Data Sheet

MH-Series MS Analog/Digital
Magnetostrictive Linear Position Sensors

- Smallest magnetostrictive Sensor for Mobile Hydraulics
- Analog output up to 2,500 mm
- Digital output up to 1,500 mm
1. Product description and technology

Temposonics sensors can be used in versatile mobile machines without any restriction and replace contact-based linear sensors like potentiometers. Highly dynamic systems are controlled safely by means of Temposonics sensors, thus enhancing the productivity, availability and quality of the working process of the machine. Insensitive to vibration, shocks, dust and weathering influence and electro-magnetic disturbances. Temposonics® MH Series sensors are successfully used in front axle and articulated frame steering cylinders, hydraulic jacks and in steering systems for hydraulic units on agricultural and construction machinery.

Simple Mechanics
The extremely robust sensor consists of the following main parts:

1. The innovative connector system which is easy to install in a few seconds, any soldering or crimping needless, dust-and waterproof up to IP69K.
2. The flange housing with built-in electronics and signal converter.
3. The position magnet as only moving part, which is assembled into the piston bottom. This permanent magnet travels wear-free and contactless along the pressure pipe and measures the actual position.
4. The pressure pipe placed within the drilled piston rod contains the protected magnetostrictive sensing element.

- Due to small dimensions MH sensors require only little space
- Suitable for operating pressures up to 350 bar
- Unaffected by surrounding media such as ageing or foaming oil
- Insensitive to shock and vibration
- Designed for all current supply voltages (12/24 VDC)
- Temposonics® sensors offer all common used output signals:
  - Analog: VDC/mA
  - Bus protocols: CANopen, SAE J1939

Magnetostriction
Temposonics linear sensors are based on the magnetostrictive technology. By measuring the actual position with a non-contact position magnet the sensor operates 100% wear-free. The absolute operating principle enables reliable readings without any reference point or recalibration. A mechanical strain pulse is triggered by the travelling position magnet. The runtime of this ultrasonic wave is measured precisely and compiled into standard electronic output signals.

Measurement principle
2. Temposonics connector system M12

Temposonics presents the innovative connector system for Temposonics® MH-Series

The connector system meets the highest protection requirements important for a harsh environment in mobile hydraulic applications. Protection type IP69K performs water and dust proof. In addition it is even resistive against high pressure water cleaning.

1. The MH sensor is delivered by Temposonics together with the new connector system:
   The connector insert carrier is already connected to the sensor conductors, i.e. no soldering, any colour or connection mistake.

2. The connector insert is taken out of the cylinder through a bore hole. The flange can easily be clicked in position from outside.

3. Four standard screws must be tightened to mount the connector system on the cylinder. In case of using angled type connectors the connector insert can be rotated inside the flange in 45° steps.

4. With a corresponding mating plug the connector system fulfills an IP rating of IP69K.

- Absolutely easy and safe installation.
- No brazing or crimping of connecting leads is required.
### Mechanical configurations

<table>
<thead>
<tr>
<th>Form factor</th>
<th>D</th>
<th>Z = 63.5 mm (s ≤ 2500 mm*), Ø 7 mm pressure pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F</td>
<td>Z = 36.5 mm (s ≤ 1200 mm), Ø 7 mm pressure pipe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stroke range</th>
<th>s</th>
<th>0050…2500 mm (in 5 mm steps)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire length</td>
<td>w</td>
<td>60…240 mm (in 20 mm steps)</td>
</tr>
</tbody>
</table>

*Note: Digital output only up to 1500 mm stroke range

### Electrical configurations

#### MH Analog

<table>
<thead>
<tr>
<th>Model no.</th>
<th>MS</th>
<th>D</th>
<th>1500</th>
<th>M - N</th>
<th>12</th>
<th>G - 3</th>
<th>V12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form factor</td>
<td>D</td>
<td>1 = VDC</td>
<td>3 = GND</td>
<td>4 = Sig</td>
<td>2 = n.c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1 = VDC</td>
<td>2 = Sig</td>
<td>3 = GND</td>
<td>4 = n.c.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH Digital</td>
<td>F</td>
<td>2 = VDC</td>
<td>3 = GND</td>
<td>4 = CAN HI</td>
<td>5 = CAN LO</td>
<td>1 = n.c.</td>
<td></td>
</tr>
<tr>
<td>MH Analog</td>
<td>A01</td>
<td>4…20 mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V12</td>
<td>0.5…4.5 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH Digital</td>
<td>C01</td>
<td>CANopen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J01</td>
<td>SAE J1939</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### MH Digital

