CYSJ902 GaAs HALL-EFFECT ELEMENTS

CYSJ902 series Hall-effect element is a ion-implanted magnetic field sensor made of mono-crystal gallium arsenide (GaAs) semiconductor material group III-V using ion-implanted technology. It can convert a magnetic flux density signal linearly into voltage output.

FEATURES
- High Linearity
- Superior Temperature Stability
- Miniature Package
- Replacements of THS119, KSY14 and KSY44 etc.

TYPICAL APPLICATION
- Magnetic Field Measurement
- DC Brushless Motor
- Current Sensor
- Non-contact Switch
- Position Control
- Detection of Revolution

ABSOLUTE MAXIMUM RATING (Table 1.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Input Current (Voltage)</td>
<td>l_c (V_c)</td>
<td>13 (12) mA (V)</td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>T_A</td>
<td>CYSJ902</td>
<td>CYSJ902H</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-40~125</td>
<td>-55~150 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>T_S</td>
<td>-45~150</td>
<td>-55~150 °C</td>
</tr>
<tr>
<td>MTBF (Mean Time Between Failures)</td>
<td></td>
<td>&gt;100k</td>
<td>hour</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS (T_A=25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hall output voltage</td>
<td>V_H</td>
<td>B=50mT, l_c=5mA</td>
<td>36~54</td>
<td>mV</td>
</tr>
<tr>
<td>Offset voltage</td>
<td>Vos(V_u)</td>
<td>l_c=5mA, B=0</td>
<td>±5</td>
<td>mV</td>
</tr>
<tr>
<td>Input resistance</td>
<td>R_in</td>
<td>B=0mT, l_c=0.1mA</td>
<td>650~850</td>
<td>Ω</td>
</tr>
<tr>
<td>Output resistance</td>
<td>R_out</td>
<td>B=0mT, l_c=0.1mA</td>
<td>650~850</td>
<td>Ω</td>
</tr>
<tr>
<td>Temperature coefficient of Hall output voltage</td>
<td>αV_H</td>
<td>l_c=5mA, B=50mT (T_a=25°C ~ 125°C)</td>
<td>-0.06</td>
<td>%/°C</td>
</tr>
<tr>
<td>Temperature coefficient of input resistance</td>
<td>αR_in</td>
<td>l_c=0.1mA, B=0mT (T_a=25°C ~ 125°C)</td>
<td>0.3</td>
<td>%/°C</td>
</tr>
<tr>
<td>Linearity</td>
<td>ΔK_V</td>
<td>l_c=5mA, B=0.1~0.4T</td>
<td>±1.0</td>
<td>%</td>
</tr>
</tbody>
</table>

Notes:

\[ V_H = V_{HM} - V_{os}(V_u) \] (V_{HM}: measured voltage)

\[ \alpha V_H = \frac{1}{V_H(T_1)} x \frac{V_H(T_2) - V_H(T_1)}{T_2 - T_1} \times 100, \]

\[ \Delta K_H = \frac{K(B_1) - K(B_2)}{[K(B_1) + K(B_2)]} \times 200 \]

\[ T_1=25°C, T_2=125°C, \quad B_1=0.4T, B_2=0.1T \]

\[ K_H = \frac{V_H}{I_C B} \]
Package Outline Drawing (Unit: mm)

Characteristic Curves

**Figure 1.** Maximum Input Current $I_{\text{max}}$
Figure 2. Input resistance $R_{in}$ as a function of ambient temperature $T_a$.

Figure 3. Hall voltage $V_H$ as a function of magnetic flux density $B$. 
Figure 4. Hall voltage $V_H$ as a function of magnetic flux density $B$ (0 -1800mT).

Table 3. Linearity of CYSJ902 in different ranges

<table>
<thead>
<tr>
<th>Measuring range</th>
<th>0-500mT</th>
<th>0-1000mT</th>
<th>0-1500mT</th>
<th>0-1800mT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under supplying 5mA</td>
<td>-0.18% ~ 0.08%</td>
<td>-0.25% ~ 0.40%</td>
<td>-0.60% ~ 1.10%</td>
<td>-0.85% ~ 1.5%</td>
</tr>
<tr>
<td>Under supplying 6V</td>
<td>-0.25% ~ 0.45%</td>
<td>-1.15% ~ 0.70%</td>
<td>-2.20% ~ 1.15%</td>
<td>-2.65% ~ 1.50%</td>
</tr>
</tbody>
</table>
Figure 4. Hall voltage $V_H$ as a function of ambient temperature $T_a$.

Figure 5. Hall voltage $V_H$ as a function of electrical stimuli $I_c/V_c$. 

