Formaldehyde Gas Sensor

SMD1001 Product Datasheet

1. Product Introduction

The SMD1001 formaldehyde gas sensor is a semiconductor gas sensor developed based on MEMS technology and can be used to detect formaldehyde gas content in different scenarios.

The formaldehyde gas sensitive material and sensing electrodes are developed and made by IDM independently. When formaldehyde gas reach the sensitive material, the conductivity of the sensitive material will change. A specific test circuit can be used to convert the value of conductance into an output voltage signal corresponding to the gas concentration.

2. Sensor Characteristics

- Very small size
- Low power consumption
- High sensitivity
- Fast response recovery
- Good stability
- Long life time

3. Main Application

- Air purifiers
- Air conditioner fresh air
- Smart wearable devices
- Portable detectors

4. Product Description

4.1 Technical parameters

Table 1

Product Number		SMD1001	
Product Type		MEMS Semiconductor Sensors	
Package		Ceramic Package	
Target Gas		Formaldehyde	
Measurement Range		0 ~ 3 ppm(formaldehyde)	
Resolution		0.04 ppm(formaldehyde)	
Electrical Parameters	Sensor Working Voltage	V_C	≤ 5V or 3.3V DC
	Heating Voltage	V_H	1.8 ±0.05V DC
	Load Resistance	R	Adjustable (refer to delivery sheet)
	Heater Resistance	R_H	43±5Ω （at room temperature）
	Heating Power	P_H	≤ 36mW
Sensor Performance Under Standard Test Conditions	Base Resistance	R_S	10-500KΩ （Tested in Air）
	Sensitivity	S	R_0(in air)/R_S(in 0.4ppm formaldehyde) ≥ 1.8
	Response Ratio	α	≤ 0.6($R_{0.4PPM}$/$R_{0.01PPM}$ formaldehyde)
Standard Test Conditions	Temperature	20±2℃	
	Humidity	55±5%RH	
	Preheating Time	3-5 min	
Response Time(T_{90})		< 15s	
Recovery Time(T_{10})		< 60s	
Life Time		≥ 3 years	

Note: in following section, if the unit is resistance, it is calculated by this formula:

$$R = \frac{R_L(V_{CC} - V_{OUT})}{V_{OUT}}$$

Each item definition refer table1

4.2 Dimension and pin definition

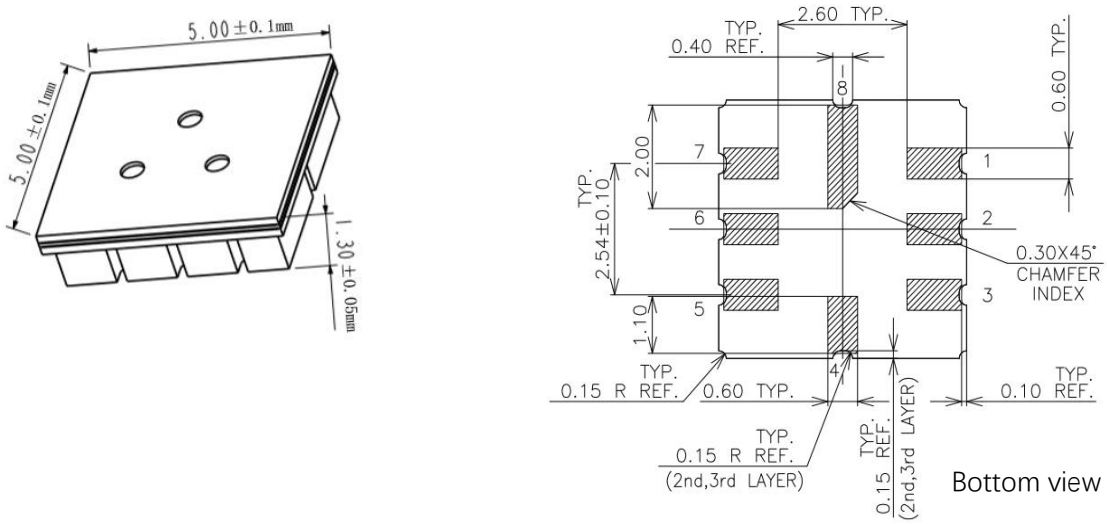


Table 2

Pin Number	Name	Definition
1	VH+	Heating voltage supply
2	VCC	Sensor voltage supply
3	NG	/
4	NG	/
5	NG	/
6	NG	/
7	HOT	Heating GND
8	VOUT	Sensor output voltage

