MH-Series MH Threaded CANbus
Magnetostrictive Linear Position Sensors

- Stroke length up to 2500 mm
- Available with M18×1.5 and ¾"-16 mounting thread
- Sensor rod with Ø 7 mm or Ø 10 mm
- Rugged to withstand off-highway shock & vibration
- M12 connector or cable output
MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Temposonics rely on the company’s proprietary magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

MH THREADED SENSOR

The Temposonics® MH-Series sensors are specifically designed for direct stroke measurement in hydraulic cylinders. The MH Threaded sensor extends the rugged design of the Temposonics® MH Series sensors to external threaded installations. A M12 connector system ensures protection to IP69K. The inherent absolute capabilities ensure that the MH Threaded sensor is always ready. With two connections styles, the responsive magnetostrictive linear position sensors can be integrated into most installations. Temposonics® MH Threaded sensors can be used in applications where access is available from the outside of the cylinder. Example applications include lift and tilt cylinders, hydraulic jacks, and hydraulic steering systems in agricultural and construction machinery.

Fig. 1: Time-of-flight based magnetostrictive position sensing principle

Fig. 2: Typical applications
**TECHNICAL DATA**

### Input

**Signal characteristic**  
Bus-protocol: SAE J1939, CANopen protocol according CiA DS-301 V4.1, device profile DS-406 V3.1

**Measured value**  
Position & velocity

### Output

<table>
<thead>
<tr>
<th>Resolution (position)</th>
<th>0.1 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution (velocity)</td>
<td>1 mm/s</td>
</tr>
<tr>
<td>Boot up time</td>
<td>Typ. 400 ms</td>
</tr>
<tr>
<td>Cycle time</td>
<td>Output</td>
</tr>
<tr>
<td></td>
<td>Cycle time</td>
</tr>
<tr>
<td>Linearity</td>
<td>Stroke length</td>
</tr>
<tr>
<td></td>
<td>Linearity</td>
</tr>
<tr>
<td>Internal sample rate</td>
<td>1 ms</td>
</tr>
<tr>
<td>Setpoint tolerance</td>
<td>±0.2 mm</td>
</tr>
</tbody>
</table>

### Operating conditions

**Operating temperature electronics**  
−40…+105 °C

**Storage temperature**  
−25…+65 °C

**Fluid temperature**  
−40…+85 °C

**Humidity**  
90 % relative humidity, no condensation, EN60068-2-30

**Ingress protection – M12 connector**  
IP67/IP69K (connectors correctly fitted), EN60529

**Ingress protection – Sensor housing**  
IP67/IP69K, EN60529

**Shock**  
100 g (11 ms) single shock, 50 g (11 ms) at 1000 shocks per axis, IEC 60068-2-27

**Vibration test (IEC 60068-2-64)**  
Ø 7 mm sensor rod  
15 g (r.m.s.) (10…2000 Hz)  
Ø 10 mm sensor rod  
20 g (r.m.s.) (10…2000 Hz)

**EMC**  
2009/64/EG Road vehicles
2009/19/EG Agricultural and Forest machines
ISO 14982 Emissions/Immunity
ISO 7637-1/2 Transient Impulses
ISO / TR 10605 Electrostatic Discharge (E.S.D.)

**Pressure (according to DIN EN ISO 19879)**  
Ø 7 mm sensor rod  
300 bar  
400 bar  
525 bar

**P MAX (max. overload)**  
400 bar  
550 bar

**P STATIC (proof pressure)**  
525 bar  
550 bar

**Design/Material**

- Sensor electronics housing: Stainless steel 1.4305 (AISI 303)
- Sensor rod – Ø 7 mm: Stainless steel 1.4301 (AISI 304)
- Sensor rod – Ø 10 mm: Stainless steel 1.4306 (AISI 304L)
- Stroke length: 50…2500 mm
- Mounting position: Any
- Mounting instruction: Please consult the technical drawings

