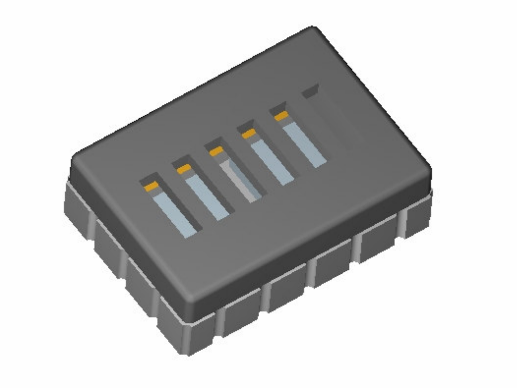
MiCS – 4514

CO & NO_2 Automotive Sensor

This datasheet describes the MiCS-4514 for use in automobile applications. The package and the mode of operation described in this document target the detection of reducing gases like CO and hydrocarbons, and oxidizing gases like NO_2. These gases are present in traffic and are responsible for poor cabin air quality. Detection of both types of gases allows the closure of the recirculation flaps in all road conditions that would lead to undesirable odors or pollution levels in the cabin.

Features:



- Low heater current
- Wide detection range
- Wide temperature range
- High sensitivity
- Quick pre-heating
- ESD protection diodes
- Two sensors in one SMD package with miniature dimensions
- High resistance to shock and vibrations
- Compliant with automotive test requirements

Sensor Configuration

The silicon gas sensor structure consists of an accurately micromachined diaphragm with an embedded heating resistor and the sensing layer on top.
The MiCS-4514 includes two sensor chips with independent heaters and sensitive layers: the sensor that detects oxidizing gases (OX) and the sensor that detects reducing gases (RED). The internal connections are shown below.

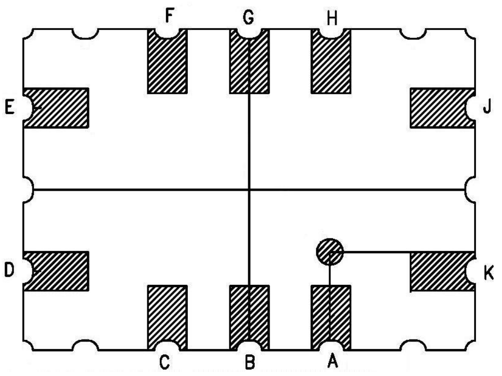


Figure 1: MiCS-4514 configuration (bottom view)

Pin Number	
A	Rh1 OXY
B	Rs1 OXY
C	Rh1 RED
D	Rs1 RED
E	NC
F	Rh2 RED
G	Rs2 RED
H	Rh2 OXY
J	Rs2 OXY
K	NC

Rs: sensor resistance
Rh: heater resistance

Operating Mode:

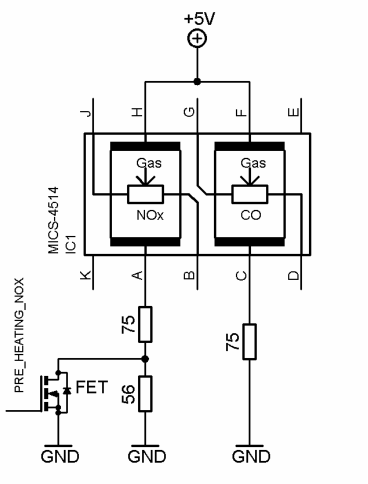
The recommended mode of operation is constant power on each sensor. The nominal power for the RED sensor is P_H = 83 mW , while the nominal power for the OX sensor is P_H = 43 mW. The resulting temperatures of the sensing layers are respectively about 360℃ and 220℃, in air at approximately 20℃.

Detection of the pollution gases is achieved by measuring the sensing resistance of both sensors:

- RED sensor resistance decreases in the presence of CO and hydrocarbons.
- OX sensor resistance increases in the presence of NO_2.

Power circuit example:

As shown below, two external load resistors can be used to power both heaters with a single 5 V power supply.

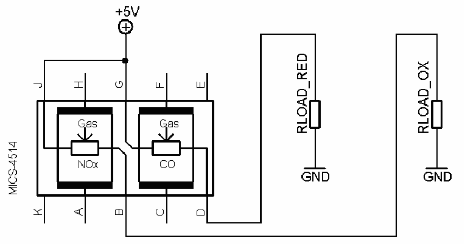


RDRED is 75 Ω and RDOX is 131 Ω. These resistors are necessary to obtain the right temperatures on the two independent heaters while using a single 5 V power supply. The resulting voltages are typically VHRED = 2.5 V and VHOX = 1.7 V.

Figure 2: MiCS-4514 with recommended supply circuit (Top View)

Measurement circuit example:

As shown below, the sensitive resistance shall be read by using a load resistor.



