

Installation Manual

MH-Series XTERNAL MOUNT

Magnetostrictive Linear Position Sensors



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1. Introduction

1.1 Purpose and use of this manual

Before starting the operation of Temposonics® position sensors, read this documentation thoroughly and follow the safety information. Keep the manual for future reference!

The content of this technical documentation and of its annex is intended to provide information on mounting, installation and commissioning by qualified automation personnel ¹ or instructed service technicians who are familiar with the project planning and dealing with Temposonics® sensors.

1.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid danger that might affect the life and health of operating or service personnel or cause material damage are highlighted by the preceding pictogram which is defined below.

Symbol	Meaning
NOTICE	This symbol is used to point to situations that may lead to material damage, but not to personal injury.

2. Safety instructions

2.1 Intended use

This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation: the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

- The MH-Series sensor systems are intended exclusively for measurement tasks on mobile hydraulic equipment. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other electronic control unit.

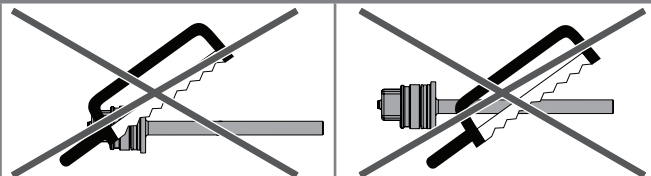
^{1/} The term qualified technical personnel characterizes persons who:

- are familiar with the safety concepts of automation technology applicable to the particular project,
- are competent in the field of electromagnetic compatibility (EMC),
- have received adequate training for commissioning and service operations
- are familiar with the operation of the device and know the information required for correct operation provided in the product documentation.

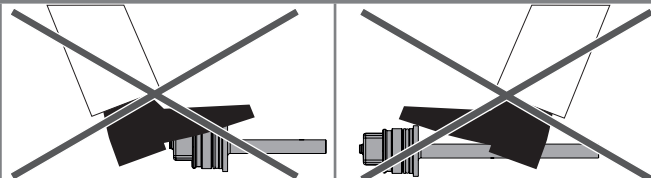
2.2 Foreseeable misuse

Foreseeable misuse	Consequence
Wrong sensor connection	The sensor will not work properly or will be destroyed
Operate the sensor out of the operating temperature range	No signal output /The sensor can be damaged
Power supply is out of the defined range	Signal output is wrong / no signal output / the sensor will be damaged
Position measurement is influenced by an external magnetic field	Signal output is wrong
Cylinder bore hole too small	Component damage due to excessive installation force required.
Cylinder bore hole after welding too small	Component damage due to excessive installation force required.
Sharp Edges	Damage to cables and conductors
Rough sensor handling	Destruction of internal components
Welding after installation	High energy voltage peaks or currents are fed to the sensor, damaging housing or electronic components.
Cables are damaged	Short circuit – the sensor can be destroyed / sensor does not respond
Loose connectors	Liquid can penetrate into the sensor housing through cables or strands and cause short circuit or corrosion of electronics components
Spacer(s) are missing or installed in wrong order	Error in position measurement
Wrong connection of ground/shield	Signal output is disturbed / The electronics can be damaged

Do not reprocess the sensor afterwards.
→ The sensor might be damaged.



Do not step on the sensor.
→ The sensor might be damaged.



2.3 Installation, commissioning and operation

The position sensors must be used only in technically safe condition. To maintain this condition and to ensure safe operation, installation, connection and service, work may be performed only by qualified technical personnel.

If danger of injury to persons or of damage to operating equipment is caused by sensor failure or malfunction, additional safety measures such as plausibility checks, limit switches, EMERGENCY STOP systems, protective devices etc. are required. In the event of trouble, shut down the sensor and protect it against accidental operation.

Safety instructions for commissioning

To maintain the sensor operability, it is mandatory to follow the instructions given below.

1. Protect the sensor against mechanical damage during installation and operation.
2. Connect the sensor very carefully and pay attention to the polarity of connections and power supply.
3. Use only approved power supplies.
4. Ensure that the specified permissible limit values of the sensor for operating voltage, environmental conditions, etc. are met.
5. Check the function of the sensor regularly and provide documentation of the checks.
6. Before applying power, ensure that nobody's safety is jeopardized by starting machines.

2.4 Safety instructions for use in explosion-hazardous areas

The sensor is not suitable for operation in explosion-hazardous areas.

2.5 Warranty

Temposonics grants a warranty period for the Temposonics® position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application². The Temposonics obligation is limited to repair or replacement of any defective part of the unit. No warranty can be provided for defects that are due to improper use or above average stress of the product, as well as for wear parts. Under no circumstances will Temposonics accept liability in the event of offense against the warranty rules, no matter if these have been assured or expected, even in case of fault or negligence of the company. Temposonics explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to increase or change the scope of warranty.

2.6 Return

For diagnostic purposes, the sensor can be returned to Temposonics. Any shipment cost is the responsibility of the sender². For a corresponding form, see chapter "5. Appendix - Safety declaration".

^{2/} See also applicable Temposonics sales and delivery on www.temposonics.com

3. Identification

3.1 Order code of Temposonics® XTERNAL MOUNT – Full assembly (Analog output)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
X	M	H						M	A	G			3			
a		b		c					d		e		f	g		

a	Sensor model	
X	M	XTERNAL MOUNT

b	Design	
Full assembly		
H	B	Rod: Ø 5 mm/dead zone: 36.5 mm/stroke length: 50...1000 mm/flat endplug
H	D	Rod: Ø 7 mm/dead zone: 63.5 mm/stroke length: 50...2500 mm/flat endplug
H	F	Rod: Ø 7 mm/dead zone: 36.5 mm/stroke length: 50...2500 mm/flat endplug
H	J	Rod: Ø 7 mm/dead zone: 65 mm/stroke length: 50...2500 mm/conical endplug
H	Y	Rod: Ø 7 mm/dead zone: 38 mm/stroke length: 50...2500 mm/conical endplug

c	Stroke length	
X	X	X X M 0050...2500 mm in 5 mm steps (rod: Ø 7 mm)
X	X	X X M 0050...1000 mm in 5 mm steps (rod: Ø 5mm)

d	Electronics module connector	
DEUTSCH® style connector (DT/AT 04-4P) (VDC – GND – SIG)		
A	G	Connector wiring G: 1-3-4

e	Sensing element wire length	
0	5	50 mm (default)
0	8	75 mm
1	0	100 mm
1	5	150 mm

f	Operating voltage	
3	12/24 VDC nominal (8...32 VDC)	

g	Output	
V	1	1 0.25...4.75 VDC
V	1	2 0.5...4.5 VDC
V	1	5 0.15...4.9 VDC
A	0	1 4...20 mA

