Gas Sensor for VOC Gas
（Model: MQ138）
Manual

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Zhengzhou Winsen Electronics Technology Co., Ltd
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Zhengzhou Winsen Electronics Technology CO., LTD
MQ138 VOC Gas Sensor

Profile
Sensitive material of MQ138 gas sensor is SnO₂, which with lower conductivity in clean air. When VOC gas exists, the sensor’s conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit. MQ138 gas sensor has high sensitivity to toluene, acetone, alcohol, methanol, also can monitor hydrogen and other organic vapour well. It can detect kinds of organic gases and is a kind of low-cost sensor for kinds of applications.

Features
It has good sensitivity to organic vapour gas in wide range, and has advantages such as long lifespan, low cost and simple drive circuit &etc.

Main Applications
It is widely used in domestic VOC gas alarm, industrial VOC gas leakage alarm and portable VOC gas detector.

Technical Parameters

<table>
<thead>
<tr>
<th>Model</th>
<th>MQ138</th>
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<tbody>
<tr>
<td>Sensor Type</td>
<td>Semiconductor</td>
</tr>
<tr>
<td>Standard Encapsulation</td>
<td>Bakelite, Metal cap</td>
</tr>
<tr>
<td>Target Gas</td>
<td>toluene, acetone, alcohol, hydrogen</td>
</tr>
<tr>
<td>Detection range</td>
<td>5~500ppm</td>
</tr>
<tr>
<td>Loop Voltage</td>
<td>Vc ≤24V DC</td>
</tr>
<tr>
<td>Heater Voltage</td>
<td>Vh 5.0V±0.1V AC or DC</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>RL Adjustable</td>
</tr>
<tr>
<td>Heater Resistance</td>
<td>RH 29Ω±3Ω (room tem.)</td>
</tr>
<tr>
<td>Heater consumption</td>
<td>PH ≤900mW</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>S Rs(in air)/Rs(in 50ppm toluene)≥2</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>△Vs 0.5V (in 50ppm toluene)</td>
</tr>
<tr>
<td>Concentration Slope</td>
<td>α ≤0.6{(R200ppm/R50ppm)toluene}</td>
</tr>
<tr>
<td>Tem. Humidity</td>
<td>20℃±2℃; 55%±5%RH</td>
</tr>
<tr>
<td>Standard test circuit</td>
<td>Vc:5.0V±0.1V; Vh:5.0V±0.1V</td>
</tr>
<tr>
<td>Preheat time</td>
<td>Over 48 hours</td>
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</table>

Fig1. Sensor Structure
Unit: mm

NOTE: The change of Output voltage(△Vs) is the difference value between VRL in test environment and
Basic Circuit

Fig2. MQ138 Test Circuit

Instructions: The above fig is the basic test circuit of MQ138. The sensor requires two voltage inputs: heater voltage \( V_H \) and circuit voltage \( V_C \). \( V_H \) is used to supply standard working temperature to the sensor and it can adopt DC or AC power, while \( V_{RL} \) is the voltage of load resistance \( R_L \) which is in series with sensor. \( V_C \) supplies the detect voltage to load resistance \( R_L \) and it should adopt DC power.

Description of Sensor Characters

Fig3. Typical Sensitivity Curve

The ordinate is resistance ratio of the sensor \( \frac{R_s}{R_0} \), the abscissa is concentration of gases. \( R_s \) means resistance in target gas with different concentration, \( R_0 \) means resistance of sensor in clean air. All tests are finished under standard test conditions.

Fig4. Typical temperature/humidity characteristics

The ordinate is resistance ratio of the sensor \( \frac{R_s}{R_{so}} \). \( R_s \) means resistance of sensor in 50ppm toluene under different tem. and humidity. \( R_{so} \) means resistance of the sensor in 50ppm toluene under 20°C/55%RH.
Cautions

1. Following conditions must be prohibited
   1.1 Exposed to organic silicon steam
       Sensing material will lose sensitivity and never recover if the sensor absorbs organic silicon steam. Sensors must avoid exposing to silicon bond, fixture, silicon latex, putty or plastic contain silicon environment.