The two voltages measured on the load resistors are directly linked to the resistances of the RED and OX sensors respectively. RLOAD must be 820 ohm at the lowest in order not to damage the sensitive layer.

Figure 3: MiCS-4514 with measurement circuit (top view)

Important Precautions:

Please read the following instructions carefully before using the MiCS-4514, to avoid erroneous readings and to prevent permanent damage to the device.

- The sensor must be reflow soldered in a neutral atmosphere, without soldering flux vapors
- The sensor must not be exposed to high concentrations of organic solvents, ammonia, silicone vapor or cigarette smoke in order to avoid poisoning the sensitive layer.
- Heater voltages above the specified maximum rating will destroy the sensor due to overheating.
- This sensor is to be placed in a filtered package that protects it against water and dust projections.
- We strongly recommend using ESD protection equipment to handle the sensor.
- For any additional questions, please contact us at: apps@microchemical.com

Sensor Characteristics

RED Sensor

The typical sensor response to CO in air is represented in Figure 4. The sensor resistance R_S is normalized to the resistance under air (R_0).

RED Sensor Sensitivity

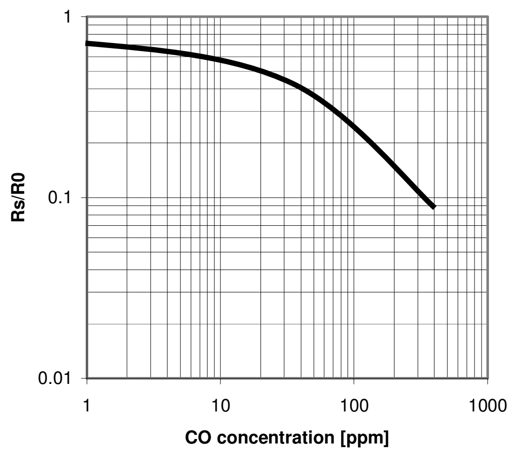


Figure 4: R_s / R_0 as a function of CO concentration at 40% RH and 25°C, measured on an engineering test bench

OX Sensor

The typical sensor response to NO_2 in air is represented in Figure 5. The sensor resistance R_S is normalized to the resistance under air (R_0).

OX Sensor Sensitivity

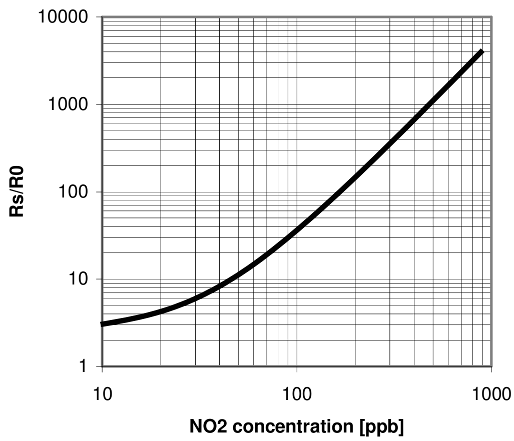


Figure 5: R_s / R_0 as a function of NO_2 concentration at 40% RH and 25°C, measured on an engineering test bench

Electrical Specifications

Rating	Symbol	Value / Range	Unit
Maximum Heater Power Dissipation	P_H	88 (RED sensor) / 50 (OX sensor)	mW
Maximum Sensitive Layer Power Dissipation	P_S	8	mW
Voltage Supply	V_{supply}	4.9 – 5.1	V
Relative Humidity Range	R_H	5 – 95	%RH
Ambient Operating Temperature	T_{amb}	-30 – 85	°C
Storage Temperature Range	T_{sto}	-40 – 120	°C
Storage Humidity Range	RH_{sto}	5 – 95	%RH

Table 1

Operating Conditions (RED sensor / OX sensor):

Parameter (RED sensor / OX sensor)	Symbol	Typ	Min	Max	Unit
Heating Power,	P_H	83/43	78/30	88/50	mW
Heating Voltage,	V_H	2.5/1.7	-	-	V
Heating Current,	I_H	34/26	-	-	mA
Heating Resistance at nominal power,	R_H	74/66	66/59	82/73	Ω

Table 2

Sensitivity Characteristics for back-end test (RED sensor / OX sensor):

Characteristic/RED sensor	Symbol	Typ	Min	Max	Unit
CO Detection Range	FS		1	1000	ppm
Sensing Resistance in air [1]	R_0	-	100	1000	kΩ
Sensitivity Factor [2]	S_R	3.0	1.8	6.6	-
Sensitivity CO 60 ppm [3]	S_{60}	9	2	18	-

Table 3.1

Characteristic/OX sensor	Symbol	Typ	Min	Max	Unit
NO_2 Detection Range	FS		0.05	5	ppm
Sensing Resistance in air [1]	R_0	-	0.8	8	kΩ
Sensitivity Factor [2]	S_R	55	6	100	-

Table 3.2

[1] Sensing Resistance in air R_0 is measured under controlled ambient conditions, i.e. synthetic air at 23±5°C and 50±10 %RH for RED sensor and synthetic air at 23±5°C and ≤ 5 %RH for OX sensor

[2] Sensitivity Factor S_R is defined for RED sensor as R_S at 60ppm of CO, divided by R_S at 200ppm of CO, and for OX sensor, as R_S at 0.25ppm of NO_2, divided by R_S in air. Test conditions are 23±5°C and 50±10 %RH for RED sensor and 23±5°C and ≤ 5 %RH for OX sensor.