* / According to calculations under use of the FKM guideline

### Cycles

<table>
<thead>
<tr>
<th>Dynamic pressure: &lt; 2 x 10⁶ pressure cycles</th>
<th>Ø 7 mm sensor rod</th>
<th>Ø 10 mm sensor rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN (nominal operating)</td>
<td>300 bar</td>
<td>320 bar</td>
</tr>
<tr>
<td>PMAX (max. overload)</td>
<td>400 bar</td>
<td>400 bar</td>
</tr>
<tr>
<td>P STATIC (proof pressure)</td>
<td>525 bar</td>
<td>550 bar</td>
</tr>
<tr>
<td>Proof pressure: Maximum 5 minutes testing time for cylinder pressure test</td>
<td>525 bar</td>
<td>550 bar</td>
</tr>
</tbody>
</table>
## Electrical connection

<table>
<thead>
<tr>
<th>Connection type</th>
<th>M12 connector or cable output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Voltage</td>
<td>12 VDC (8…32 VDC)</td>
</tr>
<tr>
<td></td>
<td>24 VDC (8…32 VDC)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Typ. &lt; 100 mA</td>
</tr>
<tr>
<td></td>
<td>Typ. &lt; 50 mA</td>
</tr>
<tr>
<td>Inrush current</td>
<td>Max. 1.0 A/2 ms</td>
</tr>
<tr>
<td></td>
<td>Max. 1.5 A/2 ms</td>
</tr>
<tr>
<td>Voltage supply ripple</td>
<td>&lt; 1 %</td>
</tr>
<tr>
<td></td>
<td>&lt; 1.5 W</td>
</tr>
<tr>
<td>Power drain</td>
<td></td>
</tr>
<tr>
<td>Over voltage protection</td>
<td>Up to +36 VDC</td>
</tr>
<tr>
<td>Polarity protection</td>
<td>Up to -36 VDC</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>R ≥ 10 MO @ 60 sec.</td>
</tr>
<tr>
<td>Electric strength</td>
<td>500 VDC (DC ground to machine ground)</td>
</tr>
</tbody>
</table>

## TECHNICAL DRAWING

### MH-G with M12 connector: Rod: Ø 10 mm + end plug with male M8 thread / Dead zone: 55.5 mm

![Technical Drawing 1](image1)

### MH-G with cable outlet: Rod: Ø 10 mm + end plug with male M8 thread / Dead zone: 55.5 mm

![Technical Drawing 2](image2)

Controlling design dimensions are in millimeters

Fig. 3: Temposonics' MH-Series MH Threaded (MH-G)
MH-H with M12 connector: Rod: Ø 7 mm / Dead zone: 63.5 mm

MH-H with cable outlet: Rod: Ø 7 mm / Dead zone: 63.5 mm

Controlling design dimensions are in millimeters

Fig. 4: Temposonics® MH-Series MH Threaded (MH-H)
MH-K with M12 connector: Rod: Ø 10 mm + end plug with female M6 thread / Dead zone: 52.5 mm

MH-K with threaded flange M18×1.5: Rod: Ø 10 mm + end plug with female M6 thread / Dead zone: 52.5 mm

Controlling design dimensions are in millimeters

Fig. 5: Tempsonics® MH-Series MH Threaded (MH-K)
MH-N with M12 connector: Rod: Ø 10 mm / Dead zone: 63.5 mm

MH-N with threaded flange M18×1.5: Rod: Ø 10 mm / Dead zone: 63.5 mm

Controlling design dimensions are in millimeters

Fig. 6: Temposonics® MH-Series MH Threaded (MH-N)
MH-P with M12 connector: Rod: Ø 7 mm / Dead zone: 45.5 mm

MH-P with cable outlet: Rod: Ø 7 mm / Dead zone: 45.5 mm

Controlling design dimensions are in millimeters

Fig. 7: Temposonics’ MH-Series MH Threaded (MH-P)
MH-T with M12 connector: Rod: Ø 10 mm / Dead zone: 45.5 mm

