Introduction

Bourns® Type 6000 Non-Contacting Multiturn Angle Sensor is based on two magneto-resistive (AMR) sensor chips. Each sensor chip converts an angle position of a permanent magnet into two analog signals (one sine and one cosine signal). A highly efficient algorithm enables estimating the absolute angular position of a drive shaft that is connected to the device.

Specifications

Angular Position
- Range: -780 ° to +780 °
- Resolution: 0.1 °
- Absolute Linearity: ±1.4 °

Angular Speed
- Range: -1016 to +1016 °/s
- Resolution: *4 °/s

Data and Control Interface
- CAN 2.0A (Optional CAN 2.0B) See CAN Protocol
- Baud Rate: 500 kbit/s
- Data Rate: 10 ms
- Measure Data Delay: < 10 ms

Adjusting a Zero Position: via CAN bus
- Calibration Control: via CAN bus
- “On Board” Software Update: See CAN Protocol
- Power Supply Voltage: +8 V to +16 V
- Supply Current: 50 mA
- Ambient Temperature: -40 °C to +85 °C

* The sensor measures positive and negative speed, but only the absolute value is output in the CAN message

CAN Protocol

The device sends a CAN message with the measurement data every 10 msec. The layout of the transmitted message is shown below.

CAN Transmit Message

<table>
<thead>
<tr>
<th>CAN-ID Kind of Message</th>
<th>Byte</th>
<th>Bits</th>
<th>Signal Destination</th>
<th>Unit</th>
<th>Measure Range</th>
<th>Measure Range (Digit)</th>
<th>Offset</th>
<th>Resolution (Unit/Digit)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 x 280 transmit</td>
<td>0-1</td>
<td>16-23</td>
<td>Absolute angle position</td>
<td>Degree</td>
<td>-780...+780</td>
<td>57735...7800</td>
<td>0</td>
<td>0,1</td>
<td>Fault/not calibrated/ default: 0x7FFF</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>24-27</td>
<td>Angle speed</td>
<td>Degree/s</td>
<td>0...+1016</td>
<td>0...254</td>
<td>0</td>
<td>4</td>
<td>Fault default: 0xFF</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>28-31</td>
<td>Free</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>Internal use only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>32-35</td>
<td>Message counter</td>
<td>0...15</td>
<td>0...15</td>
<td>1</td>
<td>Should be incremented by each message</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>36-39</td>
<td>Check sum</td>
<td>0...15</td>
<td>0...15</td>
<td>1</td>
<td>Check sum: see below</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Absolute Angle Position:
- Signed (integer)
- Angle position [degree] = N · 0.1, for 0 < N ≤ 32767 (N - digital value of the message) = (N-65536) · 0.1, for N > 32767

Angle Speed:
- Unsigned (char)
- Rotation speed [degree/s] = S · 4, for 0 < S ≤ 254 (S - digital value of the message) = 0xFF, for S > 254

Specifications are subject to change without notice. The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time. Users should verify actual device performance in their specific applications.

Features
- True power-on system
- Right angled or straight line connector
- Output over CAN bus
- Various column mounting proposals
Non-Contacting Multiturn Angle Sensor Type 6000

CAN Protocol (Continued)

Rule to build the check sum:
- Temp_result = lower byte (Angle position) XOR higher byte
- (Angle position) XOR (Angle speed) XOR
- (Internal status)
- Check sum = higher nibble (Temp_result) XOR lower nibble (Temp_result) XOR (Message counter)

The device is also able to receive messages. They are shown below.

### CAN Receive Message

<table>
<thead>
<tr>
<th>CAN-ID Kind of Message</th>
<th>Byte</th>
<th>Bits</th>
<th>Signal Destination</th>
<th>Unit</th>
<th>Measure Range</th>
<th>Measure Range (Digit)</th>
<th>Offset</th>
<th>Resolution (Unit/Digit)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x7C0 receive</td>
<td>0</td>
<td>0-3</td>
<td>Command word</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>4-7</td>
<td>SAS transmit identifier (SAS ID) bits 0-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>8-14</td>
<td>SAS transmit identifier (SAS ID) bits 4-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>15</td>
<td>Free</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Command Word (CW)**

<table>
<thead>
<tr>
<th>CW bit3</th>
<th>CW bit2</th>
<th>CW bit1</th>
<th>CW bit0</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Set up the zero position</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Clear the old zero position</td>
</tr>
</tbody>
</table>

**Note:**
To set up a new zero position, first it is necessary to delete the old zero position.

**Automatic Self-Test**

The device checks the angular speed value, which is limited to 1016 degrees per second. If this limit exceeded, the device sends an error message according to the CAN Transmit Message (page 1).

**Design and Mechanical Interface**

**Housing - Device View**

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Typical Test Results @ R.T.

The first graph shows a typical linearity measurement curve taken at room temperature. The second graph shows the deviation (absolute non-linearity) over four turns of the steering wheel.

Output Code and Absolute Linearity

Definition of Output Signal According to Rotation of Steering Wheel

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