M-Series PWM - Temposonics® MH
Magnetostrictive Linear Position Sensors

- Linear, absolute Measurement in Hydraulic Cylinders
- Non-Contact Sensing with Highest Durability
- Compact Dimensions
- Accuracy: Linearity Tolerance < ± 0.04%
- Hysteresis < ± 0.1 mm
- Direct PWM Output: Displacement
- Power Supply: 12/24 VDC
- Immunity against electromagnetic HF-fields up to 200 V/m
- Shockrating: 100 g (singlehit) / IEC 68-2-27

Designed for the Mobile World

M-Series sensors were designed with the “mobile” world in mind, and have been validated in the field by customers worldwide. Performance is second to none; high accuracy, 200 V/m EMI position output. Ruggedness is “designed in”, 100 g shock rating. The MH sensor can be fully sealed and embedded in a cylinder to ensure a long operation life. The direct connection to the Temposonics® M12 connector system and other proven mobile connectors are possible.
Magnetostriction

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.

Measuring Principle

![Measuring Principle](image)

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**Measuring Principle (simplified illustration)**

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**Simple Mechanics**

The extremely rugged sensor consist of the following main parts:

- The flange housing with signal converter and built-in electronics
- The pressure-proof sensor pipe (up to 450 bar) with flange protects the internal sensing element, the waveguide system. It fits into the bored piston rod
- The position magnet, only moving part is mounted into the piston bottom. This permanent magnet travels wearfree and contactless along the stationary sensor tube. Its magnetic field starts the measurement signal through the sensors rod wall
- The innovative Connector System can easily be mounted in a few seconds, any soldering or crimping needless, dust-and waterproof up to IP69K

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**Temposonics® MH - High Pressure Compact Sensor**

**Measuring Range 50 2500 mm**

Temposonics® MH, the new compact stainless steel position sensor is designed for installation into hydraulic cylinders, specifically for use in clevis head mobile cylinders or any space limited cylinder applications. MH type sensors are ideal choices for a wide range of standard hydraulic cylinders. Magnetostrictive displacement sensors, high quality cylinders and precise control valves form ideal driving systems for technically demanding mobile hydraulics.
### Technical Data

#### Input
- Measured variables: Displacement
- Measuring range: 50 - 2500 mm in 5 mm steps

#### Output
- Interface: PWM
- Resolution: The resolution is constant ± 0.1 mm
- Internal Cycle Time: 1 ms
- Cycle time: adjustable 1 ms...65 ms

#### Accuracy
- **Linearity:**
  - 50...250 mm ≤ ± 0.1 mm
  - 255...2000 mm ≤ ± 0.04 % full stroke
  - 2005...2500 mm ≤ ± 0.8 mm
- **Hysteresis:** ± 0.1 mm
- **Setpoint Tolerance:** ± 0.2 mm

#### Operating conditions
- **Assembly orientation:** In any direction
- **Operating temperature electronics, storage temp.:** -40°C...+105°C
- **Fluid temperature:** -30°C...+85°C
- **Dew point, humidity:** 90 % rel. humidity, no condensation acc. EN60068-2-30

#### Pressure
- **Operating pressure ratings:**
  - Ø 10 mm sensor rod
    - PN: 350 bar
    - Pmax: 450 bar
  - Ø 7 mm sensor rod
    - PN: 300 bar
    - Pmax: 400 bar
  - Pressure pulse test acc. DIN EN ISO 19879

#### IP rating
- M12 connector: IP69K plugged, EN60529
- Sensor housing: IP67, EN60529

#### Environmental testing:
- **Shock:** IEC-68-2-27
  - 100 g (11 ms) single hit
  - 50 g (11 ms) at 1000 Shocks per axis
- **Vibration:** IEC 68-2-6 (10...2000 Hz)
  - Ø 10 mm sensor rod 20g (r.m.s.)
  - Ø 7 mm sensor rod 15g (r.m.s.)
- **EMC:**
  - ISO 14982 agricultural and forestry machines
  - ISO 11452-2 (radiated immunity)
  - ISO 11452-4 (conducted immunity)
  - ISO 7637-1/2 (transient impulses)

#### Materials and dimensions
- **Sensor rod:** Stainless steel 1.4306 / AISI 304L (Ø 10 mm / Ø 7 mm)
- **Housing:** Stainless steel 1.4305 / AISI 303
- **Mechanical assembly:** Flange housing Ø 48 mm
  - O-ring 40.87 x 3.53 mm NBR 80, backup ring 42.6 x 48 x 1.4 PTFE

#### Electrical installation
- **Connector:** Connector System M12x1 with O-ring 7 x 1.35 mm NBR 70
  - Connecting flange brass nickel-plated with O-ring 13 x 1.6 NBR 70
- **Supply voltage:** 12/24 VDC (tolerance range 8 - 32 VDC)
- **Voltage supply ripple:** < 1 % p-p
- **Power drain:** < 1.5 W
- **Electric strength:** 500 VDC (DC ground to machine ground)
- **Polarity protection (GND - VDC):** Up to -36 VDC
- **Over voltage protection (GND - VDC):** Up to 36 VDC
Temposonics connector system M12

Temposonics presents the innovative Connector System for Temposonics M-Series. The Temposonics connector system meets the most exacting protection requirements important for difficult environmental conditions of mobile hydraulics applications. Protection type IP69K makes the robust metal housing not only completely dust- and waterproof, even the harshest cleaning measures can not damage the sensor.