4.3 Basic electric circuit

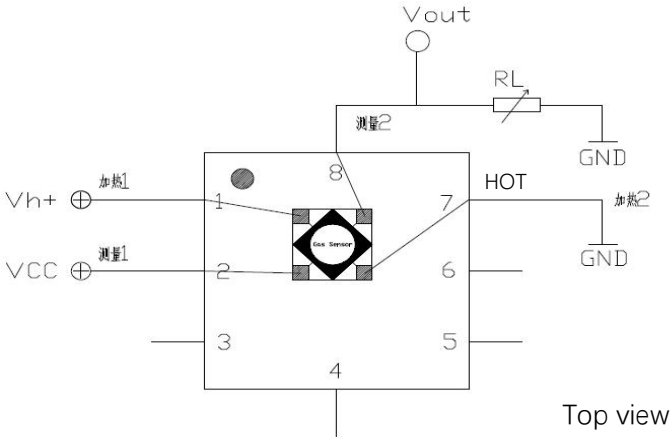


Figure above is basic test circuit for SMD1001 sensor. The sensor needs apply 2 voltages: heater voltage and sensor voltage. Vh is a specific heating voltage for the sensor heating element. Vcc is the sensor voltage. Vout is output test voltage which need connect a load resistor RL in series. These two voltage need set in specific value according to datasheet, otherwise measurement performance will reduce and even damage the sensor.

5. Sensor Characterization

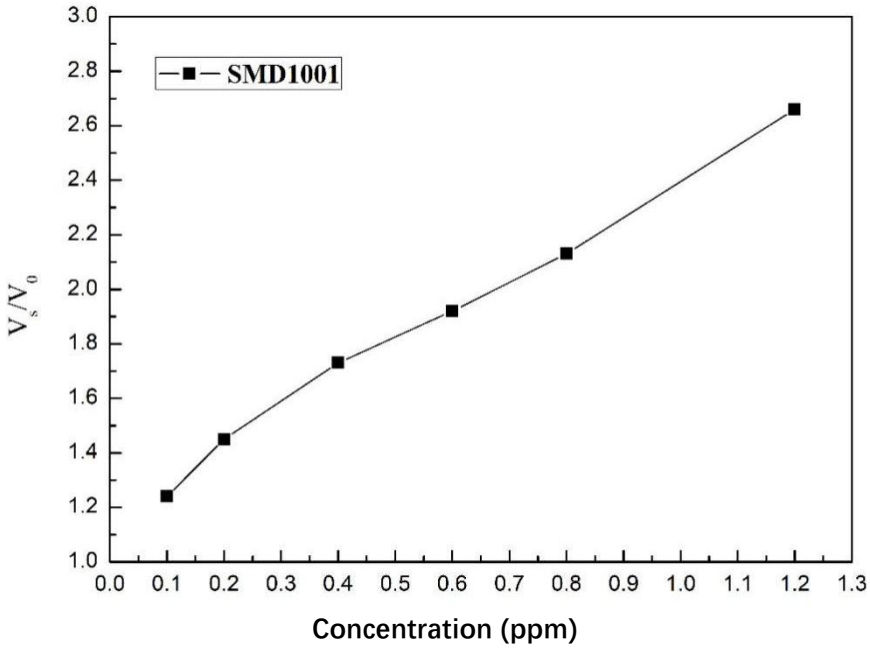


Figure 1. Sensor sensitivity characteristic curve

In above figure, the test was completed under standard test conditions, and the load resistance is 10kΩ. V0 represents the response voltage value in clean air; and Vs represents the response voltage value to formaldehyde gas in different concentrations.

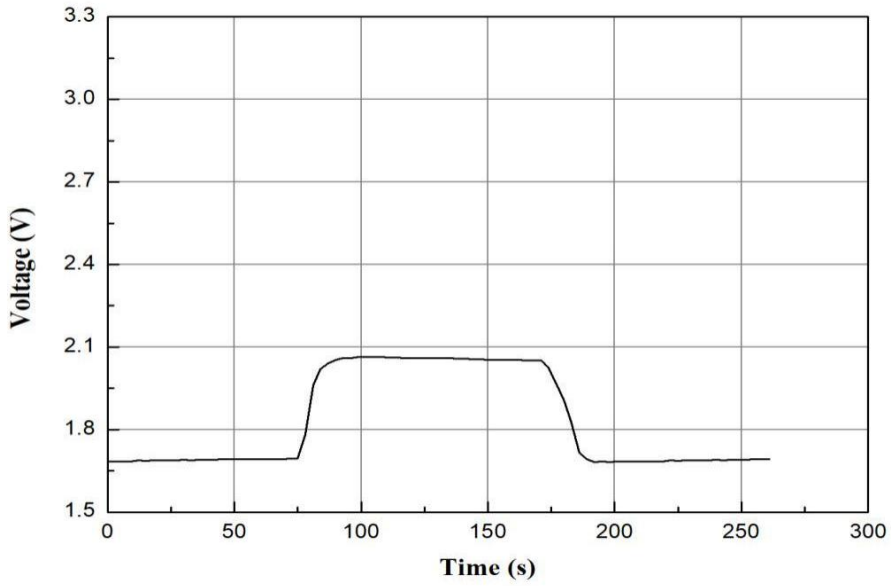


Figure 2. Sensor response-recovery characteristic curve

The curve in the figure shows the real-time response voltage curve which read out from the sensor, and the test gas is 0.4 ppm formaldehyde gas. The load resistance used was 20 kΩ. The test was completed under standard test conditions

