SENSOR SELECTOR GUIDE
Magnetostrictive Linear and Hall Effect Position Sensors
Mobile Hydraulics
MEETING THE CHALLENGES OF MOBILE HYDRAULICS APPLICATIONS

Agricultural • Construction • Forestry • Mining • Handling & Logistics • Municipal Vehicle • Railway Vehicle • Marine & Offshore Applications

Tempsonics also offers solutions for industrial and liquid level applications.
COMPANY

Temposonics is recognized as an industry leader in sensing technologies and solutions. These sensors and transmitters permit high-precision and dynamic position and/or speed measurement in state-of-the-art automation and safety-relevant systems. With a versatile and ever-increasing product portfolio and a focus on superior regional support, Temposonics cooperates closely with customers, to optimize performance and reduce downtimes.

Outstanding quality associated with practical know-how ensures that customers achieve utmost productivity and success. Continuous research, development and production of sensor systems constantly enable new solutions for measuring tasks in the industrial, mobile hydraulics as well as process technology fields to be created.

Since April 2021, the company Temposonics is part of Amphenol Corporation (NYSE: APH). Amphenol is one of the largest manufacturers of interconnect products in the world. The company designs, manufactures and markets electrical, electronic and fiber optic connectors, coaxial and flat-ribbon cable, and interconnect systems. As sensor solutions manufacturer, Temposonics matches the portfolio of the group of companies that are all part of Amphenol, enabling customers to benefit from an extended, complementary product selection.
MEASURING TECHNOLOGIES

M12 Connector System

The MTS Connector System M12 meets the highest protection requirements according to DIN EN 60529 - important for a harsh environment in mobile hydraulic applications. The plastic insert can be installed from inside the cylinder into the mounting flange. The flange can then be mounted to the cylinder and together provides an ingress protection level of IP69K. When properly connected, the M12 connector system protects against high pressure water cleaning.

Sensing element (waveguide)

Position magnet (magnetic field)

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 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 generated by the sensor element and 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.

The technology, based on magnetostriction, does not rely on moving parts and is not exposed to mechanical stress. Therefore, the sensors exhibit considerably longer lifespans and much higher reliability when compared to other technologies, even in harsh working conditions. Furthermore, since the output from sensors with magnetostrictive technology corresponds to an absolute position, rather than a relative value, it is not required to recalibrate sensors.

Hall Effect

Temposonics linear position sensors utilizing Hall Effect technology are able to determine position with a high level of repeatability and robustness. The sensor consists of sensing elements and supporting electronics in a robust sensor rod. The non-contacting position magnet is attached to the object in motion for the given application. The magnetic field, of the position magnet, perpendicular to the sensing elements creates a measurable (Hall) voltage which is proportional to the strength of the magnetic field. The Hall voltage is then converted into a linear position measurement. Since the output of the sensor corresponds to an absolute position, rather than a relative value, recalibration is not required.

The connector system is prefabricated and delivered in conjunction with the position sensor, i.e. its contact carrier is already connected to the sensor conductors. When mounting, the contact carrier is taken out of the cylinder through a bore hole, and the flanged housing can be clicked in position easily from outside. During installation of the cylinder unit into the mobile machine, the sensor can be connected at 8 different angles using a universal M12 connector. The minimized installation height of the connector system ensures successful cylinder mounting even under limited space conditions.
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Tempsonics offers full application support – from design to production and logistics excellence. Contact us for free support.

* specific stroke lengths, see page 20 and 21
Have you ever thought about how much time you’re wasting waiting for adequate support or your order?

Our commitment at Temposonics is to consistently deliver quality products on time to meet your schedules and provide first-class service. Trust in our continuous product development of high-performance position sensors and rely on our highly qualified personnel.

At Temposonics, we live by the promise of unparalleled service that enables us to take all available means to exceed your expectations. Our goal is to support you optimizing your productivity and we love the idea to make you save your valuable time.

Your Temposonics Team
MH-SERIES MH
Standard (In-Cylinder & External Mount)

The Temposonics® MH-Series sensors are specifically designed for direct stroke measurement in hydraulic cylinders. MH-Series sensors can be fully sealed and embedded in a cylinder while providing excellent protection against the environment and EMI and ensures a long operating life. The MH-Series sensors can be installed from the head side or the rod side of the cylinder depending on the cylinder design. The MH sensor is also available as an external threaded installation. A Temposonics M12 connector system ensures protection to IP69K. Various signal outputs (Analog, CANbus) are available.