3.2 Order code of Temposonics® XTERNAL MOUNT – Full assembly (CANbus output)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
X	M	H						M	A	S			3							
a		b		c					d		e		f	g			h	i		j

a	Sensor model
X M	XTERNAL MOUNT

b	Design
Full assembly	
H B	Rod: Ø 5 mm/dead zone: 36.5 mm/stroke length: 50...1000 mm/flat endplug
H D	Rod: Ø 7 mm/dead zone: 63.5 mm/stroke length: 50...2500 mm/flat endplug
H F	Rod: Ø 7 mm/dead zone: 36.5 mm/stroke length: 50...2500 mm/flat endplug
H J	Rod: Ø 7 mm/dead zone: 65 mm/stroke length: 50...2500 mm/conical endplug
H Y	Rod: Ø 7 mm/dead zone: 38 mm/stroke length: 50...2500 mm/conical endplug

c	Stroke length
X X X X M	0050...2500 mm in 5 mm steps (rod: Ø 7 mm)
X X X X M	0050...1000 mm in 5 mm steps (rod: Ø 5mm)

d	Electronics module connector
DEUTSCH® style connector (DT/AT 04-4P) (VDC – GND – HI – LO)	
A S	Connector wiring S: 1-3-4-2

e	Sensing element wire length
0 5	50 mm (default)
0 8	75 mm
1 0	100 mm
1 5	150 mm

f	Operating voltage
3	12/24 VDC nominal (8...32 VDC)

g	Output
C 0 1	CANopen
J 0 1	SAE J1939

h	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
7	20 kbit/s
8	10 kbit/s
SAE J1939 (J01)	
2	500 kbit/s
3	250 kbit/s

i	Node ID/Source Address
CANopen (C01)	
	Hex 01...7F
SAE J1939 (J01)	
	Hex 01...FD

j	Cycle time
A	01 msec
B	05 msec
C	10 msec
D	20 msec
E	30 msec
F	40 msec
G	50 msec

3.3 Order code of Temposonics® XTERNAL MOUNT – Electronics module (Analog output)

1	2	3	4	5	6	7	8	9	10
X	M	L	A	A	G	3			
a		b		c		d	e		

a	Sensor model		
X	M	XTERNAL MOUNT	

b	Design		
Electronics module			
L	A	Electronics module with analog output	

c	Electronics module connector		
DEUTSCH® style connector (DT/AT 04-4P) (VDC – GND – SIG)			
A	G	Connector wiring G: 1-3-4	

d	Operating voltage		
3	12/24 VDC nominal (8...32 VDC)		

e	Output		
V	1	1	0.25...4.75 VDC
V	1	2	0.5...4.5 VDC
V	1	5	0.15...4.90 VDC
A	0	1	4.00...20.0 mA

3.4 Order code of Temposonics® XTERNAL MOUNT – Electronics module (CANbus output)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
X	M	L	A	A	S	3							
a		b		c		d	e			f	g		h

a	Sensor model
X M	XTERNAL MOUNT

b	Design
Electronics module	
L A	Electronics module with CANBus output

c	Electronics module connector
DEUTSCH® style connector (DT/AT 04-4P) (VDC – GND – HI – LO)	
A S	Connector wiring S: 1-3-4-2

d	Operating voltage
3	12/24 VDC nominal (8...32 VDC)

e	Output
C 0 1	CANopen
J 0 1	SAE J1939

f	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
7	20 kbit/s
8	10 kbit/s
SAE J1939 (J01)	
2	500 kbit/s
3	250 kbit/s

g	Node ID/Source Address
CANopen (C01)	
	Hex 01...7F
SAE J1939 (J01)	
	Hex 01...FD

h	Cycle time
A	01 msec
B	05 msec
C	10 msec
D	20 msec
E	30 msec
F	40 msec
G	50 msec

3.5 Order code of Temposonics® XTERNAL MOUNT – Sensing element and pressure pipe assembly (all outputs)

1	2	3	4	5	6	7	8	9	10	11
X	M	S						M		
a		b		c					d	

a Sensor model

X	M	XTERNAL MOUNT
---	---	---------------

b Design

Sensor element

S	B	Rod: Ø 5 mm/dead zone: 36.5 mm/stroke length: 50...1000 mm/flat endplug
S	D	Rod: Ø 7 mm/dead zone: 63.5 mm/stroke length: 50...2500 mm/flat endplug
S	F	Rod: Ø 7 mm/dead zone: 36.5 mm/stroke length: 50...2500 mm/flat endplug
S	J	Rod: Ø 7 mm/dead zone: 65 mm/stroke length: 50...2500 mm/conical endplug
S	Y	Rod: Ø 7 mm/dead zone: 38 mm/stroke length: 50...2500 mm/conical endplug

c Stroke length

X	X	X	X	M	0050...2500mm in 5 mm steps (rod: Ø 7mm)
X	X	X	X	M	0050...1000 mm in 5 mm steps (rod: Ø 5mm)

d Sensing element wire length

0	5	50 mm (default)
0	8	75 mm
1	0	100 mm
1	5	150 mm

3.6 Nameplate

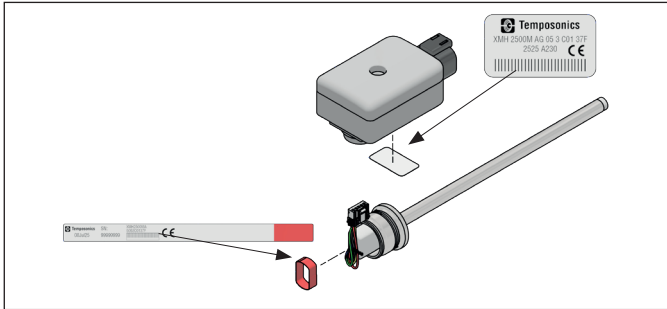


Fig. 1: Example of nameplate

Nameplate includes:

- Model Number
- Serial Number
- Date Code (DD MM YY)

3.7 Scope of delivery

XTERNAL MOUNT (full assembly):

- Full assembly with O-ring
- Sensing element assembled in pressure pipe with O-ring and Backup-ring
- M5x30 mounting screw DIN 7984 M5 x 30-A2

XTERNAL MOUNT (electronics module):

- Electronics module with O-ring
- M5x30 mounting screw DIN 7984 M5 x 30-A2

XTERNAL MOUNT (sensing element):

- Sensing element assembled in Pressure pipe with O-ring and Backup-ring

4. Product description and commissioning

4.1 Functionality and system design

Product designation

- Position sensor Temposonics® MH-Series XTERNAL MOUNT

Sensor model

- Temposonics® XTERNAL MOUNT

Stroke length

- 50...2500 mm with 7 mm pipe
- 50...1000 mm with 5 mm pipe

Output signal

- Analog (Voltage/Current)
- CANbus (SAE J1939, CANopen)

Principle of operation and system construction

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary Temposonics® 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.

