Data Sheet

MH-Series MH Threaded Analog
Magnetostrictive Linear Position Sensors

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

The absolute, linear position sensors provided by Tempsonics rely on the company’s proprietary magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Tempsonics 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 Tempsonics® MH-Series sensors are specifically designed for direct stroke measurement in hydraulic cylinders. The MH Threaded sensor extends the rugged design of the Tempsonics® MH Series sensors to external threaded installations. An 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. Tempsonics® 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 application: Agricultural sprayer
## TECHNICAL DATA

### Output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>4…20 mA</td>
</tr>
<tr>
<td>Voltage</td>
<td>0.25…4.75 VDC; 0.5…4.5 VDC</td>
</tr>
<tr>
<td>Measured value</td>
<td>Position</td>
</tr>
<tr>
<td>Signal characteristic</td>
<td>Analog output restricted by noise and ADC</td>
</tr>
</tbody>
</table>

### Measurement parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>Typ. 0.1 mm</td>
</tr>
<tr>
<td>Internal sample rate</td>
<td>2 ms</td>
</tr>
<tr>
<td>Linearity</td>
<td>0050…0250 mm ≤ ±0.1 mm; 0255…2000 mm ±0.04 % (F.S.); 2005…2500 mm ≤ ±0.8 mm</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>±0.1 mm</td>
</tr>
<tr>
<td>Setpoint tolerance</td>
<td>&lt; 1 mm</td>
</tr>
</tbody>
</table>

### Operating conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting position</td>
<td>Any</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>−40…+85 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>−25…+65 °C</td>
</tr>
<tr>
<td>Humidity</td>
<td>EN60068-2-30, 90 % rel. humidity, no condensation</td>
</tr>
<tr>
<td>Ingress protection – M12 connector</td>
<td>IP69K with M12 connector and mating plug</td>
</tr>
<tr>
<td>Ingress protection – Cable output</td>
<td>IP69K</td>
</tr>
<tr>
<td>Shock test</td>
<td>IEC 60068-2-27. 100 g (6 ms) single shock, 50 g (11 ms) at 1000 shocks per axis</td>
</tr>
<tr>
<td>Vibration test</td>
<td>Vibrations: IEC 60068-2-64, 15 g (r.m.s.) Ø 7 mm rod (10…2000 Hz) - resonance frequencies excluded; 20 g (r.m.s.) Ø 10 mm rod (10…2000 Hz) - resonance frequencies excluded</td>
</tr>
<tr>
<td>EMC test</td>
<td>2009/64/EG Road vehicles</td>
</tr>
<tr>
<td>Pressure impulse test according DIN EN ISO 19879</td>
<td>Ø 7 mm rod: 300 bar; Ø 10 mm rod: 350 bar</td>
</tr>
<tr>
<td>Operation pressure (P&lt;sub&gt;n&lt;/sub&gt;)</td>
<td>300 bar; 350 bar</td>
</tr>
<tr>
<td>Operation pressure (P&lt;sub&gt;max&lt;/sub&gt;)</td>
<td>400 bar; 450 bar</td>
</tr>
<tr>
<td>Operation pressure (P&lt;sub&gt;static&lt;/sub&gt;)</td>
<td>525 bar; 625 bar</td>
</tr>
</tbody>
</table>

### Design/Material

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor electronics housing</td>
<td>Stainless steel 1.4305 (AISI 303)</td>
</tr>
<tr>
<td>Sensor rod</td>
<td>Ø 7 mm: Stainless steel 1.4301 (AISI 304L); Ø 10 mm: Stainless steel 1.4306 (AISI 304L)</td>
</tr>
<tr>
<td>Stroke length</td>
<td>50…2500 mm</td>
</tr>
<tr>
<td>Sealing</td>
<td>O-ring 15.4 × 2.1, NBR 90 black</td>
</tr>
</tbody>
</table>

### Electrical connection

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection type</td>
<td>M12 connector or cable output</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>+12/24 VDC (8…32 VDC)</td>
</tr>
<tr>
<td>Current consumption</td>
<td>12 VDC: typ. &lt; 100 mA; 24 VDC: typ. &lt; 50 mA</td>
</tr>
<tr>
<td>Load (output VDC)</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; ≥ 10 kΩ</td>
</tr>
<tr>
<td>Load (output mA)</td>
<td>12 VDC: R&lt;sub&gt;L&lt;/sub&gt; ≤ 250 Ω; 24 VDC: R&lt;sub&gt;L&lt;/sub&gt; ≤ 500 Ω</td>
</tr>
<tr>
<td>Inrush current</td>
<td>12 VDC: max. 2.5 A/2 ms; 24 VDC: max. 4.5 A/2 ms</td>
</tr>
<tr>
<td>Supply voltage ripple</td>
<td>&lt; 1 %&lt;sub&gt;pp&lt;/sub&gt;</td>
</tr>
<tr>
<td>Power drain</td>
<td>&lt; 1 W</td>
</tr>
<tr>
<td>Over voltage protection (VDC-GND)</td>
<td>Up to +36 VDC</td>
</tr>
<tr>
<td>Polarity protection (GND-VDC)</td>
<td>Up to −36 VDC</td>
</tr>
<tr>
<td>Electric strength</td>
<td>500 VDC (DC GND to chassis GND)</td>
</tr>
</tbody>
</table>
Form Factor G
Ø 10 mm rod & M8 end plug (male)

Form Factor K
Ø 10 mm rod & M6 end plug (female)