<table>
<thead>
<tr>
<th>Output (resolution)</th>
<th>Analog Voltage/Current</th>
<th>CANbus CANopen &amp; SAE J1939</th>
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</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>(50…2500 mm: typical ±0.1 mm)</td>
<td>(Position: 0.1 mm; Velocity: 1 mm/s)</td>
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<td>MH SENSOR</td>
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<tr>
<td>Stroke length</td>
<td>50…5000 mm</td>
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</table>

MH Sensor
MH Sensor with stroke lengths up to 5000 mm

FMH Sensor
FMH Sensor with replaceable sensor element and electronics

Output (resolution)

<table>
<thead>
<tr>
<th>Analog Voltage/Current</th>
<th>CANbus CANopen &amp; SAE J1939</th>
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<tbody>
<tr>
<td>Resolution</td>
<td>(±0.2 mm)</td>
</tr>
</tbody>
</table>

Operating conditions

| Temperature            | −40…+105 °C (−40…+221 °F) |
| Shock test             | IEC 60068-2-27             |
|                        | 100 g (8 ms) single shock  |
|                        | 50 g (11 ms) at 7000 shocks per axis |
| Vibration test         | IEC 60068-2-64             |
|                        | 20 g (r.m.s.) Ø 10 mm pressure pipe |
|                        | (10…2000 Hz)              |
|                        | 15 g (r.m.s.) Ø 7 mm pressure pipe |
|                        | (10…2000 Hz) – excluding resonant frequencies |
| EMC                    | For more information see data sheet |

Design

| Stroke length         | 50…5000 mm               |

Electrical connection

| Operating voltage     | +12/24 VDC (8…32 VDC)    |

MH-SERIES FMH (Flexible MH)
Easy In-Field Serviceability

Designed for use with hydraulic cylinders in mobile applications, the externally threaded Temposonics® FMH sensor features an innovative two-part design. This design allows users to separate flexibly the sensing element and electronics from the housing without opening the hydraulic system. While it is manageable to install and remove hydraulic cylinder sensors at a manufacturing facility, it can be extremely challenging in the field. Trained service technicians can remove and replace the internal components with just 200 mm of clearance – regardless of stroke length and without breaking the hydraulic seal. This serviceability means decreased downtime and disruption, providing increased productivity. Replacement units shipped as coiled rings to ease handling and reduce shipping costs.

More information available at:
www.temposonics.com
MH-SERIES MHRM
For Railway Applications

The MHRM sensor was developed especially for railway applications and extends the portfolio of the Temposonics MH-Series sensors. It is compliant with EN 50121-3-2 and meets the special requirements for shock according to EN 61373 Cat2 (Bogie) and Cat3 (Axle), vibration according to IEC 60068-2-64 Fn Cat3 (Axle) and EMC according to DIN EN 50155.

Because of its two mounting styles, the sensor is applicable i.a. for inclination controls, in damping units or in rail processing vehicles. All MHRM sensors use the M12 connector system which meets the protection requirements to IP69K.

### Output (resolution)

- **Analog**
  - Voltage/Current
  - (typical ±0.1 mm)

- **Linearity**
  - 50…250 mm: ≤ 0.1 mm
  - 255…2000 mm: ±0.04 % (F.S.)
  - 2005…2500 mm: ≤ 0.8 mm

- **Hysteresis**
  - ≤ 0.2 mm

### Operating conditions

- **Temperature**
  - MHRM: -40…+105 °C (-40…+221 °F)
  - MHRM Threaded: -40…+105 °C (-40…+221 °F)

- **Shock test**
  - EN 61373 Cat2 (Bogie) and Cat3 (Axle)

- **Vibration test**
  - IEC 60068-2-64 Fn Cat3 (Axle)

- **EMC**
  - For more information see data sheet

### Design

- **Stroke length**
  - 50…2500 mm

### Electrical connection

- **Operating voltage**
  - +12/24 VDC (8…32 VDC)

More information available at:
www.temposonics.com
MH-SERIES MH SAFETY
SIL 2

The Temposonics® MH SAFETY sensors are specifically designed for direct stroke measurement in hydraulic cylinders. The MH-Series sensors can be installed on the head side or the rod side of the cylinder depending on the cylinder design. A Temposonics M12 connector system ensures protection to IP69K. The MH Safety models are designed according to the design principles of the IEC 61508-2/Safety Integrity Level 2). They have a Performance Level (PL) in line with ISO 13849-1 and meet the EN 954-1 standard.