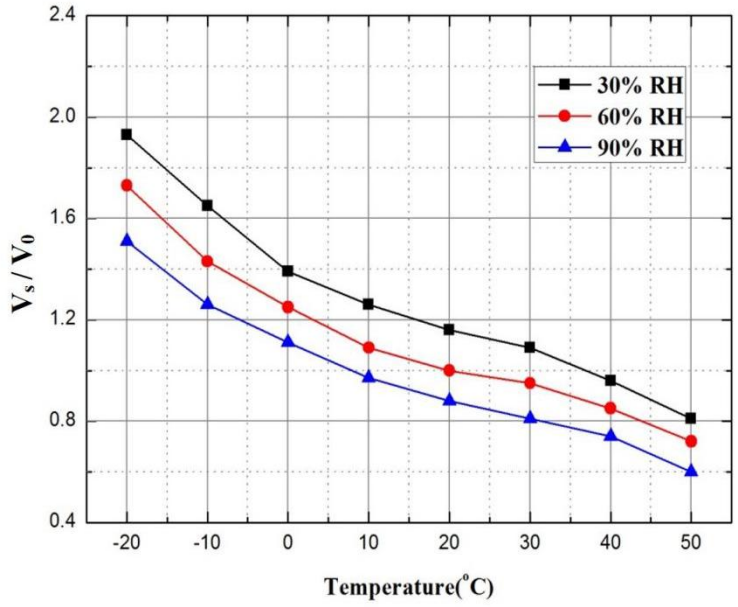


Figure 3. Sensor temperature and humidity characteristic curve

Above figure shows the temperature and humidity effect curves, Vs represents the response voltage in 0.4 ppm formaldehyde gas under different temperature and humidity conditions, and V0 represents the response voltage value in clean air under correspond temperature and humidity conditions.

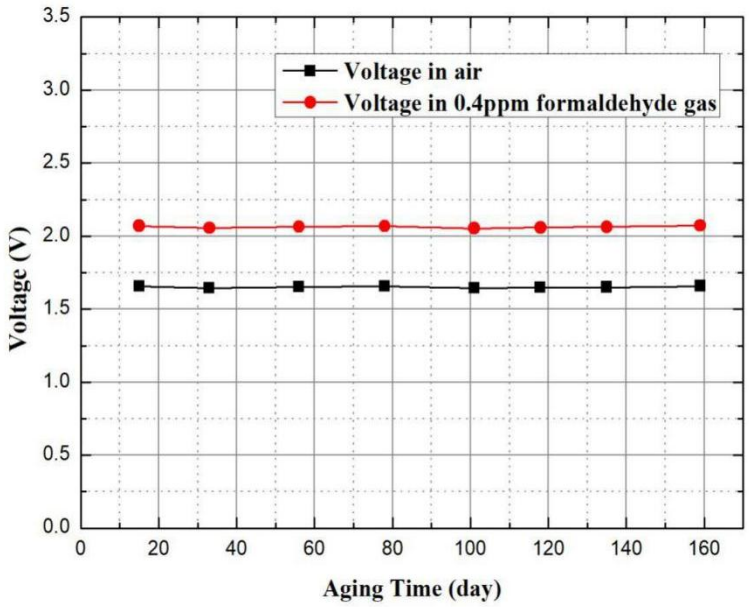


Figure 4. Sensor stability curve

The test is completed under standard test conditions. The horizontal axis is the time when sensor is continuously powered on, and the vertical axis is the test voltage value. The load resistance used is 51kΩ.

6. Product Shipping Packaging:

Plastic Tape

Precautions:

1 Situations must avoid

1.1 Exposure to volatile silicon compound vapor

The sensor should avoid being exposed to silicone adhesives, hair spray, silicone rubber, putty or other places where volatile silicone compounds exist. If the surface of the sensor is adsorbed with silicone compound vapor, the sensitive material of the sensor will be wrapped by silicon dioxide which formed by the decomposition of the silicone compound, which will degrade the sensitivity of the sensor and cannot be restored.

