MH-Series MH CANbus
Magnetostriuctive Linear Position Sensors

- Stroke length up to 2500 mm
- Linearity < 0.04 % F.S. / Resolution typ. 0.1 mm
- High reliability due to EMC, shock & vibration resistance
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 a 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 beginning 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 SENSOR

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, shock, dust and weathering influence and electro-magnetic disturbances. Temposonics® MH 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.

DESIGNED FOR THE MOBILE WORLD

MH sensors are designed for mobile machines and intended for IN cylinder use. They are validated in the field by worldwide OEM’s and replace linear potentiometers and inductive sensors.
## TECHNICAL DATA

### Output
- Bus-protocol: SAE J1939, CANopen protocol according to CiA DS-301 V4.1, device profile DS-406 V3.1
- Measured value: Position and velocity

### Measurement parameters
- Stroke length: 50…2500 mm
- Resolution (position): 0.1 mm
- Resolution (velocity): 1 mm/s
- Boot up Time: 400 ms (typical)
- Cycle Time: CANopen: 1 ms (default), SAE J1939: 20 ms (default)
- Linearity: 0.050…0.0250 mm ≤ ±0.1 mm
- Internal sample rate: 1 ms
- Setpoint tolerance: ±0.2 mm
- Measured value: Position and velocity

### Operating conditions
- Operating temperature electronics: −40…+105 °C (Option: −40…+85 °C)
- Humidity: 90 % relative humidity, no condensation, EN 60068-2-30
- Ingress protection - Connector: M12 connector: IP67/IP69K (connectors correctly fitted), EN 60529
- Ingress protection – Sensor housing: IP67, EN 60529
- Shock: 100 g (11 ms) single shock per axis, IEC 60068-2-27
- 50 g (11 ms) at 1000 shocks per axis, IEC 60068-2-29
- Vibration:
  - Operational sine vibration test IEC 60068-2-6:
    - Ø 7 mm sensor rod: 15 g (5…2000 Hz)*
    - Ø 10 mm sensor rod: 20 g (5…2000 Hz)*
  - Survival random vibration test IEC 60068-2-64:
    - 20 g RMS (20…2000 Hz) 12 h per axis*
- EMC: Compliant with:
  - ISO 13766-1:2018 Earth-moving and building construction machinery
  - EN ISO 14982:2009 Agricultural and Forestry Machinery
  - EN 13309:2010 Construction machinery
  - ISO 16750-2:2012 Road vehicles
- EMI: 200 V/m (ISO 11452-2:2019 200…2000 MHz)
  - 200 mA (ISO 11452-4:2011 20…200 MHz)

### Operating pressure ratings
- Pressure (according to DIN EN ISO 19879)**
  - PN (nominal operating):
    - Ø 7 mm sensor rod: 300 bar
    - Ø 10 mm sensor rod: 350 bar
  - Pmax (max. overload):
    - Ø 7 mm sensor rod: 400 bar
    - Ø 10 mm sensor rod: 450 bar
  - Pstatic (proof pressure):
    - Ø 7 mm sensor rod: 525 bar
    - Ø 10 mm sensor rod: 625 bar

### Design / Material
- Sensor electronics housing: Stainless steel 1.4305 (AISI 303)
- Sealing: O-ring: HNBR 70
- Sensor rod:
  - Ø 7 mm sensor rod: Stainless steel 1.4301 (AISI 304)
  - Ø 10 mm sensor rod: Stainless steel 1.4306 (AISI 304L)

---

/* Resonance frequencies excluded
**/ According to calculations under use of the FKM guideline

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Ø 7 mm sensor rod</th>
<th>Ø 10 mm sensor rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic pressure: &lt; 2 × 10^6 pressure cycles</td>
<td>300 bar</td>
<td>350 bar</td>
</tr>
<tr>
<td>Static pressure: &lt; 2 × 10^6 pressure cycles</td>
<td>400 bar</td>
<td>450 bar</td>
</tr>
<tr>
<td>Proof pressure: Maximum 5 minutes testing time for cylinder pressure test</td>
<td>525 bar</td>
<td>625 bar</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 DT connector system or single wires or cable output</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>12/24 VDC nominal (8…32 VDC)</td>
</tr>
<tr>
<td>Max Inrush current</td>
<td>1.5 A/2 ms (1.0 A/2 ms if supply &lt; 13 V)</td>
</tr>
<tr>
<td>Supply voltage ripple</td>
<td>&lt; 1 % PP</td>
</tr>
<tr>
<td>Power drain</td>
<td>&lt; 1.5 W</td>
</tr>
<tr>
<td>Bus termination (HI-LO)</td>
<td>120 Ω</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>

## TECHNICAL DRAWING

### MH-Series MH

![Fig. 4: Temposonics® MH-Series MH sensor](image_url)

