Ultrasonic Sensor Module for a Robot

(HG-M40 Series, HG-L40 Series)
### Ultrasonic Sensor Module for a Robot

#### Model: HG-M40 Series, HG-L40 Series

#### Features
- Object Detector and Range Finder
- Medium Range
- Various Directivities
- Low ‘Click Noise’
- Indoor Environment
- Minimum Dead Zone
- Real-Time Signal (5V TTL)
- Operates at 40kHz
- 3 types of Modules
  - Transceiver (HG-M40D)
  - Transmitter (HG-M40T)
  - Receiver (HG-M40R)

#### Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (KHz)</td>
<td>40±2</td>
</tr>
<tr>
<td>Input Pulse</td>
<td>TTL or Pulse (2 V ~ 10 V)</td>
</tr>
<tr>
<td>Repetition Rate of Input Pulse</td>
<td>10 Hz ~ 30 Hz</td>
</tr>
<tr>
<td>Input DC Power (Vdc)</td>
<td>10 V ~ 16 V</td>
</tr>
<tr>
<td>Driving Voltage for Sensor</td>
<td>60~70 Vpp at 12V Vdc</td>
</tr>
<tr>
<td>Output Signal</td>
<td>5 V TTL</td>
</tr>
<tr>
<td>Available for a transmitter only, a receiver only or a dual type (both a transmitter and a receiver)</td>
<td></td>
</tr>
</tbody>
</table>
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Terminals & Parts Description

1. **Pulse input terminal**: The input voltage level of a pulse should be ranging from +2V to 10 V.
   - The ultrasonic transmission part is driven at its rising edge whenever an input pulse is applied.
   - The recommended period of input pulses ranges from 10 Hz to 50 Hz. (Available from 0 to Max. 200 Hz)
   - Available for several pulse shapes such as TTL signals, impulses, square waves, sinusoidal waves or triangular waves.

2. **DC input power terminal**: The recommended voltage ranges from +DC 10 V to 16 V.

3. **Signal output terminal**: The square pulse is obtained in a receiver part and its level is 5 V.
   - The time delay of the received signals is proportional to the distance between a sensor and an obstacle.
   - The pulse width tends to be proportional to the size of an obstacle.
   - The other output levels can be given by an order production. E.g.) 3.5V, 10V, etc.

4. **GND terminal**: Electrical ground level for signals and a power.

5. **Frequency fine adjustment part**: The frequency of driving signals can be finely adjusted in the range from 38 kHz to 42 kHz. (Recommendation: please do not fix it because it has been optimized when the module was delivered out of a factory.)

6. **Receiver gain control part**: Sensitivity (Gain) is controlled by fixing a trimmer. The gain of analog amplifier ranges from 33 dB ~ 59 dB.

   *Please note that on over-amplification of the receiver gain, interference noise signals might be shown by ultrasonic waves passing over directly from a transmitter to a receiver.*

7. **Analog signal test point**: At the point, analogue signals (full waveforms) can be observed.

8. **Working Indicator**: A red LED lights when a transmitter is driven or a receiver perceives a signal.
# Ultrasonic Sensor Module for a Robot

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## Product Line-Up

<table>
<thead>
<tr>
<th>Type</th>
<th>Mode</th>
<th>Module</th>
<th>Model Name</th>
<th>Directivity (°)</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional (C)</td>
<td>Trigger Input</td>
<td>Duplex Transmitter Receiver</td>
<td>HG-M40DC</td>
<td>65</td>
<td>0.4 ~ 4.5m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-M40TC</td>
<td></td>
<td>0 ~ 6m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-M40RC</td>
<td></td>
<td>0 ~ 6m</td>
</tr>
<tr>
<td></td>
<td>Burst Input</td>
<td>Duplex Transmitter Receiver</td>
<td>HG-L40DC</td>
<td></td>
<td>0.4 ~ 6m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-L40TC</td>
<td></td>
<td>0 ~ 6m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-L40RC</td>
<td></td>
<td>0 ~ 6m</td>
</tr>
<tr>
<td>Anisotropic (A)</td>
<td>Trigger Input</td>
<td>Transmitter Receiver</td>
<td>HG-M40TA</td>
<td>H : 160</td>
<td>0 ~ 3.5m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-M40RA</td>
<td>V : 65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burst Input</td>
<td>Transmitter Receiver</td>
<td>HG-L40TA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-L40RA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broad (B)</td>
<td>Trigger Input</td>
<td>Transmitter Receiver</td>
<td>HG-M40TB</td>
<td>150</td>
<td>0 ~ 2m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-M40RB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burst Input</td>
<td>Transmitter Receiver</td>
<td>HG-L40TB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-L40RB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrow Type1 (N1)</td>
<td>Trigger Input</td>
<td>Duplex</td>
<td>HG-M40DN1</td>
<td>12</td>
<td>0.4 ~ 9m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-L40DN1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrow Type2 (N2)</td>
<td>Trigger Input</td>
<td>Duplex</td>
<td>HG-M40DN2</td>
<td>25</td>
<td>0.4 ~ 7m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HG-M40DN2</td>
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</tbody>
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Ultrasonic Sensor Module for a Robot