A 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.
B The connector insert is taken out of the cylinder through a bore hole. The flange housing can be clicked in position easily from outside.
C Four standard screws must be tightened to mount the Connector System on the cylinder.
D With a corresponding mating plug the Connector System fulfills an IP rating of IP69K.
Temposonics® MH

**PWM**

**Electrical Connection / Dimensions**

M12 connector system
4 single wire, 0.5 mm²

**Pin Assignment**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>N.C.</td>
</tr>
<tr>
<td>2</td>
<td>Power Supply 12/24 VDC</td>
</tr>
<tr>
<td>3</td>
<td>DC Ground</td>
</tr>
<tr>
<td>4</td>
<td>PWM</td>
</tr>
</tbody>
</table>

**Pin Signal**

1. N.C.
2. Power Supply 12/24 VDC
3. DC Ground
4. PWM

**Pin Assignments**

1. 16H8
2. 10
3. 12
4. 24

**Pin Assignment Diagram**

**Electrical Connection / Dimensions**

M12 connector system
4 single wire, 0.5 mm²

**Zero zone**

Measuring length

50 - 2500

Damping zone

standard shortened

63.5 36.5

**Measuring start position magnet**

**Pin 1**

N.C.

**Pin 2**

Power Supply 12/24 VDC

**Pin 3**

DC Ground

**Pin 4**

PWM

**Dimensions**

**M12 connector system**

4 single wire, 0.5 mm²

**Zero zone**

Measuring length

50 - 2500

Damping zone

standard shortened

63.5 36.5

**Measuring start position magnet**

**Ring magnet Part No. 401032**

OD 17.4 mm
ID 13.5 mm
Height 8 mm
Surface pressure max. 10 N/mm²*
in axial direction

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

**Ring magnet Part No. 400533**

OD 25.4 mm
ID 13.5 mm
Height 8 mm
Surface pressure max. 40 N/mm²*
in axial direction

**Ring magnet Part No. 201542-2**

OD 33 mm
ID 13.5 mm
Height 8 mm
Fixing holes 4.2 mm, circle Ø24 mm
Surface pressure max. 40 N/mm²*
in axial direction
Fastening torque for screws M4:
max 1 Nm

All dimensions in mm.
Mechanical Installation

The robust Temposonics® MH sensor’s new stainless-steel housing 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.

Example

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, installation from the head side of the cylinder is also possible. In both installation methods, the cylinder is sealed by O-ring and backup ring which is ready installed on the sensor housing.

Installation Notes

- Use a non-ferrous circlip to fix the magnet.
- The bore in the piston rod is dependent on hydraulic pressure and piston velocity etc. The minimum drilling should be 10 (7 mm rod) or 13.5 mm (10 mm rod).

1. Installation in magnetic Material with Spacer

![Diagram 1](image)

Position magnet

nonferrous spacer

2. Installation in non-magnetic Material without Spacer

![Diagram 2](image)

Position magnet

Detail Flange Housing

![Diagram 3](image)

e.g. retaining with set screw DIN 913 M5x10 (with flat point!)
max. torque 0.5 Nm

All dimensions in mm.
Temposonics MH

**Sensor model**

MH = Hydraulic rod / Flange housing Ø 48 mm

**Form factor**

C = Rod-Ø 10 mm (damping zone 63,5 mm)
D = Rod-Ø 7 mm (damping zone 63,5 mm)
E = Rod-Ø 10 mm (reduced damping zone 36,5 mm)
F = Rod-Ø 7 mm (reduced damping zone 36,5 mm)
R = Rod-Ø 10 mm with rod end plug, threaded hole M4 (damping zone 63,5 mm)

**Measuring length**

0050 - 2500 mm in 5 mm steps

**Connection type**

Single wires with Connector System M12

N_ _E = 4 single wires, 0,5 mm² with Connector System M12 IP69K, 4 pin
N06E = 60 mm min. wire length
N25E = 250 mm max. wire length

**Input**

3 = 12/24 VDC

**Output**

P_ _ = PWM

15. digit: Span range

A = 5 - 95 %  •  B = 10 - 90 %  •  C = 15 - 85 %  •  D = 20 - 80 %  •  E = 25 - 75 %

16. digit: Frequency

A = 50 Hz  •  B = 60 Hz  •  C = 100 Hz  •  D = 200 Hz  •  E = 300 Hz  •  F = 400 Hz
G = 500 Hz  •  X = not defined

**Scope of delivery**

Position sensor, O-Ring, backup-ring

M12 connector system

Please order magnets separately!

**Accessories (selection)**

<table>
<thead>
<tr>
<th>OD17,4 Ring magnet</th>
<th>401 032</th>
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<tbody>
<tr>
<td>OD25,4 Ring magnet</td>
<td>400 533</td>
</tr>
<tr>
<td>OD33 Ring magnet</td>
<td>201 542-2</td>
</tr>
</tbody>
</table>

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