<table>
<thead>
<tr>
<th>Baudrate</th>
<th>3</th>
<th>250 kbit/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>125 kbit/sec</td>
<td></td>
</tr>
</tbody>
</table>

#### Node ID

| 7F | hex |
| FD | hex |

All dimensions in mm

Please see detailed model configuration on page 11 and 13.

*Note: Digital output only up to 1500 mm stroke range
3.1 Dimensions

**Mechanical configurations**

- **Form factor**
  - D: \(Z = 63.5\text{ mm (s \leq 2500 mm)}, \varnothing 7\text{ mm pressure pipe}\)
  - F: \(Z = 36.5\text{ mm (s \leq 1200 mm)}, \varnothing 7\text{ mm pressure pipe}\)

- **Stroke range**
  - \(s\): 0050...2500 mm (in 5 mm steps)*

- **Wire length**
  - \(w\): 300...9000 mm (in 100 mm steps)

**Electrical configurations**

- **MS Analog**
  - A01: 4...20 mA
  - V12: 0.5...4.5 VDC

- **MS Digital**
  - C01: CANopen
  - J01: SAE J1939

**Model no.**

<table>
<thead>
<tr>
<th>D</th>
<th>1500</th>
<th>M-T</th>
<th>10</th>
<th>A</th>
<th>3</th>
<th>V12</th>
<th>V11</th>
<th>A01</th>
<th>C01</th>
<th>J01</th>
<th>7F</th>
<th>FD</th>
</tr>
</thead>
</table>

*Note: Digital output only up to 1500 mm stroke range*
4. In Cylinder assembly

Mechanical installation
The robust Temposonics model MH sensor is designed for direct stroke measurement in hydraulic cylinders. The Temposonics® MH sensor can be installed from the head side or the rod side of the cylinder depending on the cylinder design.

Sensor installation
The method of installation is entirely dependent on the cylinder design. While the most common method of installation is from the rod side of the cylinder, an installation from the head side of the cylinder is also possible. In both installation methods, the hermetic sealing of the cylinder is given by an O-ring with additional back up ring.

Please pay attention:
• The position magnet shall not touch the pressure pipe.
• Piston rod drilling:
  Depth: \( S + Z + 3 \text{ mm} \)
  Diameter:

<table>
<thead>
<tr>
<th>Pressure Pipe</th>
<th>Ø 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling</td>
<td>Ø 10</td>
</tr>
</tbody>
</table>
• Do not exceed operating pressure.

Example

M12 connector system

<table>
<thead>
<tr>
<th>Flange housing with O-ring and back-up ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. retaining with set screw DIN 913 M5 × 10 (with flat point!) max. torque 0.5 Nm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>B - Ø Cylinder</th>
<th>D - Ø min.</th>
<th>H - Depth</th>
<th>d - Ø min.</th>
<th>h - Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td>≥ 32</td>
<td>28H7 screwed 28G7 welded</td>
<td>26.8 ± 0.2</td>
<td>23.5</td>
<td>&lt; 25</td>
</tr>
</tbody>
</table>

Please pay attention to installation manual!

All dimensions in mm
4.1. Position magnets

Position magnets (please order separately)

<table>
<thead>
<tr>
<th>Part no.</th>
<th>401 032</th>
<th>400 533</th>
<th>201 542-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD_m</td>
<td>17.4 mm</td>
<td>25.4 mm</td>
<td>32.8 mm</td>
</tr>
<tr>
<td>ID_m</td>
<td>13.5 mm</td>
<td>13.5 mm</td>
<td>13.5 mm</td>
</tr>
<tr>
<td>Height</td>
<td>7.9 mm</td>
<td>7.9 mm</td>
<td>7.9 mm</td>
</tr>
</tbody>
</table>