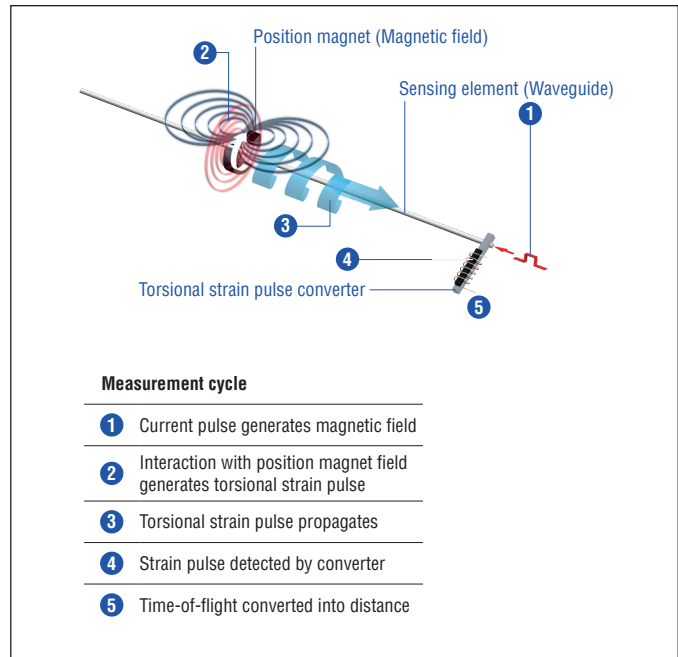


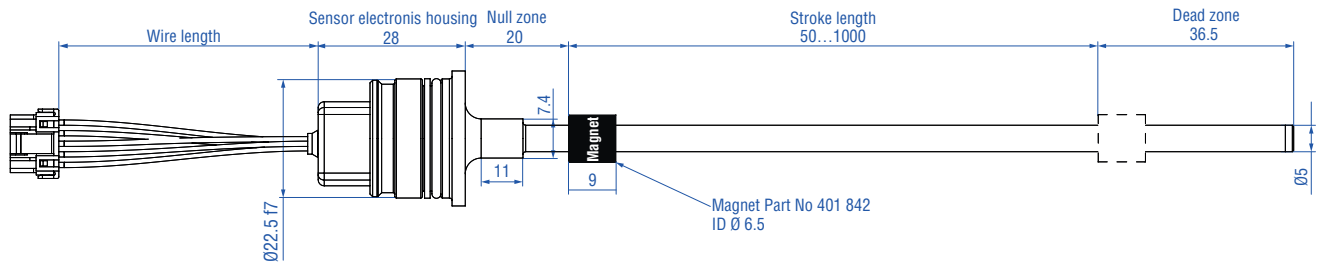
Fig. 2: Principle of operation: Time-based magnetostrictive position sensing principle

Modular mechanical and electronic construction

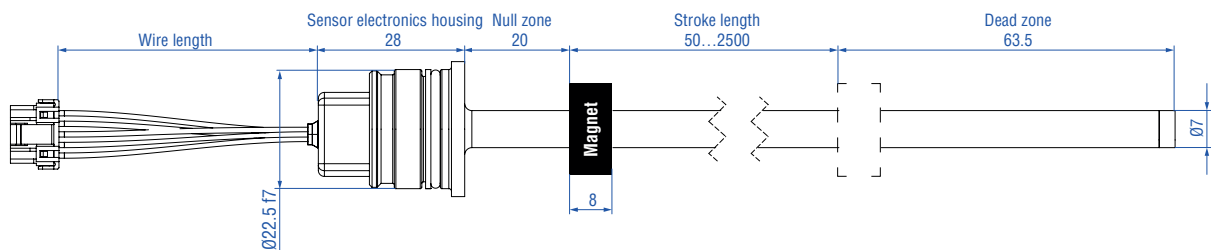
- The sensor rod protects the inner sensor element.
- The sensor electronics housing, an enclosure mounted outside of the cylinder, contains the electronic interface with active signal conditioning.
- The position magnet travels along the sensor rod and triggers the measurement through the sensor rod wall.
- The sensor can be connected directly to a control system.

4.2 Styles and installation of Temposonics® XTERNAL MOUNT

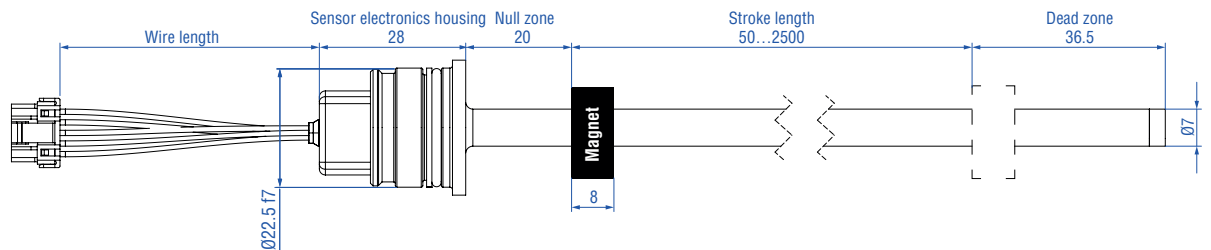
XM-HB – Ø 5 mm pressure pipe dead zone: 36.5 mm stroke length: 50...1000 mm (flat endplug)



XM-HD – Ø 7 mm pressure pipe dead zone: 63.5 mm stroke length: 50...2500 mm (flat endplug)



XM-HF – Ø 7 mm pressure pipe dead zone: 36.5 mm stroke length: 50...2500 mm (flat endplug)



