposed to high concentrations of organic solvents, ammonia, or silicone vapors in order to avoid poisoning the sensitive layer.
- Heating powers above the specified maximum rating of 120mW can destroy the sensor due to overheating.
- This sensor is to be placed in a filtered package that protects it against any water or dust projection.
- For any additional questions, please contact us at: apps@microchemical.com

Operating Mode:

The recommended mode of operation is a constant power mode. A heater power of P_H = 102 mW is applied. This causes the temperature of the sensing resistor (R_S) to reach about 450°C.

Detection of ethanol is achieved by measuring the sensing resistor R_S during operation.

Sensor Response:

The sensor response to ethanol in air is represented in Figure 1. The sensor resistance R_S is normalized to the resistance under air (R_0).

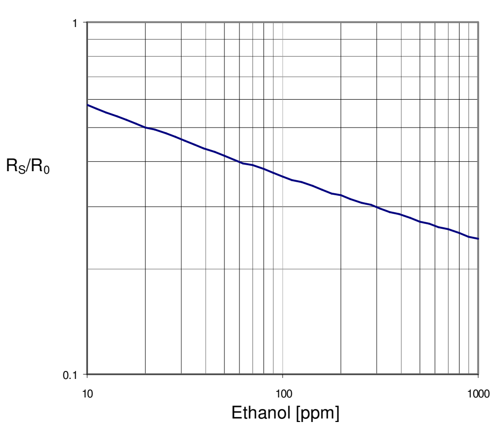
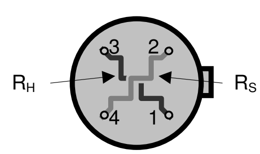


Figure 1: R_S / R_0 as a function of gas concentration at 50% RH and 25°C.

Measurement Circuit:

Figure 2 shows the pin connections of the MiCS-5131 gas sensor. A simple circuit to measure the ethanol level is proposed in Figure 3. The heating voltage V_H is applied to pins 3 and 1. A load resistor R_L is connected in series with R_S to convert the resistance R_S to a voltage V_S between pins 2 and 4. R_S can then be calculated by the following expression:

$$R_S = R_L / (V_{CC} - V_S) \cdot V_S$$



Pin Number	
1	Heater Ground
2	Sensor Pin
3	Heater Power
4	Sensor Pin

Figure 2: Equivalent circuit (top view) of MiCS 5131.

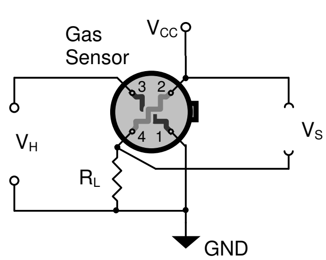


Figure 3: Measurement circuit for ethanol detection.

Cross Sensitivity:

The following figure illustrates the MiCS-5131 cross sensitivity to CH_4, CO, C_2H_5OH and H_2.

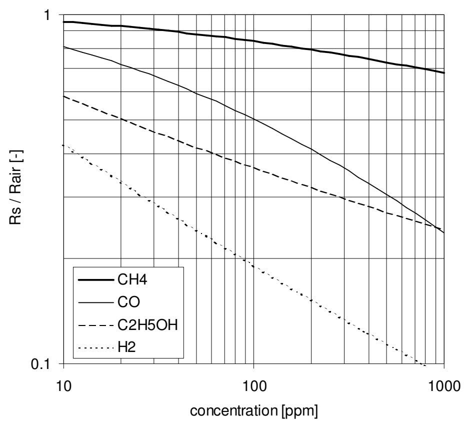


Fig. 4: Sensitivity to CO, H2, CH4, and C2H5OH at 25°C and 50% RH.

Response time:

A typical response curve under laboratory conditions is shown in figure 5. The test gas is 60ppm of C2H5OH and the sensing resistance reaches 90% of its final change in about one second.

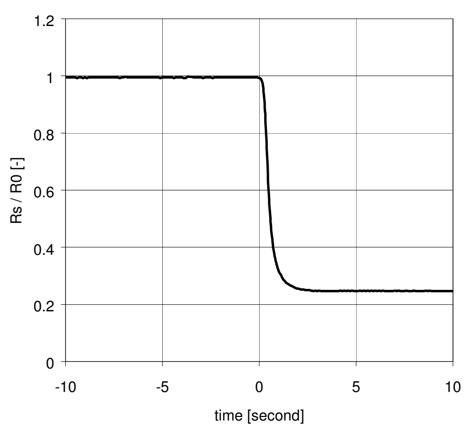


Fig. 5: Response time to 60ppm C2H5OH

Temperature and Humidity dependence:

Temperature and humidity also affect the resistance value of the sensor. Humidity is water (H2O) in gas phase, which reacts with the sensing layer like a reducing gas. Increasing humidity causes a decrease of the sensing resistance. As for the temperature, the effect is the same as for the humidity, i.e. decreasing resistance with increasing temperature. This negative temperature coefficient is due to the semiconductor properties of the sensing layer material.

