Thank you for purchasing of gas sensor module. Please carefully read this manual before using the module.

■Basic specifications

Power supply: 5VDC
Output: Analogue 0 to 5V
*Not indicating gas concentration.
Gas sensor: SP3S-AQ2-01
I/O connector: XHP-3 (Mfr: JST)

■Before measurement

1) Install the module in the measurement equipment.
2) Connect 5V DC power supply to pins 1 and 3. Do not supply the power yet.
3) Connect analogue output reading equipment (e.g. volt meter) to pins 2 and 3.

(I/O connector specifications)

Terminal #	Name	Color	Specifications
1	Power supply (+)	Red	DC5V±4%
2	Analogue output	White	Range : 0－5V Tolerance: ±10%
3	GND	Black	Common for Terminals 1 and 2

■Measurement

1) Turn 5V power supply on.
2) After analogue output is stabilized in clean air, adjust the mounted potentiometer so that the reading should be 0.5 to 1.5V.
3) Read analogue output under actual gas to evaluate the sensor performance through equations below.

Equations

Sensitivity is defined as below.

$$Sensitivity = Rs(gas)/Rs(air)$$

Where Rs(gas) = Sensor resistance in gas
Rs(air)=Sensor resistance in clean air

In case of this module (EVM-SP-02), you can calculate sensor resistance (Rs[kΩ]) with the equation below.

$$Rs = RL*(5/Vout) - 1)$$

Where RL = load resistance in kΩ. The value of RL can be ignored to obtain Sensitivity.
Vout = output voltage in volt.

e.g. If you obtain 1.0V for clean air and 2.0V for target gas, the sensitivity will be:
Sensitivity = Rs(gas)/Rs(air)=1.5/4=0.375

Generally, the relation between sensor resistance and gas concentration is linear in log-log scale. Rs decreases with an increase of gas concentration. The smaller value of the above "Sensitivity" indicates higher sensitivity.

Standard curve

Semiconductor gas sensor is different in sensitivity and sensor resistance piece by piece. If you intend to make a precise measurement, you should prepare "Standard curve" as below.

① *Keep power on the module for 24 hours to stabilize the sensor.*
② *Measure analogue output in clean air.*
③ *Measure analogue outputs in several known gas concentrations.*
④ *Calculate the Sensitivities with the values obtain in the above ② and ③.*
⑤ *Plot the standard curve with sensitivity on Y-axis and gas concentration on X-axis in log-log scale.*

You can find the unknown gas concentration with the above standard curve.

■End of measurement

1）Turn off the power supply.
2）Remove the analogue output equipment from the module.
3）Store the module under clean atmosphere at normal temperature and humidity.

■Notes for operation

This module is designed to easily evaluate semiconductor gas sensors and NOT a precision measurement device. Please consider the following notes while using the module.

-1. Ambient temperature and humidity change may influence analogue output.

Semiconductor gas sensors are influenced by ambient temperature and humidity change. Water vapor is considered as a kind of gas. Therefore, use the module where temperature and humidity do not change rapidly. They also change day by day. This will also influence the sensor resistance. Use the module under the smallest change in temperature and humidity. Recommendable operating temperature is 0 to 40C.

-2. Wind effect may cause the module's sensitivity

The sensor has a heater warming the sensing material. If the wind directly hits the sensor, the operating temperature decreases, resulting in sensitivity drift.

To avoid the above, the module should be kept under no or slight wind condition. If the module is mounted in the middle of an air flow, re-design your enclosure to prevent direct air flow.

-3. High concentration gas may cause the module to be defective.

Gas sensor is stabilized with oxygen molecules adsorbed on the sensing element surface. In case the sensor is exposed in high concentration gas or is directly hit by gas, the surface will temporarily lack of oxygen. This may cause the module to be defective. Maximum allowable gas concentration is 5000ppm in general.

-4. Responding to more than one kind of gas

Gas selectivity is controlled by gas sensing materials and additives. However, the sensor is also sensitive to other gases than target gases. Then, the output from the module reflects the sum of different gas sensitivity if more than one gas is used.

-5. Non-odor gases

The gas sensors are sensitive to reducing gases including non-odor gases such as carbon monoxide, hydrogen, methane, etc. If your target gas is odor gas such as alcohol, confirm whether odorless gas coexists.

-6. Sensor may be poisoned by silicone compounds.

If the semiconductor gas sensor is used in the presence of silicone compounds, the silicone membrane forms on the sensing material surface, resulting in sensitivity deterioration. In the worst case, the sensor never returns to the original characteristics.

-7. Characteristics of gas sensor are stable with continuous power supply.

This module is stable in characteristics if used with a continuous power supply.

-8. Sensitivity may temporarily lower when the module is powered on after long time storage

Long time storage without power supply to the sensor may cause the sensitivity and sensor resistance to lower temporarily. This is because water vapor and miscellaneous gases are adsorbed on the sensing element surface. After power on, however, the sensitivity recovers with time and becomes completely stable in several hours. Pre-heat the sensor for at least one hour before measurement.

-9. Tends to be highly sensitive over long time operation.

The sensor tends to gradually become highly sensitive and lower sensor resistance to gas over long-time operation. This is a general limitation of semiconductor gas sensors.

-10. Avoid dew condensation

If dew condensation occurs many times on the sensing element, its materials is deformed, causing the sensor to be defective.

-11. Take a full evaluation if the module is used for mass production products.

This module is designed to evaluate the sensor. If your mass production product is equipped with this module, take a full evaluation of this module.