Model: HG-M40 Series, HG-L40 Series

Module and Mode Description

1. Module
   ① Transceiver (D):
      • Not only it works as Transceiver module but also it can be used as
        transmitter or receiver with different wire connection. Transceiver can detect
        from 30cm~40cm and farther since it has to transmit the ultrasonic waves
        and wait until it returns. However, it is possible to perceive whether objects
        are there or not.
   ② Transmitter (T): Only transmits the ultrasonic waves.
   ③ Receiver (R): Only receives the ultrasonic waves.
      ※ 1~2cm of close detection is available when 2 or more sets of transmitters
         and receivers are used.
      ※ In the same way, even in the case of Transceiver, when it is used as either
         Transmitter or Receiver independently, it can measure an obstacle as nearest
         as 1~2Cm.

2. Mode
   ① Trigger Input Mode (M-type)
   ② Burst Input Mode (L-type)

3. Difference between M-type and L-type.

<table>
<thead>
<tr>
<th>Trigger Input Mode</th>
<th>Burst Input Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Built in 40kHz oscillator</td>
<td>- Simple structure with only amplifier and output circuitry (No oscillator).</td>
</tr>
<tr>
<td>- Always ‘Standby’</td>
<td>- External 40 kHz burst signal must be given to operate. (external oscillator or software is needed to make signal)</td>
</tr>
<tr>
<td>- Wave occurs one by one with external trigger pulse.</td>
<td>- Changeable pulse frequency, duration time and radio frequency at user’s convenience.</td>
</tr>
<tr>
<td>- Pulse frequency is adjustable but trigger burst and duration time (approx. 1mS) are fixed.</td>
<td>- Multi channel available with CPU circuit or S/W.</td>
</tr>
<tr>
<td>- Strong ultrasonic wave with low click noise.</td>
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</tr>
</tbody>
</table>
Ultrasonic Sensor Module for a Robot

- Model: HG-M40 Series, HG-L40 Series

- Timing Chart

1. Trigger Pulse input waveform
2. Transmit power output to sensor unit
3. Amplified signal in receiver circuit (at TP1)
4. Final output waveform in receiver circuit
5. Object detected signal excluding the internal crosstalk
Ultrasonic Sensor Module for a Robot

- Model: HG-M40 Series, HG-L40 Series

- Timing Chart of Range Finder

① Trigger Pulse (The pulse width must be adjustable)  
   (1.5ms ~ 2.5ms)

② Inverted Waveform of ①

③ Receiver Output Signal

④ Actual Receive Signal (After excluding the internal crosstalk)

⑤ Distance Pulse Output  
   (The pulse width is proportional to the distance)
Ultrasonic Sensor Module for a Robot

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- Each product-oriented graph
  - Conventional(C)
  - Anisotropic(A)
Ultrasonic Sensor Module for a Robot

Model: HG-M40 Series, HG-L40 Series

Each product-oriented graph

- Broad (B)
- Narrow Type1 (N1)
- Narrow Type2 (N2)
Ultrasonic Sensor Module for a Robot

- **Model**: HG-M40 Series, HG-L40 Series

- **Ultrasonic Distance Measuring Principle**

  - **Principle**
    - Ultrasonic wave, which was sent from ‘Transmitter’, is reflected by an obstacle.
    - Two receivers gets the reflected wave each and measures distance and time of flight proportion to each paths \((P1+P2, P1+P3)\)
    - The obstacle’s coordinate can be determined by calculating intersection points of two ovals which is correspond to length of two paths.
Ultrasonic Sensor Module for a Robot

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- **Application**

```
                      Near
                     +12V
                  (R)
                     +12V
                  (T)
                      +12V
                  (R)
                       
          OBJECT
```

Direction and distance finder for mobile robot

```
Trigger
Generator

① +12V
T/R

②
③
④

OBJECT

⑤ OUTPUT
```

Range finder with only one module