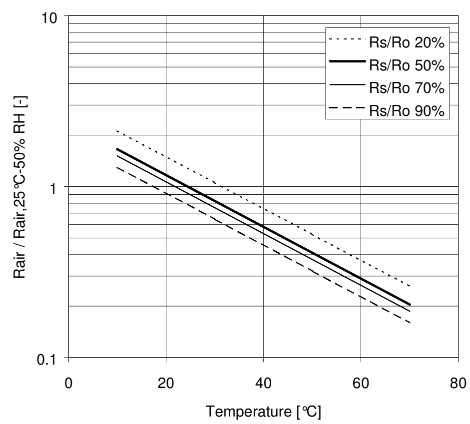


Fig. 6: Temperature dependence of baseline resistance Rair for 20%, 50%, 70% and 90% RH.

Electrical Specifications

Maximum Ratings:

Rating	Symbol	Value / Range	Unit
Maximum Sensor Supply Voltage	V_{CC}	5	V
Maximum Heater Power Dissipation	P_H	120	mW
Maximum Sensor Power Dissipation	P_S	1	mW
Relative Humidity Range	R_H	5 – 95	%RH
Ambient Operating Temperature	T_{amb}	-40 – 120	°C
Storage Temperature Range	T_{sto}	-40 – 120	°C
Storage Humidity Range	RH_{sto}	5 – 95	%RH

Table 1

Operating Conditions:

Parameter	Symbol	Typ	Min	Max	Unit
Heating Power, [1]	P_H	102	85	120	mW
Heating Voltage,	V_H	3.2	-	-	V
Heating Current,	I_H	32	-	-	mA
Heating Resistance, [2]	R_H	100	90	110	Ω

Table 2

[1] A minimum value of 85mW ensures sufficient sensitivity to ethanol. Heating powers above 120mW can cause permanent damage to the sensor when ambient temperatures exceed 120°C.

[2] Heating resistor values from sensors out of production range between 90 and 110 Ohm. Due to material properties of the heating resistor its value increases during operating life. This behavior has to be taken into account in the application design.

Sensitivity Characteristics:

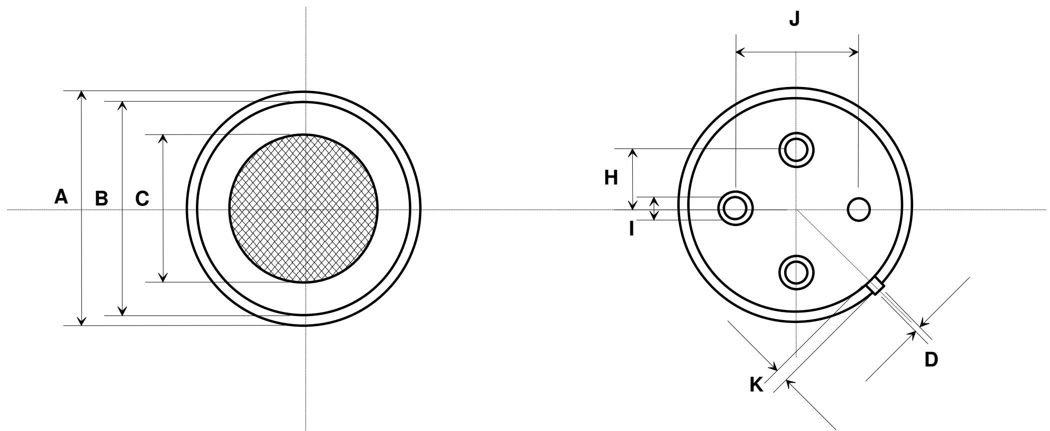
Characteristic	Symbol	Typ	Min	Max	Unit
Ethanol Detection Range	FS		10	1000	ppm
Sensing Resistance in air [3]	R_0	24	18	180	kΩ
Sensitivity Factor [4]	S_R	1.4	1.3	1.8	-

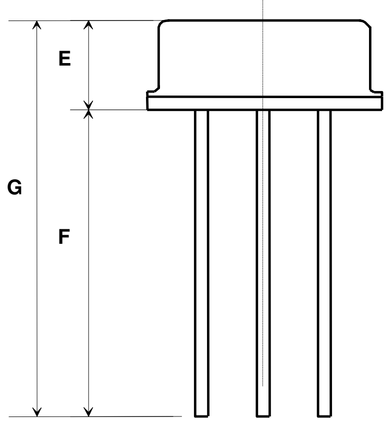
Table 3

[3] Sensing Resistance in air R_0 is measured under controlled ambient conditions, i.e. synthetic air at 23±2°C and 50±5 %RH.

[4] Sensitivity Factor S_R is defined as R_S at 60ppm of CO divided by R_S at 200ppm of CO. Test conditions are 50±5 %RH and 23±2°C.

Package Dimensions and Filter





Dimension	Min [mm]	Max [mm]
A	9	9.15
B	8.15	8.30
C	5.75	5.85
D	0.6	0.9
E	3.5	3.9
F	9.0	10.0
G	12.5	13.9
H	2.41	2.67
I	0.55	0.65
J	4.83	5.33
K	0.7	0.9