Output (resolution)
- Analog: Voltage/Current (typical ±0.1 mm)
- CANbus: CANopen Safety protocol according EN 50325-5 (Position: ±0.1 mm; Velocity: ±1 mm/s)

Operating conditions
- Temperature: −40...+100 °C (−40...+212 °F)
- Shock test: IEC 60068-2-27
  - 100 g (6 ms) single shock
  - 50 g (11 ms) at 1000 shocks per axis
- Vibration test: IEC 60068-2-64
  - 25 g (sinusoidal) (10...2000 Hz)
- EMC: For more information see data sheet

Design
- Stroke length: 50...2500 mm

Electrical connection
- Operating voltage: +12/24 VDC (8...32 VDC)

Safety Classification
- IEC 61508-2: SIL 2 (Device type B)
- ISO 13849-1: PLd – Category 2

Approvals
- E1 type-approved

MH-SERIES MT
Redundant

Temposonics has developed the redundant position sensor MT to maximize safety and availability of mobile machines. The MT sensor is a redundant sensor with two discrete sensing elements, electronic boards and output connections. Both sensing elements are enclosed in a single pressure-resistant stainless steel rod for direct stroke measurement in the hydraulic cylinder, which provides excellent protection against the environment and EMI and ensures a long operating life. Dual Temposonics M12 connector systems ensure protection to IP69K.

Output (resolution)
- Analog: Voltage/Current (typical ±0.1 mm)
- CANbus: CANopen Safety protocol according EN 50325-5

Operating conditions
- Temperature: −40...+105 °C (−40...+221 °F)
- Shock test: IEC-60068-2-27
  - 100 g (6 ms) single shock
  - 50 g (11 ms) at 1000 Shocks per axis
- Vibration test: IEC 60068-2-6
  - 15 g (sinusoidal) (10...2000 Hz)
- EMC: For more information see data sheet

Design
- Stroke length: 50...2500 mm

Electrical connection
- Operating voltage: +12/24 VDC (8...32 VDC)

More information available at: www.temposonics.com
MH-SERIES MS
For Smaller Bore Cylinders

The Temposonics® MS sensors are specifically designed for direct stroke measurement in hydraulic cylinders with bore diameters of 28 mm or larger. MS-Series sensors can be fully sealed and embedded in a cylinder which provides excellent protection against the environment and EMI and ensures a long operating life. The MS-Series sensors can be installed from the head side or the rod side of the cylinder depending on the cylinder design. A Temposonics M12 connector system ensures protection to IP69K. Various signal outputs (Analog, CANbus) are available.

Output (resolution)
- Analog: Voltage/Current (Position: Typical 0.1 mm)
- CANbus: CANopen & SAE J1939 (Position: 0.1 mm; Velocity: 1 mm/s)

Operating conditions
- Temperature: -40°…+105 °C (-40°…+221 °F)
- Shock test: IEC 60068-2-27
  - 100 g (6 ms) single shock
  - 50 g (11 ms) at 1000 shocks per axis
- Vibration test: IEC 60068-2-64
  - 15 g (r.m.s.) (10…2000 Hz)
- EMC: For more information see data sheet

Design
- Stroke length: Analog: 50…2500 mm
- CANbus: 50…1500 mm

Electrical connection
- Operating voltage: +12/24 VDC (8…32 VDC)

MH-SERIES MXR
External Mount

The MH-Series Model MXR sensor is ideal for retrofitting older equipment or for external mounting. The magnetostriective sensor includes a stainless steel housing and can be mounted externally alongside a hydraulic cylinder. The MH-Series Model MXR sensor is available in two versions: the MXRC and the MXRS. Although the two versions are similar in both appearance and performance, there are unique features distinguishing the two sensors from one another. The MXRC is available in four discrete stroke lengths up to 250 mm, while the MXRS is available in stroke lengths from 100 to 500 mm (50 mm ordering increments). The MXRC works with a 5 VDC operating voltage, and provides a voltage output that is ratiometric to the operating voltage. The MXRS can work with an operating voltage of either 12 or 24 VDC, and has multiple analog and digital output options available.

