TGS 2180 - water vapor detection for automatic control of microwave ovens

Features:

* Low power consumption
* High sensitivity to water vapor
* High temperature durability
* Long life and low cost
* Uses simple electrical circuit
* Small size

Applications:

* Automatic cooking control in microwave ovens

The sensing element is comprised of a metal oxide semiconductor layer formed on an alumina substrate of a sensing chip together with an integrated heater. The **TGS 2180** has relatively high sensitivity to water vapor and low sensitivity to organic vapors which may be generated from cooking food. The sensor's conductivity increases depending on absolute humidity. A simple electrical circuit can convert the change in conductivity to an output signal which corresponds to absolute humidity.

Cooking condition can be detected by monitoring changes in sensor resistance ratio, whcih can be uniquely determined depending on the type of food, but independent from the food's weight. With quick response to water vapor and excellent durability in high temperature operation, TGS 2180 is an ideal sensor for automatic cooking time control in microwave ovens.
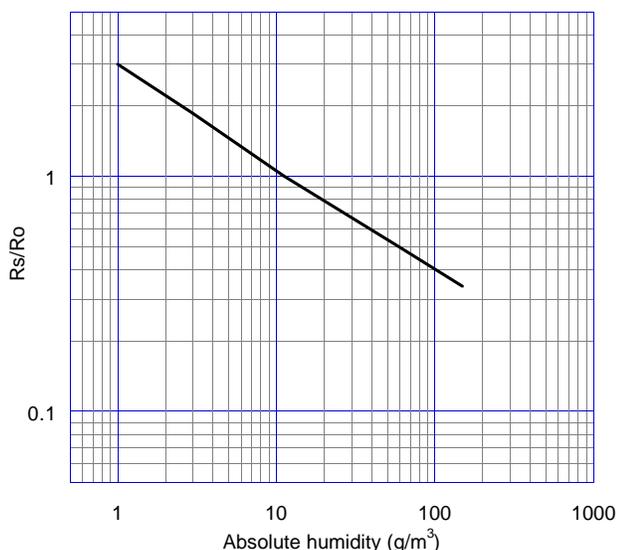
Due to miniaturization of the sensing chip, TGS 2180 requires a heater current of only 166mA and the device is housed in a standard plastic housing package.

The figure below represents typical sensitivity characteristics, all data having been gathered at standard test conditions (see reverse side of this sheet). The Y-axis is indicated as *sensor resistance ratio* (Rs/Ro) which is defined as follows:

Rs = Sensor resistance in water vapor at various absolute humidities
Ro = Sensor resistance in clean air at $11.2 g/m^3$ of absolute humidity (corresponding to 20˚C/65%RH)

The figure below represents sensitivity to various gases. Again, the Y-axis is indicated as *sensor resistance ratio* (Rs/Ro), defined as follows:

Rs = Sensor resistance in vaious concentrations of gases
$Ro = Ro$ = Sensor resistance in clean air at $11.2 g/m^3$ of absolute humidity (corresponding to 20˚C/65%RH)
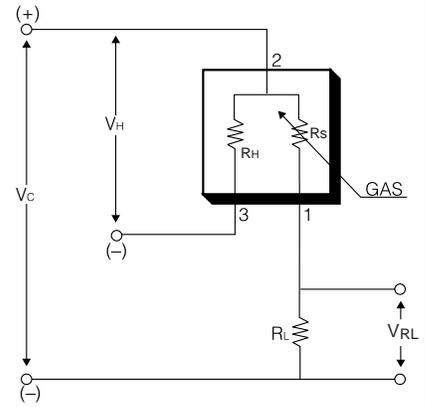
Sensitivity Characteristics to Water Vapor:

Rs/Ro vs Absolute humidity (g/m³)

Sensitivity Characteristics to Various Gases:
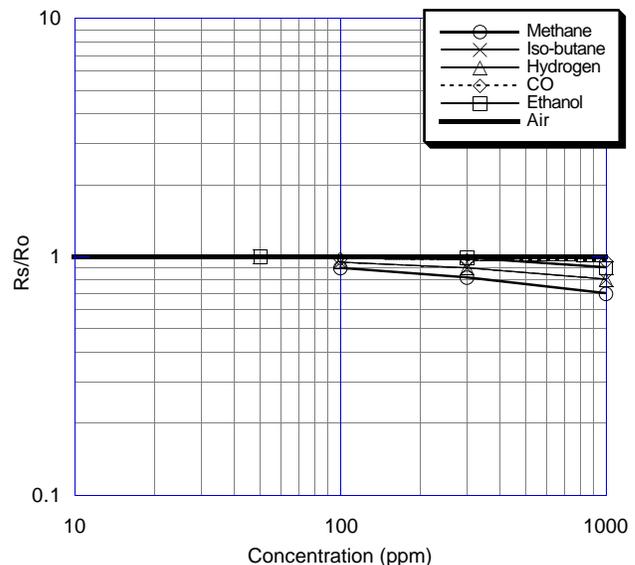
Methane
Iso-butane
Hydrogen
CO
Ethanol
Air