Controlling design dimensions are in millimeters
Unless otherwise stated, apply to the general tolerances according to DIN ISO 2768-m
TECHNICAL DRAWING

Form Factor P
Ø 7 mm rod & flat plug

Form Factor T
Ø 10 mm rod & flat plug

CONNECTOR WIRING

<table>
<thead>
<tr>
<th>M12 connector</th>
<th>Cable output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>E</td>
</tr>
<tr>
<td>1</td>
<td>not connected</td>
</tr>
<tr>
<td>2</td>
<td>VDC</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>SIG</td>
</tr>
</tbody>
</table>
### FREQUENTLY ORDERED ACCESSORIES

<table>
<thead>
<tr>
<th><strong>Position magnets</strong></th>
<th><strong>Float</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Position magnets" /></td>
<td><img src="image" alt="Float" /></td>
</tr>
</tbody>
</table>

#### Ring magnet
- **Part no. 401 032**
  - Material: PA neobind
  - Weight: Ca. 5 g
  - Operating temperature: −40…+100 °C
  - Surface pressure: Max. 20 N/mm²

#### Ring magnet
- **Part no. 400 533**
  - Material: PA ferrite
  - Weight: Ca. 10 g
  - Operating temperature: −40…+100 °C
  - Surface pressure: Max. 40 N/mm²

#### Ring magnet
- **Part no. 201 542-2**
  - Material: PA ferrite GF20
  - Weight: Ca. 14 g
  - Operating temperature: −40…+100 °C
  - Surface pressure: Max. 40 N/mm²

#### Float
- **Part no. 561 612**
  - Material: Stainless steel AISI 304
  - Density: 720 kg/m³
  - Specific gravity: 0.61 maximum
  - Max. pressure: 40 bar
  - Weight: Ca. 42 g
  - For sensors with Ø 10 mm rod
  - For sensors with up to 2000 mm stroke length

#### Collar
- **Part no. 560 777**
  - Material: Stainless steel 1.4301 (AISI 304)
  - Weight: Ca. 30 g
  - Hex key 1/8” required
  - For sensors with Ø 10 mm rod

#### Test kit
- **Part no. 280 618**
  - Kit includes:
    - 12 VDC battery charger with adapter (EU & UK)
    - Cable with M12 connector
    - Cable with pigtailed wires
    - Carrying case

#### Cord sets and adapter cables
- **4 pin M12 to DT04 connector**
  - **Part no. 254 600**
    - M12 connector: Brass/Nickel
    - DT connector: DT04 3 pin
    - Material: PVC Jacket
    - Cable length: 275 mm
    - Cable Ø: 5 mm
    - Operating temperature: −40…+105 °C

- **4 pin M12 to DTM06 connector**
  - **Part no. 254 597**
    - M12 connector: Brass/Nickel
    - DT connector: DTM06 3 pin
    - Material: PVC Jacket
    - Cable length: 275 mm
    - Cable Ø: 5 mm
    - Operating temperature: −40…+105 °C
INSTALLATION

Hydraulics sealing
For sealing the flange contact surface, a sealing via an O-ring 15.3 × 2.2 mm in the undercut is necessary. A screw hole based on ISO 6149-1 must be provided.

Screw hole based on ISO 6149-1

<table>
<thead>
<tr>
<th>Thread (d₁×P)</th>
<th>d₁</th>
<th>d₂</th>
<th>d₃</th>
<th>d₄</th>
<th>L₁</th>
<th>L₂</th>
<th>L₃</th>
<th>L₄</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>
</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.

For In-Cylinder installation:
- The plunger borehole:
  - Ø 7 mm rod: ≥ Ø 10 mm
  - Ø 10 mm rod: ≥ Ø 13 mm
  - This dimension applies when tap drill cannot pass through entire boss.
- The bore depth in piston:
  - Null zone + Stroke length + Dead zone + > 3 mm

Magnet installation for In-Cylinder applications

Magnet installation for float applications
## 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>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### a Sensor model
- M: Rod

### b Form factor
- G: Threaded port M18×1.5, rod Ø 10 mm, M8 plug (male)
- K: Threaded port M18×1.5, rod Ø 10 mm, M6 plug (female)
- P: Threaded port M18×1.5, rod Ø 7 mm, flat plug
- T: Threaded port M18×1.5, rod Ø 10 mm, flat plug

### c Stroke range (mm)
- 0050…2500 mm (in 5 mm steps)

### d Electrical wiring

#### M12 connector (VDC - GND - SIG)
- M 0 0 E: 4 pin (2-3-4)
- M 0 0 G: 4 pin (1-3-4)
- M 0 0 H: 4 pin (1-3-2)

#### Cable output
- C 0 3 A: 300 mm pigtailed wire termination
- C 0 5 A: 500 mm pigtailed wire termination
- C 1 0 A: 1000 mm pigtailed wire termination
- C 2 0 A: 2000 mm pigtailed wire termination
- C 3 0 A: 3000 mm pigtailed wire termination
- C 5 0 A: 5000 mm pigtailed wire termination

### e Supply voltage
- 3: +12/24 VDC (8…32 VDC)

### f Output
- V 1 1: 0.25…4.75 VDC
- V 1 2: 0.5…4.5 VDC
- V 1 3: 4.75…0.25 VDC
- V 1 4: 4.5…0.5 VDC
- A 0 1: 4…20 mA
- A 0 4: 20…4 mA

## DELIVERY

- Position sensor, O-ring
- Accessories have to be ordered separately.

Operation manuals & software are available at: [www.temposonics.com](http://www.temposonics.com)
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