Output (resolution)
- Analog: Voltage/Current (Position: Typical 0.1 mm)
- CANbus: CANopen & SAE J1939 (Position: 0.1 mm; Velocity: 1 mm/s)

Operating conditions
- Temperature: -40°…+105 °C (-40°…+221 °F)
- Shock test*: IEC 60068-2-27
  - MXRS: 100 g single shock
  - MXRC: 5 g single shock
- Vibration test*: IEC 60068-2-6
  - MXRS: 15 g (10…2000 Hz)
  - MXRC: 1 g (10…150 Hz)
- EMC: For more information see data sheet

Design
- Stroke length: MXRS: 100…500 mm
  - MXRC: 100…250 mm

Electrical connection
- Operating voltage: +12/24 VDC (8…32 VDC)

* The shock and vibration rating is stated for a fully retracted sensor. The rating for full or partially extended sensor depends on the application.
C-SERIES Compact

The Temposonics® C-Series is the smallest sensor series on the market that offers all the advantages of magnetostrictive measurement technology. This makes the C-Series ideal for integration in small applications. The low weight allows installation in small portable OEM products. Due to the contact-free measuring principle, the sensor is completely wear-free and does not have to be readjusted again. In addition, the C-Series is cost-effective and has low energy requirements with an operating supply from 5 VDC or 12 VDC.

Output (resolution)

| Output (resolution) | Analog   | Voltage (infinite) | PWM      | Controller dependent |

Operating conditions

| Temperature       | −40...+75 °C (−40...+167 °F) |
| Shock test        | IEC-68-2-27 10 g (11ms) single hit 10 g (11ms) 1000 shocks per axis |
| Vibration test    | IEC 68-2-6 (10...2000 Hz) 10 g (sinusoidal) excluding resonant frequencies |
| EMC               | For more information see data sheet |

Design

| Stroke length     | 72, 109, 128, 148, 162, 186, 194, 217, 250 mm |

Electrical connection

| Operating voltage | CS: 5 VDC (tolerance range 4.75...5.5 VDC), CM: 12 VDC (tolerance range 9...15 VDC) |

C Sensor

OEM sensor

C-SERIES Off-highway

The Temposonics® C-Series is the smallest sensor series on the market that offers all the advantages of magnetostrictive measurement technology. The C-Series mobile sensor is designed for battery powered off-highway applications found on mobile paving machines, agricultural equipment, watercraft, recreational vehicles, and others. It is ideal for measuring small cylinder strokes that are restricted by size and weight. Due to the contact-free measuring principle, the sensor is completely wear-free and does not have to be readjusted again.

Output (resolution)

| Output (resolution) | Analog   | 0.3 mm |

Operating conditions

| Temperature       | −40...+85 °C (−40...+185 °F) |
| Shock test        | IEC 60068-2-27, 100 g (6 ms) single shock per axis; IEC 60068-2-29, 50 g (11 ms) at 1000 shocks per axis |
| Vibration test    | IEC 60068-2-64 15 g RMS 2000 Hz 12 h per axis Operational sine vibration test with pressure pipe: IEC 60068-2-6 (5...2000 Hz) 25 g (10 mm) 6 sweeps per axis |
| EMC               | For more information see data sheet |

Design

| Stroke length     | 72, 109, 128, 148, 162, 186, 194, 217, 250, 275 mm |

Electrical connection

| Operating voltage | 12/24 VDC (8...32 VDC) |

More information available at:

www.temposonics.com
HE-SERIES
With Hall Effect Technology

The HE-Series utilizing Hall Effect technology is specifically designed for direct stroke measurement in hydraulic cylinders with bore diameters of 25 mm or larger. With virtually no dead zone, tight pin to pin measurements can be achieved. HE sensors can be fully sealed and embedded in a cylinder which provides excellent protection against the environment and EMI and ensures a long operating life. With six different mounting styles, the HE sensors can be installed externally from the head side or internally from the rod side of the cylinder depending on the cylinder design. A Temposonics M12 connector system ensures protection to IP69K. Analog signal outputs are available.

Output (resolution)
- Analog Voltage/Current (< 0.2 mm)

Operating conditions
- Temperature: −40…+85 °C (−40…+185 °F)
- Shock test
  - IEC 60068-2-27
  - 50 g/10 ms up to 500 mm sensor length
  - 100 g/6 ms up to 180 mm sensor length
- Vibration test
  - IEC 60068-2-6
  - 15 g (r.m.s.) (10...2000 Hz)
  - DIN EN 60068-2-64
  - 10 g (r.m.s. random)
- EMC
  - For more information see data sheet

Design
- Stroke length: 100…500 mm

Electrical connection
- Operating voltage: +5, +12, +24 VDC (4.75...32 VDC)

More information available at:
www.temposonics.com
TRUST THE EXPERTS
...AND SAVE TIME FOR THE THINGS YOU LOVE.