Controlling design dimensions are in millimeters

Fig. 3: Temposonics® MH-Series XTERNAL MOUNT

NOTICE

See figure 9 section 4.6 for detailed dimensions

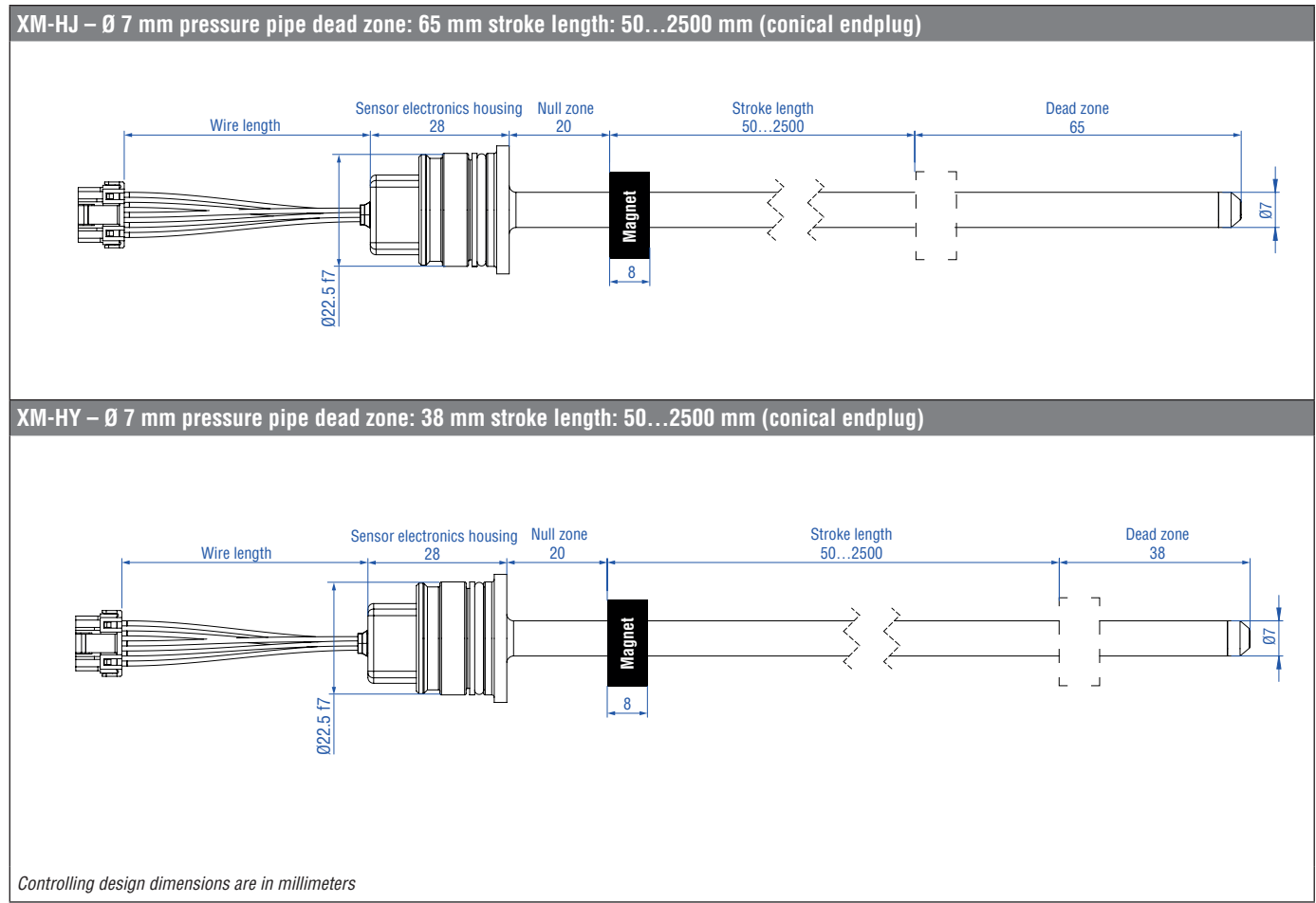
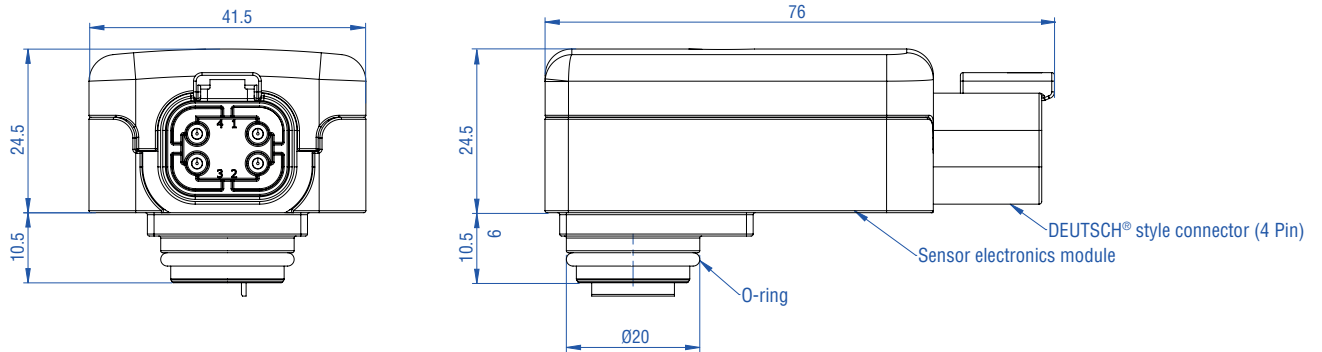


Fig. 4: Temposonics® MH-Series XTERNAL MOUNT

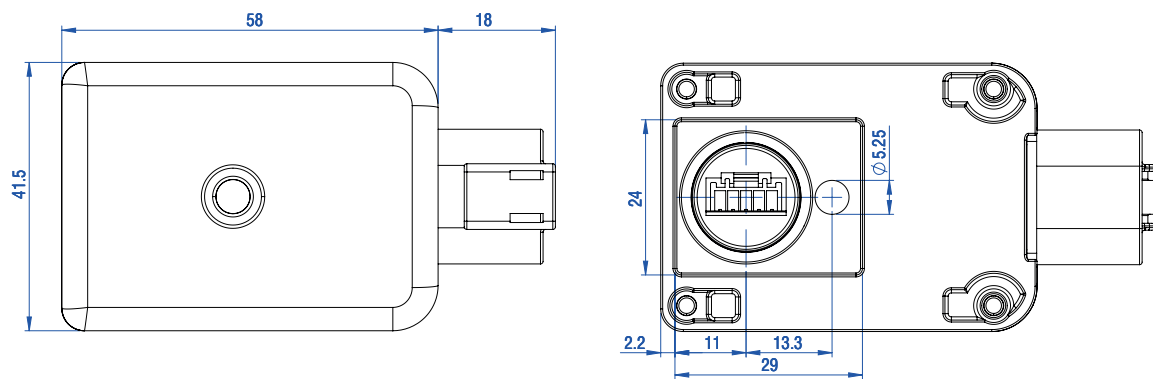
XM-LA – Electronics module with DEUTSCH® style connector



Controlling design dimensions are in millimeters

Fig. 5: Temposonics® XTERNAL MOUNT sensor electronics module side view

XM-LA – Sensor electronics module with DEUTSCH® style connector

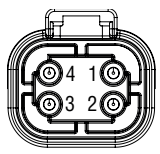


Controlling design dimensions are in millimeters

Fig. 6: Temposonics® XTERNAL MOUNT sensor electronics module top and bottom view

4.3 Connector wiring of Temposonics® XTERNAL MOUNT

DEUTSCH® style connector (DT/AT 04-4P)



View on connector

	Analog (G)	CANbus (S)
Pin	Function	Funktion
1	VDC	VDC
2	not connected	CAN_L
3	GND	GND
4	SIG	CAN_H

NOTICE

The external electronics module uses a rectangular DEUTSCH® style connector for both Analog and CANbus configurations. The connector is comparable to a DT04-4P or Amphenol AT04-4P. For wiring harnesses connecting to the XTERNAL MOUNT sensor, a mating socket such as a DEUTSCH® DT06-4S or Amphenol AT06-4S is recommended.