Characteristics

<table>
<thead>
<tr>
<th>Material</th>
<th>PA neobond</th>
<th>PA ferrite</th>
<th>PA ferrite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>ca. 5 g</td>
<td>ca. 10 g</td>
<td>ca. 14 g</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>−40...+100 °C</td>
<td>−40...+100 °C</td>
<td>−40...+100 °C</td>
</tr>
<tr>
<td>Surface pressure*</td>
<td>max. 20 N/mm²</td>
<td>max. 40 N/mm²</td>
<td>max. 40 N/mm²</td>
</tr>
<tr>
<td>Fastening torque for M4 screws</td>
<td>–</td>
<td>–</td>
<td>max. 1 Nm</td>
</tr>
</tbody>
</table>

*M max. mechanical burden, e.g. by circlip, lock washers etc.

4.2. Magnet assembly in piston

Pressure pipe Ø 7
Piston rod drilling (min.) Ø 10

Stainless steel (non-magnetic)

S = OD_m × 5 × ID_m

Material:
- POM, PU, Aluminum
- Steel

<table>
<thead>
<tr>
<th>Magnet (M)</th>
<th>401 032</th>
<th>400 533</th>
<th>201 542-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD</td>
<td>17.5 mm²²</td>
<td>25.5 mm²²</td>
<td>32.9 mm²²</td>
</tr>
<tr>
<td>h - Depth</td>
<td>13.5 mm</td>
<td>13.5 mm</td>
<td>13.5 mm</td>
</tr>
</tbody>
</table>

Please pay attention to installation manual!
5. Electrical installation

### MS Analog

**PIN assignment M12 (4 pin)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VDC</td>
<td>VDC</td>
</tr>
<tr>
<td>2</td>
<td>n.c.</td>
<td>Signal</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>Signal</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

**Pin assignment “G”**

1. +12/24 VDC
2. n.c.
3. GND (0 V)
4. Signal: mA, VDC

**Pin assignment “H”**

1. +12/24 VDC
2. Signal: mA, VDC
3. GND (0 V)
4. n.c.

### MS Digital

**PIN assignment M12 (5 pin)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n.c.</td>
</tr>
<tr>
<td>2</td>
<td>VDC</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>CAN HI</td>
</tr>
<tr>
<td>5</td>
<td>CAN LO</td>
</tr>
</tbody>
</table>

**Pin assignment “F”**

1. n.c.
2. +12/24 VDC
3. GND (0 V)
4. CAN HI
5. CAN LO

**Wire assignment**

- **Color**
  - BN: VDC
  - WH: GND
  - GN: Signal

- **Bus termination external**

```
+12/24 VDC  
\[\text{BAT}\]  
\[\text{GEN}\]  
\[\text{M}\]  
```

**All dimensions in mm**

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Please pay attention to installation manual!

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Connecting schematics on vehicle electronics:
Typical Applications for Linear Motion Control in hydraulic cylinders

- Blade Control: Press and return operation
- Lift Control: Speed of lift up and lowering related to actual load
- Auxiliary Steering
- Front Loader: Controlled Parallel Guidance
- Cabin Suspension
- Electro-Hydraulic Hitch Control
- Axle Suspension
- Steer by Wire: Electro-Hydraulic Steering
6.1 MS Analog: Technical data

### Input

<table>
<thead>
<tr>
<th>Measured value</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke range</td>
<td>50…2500 mm (in 5 mm steps)</td>
</tr>
</tbody>
</table>

### Output

<table>
<thead>
<tr>
<th>Signal characteristic</th>
<th>Analog output restricted by noise or A/D converter of control unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>0.25…4.75 VDC / 0.5…4.5 VDC</td>
</tr>
<tr>
<td>Current</td>
<td>4…20 mA</td>
</tr>
<tr>
<td>Resolution</td>
<td>Typ. 0.1 mm</td>
</tr>
<tr>
<td>Power up time</td>
<td>Typ. 250 ms</td>
</tr>
<tr>
<td>Mounting zone</td>
<td>22 mm</td>
</tr>
<tr>
<td>Damping</td>
<td>36.5 / 63.5 mm</td>
</tr>
</tbody>
</table>