MH-T with cable output: Rod: Ø 10 mm / Dead zone: 45.5 mm

Controlling design dimensions are in millimeters

Fig. 8: Temposonics® MH-Series MH Threaded (MH-T)
MH-W with M12 connector: Rod: Ø 10 mm / Dead zone: 63.5 mm

MH-W with cable outlet: Rod: Ø 10 mm / Dead zone: 63.5 mm

Controlling design dimensions are in millimeters

Fig. 9: Temposonics® MH-Series MH Threaded (MH-W)
CONNECTOR WIRING

M12 connector (M00F)

- Attached A-coded M12 connector attached
- Toolless assembly
- Sealing IP67, up to IP69K on plugged mating connector

Controlling design dimensions are in millimeters

<table>
<thead>
<tr>
<th>Connector wiring</th>
<th>M00F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Function</td>
</tr>
<tr>
<td>1</td>
<td>do not connect</td>
</tr>
<tr>
<td>2</td>
<td>VDC</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>CAN_H</td>
</tr>
<tr>
<td>5</td>
<td>CAN_L</td>
</tr>
</tbody>
</table>

Pigtail cable (C...A)

- PUR cable
- Ø 5 mm, non-shielded, 3 × 0.5 mm²
- Flexible, oil resistance

<table>
<thead>
<tr>
<th>Connector wiring</th>
<th>C...A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Function</td>
</tr>
<tr>
<td>BN</td>
<td>VDC</td>
</tr>
<tr>
<td>WH</td>
<td>GND</td>
</tr>
<tr>
<td>GN</td>
<td>CAN_L</td>
</tr>
<tr>
<td>YE</td>
<td>CAN_H</td>
</tr>
</tbody>
</table>

Connection schematics

To ensure proper operation of the sensor, the hydraulic cylinder must be connected to the machine ground. Grounding is often ensured by the mechanical contact between the cylinder and other machine elements. If the cylinder is connected with the machine separately, separate grounding, for example via a grounding strap directly on the cylinder must be ensured.

Controlling design dimensions are in millimeters
**FREQUENTLY ORDERED ACCESSORIES**

<table>
<thead>
<tr>
<th>Position magnets</th>
<th>Float</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Position magnets" /></td>
<td><img src="image2.png" alt="Float" /></td>
</tr>
<tr>
<td><strong>Ring magnet OD17.4</strong>&lt;br&gt;Part no. 401 032</td>
<td><strong>Ring magnet OD25.4</strong>&lt;br&gt;Part no. 400 533</td>
</tr>
<tr>
<td>Material: PA neobond&lt;br&gt;Weight: Approx. 5 g&lt;br&gt;Surface pressure: Max. 20 N/mm²&lt;br&gt;Operating temperature: −40...+105 °C (−40...+221 °F)</td>
<td>Material: PA ferrite&lt;br&gt;Weight: Approx. 10 g&lt;br&gt;Surface pressure: Max. 40 N/mm²&lt;br&gt;Operating temperature: −40...+105 °C (−40...+221 °F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Floats</th>
<th>Float kits</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Float" /></td>
<td><img src="image4.png" alt="Float kit" /></td>
</tr>
<tr>
<td><strong>Float</strong>&lt;br&gt;Part no. 254 886</td>
<td><strong>Float kit for Ø 7 mm</strong>&lt;br&gt;Part no. 201 971</td>
</tr>
<tr>
<td>Material: PP, Moplen5, red&lt;br&gt;Specific gravity: Max. 0.53 g/cm³&lt;br&gt;Pressure: Max. 4 bar&lt;br&gt;Weight: Ca. 23 g&lt;br&gt;Operating temperature: −20...+80 °C</td>
<td>Kit includes:&lt;br&gt;- Mounting flange (5 bolt) for sensors with M18×1.5 thread (part no. 404 205)&lt;br&gt;- Stop collar for Ø 7 mm (part no. 562 077)&lt;br&gt;- Float (part no. 201 611)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flange</th>
<th>Collar</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Flange" /></td>
<td><img src="image6.png" alt="Collar" /></td>
</tr>
<tr>
<td><strong>Mounting flange (5 bolt) for sensors with M18×1.5 thread</strong>&lt;br&gt;Part no. 404 205</td>
<td><strong>Stop collar for Ø 10 mm</strong>&lt;br&gt;Part no. 560 777</td>
</tr>
<tr>
<td>Material: Stainless Steel 1.4305 (AISI 303)</td>
<td>Provides end of stroke stops for float&lt;br&gt;Material: Stainless steel 1.4305 (AISI 303)&lt;br&gt;Weight: Approx. 30 g&lt;br&gt;Hex key 3/4&quot; required</td>
</tr>
</tbody>
</table>