Fig. 7: Connector wiring

4.4 Temposonics® XTERNAL MOUNT – Cylinder installation

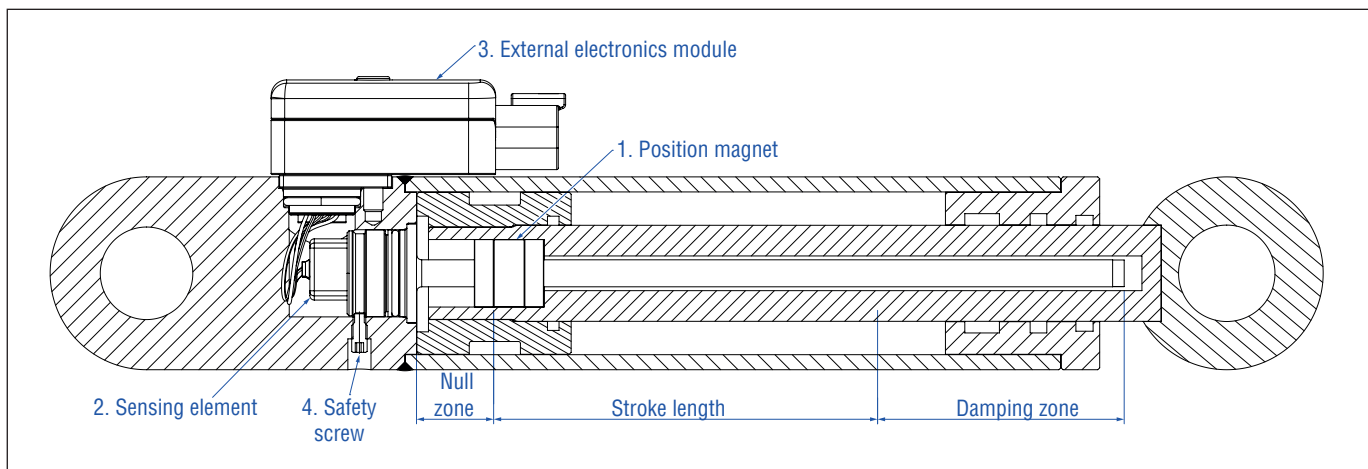


Fig. 8: Cylinder installation

Overview of XTERNAL MOUNT installation in a hydraulic cylinder

1. Position magnet mounting to cylinder rod
2. Sensing element
3. External electronics module
4. Safety screw

NOTICE

Installation dimensions may vary depending on the type of cylinder and the desired mounting of the sensor connector.

NOTICE

Spacer, circlip, safety screw, magnet retention parts, etc. are not provided by Temposonics.

A DIN 7984 M5 x 30, 8.8 screw is provided with the full assembly of the XTERNAL MOUNT sensor to retain the electronics module assembly to the cylinder.

4.5 Installing position magnet

Magnet installation

1	Circlip		
2	Non-magnetic spacer (≥ 5 mm)		
3	Position magnet		
4	Non-magnetic spacer (≥ 5 mm)		
	401 032	400 533	401 842
A	14.7 mm	25.4 mm	9 mm
B	≥ 18 mm	≥ 18 mm	≥ 19 mm
	Sensor rod		Piston rod drilling
C	Ø 7 mm Ø 5 mm		Ø 10 mm Ø 7 mm

- Magnet and spacers are typically fastened into piston using a circlip/retaining ring 1
- Note - Use a LOW PROFILE Internal retaining ring to prevent wear against the sensor pipe during cylinder operation.
- A non-magnetic spacer 4 is required to offset the ring magnet from a magnetic piston face.
- A second non-magnetic spacer 2 is optional.
- The retaining ring and spacers are not supplied by Temposonics and typically specified by the cylinder manufacturer.

Fig. 9: Assembly sequence of magnet

4.6 Temposonics® XTERNAL MOUNT – Electronics module replacement procedure

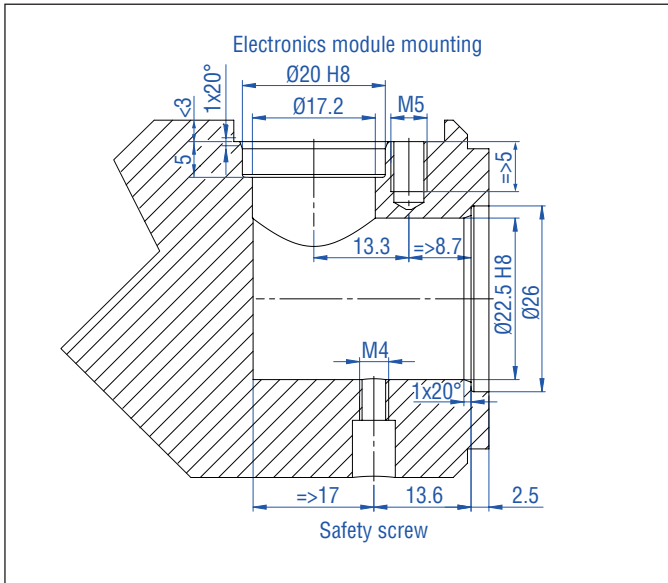


Fig. 10: Mounting dimensions for Sensing Element and Electronics Assembly

Chamfered edge for insertion

For correct and easy sensor mounting in the cylinder, a chamfered edge as shown in the drawing is required. To avoid damaging the O-ring during installation, the radius at the transition from borehole to chamfered edge must be R0.6-R1. Without this radius, there would be a sharp edge, which could damage the O-ring.

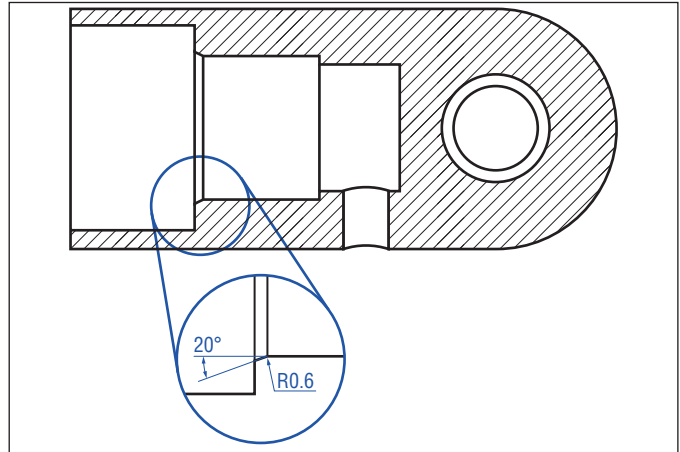


Fig. 11: Sensing Element feed-in chamfer

4.6.1 Installing sensing element and electronic assembly

Required feed-in chamfer

- For correct and easy mounting in the cylinder, a chamfered edge as shown in the drawings above is required. To avoid damaging the O-ring during installation, the radius at the transition from bore hole to chamfered edge must be R0.6 – R1. Without this radius, there would be a sharp edge, which could damage the O-ring.
- A 20 degree lead in angle long enough to capture the O-ring is recommended.