Connection

Circuit 1

Circuit 2

Application Notes

The Hall voltage $V_H$ can be positive and negative. But if one connects the sensor as follows (circuit 1):

- Pin 1: positive input voltage $V_+$, for instance +5VDC.
- Pin 3: GND
- Pin 2: OUTPUT
- Pin 4: GND

One can only measure the positive voltage at the pin 2. This means that the output voltage at zero magnetic field is not zero. This voltage is called as offset voltage. The output voltage in this case is not equal to the Hall voltage. The output voltage is equal to the sum of offset voltage and Hall voltage.

The offset voltage will be zero if you connect double power supplies $V_+$ and $V_-$ to the sensor (circuit 2):

- Pin 1: positive input voltage $V_+$, for instance +5VDC.
- Pin 3: negative input voltage $V_-$, for instance -5VDC
- Pin 2: OUTPUT
- Pin 4: GND

In this case the output voltage is equal to the Hall Voltage.
Reliability Test Terms

Table 4. Reliability Test Terms, Conditions and Durations.

<table>
<thead>
<tr>
<th>Item</th>
<th>Terms</th>
<th>Conditions</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Temperature Storage (HTS)</td>
<td>[JEITA EIAJ ED-4701]  Ta=150(0~10)°C</td>
<td>1000h</td>
</tr>
<tr>
<td>2</td>
<td>Heat Cycle (HC)</td>
<td>[JEITA EIAJ ED-4701]  Ta=55°C~150°C  high temp. - normal temp. - low temp. 30 min - 5 min - 30 min</td>
<td>50cycles</td>
</tr>
<tr>
<td>3</td>
<td>Temp. Humidity Storage (THS)</td>
<td>[JEITA EIAJ ED-4701]  Ta =85 ± 3°C, RH =85 ± 5%</td>
<td>1000h</td>
</tr>
<tr>
<td>4</td>
<td>Resist. to Hand Soldering Heat (RHSH)</td>
<td>[JEITA EIAJ ED-4701] Dipped in the 300 ±5°C solder up to the 1 mm part from the body</td>
<td>5 sec</td>
</tr>
<tr>
<td>5</td>
<td>High Temp. Operating (HTO)</td>
<td>Ta =125°C, Vc =7.5V</td>
<td>1000h</td>
</tr>
</tbody>
</table>

Criteria:
- Variation of Hall Voltage $V_H$ and input/output resistances $R_{in}/R_{out}$ are less than 20%.
- Variation of offset voltage $V_{os}$ is less than 1mV.
- Other parameters in Table 2 are still within their ranges stated in Table 2.

Soldering Conditions
The following conditions should be preserved. Solder ability should be checked by yourself, because it is depend on solder paste material and other parameters.

Material of solder flux
Use the resin based flux and refrain from using organic or inorganic acid based and water-soluble one.

Cleansing of solder flux conditions
- Use Ethanol or Isopropyl alcohol as cleansing material.
- Process temperature should be 50°C or less.
- Duration should be 5 min or less.

Hand soldering conditions
- Apart from the mold resin more than 1mm.
- Solder at temperature 300°C for less than 5s.

Wave soldering conditions
- Temperature in Pre-heating zone should be lower than 150°C.
- Temperature in Soldering zone should be lower than 280°C.

Precautions for ESD
This product is the device that is sensitive to ESD (Electrostatic Discharge). Handling Hall Elements with the ESD-Caution mark under the environment in which
- Static electrical charge is unlikely to arise. (Ex: Relative Humidity; over 40%RH).
- Wearing the antistatic suit and wristband when handling the devices.
- Implementing measures against ESD as for containers that directly touch the devices.

**Precautions for Storage**

- Products should be stored at an appropriate temperature and humidity (5 to 35°C, 40 to 60% RH) after the unsealing of MBB. Using self-sealer is highly recommended for keeping products away from chlorine and corrosive gas.
- Long-term storage
  Products are sealed in MBB with a desiccant and a moisture indicator. The moisture indicator should be checked right after the unsealing of MBB. If the moisture indicator reveals the internal moisture is above 50%HR, please contact the local distributor.
- For storage longer than 2 years, it is recommended to store in nitrogen atmosphere with MBB sealed. Oxygen and H2O of atmosphere oxidizes leads of products and lead solder ability get worse.

**Precautions for Safety**

- Do not alter the form of this product into a gas, powder or liquid through burning, crushing or chemical processing.
- Observe laws and company regulations when discarding this product.

**Order Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Operating Temperature</th>
<th>Package</th>
<th>MOQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYSJ902</td>
<td>-40°C ~ 125°C</td>
<td>SIP/2.75x2.8x0.9mm</td>
<td>500ea or 1000ea</td>
</tr>
<tr>
<td>CYSJ902H</td>
<td>-55°C ~ 150°C</td>
<td>SIP/2.75x2.8x0.9mm</td>
<td>500ea or 1000ea</td>
</tr>
</tbody>
</table>