- **Null:** 30 mm (1.18 in.)
- **Stroke length:** 50 mm (1.96 in.) to 2500 mm (98.42 in.)
- **Dead zone:** 63.5 mm (2.49 in.) or 36.5 mm (1.44 in.)
- **Stroke length start ‘Null’ position:** 11.5 mm (0.45 in.)
- **Stroke length end ‘Span’ position:** 7 mm (0.27 in.) dia. or 10 mm (0.39 in.) dia.
CONNECTOR WIRING

M12 connector (N…F)
- Single lead wires 0.22 mm²
- Attached A-coded M12 connector attached
- Toolless assembly
- Sealing IP67, up to IP69K with plugged mating connector

**Connector wiring**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>–</td>
<td>not connected</td>
</tr>
<tr>
<td>2</td>
<td>BN</td>
<td>VDC</td>
</tr>
<tr>
<td>3</td>
<td>WH</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>YE</td>
<td>CAN_H</td>
</tr>
<tr>
<td>5</td>
<td>GN</td>
<td>CAN_L</td>
</tr>
</tbody>
</table>

View on connector

Single wires pigtail (N…A)
- Single lead wires 0.5 mm²
- Insulation PVC

**Connector wiring**

<table>
<thead>
<tr>
<th>Wire</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<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>

Fig. 5: Connector wiring
**Pigtail cable (T…A)**

- PUR cable, black
- Ø 5 mm, non-shielded, 4 × 0.5 mm²
- Flexible, oil resistance

**DT connector system S (A…S)**

- Single lead wires 0.22 mm²
- Attached DT compatible connector
- Sealing IP69K (with or without mating connector)
- Wiring sequence controlled at sensor

**Connector wiring**

<table>
<thead>
<tr>
<th>Wire</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<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>

**Pinout S**

- Pin 1: VDC
- Pin 2: CAN_L
- Pin 3: GND
- Pin 4: CAN_H

**View on connector**

Controlling design dimensions are in millimeters.
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.

**MECHANICAL INSTALLATION**

**Installation in a hydraulic cylinder**

The robust Temposonics® 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. In both installation methods, the sensor seals the cylinder by using an O-ring and backup ring which is installed on the sensor housing.

**NOTICE**

- Sealing: Take action against water ingress by sealing the cavity on the cover side.
- Cable glands should have IP69K rating.

**Pressure:**

- Do not exceed the operating pressure.

**Avoid part collision:**

- The bore depth in piston:
  - Null zone + stroke length + dead zone + > 3 mm
- The position magnet shall not touch the pressure pipe.

- Note the piston rod drilling:
  - Ø 7 mm rod: ≥ Ø 10 mm
  - Ø 10 mm rod: ≥ Ø 13 mm

**Space requirements**

### M12 connector system / cable outlet

<table>
<thead>
<tr>
<th>B</th>
<th>D</th>
<th>d</th>
<th>h</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 mm</td>
<td>48H8</td>
<td>&gt; 32.5 mm</td>
<td>&lt; 40 mm</td>
<td>21.2 mm</td>
</tr>
</tbody>
</table>

### DT connector system

<table>
<thead>
<tr>
<th>B</th>
<th>D</th>
<th>d</th>
<th>h</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 mm</td>
<td>48H8</td>
<td>&gt; 32.5 mm</td>
<td>&lt; 40 mm</td>
<td>21.2 mm</td>
</tr>
</tbody>
</table>

**NOTICE**

Installation Manual for MH sensors (document part no. 551289)

Installation Manual for DT connector system (document part no. 552093)
Set screw

- e.g. retaining with set screw (with flat point) ISO 4026 M5×10 (DIN 913).
- Fastening torque: ≤ 0.5 Nm

**NOTICE**

Avoid sensor damage:
- The screw may touch the sensor housing.
- Tightening torque: ≤ 0.5 Nm.

**Lock set screw:**
- Lock the set screw against falling out.
- Make sure that the threads are free of oil, grease and dirt.

**Sealing:**
- Consider a seal against water ingress (capillary effect).

MECHANICAL INSTALLATION – POSITION MAGNET

**Magnet installation**

1. Circclip
2. Non-magnetic spacer
3. Position magnet
4. Non-magnetic spacer (≥ 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>≥ 18 mm</td>
</tr>
<tr>
<td>Rod Ø 7 mm</td>
</tr>
<tr>
<td>Rod Ø 10 mm</td>
</tr>
</tbody>
</table>

**NOTICE**

Spacers, circlip, pretension parts etc. are not part of Temposonics shipment!