Safety screw

To securely retain the sensing element within the cylinder, a DIN 915 M4x10 extended tip safety screw (set screw) should be used. This safety screw is only required for fixing the sensor housing in axial direction and needs to butt only against the groove, i.e. the screw may be tightened only with a torque of 0.5 Nm to prevent damaging the sensor. The set screw should be inserted with a resoluble safety adhesive, e.g. Loctite blue.

Not recommended:

- Hexagon head screws
- Countersunk/flat head screws
- Self-tapping screws

NOTICE

Sealing:

- Take action against water ingress by sealing the cavity on the cover side.

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: $\geq \text{Ø } 10\text{mm}$ for $\text{Ø } 7\text{mm}$ rod and $\geq \text{Ø } 7\text{mm}$ for $\text{Ø } 5\text{mm}$ rod

NOTICE

To avoid sensor damage:

- Do not select a screw with a sharp point
- Tightening torque: $\leq 0.5 \text{ Nm}$.

Set screw:

- The dimensions of screw for mounting the electronics module should be selected so that it does not interfere with the set screw location.
- DIN 915 M4 extended tip recommended M5 or M4 screw (with flat or cup end) may used
- For M5, ensure that the screw lands on the angled side of the set screw channel
- Note: M5 screw may not seat completely into the set screw channel, but will properly retain the sensor
- M4 screw (with flat or cup end) will seat completely

Sealing:

- It is recommended to seal the set screw cavity against water ingress

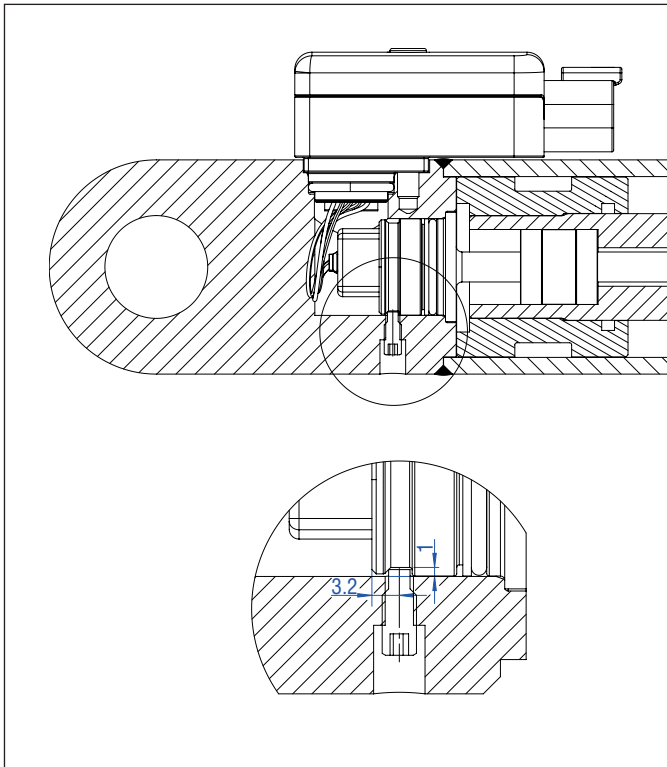


Fig. 12: Sensing element details for safety screw mounting

4.6.2 Electronics module installation

Required feed-in chamfer

- For correct and easy sensor mounting of the Electronics Module, a chamfered edge as shown in figure 11 is required. To avoid damaging the O-ring during installation, the radius at the transition from bore hole to chamfered edge must be R0.6 – R1. Without this radius, there would be a sharp edge, which could damage the O-ring.
- A 20 degree lead in angle long enough to capture the O-ring is recommended.

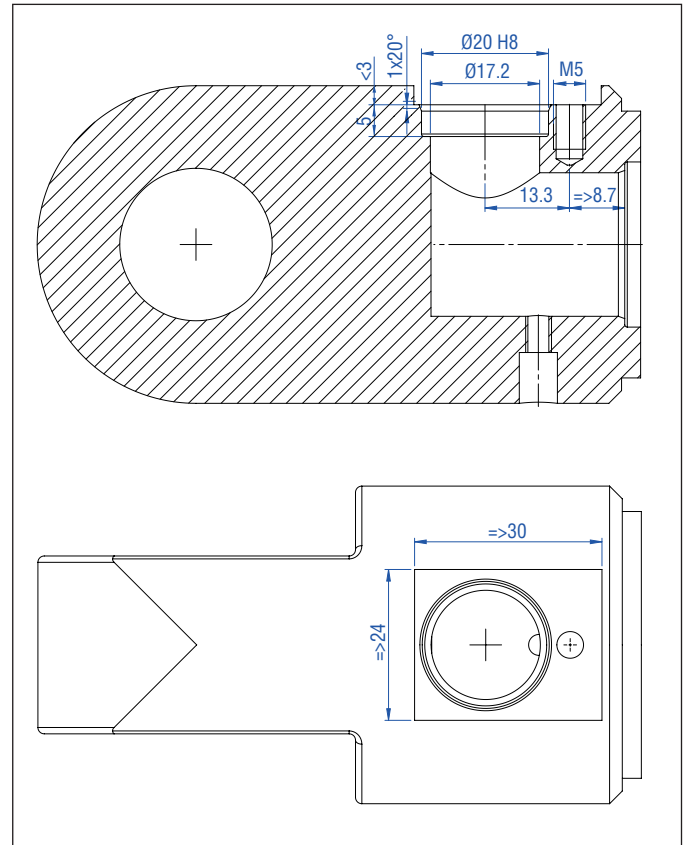


Fig. 13: Electronics assembly port dimensions

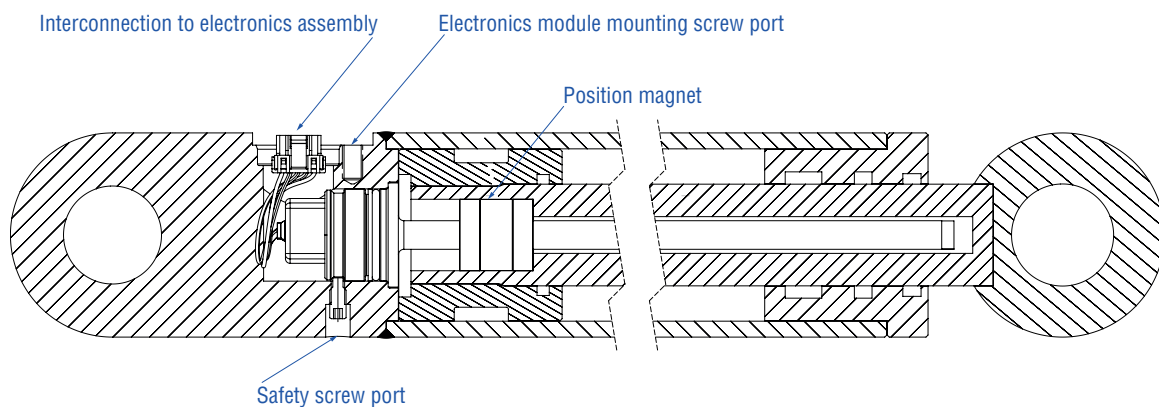
NOTICE

Take care to mount the Electronics Module in a location that does not interfere with the safety screw.