| Stop collar for Ø 7 mm<br>Part no. 562 077 | Provides end of stroke stops for float<br>Material: Stainless steel 1.4305 (AISI 303)<br>Weight: Approx. 30 g<br>Hex key 2.5 mm required |

*Controlling design dimensions are in millimeters*
Test kits

**Testkit CANbus for US**
Part no. 253 879

Kit includes:
- 1 x USB CAN-Modul
- 1 x USB CAN-Modul Utility CD (driver & manual)
- 1 x USB cable
  - cable with M12 connector and RS232 connector
- 1 x cable with RS232 connector
- 1 x carrying case
- 1 x 12 VDC power supply

**Testkit CANbus for EU**
Part no. 254 267

Kit includes:
- 1 x USB CAN-Modul
- 1 x USB CAN-Modul Utility CD (driver & manual)
- 1 x USB cable
  - cable with M12 connector and RS232 connector
- 1 x cable with RS232 connector
- 1 x carrying case
- 1 x 12 VDC power supply

Cables

**Cable with M12 A-coded female connector (5 pin), straight – pigtail**
Part no. 370 673

Material: PUR jacket; black
Features: Shielded
Cable length: 5 m (16.4 ft)
Ingress protection: IP67 (correctly fitted)
Operating temperature:
-25...+80 °C (-13...+176 °F)

**Cable with M12 A-coded female connector (5 pin), angled – pigtail**
Part no. 370 675

Material: PUR jacket
Features: Shielded
Cable length: 5 m (16.4 ft)
Ingress protection: IP67 (correctly fitted)
Operating temperature:
-25...+80 °C (-13...+176 °F)
**INSTALLATION**

**Hydraulics sealing**
For sealing the flange contact surface, a sealing via an O-ring in the undercut is necessary. A screw hole based on ISO 6149-1 (metric) or SAE J1926-1 (imperial) must be provided.

---

**Threaded port**

<table>
<thead>
<tr>
<th>Thread</th>
<th>(d_1\times P)</th>
<th>(d_2)</th>
<th>(d_3)</th>
<th>(d_4)</th>
<th>(L_1)</th>
<th>(L_2)</th>
<th>(L_3)</th>
<th>(L_4)</th>
<th>(Z\°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M18×1.5</td>
<td>55</td>
<td>13</td>
<td>24.5</td>
<td>19.8</td>
<td>2.4</td>
<td>28.5</td>
<td>2</td>
<td>22</td>
<td>15°</td>
</tr>
<tr>
<td>3/4&quot;-16 UNF</td>
<td>30</td>
<td>10</td>
<td>22</td>
<td>20.6</td>
<td>2.5</td>
<td>17.5</td>
<td>2.4</td>
<td>14.3</td>
<td>15°</td>
</tr>
</tbody>
</table>

---

- Note the fastening torque of 50 Nm.
- The flange contact surface must be seated completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not make contact with the sensor rod.
- The peak pressure should not be exceeded.
- Protect the sensor rod against wear.
- Note the piston rod drilling:
  - \(\Omega 7\) mm rod: \(\geq \Omega 10\) mm
  - \(\Omega 10\) mm rod: \(\geq \Omega 13\) mm

**NOTICE**
The bore depth in piston:
Null zone + Stroke length + Dead zone + > 3 mm

Controlling design dimensions are in millimeters.