### Accuracy

<table>
<thead>
<tr>
<th>Measured value</th>
<th>Linearity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0050…0250 mm</td>
<td>≤ ±0.1 mm</td>
</tr>
<tr>
<td>0255…2000 mm</td>
<td>±0.04 % (F.S.)</td>
</tr>
<tr>
<td>2005…2500 mm</td>
<td>≤ ±0.8 mm</td>
</tr>
</tbody>
</table>

### Power up time and Mounting zone

- Power up time: Typ. 250 ms
- Mounting zone: 22 mm

### Operating conditions

- Mounting position: Any
- Operating temperature electronics: −40…+105 °C
- Storage temperature: −25…+ 65 °C
- Fluid temperature: −30…+ 85 °C
- Dew point, humidity: EN60068-2-30, 90 % rel. humidity, no condensation

### Pressure

- Nominal operating pressure (P<sub>n</sub>): 300 bar
- Max. overload pressure in cylinder (P<sub>max</sub>): 400 bar
- Max. static proof pressure in cylinder (P<sub>proof</sub>): 525 bar

### IP rating

- M12 connector: EN60529 (IP69K) when plugged
- Sensor housing: EN60529 (IP67)

### Environmental testing

- Shock test: IEC 60068-2-27, 100 g (11 ms) single shock, 50 g (11 ms) at 1000 shocks per axis
- Vibration test: IEC 60068-2-64, 15 g (r.m.s.) Ø 7 mm pressure pipe (10…2000 Hz) – resonance frequencies excluded
- EMC test & evaluation: ISO 14982 Agricultural and forest machines
  - Construction machines: EN 13309
  - Immunity: ISO 11452-2 (200 V/m Antenna), ISO 11452-4 (200 mA BCI)
  - Emissions: CISPR 16
  - Transiente Impulses: ISO 7637-2
  - E.S.D.: ISO/TR 10605

### Materials and dimensions

- Pressure pipe: Stainless steel 1.4306 / AISI 304L
- Housing: Stainless steel 1.4305 / AISI 303
- Sealing: O-ring 23.47 x2.62 mm NBR; Backup Ring 28 x 2 x 1.4 mm, Parker Parbaks 8-119 N1444-90 or 8-119 N0300-90
- M12 connector insert: Material: polyamide reinforces; O-ring 7 x 1.35 mm NBR 70; pins: brass with gold plated pins
- M12 flange: Brass nickel-plated with O-ring 13 x 1.6 NBR 70

### Electrical installation

<table>
<thead>
<tr>
<th>Connector</th>
<th>M12 male plug or cable assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>12 VDC (8…32 VDC)</td>
</tr>
<tr>
<td>Current consumption</td>
<td>Typ. ≤ 100 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 current (output VDC)</td>
<td>Typ. 0.5 mA</td>
</tr>
<tr>
<td>Load (output mA)</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; ≤ 250 Ω</td>
</tr>
<tr>
<td>Inrush current</td>
<td>Max. 2.5 A/2 ms</td>
</tr>
<tr>
<td>Supply voltage ripple</td>
<td>&lt; 1 % p-p</td>
</tr>
<tr>
<td>Power drain</td>
<td>&lt; 1 W</td>
</tr>
<tr>
<td>Over voltage protection (GND-VDC)</td>
<td>Up to +36 VDC</td>
</tr>
<tr>
<td>Polarity protection (GND-VDC)</td>
<td>Up to –36 VDC</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>R ≥ 10 MΩ @ 60 sec</td>
</tr>
<tr>
<td>Electric strength</td>
<td>500 VDC (DC GND to chassis GND)</td>
</tr>
</tbody>
</table>
**Temposonics® Model configurator**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>S</th>
<th>a</th>
<th></th>
<th>b</th>
<th>c</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>e</th>
<th>f</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Sensor model</td>
<td>M</td>
<td>S</td>
<td>Flange housing Ø 28 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Form factor</td>
<td>D</td>
<td>≤ 2500 mm, Pressure pipe Ø 7 mm, Damping: 63.5 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>≤ 1200 mm, Pressure pipe Ø 7 mm, Damping: 36.5 mm</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Stroke range (mm)</td>
<td></td>
<td>0050…2500 mm (in 5 mm steps)</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Electrical wiring</td>
<td>M12 connector (VDC – GND – SIG) incl. M12 flange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>4 pin (1-3-4), 60…240 mm cable length (in 20 mm steps)</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>4 pin (1-3-2), 60…240 mm cable length (in 20 mm steps)</td>
<td>H</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>300…9000 mm cable length (in 100 mm steps)</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Supply voltage</td>
<td>3</td>
<td>+12 / 24 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Output</td>
<td>V</td>
<td>1</td>
<td>0.25…4.75 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>2</td>
<td>0.5…4.5 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>0</td>
<td>4…20 mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Scope of delivery:**
Position sensor, O-ring, backup-ring, M12 connector system (optional)