   1.2 High Corrosive gas
       If the sensors are exposed to high concentration corrosive gas (such as H₂S, SO₂, Cl₂, HCl etc.), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation.

   1.3 Alkali, Alkali metals salt, halogen pollution
       The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as fluorine.

   1.4 Touch water
       Sensitivity of the sensors will be reduced when spattered or dipped in water.

   1.5 Freezing
       Do avoid icing on sensor’s surface, otherwise sensing material will be broken and lost sensitivity.

   1.6 Applied higher voltage
       Applied voltage on sensor should not be higher than stipulated value, even if the sensor is not physically damaged or broken, it causes down-line or heater damaged, and bring on sensors’ sensitivity characteristic changed badly.

   1.7 Voltage on wrong pins
       For 6 pins sensor, Pin 2&5 is heating electrodes, Pin (1,3)/(4,6) are testing electrodes (Pin 1 connects with Pin 3, while Pin 4 connects with Pin 6). If apply voltage on Pin 1&3 or 4&6, it will make lead broken; and no signal putout if apply on pins 2&4.

2. Following conditions must be avoided

Fig5. Sensitivity Curve
Fig5 shows the $V_{RL}$ in toluene with different concentration. The resistance load $R_l$ is 4.7 KΩ and the test is finished in standard test conditions.

Fig6. Responce and Resume
Fig5 shows the changing of $V_{RL}$ in the process of putting the sensor into target gas and removing it out.

Fig7. Lead sketch
2.1 Water Condensation
Indoor conditions, slight water condensation will influence sensors’ performance lightly. However, if water condensation on sensors surface and keep a certain period, sensors’ sensitive will be decreased.

2.2 Used in high gas concentration
No matter the sensor is electrified or not, if it is placed in high gas concentration for long time, sensors characteristic will be affected. If lighter gas sprays the sensor, it will cause extremely damage.

2.3 Long time storage
The sensors resistance will drift reversibly if it’s stored for long time without electrify, this drift is related with storage conditions. Sensors should be stored in airproof bag without volatile silicon compound. For the sensors with long time storage but no electrify, they need long galvanical aging time for stability before using. The suggested aging time as follow:

<table>
<thead>
<tr>
<th>Storage Time</th>
<th>Suggested aging time</th>
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<tbody>
<tr>
<td>Less than one month</td>
<td>No less than 48 hours</td>
</tr>
<tr>
<td>1 ~ 6 months</td>
<td>No less than 72 hours</td>
</tr>
<tr>
<td>More than six months</td>
<td>No less than 168 hours</td>
</tr>
</tbody>
</table>

2.4 Long time exposed to adverse environment
No matter the sensors electrified or not, if exposed to adverse environment for long time, such as high humidity, high temperature, or high pollution etc., it will influence the sensors’ performance badly.

2.5 Vibration
Continual vibration will result in sensors down-lead response then break. In transportation or assembling line, pneumatic screwdriver/ultrasonic welding machine can lead this vibration.

2.6 Concussion
If sensors meet strong concussion, it may lead its lead wire disconnected.

2.7 Usage Conditions
2.7.1 For sensor, handmade welding is optimal way. The welding conditions as follow:
- Soldering flux: Rosin soldering flux contains least chlorine
- homothermal soldering iron
- Temperature: 250℃
- Time: less than 3 seconds

2.7.1 If users choose wave-soldering, the following conditions should be obey:
- Soldering flux: Rosin soldering flux contains least chlorine
- Speed: 1-2 Meter/ Minute
- Warm-up temperature: 100±20℃
- Welding temperature: 250±10℃
- One time pass wave crest welding machine

If disobey the above using terms, sensors sensitivity will reduce.