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**MECHANICAL INSTALLATION – POSITION MAGNET**

**Magnet installation**

1. Circclip
2. Non-magnetic spacer
3. Position magnet
4. Non-magnetic spacer (\(\geq 5\) mm)

<table>
<thead>
<tr>
<th>Position magnet (Part no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(401\ 032)</td>
</tr>
<tr>
<td>17.4 mm</td>
</tr>
<tr>
<td>(\geq 18) mm</td>
</tr>
<tr>
<td>Rod (\Omega 7) mm</td>
</tr>
<tr>
<td>Rod (\Omega 10) mm</td>
</tr>
</tbody>
</table>

**MECHANICAL INSTALLATION – FLOAT**

**Float installation**

- A: MH threaded sensor
- B: Float
- C: Stroke length
- D: Dead zone
- E: Stop collar

---

Fig. 12: Sealing via O-ring in the flange undercut

Fig. 13: Dimensions for magnet mounting

Fig. 14: Dimensions for float mounting
**ORDER CODE**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<th>11</th>
<th>12</th>
<th>13</th>
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<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>H</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
<td>g</td>
<td>h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**a Sensor model**

M H Threaded flange

**b Design**

G Threaded flange M18×1.5: Rod: Ø 10 mm + end plug with male M8 thread / Dead zone: 55.5 mm / Stroke length: 50…1200 mm

H Threaded flange M18×1.5: Rod: Ø 7 mm / Dead zone: 63.5 mm / Stroke length: 50…2500 mm

K Threaded flange M18×1.5: Rod: Ø 10 mm + end plug with female M6 thread / Dead zone: 52.5 mm / Stroke length: 50…1200 mm

N Threaded flange M18×1.5: Rod: Ø 10 mm / Dead zone: 63.5 mm / Stroke length: 50…2500 mm

P Threaded flange M18×1.5: Rod: Ø 7 mm / Dead zone: 45.5 mm / Stroke length: 50…1200 mm

T Threaded flange M18×1.5: Rod: Ø 10 mm / Dead zone: 45.5 mm / Stroke length: 50…1200 mm

W Threaded flange ¾"-16 UNF: Rod: Ø 10 mm / Dead zone: 63.5 mm / Stroke length: 50…2500 mm

**c Stroke length**

X X X X M 0050…2500 mm (in 5 mm steps)

**d Electrical wiring**

M12 connector

M 0 0 F M12 connector (5 pin)

Cable outlet

<table>
<thead>
<tr>
<th>C</th>
<th>0</th>
<th>3</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0</td>
<td>5</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>0</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>0</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
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<td>A</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>0</td>
<td>A</td>
</tr>
</tbody>
</table>

**e Operating voltage**

3 +12 / 24 VDC (8…32 VDC)

**f Output**

C 0 1 CANopen with cycle time 1 ms (default setting)

J 0 1 SAE J1939 with cycle time 20 ms (default setting)

**g Baud rate**

CANopen (C01)

0 1000 kbit/s

1 800 kbit/s

2 500 kbit/s

3 250 kbit/s (default)

4 125 kbit/s

6 50 kbit/s

SAE J1939 (J01)

2 500 kbit/s

3 250 kbit/s (default)

**h Node ID (CANopen) / Source address (SAE J1939)**

CANopen (C01)

Hex 01…7F (default: 7F)

SAE J1939 (J01)

Hex 01…FD (default: FD)

**DELIVERY**

- Position sensor
- O-ring

Accessories have to be ordered separately

Manuals, Software & 3D models available at: www.temposonics.com