Rs/Ro vs Concentration (ppm)

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Basic Measuring Circuit:

The sensor requires two voltage inputs: heater voltage (V_H) and circuit voltage (V_C). The heater voltage (V_H) is applied to the integrated heater in order to maintain the sensing element at a specific temperature which is optimal for sensing. Circuit voltage (V_C) is applied to allow measurement of voltage (V_{out}) across a load resistor (R_L) which is connected in series with the sensor. DC voltage is required for the circuit voltage since the sensor has a polarity. A common power supply circuit can be used for both V_C and V_H to fulfill the sensor's electrical requirements. The value of the load resistor (R_L) should be chosen to optimize the alarm threshold value, keeping power consumption (P_S) of the semiconductor below a limit of 15mW. Power consumption (P_S) will be highest when the value of R_S is equal to R_L on exposure to gas.

Specifications:

Model number		TGS 2180	
Sensing element type		S1	
Standard package		Plastic	
Target gases		Water vapor	
Typical detection range		$1 \sim 150 g/m^3$	
Standard circuit conditions	Heater voltage V_H	5.0±0.2V DC/AC	
	Circuit voltage V_C	5.0±0.2V DC	$P_S \leq$ 15mW
	Load resistance R_L	Variable	0.45kΩ min.
Electrical characteristics under standard test conditions	Heater resistance R_H	18±2Ω at room temp. (typical)	
	Heater current I_H	166mA	
	Heater power consumption P_H	830mW (typical)	
	Sensor resistance R_S	$23 \sim 145$kΩ in air at 20˚C/65%RH	
	Sensitivity to water vapor (change ratio of R_S) NOTE 1	0.77 ~ 0.92	$\dfrac{\text{Rs air at 25˚C/68\%RH}}{\text{Rs air at 20˚C/65\%RH}}$
	Sensitivity to EtOH (change ratio of R_S)	0.83 ~ 1.11	$\dfrac{\text{Rs (300ppm EtOH)}}{\text{Rs air}}$
Standard test conditions	Test gas conditions	normal air at 20±2˚C, 65±5%RH	
	Circuit conditions	V_C = 5.0±0.05V DC \newline V_H = 5.0±0.05V DC	
	Conditioning period before test	2 days	

NOTE 1: absolute humidity at 25˚C/68%RH = $15.6 g/m^3$
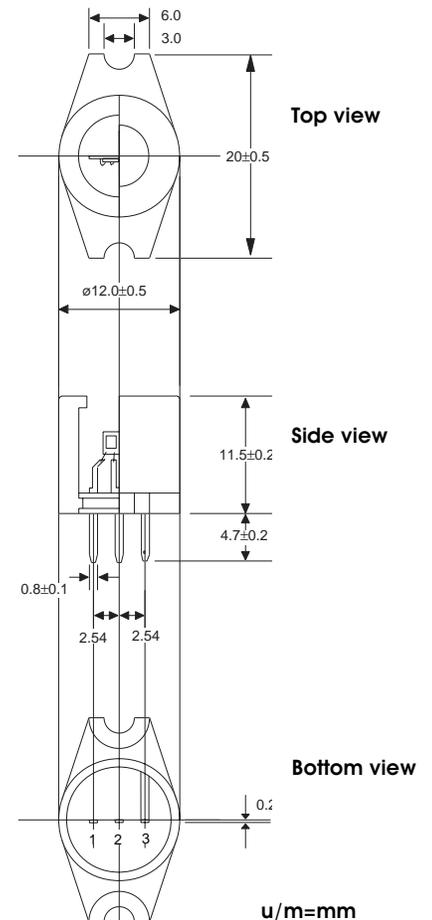absolute humidity at 20˚C/65%RH = $11.2 g/m^3$

The value of power consumption (P_S) can be calculated by utilizing the following formula:

$$P_S = \frac{(V_C - V_{out})^2}{R_S}$$

Sensor resistance (R_S) is calculated with a measured value of V_{out} by using the following formula:

$$R_S = \frac{V_C \times R_L}{V_{out}} - R_L$$

Structure and Dimensions:

6.0
3.0

Top view

20±0.5

ø12.0±0.5

Side view

11.5±0.2

4.7±0.2

0.8±0.1

2.54   2.54

Bottom view

0.2

1 2 3

u/m=mm

Pin connection:
1: Sensor electrode (-)
2: Common (+)
3: Heater (-)

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