Fig. 11: Set screw

Fig. 12: Dimensions for magnet mounting

Controlling design dimensions are in millimeters
**ORDER CODE**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| M | H |   |   |   |   |   | M |   |   |   |   |   |   |   |   |   |   |   |   |
| a | b | c | d | e | f | g | h | i |   |   |   |   |   |   |   |   |   |   |   |

**a. Sensor model**

- **M H** Pressure fit flange

**b. Design**

- **Ø 10 mm rod**
  - **C** Rod: Ø 10 mm + flat end plug / Dead zone: 63.5 mm / Stroke length: 50…2500 mm
  - **E** Rod: Ø 10 mm + flat end plug / Dead zone: 36.5 mm / Stroke length: 50…1200 mm
  - **L** Rod: Ø 10 mm + end plug with female M6 thread / Dead zone: 69.5 mm / Stroke length: 50…2500 mm
  - **R** Rod: Ø 10 mm + end plug with female M4 thread / Dead zone: 69.5 mm / Stroke length: 50…1200 mm

- **Ø 7 mm rod**
  - **D** Rod: Ø 7 mm + flat end plug / Dead zone: 63.5 mm / Stroke length: 50…2500 mm
  - **F** Rod: Ø 7 mm + flat end plug / Dead zone: 36.5 mm / Stroke length: 50…1200 mm

**c. Stroke length**

- **X X X X M** 0050…2500 mm

**d. Electrical wiring**

- **M12 connector (VDC – GND – HI – LO) incl. flange**
  - **N** 60…240 mm wire length (in 20 mm steps)  
  - Examples wire length N06F = 60 mm  
  - Connector wiring: F: 2-3-4-5
  - **A** 60…240 mm wire length (in 20 mm steps)  
  - Examples wire length N20A = 200 mm

- **Single wires**
  - **N** 60…240 mm wire length (in 20 mm steps)  
  - Examples wire length N06F = 60 mm  
  - Connector wiring: F: 2-3-4-5
  - **A** 60…240 mm wire length (in 20 mm steps)  
  - Examples wire length N20A = 200 mm

- **Cable outlet**
  - **T** 300…9900 mm cable length (in 100 mm steps)  
  - Examples wire length T10A = 1000 mm

- **DT connector system (VDC – GND – HI – LO)**
  - **A** 60…240 mm wire length (in 20 mm steps)  
  - Connector wiring: 1-3-4-2

**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
  - **5** 50 kbit/s
  - **6** 20 kbit/s
  - **7** 10 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
- Backup-ring
- M12 connector system incl. M12 flange (when option selected)
- DT connector system incl. connector assembly and retainer (when option selected)

Accessories (e.g. position magnets) have to be ordered separately

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

Position magnets

<table>
<thead>
<tr>
<th>Ring magnet OD17.4</th>
<th>Ring magnet OD25.4</th>
<th>Ring magnet OD33</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 neobond</td>
<td>Material: PA ferrite</td>
<td>Material: PA ferrite GF20</td>
</tr>
<tr>
<td>Weight: Approx. 5 g</td>
<td>Weight: Approx. 10 g</td>
<td>Weight: Approx. 14 g</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>
<tr>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
</tr>
</tbody>
</table>

M12 flange

<table>
<thead>
<tr>
<th>M12 Flange</th>
<th>DT connector system retainer</th>
<th>DT connector assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part no. 253 769</td>
<td>Part no. 520 101</td>
<td>Part no. 255 098</td>
</tr>
<tr>
<td>Material: Brass, nickel-plated</td>
<td>Material: 1.4310</td>
<td>Material: PA66</td>
</tr>
<tr>
<td>Weight: Approx. 5 g</td>
<td>Weight: Ca. 1.7 g</td>
<td>Weight: Approx. 6 g</td>
</tr>
<tr>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
</tr>
</tbody>
</table>

Controlling design dimensions are in millimeters
Test kit

Test kit CANbus for US
Part no. 253 879

Kit includes:
1 × Software
1 × USB CAN-Module
1 × Manual
1 × USB cable with M12 connector and D-SUB connector
1 × cable with D-SUB connector
1 × carrying case
1 × 12 VDC power supply

Test software CANbus
Part no. 625 129

Software for MH CANbus

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)

Wiring

<table>
<thead>
<tr>
<th>Wires</th>
<th>Color</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>↔</td>
<td>1</td>
</tr>
<tr>
<td>WH</td>
<td>↔</td>
<td>2</td>
</tr>
<tr>
<td>BU</td>
<td>↔</td>
<td>3</td>
</tr>
<tr>
<td>BK</td>
<td>↔</td>
<td>4</td>
</tr>
<tr>
<td>GY</td>
<td>↔</td>
<td>5</td>
</tr>
</tbody>
</table>

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

Wiring

<table>
<thead>
<tr>
<th>Wires</th>
<th>Color</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>↔</td>
<td>1</td>
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<td>WH</td>
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<td>2</td>
</tr>
<tr>
<td>BU</td>
<td>↔</td>
<td>3</td>
</tr>
<tr>
<td>BK</td>
<td>↔</td>
<td>4</td>
</tr>
<tr>
<td>GY</td>
<td>↔</td>
<td>5</td>
</tr>
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Material: PUR jacket; black
Features: Shielded
Cable length: 5 m (16.4 ft)
Ingress protection: IP67 (correctly fitted)
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