Electronics module assembly screw

A DIN 7984 M5 x 30, 8.8 screw is provided with the full assembly of the XTERNAL MOUNT sensor to retain the electronics assembly to the cylinder. The screw should be inserted with a resoluble safety adhesive, e.g. loctite blue 243®, and tightened to a torque of 6Nm. Special care should be taken to ensure the screw does not break through to the sensing element cavity or other pressurized areas of the cylinder.

4.6.3 Sensing element and electronics module installation procedure



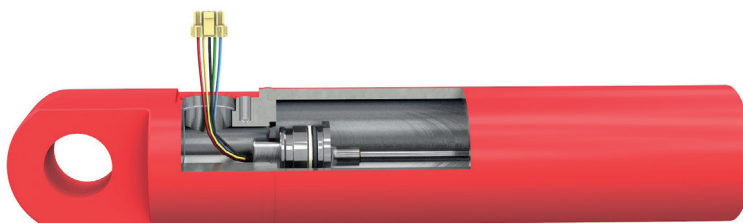
Step 1: Lubricate sensor O-ring and backup ring before mounting



NOTICE

Feed the plastic interconnection through the cylinder wall carefully. (note: rigid wire and a short piece of flexible tubing may be used as a guide). Make sure to keep the conductors away from sharp or pointed edges

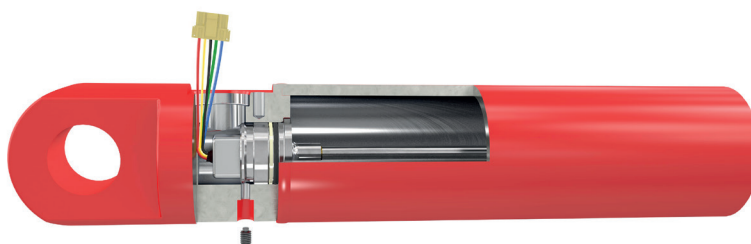
Step 2: Pull the connector through the cavity and out of the port. Carefully engage the sensor o-ring and seat the sensor fully into the cavity backstop.



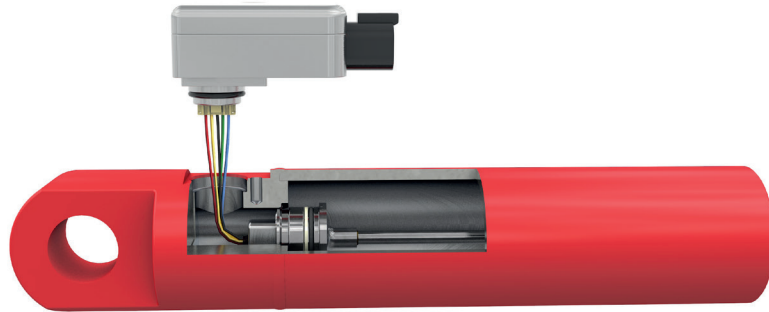
NOTICE

Do not hit the sensor during installation. Never use a steel hammer. Do not hit the sensor during installation. Shock may cause damage.

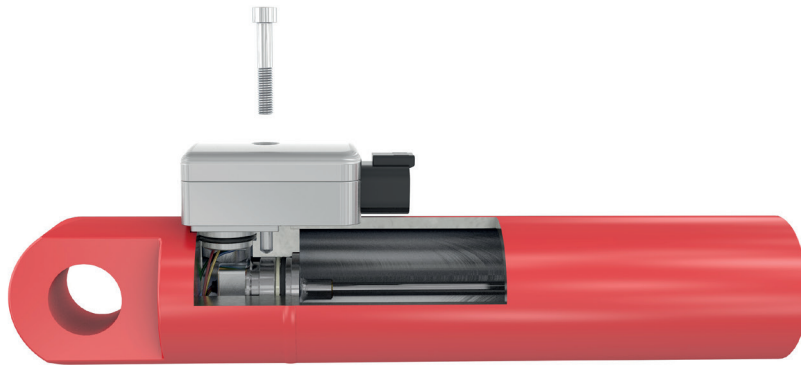
Step 3: Apply resolvable safety adhesive and install M4x10 Safety Screw and tighten (recommended torque 0.5m Nm)



Step 4: Lubricate electronics assembly O-rings and insert fully into the port.



Step 5: Apply resoluble safety adhesive and fasten using included M5x30, 8.8 screw to a torque of 6Nm.



Step 6: Finished installation



4.7 Frequently ordered accessories

Position magnets			
<p>Ring magnet OD17.4 Part no. 401 032</p>	<p>Ring magnet OD25.4 Part no. 400 533</p>	<p>Ring magnet OD9 Part no. 401 842</p>	<p>Ring magnet OD28 Part no. 400 424</p>
<p>Material: PA neobond Weight: Approx. 5 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm² Operating temperature: -40...+120 °C (-40...+248 °F)</p>	<p>Material: Strontium ferrite compound nylon 12 Weight: ca. 1 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p>Material: Composite PA ferrite GF20 Weight: Approx. 6 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+100 °C (-40...+212 °F)</p>

Position magnet	Test kit	Test software
<p>Ring magnet OD20 Part no. 254 012</p>	<p>Test kit Analog Part no. 280 618</p>	<p>Testsoftware CANbus Part no. 625 129</p>
<p>Material: Composite neobond Weight: Approx. 8.5 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p>Kit includes: 1 × MH-Series Analog / PWM Tester 1 × 12 VDC battery charger with adapter (adapter main plug EU, adapter main plug UK) 1 × cable with M12 connector 1 × cable with pigtailed wires 1 × carrying case</p>	<p>Software for MH CANbus</p>