1.2 Highly corrosive environment

the sensor is exposed to high concentration of corrosive gas (such as H2 S, SOX , Cl2 , HCl, etc.), it will not only cause corrosion or damage to the heating material and sensor leads, but also cause irreversible deterioration of the performance of sensitive materials.

1.3 Pollution by alkali, alkali metal salts and halogens

The performance of the sensor may also deteriorate when it is contaminated by alkali metals, especially salt water spray, or exposed to halogens such as Freon.

1.4 Directly touch with water

Splashing or immersing the sensor in water will cause the sensor's sensitivity to decrease.

1.5 Freeze

If sensor surface appear with ice, it will cause sensing material crack and lost sensitive property.

1.6 Applied voltage is too high

If the voltage applied to the sensor or heater is higher than the specified value, even if the sensor is not physically damaged or destroyed, it may cause damage to the leads and/or heater or cause the sensor's sensitivity characteristics to degrade.

1.7 Voltage connect pin mismatch

If the sensor and heater wire is connected in wrong pins, it will cause damage to the leads and/or heater and cause the sensor's sensitivity to deteriorate.

2. Situations need attention

2.1 Condensation

Under indoor use conditions, slight condensation will have small impact on the sensor performance. However, if water condenses on the surface of the sensitive layer and remains for a long time, the sensor characteristics may deteriorate.

2.2 In high concentration gas

Regardless of whether the sensor is powered on or not, long-term place in high-concentration gas will affect the sensor characteristics. For example, if the sensor directly be spray by lighter gas (butane), that will cause great damage to the sensor.

2.3 Long-term storage

If the module is stored for a long time even without power on, the sensor resistance may have a reversible drift, which is related to the storage environment. The sensor should be stored in a sealed bag that does not contain volatile silicon compounds. After long-term storage, the sensor needs a longer time preheat process to stabilize. The storage time and corresponding preheating time are recommended as following:

Storage time	Recommended preheating time
Less than 1 month	Not less than 6 hours
1-6 months	Not less than 12 hours
More than 6 months	No less than 24 hours

2.4 Long-term exposure to extreme environments

Regardless of whether the sensor is powered or not, to exposure in extreme conditions, such as high humidity, high temperature or high pollution for long time, it will seriously affect sensor performance.

2.5 Vibration

Frequently, excessively vibration may cause the sensor's internal leads to break. This type of vibration can be generated during transportation and by using pneumatic screwdrivers or ultrasonic welders in the assembly line.

2.6 Excessive impact

If the sensor is subjected to a strong impact or falls, internal lead wires may break.

2.7 Conditions of assembling:

2.7.1 Manual welding is the most ideal welding method for sensors. The recommended welding conditions are as following:

Flux: Rosin flux with minimal chlorine content

Constant temperature soldering iron

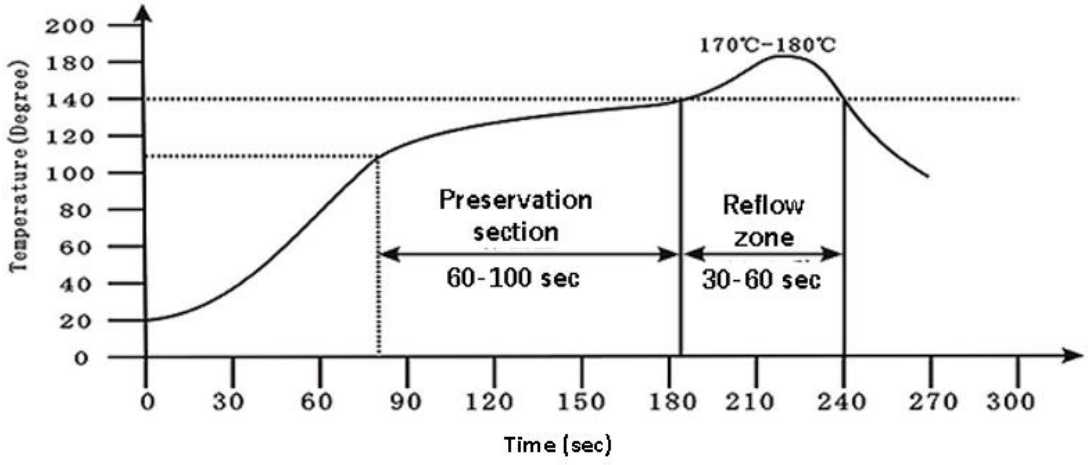
Temperature: not over 250℃

Time: no more than 3 seconds

2.7.2 The following conditions are recommended when using reflow soldering

Solder paste: low temperature lead-free solder paste (Sn42Bi58)

The furnace curve is as following:



2.8 Anti-static

Anti-static bag packaging

Violation of the above usage conditions will degrade the sensor characteristics.

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