**Please order position magnets separately!**
## 6.2 MS Digital: Technical data

### Input
- **Measured value**: Position and velocity
- **Stroke range**: 50...1500 mm (in 5 mm steps)
- **Velocity range**: 0...1000 mm/s

### Output
- **Signal characteristic**: Bus-protocol: SAE J1939, CANopen protocol according to CiA DS-301 V4.1, device profile DS-406 V3.1
- **Resolution (position)**: 0.1 mm
- **Resolution (velocity)**: 1 mm/s
- **Boot up time**: Typ. 400 ms
- **Cycle time**
  - CANopen: 1 ms
  - SAE J1939: 20 ms
- **Mounting zone**: 22 mm
- **Damping**: 36.5 / 63.5 mm

### Accuracy
- **Linearity**: 0.050...0.250 mm ≤ ±0.1 mm,
  0.255...1.500 mm ±0.04 % (F.S.)
- **Hysteresis**: ±0.1 mm
- **Internal sample rate**: 1 ms
- **Setpoint tolerance**: ±0.2 mm

### Operating conditions
- **Mounting position**: Any
- **Operating temperature electronics**: −40...+105 °C
- **Storage temperature**: −25...+ 65 °C
- **Fluid temperature**: −30...+ 85 °C
- **Dew point, humidity**: EN60068-2-30, 90 % rel. humidity, no condensation

### Pressure
- **Operating pressure ratings**: Pressure impulse test according to DIN EN ISO 19879
- **Pressure Pipe**: Ø 7 mm pressure pipe
- **Nominal operating pressure (Pₚ)**: 300 bar
- **Max. overload pressure in cylinder (Pₘₚ)**: 400 bar
- **Max. static proof pressure in cylinder (Pₚₒₒ)**: 525 bar

### IP rating
- **M12 connector**: EN60529 (IP69K) when plugged
- **Sensor housing**: EN60529 (IP67)

### Environmental testing
- **Shock test**: IEC 60068-2-27, 100 g (11 ms) single shock, 50 g (11 ms) at 1000 shocks per axis
- **Vibration test**: 15 g (r.m.s.) Ø 7 mm pressure pipe (10...2000 Hz) – resonance frequencies excluded
- **EMC test & evaluation**
  - ISO 14982 Agricultural and forest machines
  - EN 13309 Construction machines
  - Immunity:
    - ISO 11452-2 (200 V/m Antenna), ISO 11452-4 (200 mA BCI)
  - Emissions:
    - CISPR 25
  - Transiente Impulses: ISO 7637-2
  - E.S.D.:
    - ISO/TR 10605

### Materials and dimensions
- **Pressure pipe (Ø 10 mm / Ø 7 mm)**: Stainless steel 1.4306 / AISI 304L
- **Housing**: Stainless steel 1.4305/AISI 303
- **Sealing**: O-ring 23.47 ×2.62 mm NBR; Backup Ring 28 × 2 × 1.4 mm, Parker Parbaks 8-119 N1444-90 or 8-119 N0300-90
- **M12 connector insert Material**: polyamide reinforces; O-ring 7 × 1.35 mm NBR 70; pins: brass with gold plated pins
- **M12 flange Brass nickel-plated with O-ring 13 × 1.6 NBR 70**