Controlling design dimensions are in millimeters

5. Technical Data

5.1 Technical data of Temposonics® XTERNAL MOUNT Analog

Output	
Voltage	0.15...4.9 VDC/0.25...4.75 VDC/0.5...4.5 VDC
Current	4...20 mA
Measured value	Position
Measurement parameters	
Stroke length	50...2500 mm mit 7 mm pipe 50...1000 mm mit 5 mm pipe
Resolution	±0.1 mm
Power up time	200 ms (typical)
Repeatability	±0.1 mm
Linearity	0050...0250 mm ≤ ±0.2 mm 0255...2000 mm ±0.04 % (F.S.) 2005...2500 mm ≤ ±0.8 mm
Internal sample rate	2 ms
Setpoint tolerance	≤ 1 mm
Operating conditions	
Operating temperature electronics	-40...+105 °C
Humidity	90 % relative humidity, no condensation, EN 60068-2-30
Ingress protection – Electronics module	IP67/IP69K EN60529 (when properly mounted)
Shock test	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 test	Operational sine vibration test IEC 60068-2-6: 20 g (20...2000 Hz) with 7 mm pipe 15 g (20...2000 Hz) with 5 mm pipe Survival random vibration test IEC 60068-2-64: 15 g RMS (20...2000 Hz) 72 h per axis with 7 mm pipe and 5 mm pipe
EMC	Compliant with: ISO 13766-1:2018 Earth-moving and building construction machinery ISO 16750-2:2012 Road vehicles
EMI	200 V/m (200...1000 MHz), ISO 11452-2: 2019 200 mA (20...400 MHz), ISO 11452-4: 2020
Operating pressure ratings	
	Pressure (according to DIN EN ISO 19879)*
PN (nominal operating)	350 bar with 7 mm pipe 300 bar with 5 mm pipe
Pmax (max. overload)	450 bar with 7 mm pipe 350 bar with 5 mm pipe
Pstatic (proof pressure)	625 bar with 7 mm pipe 400 bar with 5 mm pipe
Design/Material	
Sensor electronics module	Zinc Alloy ZP5 (ZnAl4Cu1)
Sensor rod	Stainless steel 1.4306 (AISI 304L)
Sealing	O-rings: H-NBR 70

* / According to calculations under use of the FKM guideline

Cycles	Sensor pipe
Dynamic pressure: > 2 × 10 ⁶ pressure cycles	350 bar with 7 mm pipe 300 bar with 5 mm pipe
Static pressure: > 2 × 10 ⁴ pressure cycles	450 bar with 7 mm pipe 350 bar with 5 mm pipe
Proof pressure: Maximum 5 minutes testing time for cylinder pressure test	625 bar with 7 mm pipe 400 bar with 5 mm pipe

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Electrical connection	
Connection type	DEUTSCH® style connector DT/AT 04-4P)
Operating voltage	12/24 VDC nominal (8...32 VDC)
Min load resistance (output VDC)	10 kΩ
Max Inrush current	3.0 A/2 ms (1.5 A/2 ms if supply < 13 V)
Supply voltage ripple	< 1 % _{PP}
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)

5.2 Technical data of Temposonics® XTERNAL MOUNT CANbus

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 for 7 mm pipe 50...1000 mm for 5 mm pipe
Resolution (position)	±0.1 mm
Resolution (velocity)	1 mm/s
Boot up time	400 ms (typical)
Cycle time	Programmable
Linearity	0050...0250 mm ≤ ±0.2 mm 0255...2000 mm ±0.04 % (F.S.) 2005...2500 mm ≤ ±0.8 mm
Internal sample rate	1 ms
Setpoint tolerance	±0.5 mm
Operating conditions	
Operating temperature electronics	-40...+105 °C
Humidity	90 % relative humidity, no condensation, EN 60068-2-30
Ingress protection – Electronics module	P67/IP69K EN60529 (when properly mounted)
Shock test	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 test	Operational sine vibration test IEC 60068-2-6: 20 g (20...2000 Hz) Survival random vibration test IEC 60068-2-64: 15 g RMS (20...2000 Hz) 12 h per axis
EMC	Compliant with: ISO 13766-1:2018 Earth-moving and building construction machinery ISO 16750-2:2012 Road vehicles
EMI	200 V/m (200...2000 MHz), ISO 11452-2: 2019 200 mA (20...200 MHz), ISO 11452-4: 2011
Operating pressure ratings	
	Pressure (according to DIN EN ISO 19879)*
PN (nominal operating)	350 bar with 7 mm pipe 300 bar with 5 mm pipe
Pmax (max. overload)	450 bar with 7 mm pipe 350 bar with 5 mm pipe
Pstatic (proof pressure)	625 bar with 7 mm pipe 400 bar with 5 mm pipe
Design/Material	
Sensor electronics module	Zinc Alloy ZP5 (ZnAl4Cu1)
Sensor rod	Stainless steel 1.4306 (AISI 304L)
Sealing	O-rings: H-NBR 70

*/ According to calculations under use of the FKM guideline

Cycles	Sensor pipe
Dynamic pressure: > 2 × 10 ⁶ pressure cycles	350 bar with 7 mm pipe 300 bar with 5 mm pipe
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Connection type	DEUTSCH® style connector DT/AT 04-4P)
Operating voltage	12/24 VDC nominal (8...32 VDC)
Max Inrush current	3.5 A/2 ms (2.0 A/2 ms if supply < 13 V)
Supply voltage ripple	< 1 % _{pp}
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)

6. Appendix - Safety declaration

Dear Customer,

If you return one or several sensors for checking or repair, we need you to sign a safety declaration. The purpose of this declaration is to ensure that the returned items do not contain residues of harmful substances and/or that people handling these items will not be in danger.

Temposonics order code: _____ Sensor model(s): _____

Serial number(s): _____ Stroke length(s): _____

The sensor has been in contact with the following materials:

Do not specify chemical formulas.
 Please include safety data sheets of the substances, if applicable.

In the event of suspected penetration of substances into the sensor,
 consult Temposonics to determine measures to be taken before
 shipment.

Short description of malfunction:

Corporate information

Company: _____

Address: _____

Contact partner

Phone: _____

Fax: _____

Email: _____

We hereby certify that the measuring equipment has been cleaned and neutralized.
 Equipment handling is safe. Personnel exposure to health risks during transport and repair is excluded.

Stamp

Signature

Date

Temposonics, LLC Tel. +1 919 677-0100
 3001 Sheldon Drive Fax +1 (919) 677-0200
 Cary, N.C. 27513 info.us@temposonics.com
 United States www.temposonics.com

Temposonics GmbH & Co.KG Tel. +49 2351/95 87-0
 Auf dem Schüffel 9 Fax. +49 2351/56 49 1
 58513 Lüdenscheid info.de@temposonics.com
 Germany www.temposonics.com

UNITED STATES
Temposonics, LLC
Americas & APAC Region
3001 Sheldon Drive
Cary, N.C. 27513
Phone: +1 919 677-0100
E-mail: info.us@temposonics.com

GERMANY
Temposonics
GmbH & Co. KG
EMEA Region & India
Auf dem Schüffel 9
58513 Lüdenscheid
Phone: +49 2351 9587-0
E-mail: info.de@temposonics.com

ITALY
Branch Office
Phone: +39 030 988 3819
E-mail: info.it@temposonics.com

FRANCE
Branch Office
Phone: +33 6 14 060 728
E-mail: info.fr@temposonics.com

UK
Branch Office
Phone: +44 79 21 83 05 86
E-mail: info.uk@temposonics.com

SCANDINAVIA
Branch Office
Phone: +46 70 29 91 281
E-mail: info.sca@temposonics.com

CHINA
Branch Office
Phone: +86 21 3405 7850
E-mail: info.cn@temposonics.com

JAPAN
Branch Office
Phone: +81 3 6416 1063
E-mail: info.jp@temposonics.com

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