[3] Sensitivity CO 60 ppm is defined as R_S in air divided by R_S at 60 ppm CO. Test conditions are 23±5°C and 50±10 %RH. Indicative values only.

**Grey cells are subject to changes before the final datasheet is published.*

Package Dimensions

The package is compatible with SMD assembly process.

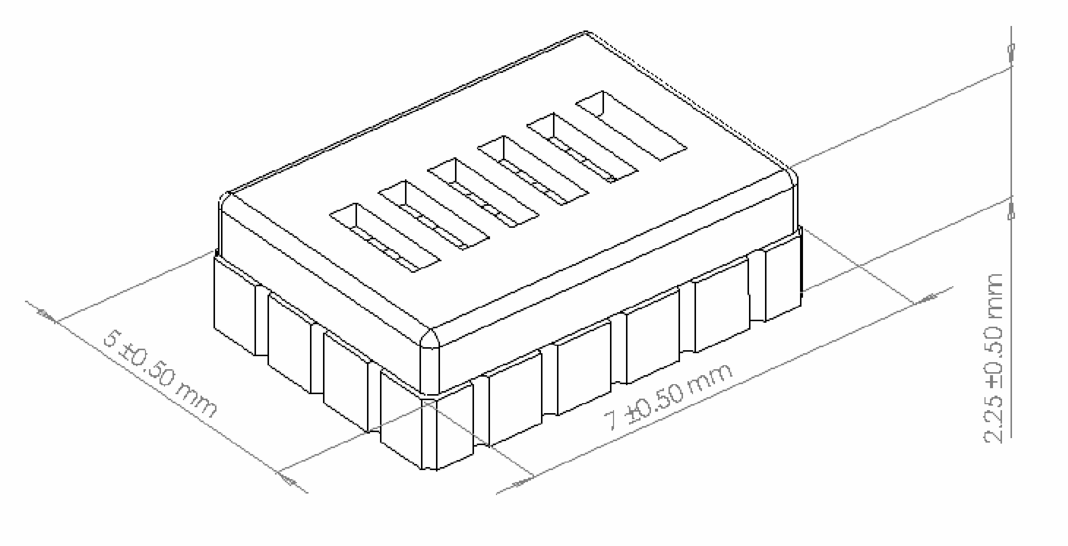


Figure 6: Package outline dimensions

Soldering pads geometry:

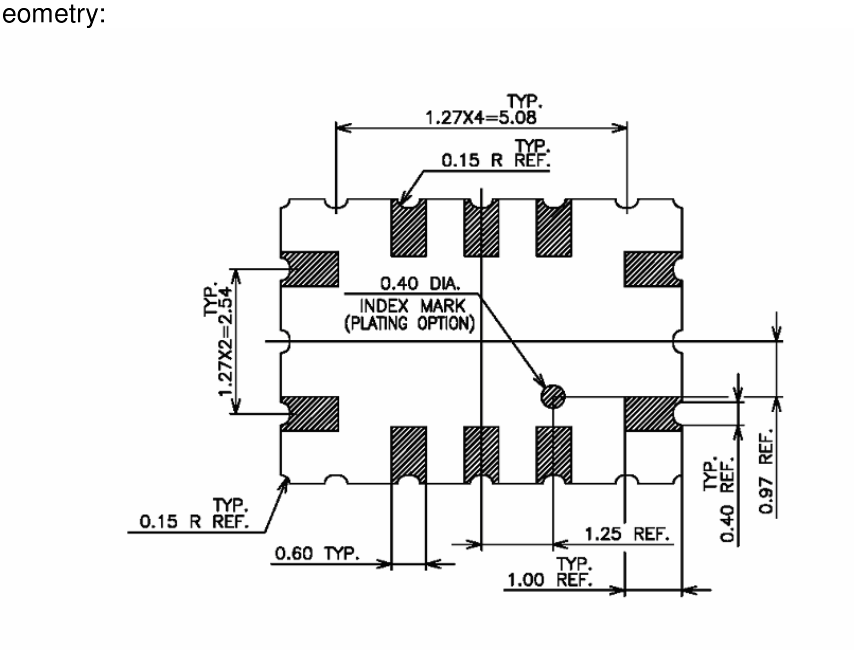


Figure 7: Soldering pads drawings