### Electrical installation
- **Connector**: M12 male plug or cable assembly
- **Supply voltage**
  - 12 VDC (8...32 VDC)
  - 24 VDC (8...32 VDC)
- **Current consumption**
  - Typ. ≤ 100 mA
  - Typ. ≤ 50 mA
- **Inrush current**
  - Max. 1.0 A @ 2 ms
  - Max. 1.5 A @ 2 ms
- **Bus termination (HI-LO)**: 120 Ω
- **Supply voltage ripple**: < 1 % p-p
- **Power drain**: < 1.5 W
- **Over voltage protection (GND-VDC)**: Up to +36 VDC
- **Polarity protection (GND-VDC)**: Up to −36 VDC
- **Insulation Resistance**: R ≥ 10 MΩ @ 60 sec.
- **Electric strength**: 500 VDC (DC GND to chassis GND)
**Temposonics® Model configurator**

- **a** Sensor model
  - M Flange housing Ø 28 mm
  - S

- **b** Form factor
  - D ≤ 1500 mm, Pressure pipe Ø 7 mm, Damping: 63.5 mm
  - F ≤ 1200 mm, Pressure pipe Ø 7 mm, Damping: 36.5 mm

- **c** Stroke range (mm)
  - 0050…1500 mm (in 5 mm steps)

- **d** Electrical wiring
  - M12 connector (VDC – GND – HI – LO) incl. M12 flange
  - N F 5 pin (2-3-4-5), 60…240 mm cable length (in 20 mm steps)
  - T A 300…9000 mm cable length (in 100 mm steps)

- **e** Supply voltage
  - 3+12/24 VDC

- **f** Output
  - C 0 1 CANopen cycle time 1 ms (default setting)
  - J 0 1 SAE J1939 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
    - 4 125 kbit/s
    - 6 50 kbit/s
  - SAE J1939 (J01)
    - 3 250 kBit/s

- **h** Node ID (CANopen) / Source adress (SAE J1939)
  - CANopen (C01)
    - hex 01…7F
  - SAE J1939 (J01)
    - hex 01…FD

**Scope of delivery:**
Position sensor, O-ring, backup-ring, M12 connector system

**Please order position magnets separately!**
**Accessories**

**Position magnets**

<table>
<thead>
<tr>
<th>OD17.4 Ring magnet</th>
<th>OD25.4 Ring magnet</th>
<th>OD33 Ring magnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part no. 401 032</td>
<td>Part no. 400 533</td>
<td>Part no. 201 542-2</td>
</tr>
<tr>
<td>Material: PA-Neobind</td>
<td>Material: PA-Ferrit</td>
<td>Material: PA-Ferrit-Gf20</td>
</tr>
<tr>
<td>Weight: ca. 5 g</td>
<td>Weight: ca. 10 g</td>
<td>Weight: ca. 14 g</td>
</tr>
<tr>
<td>Operating temperature: −40…+100 °C</td>
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<td>Operating temperature: −40…+100 °C</td>
</tr>
<tr>
<td>Surface pressure: max. 20 N/mm²</td>
<td>Surface pressure: max. 40 N/mm²</td>
<td>Surface pressure: max. 40 N/mm²</td>
</tr>
</tbody>
</table>

**Materials and Properties**

- **Material:** PA-Neobind
- **Weight:** ca. 5 g
- **Operating Temperature:** −40…+100 °C
- **Surface Pressure:** max. 20 N/mm²

- **Material:** PA-Ferrit
- **Weight:** ca. 10 g
- **Operating Temperature:** −40…+100 °C
- **Surface Pressure:** max. 40 N/mm²

- **Material:** PA-Ferrit-Gf20
- **Weight:** ca. 14 g
- **Operating Temperature:** −40…+100 °C
- **Surface Pressure:** max. 40 N/mm²
- **Fastening Torque for M4 Screw:** max. 1 Nm

**M12 Flange**

<table>
<thead>
<tr>
<th>M12 Flange (spare part)</th>
<th>Testkit Analog</th>
<th>Testkit Digital</th>
<th>Testsoftware Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part no. 253 769</td>
<td>Part no. 280 618</td>
<td>Part no. 254 267</td>
<td>Part no. 625 129</td>
</tr>
</tbody>
</table>

- **MH-Serie analog / PWM Tester**
- **12 VDC battery charger with adapter (adapter main plug EU, adapter main plug UK)**
- **cable with M12 connector**
- **cable with pigtailed wires**
- **carrying case**

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

**Order Information:**

For complete package please order both part numbers.