

Temposonics®

Magnetostrictive Linear Position Sensors

MH-Series MH Analog Data Sheet

- 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 MTS Sensors 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.

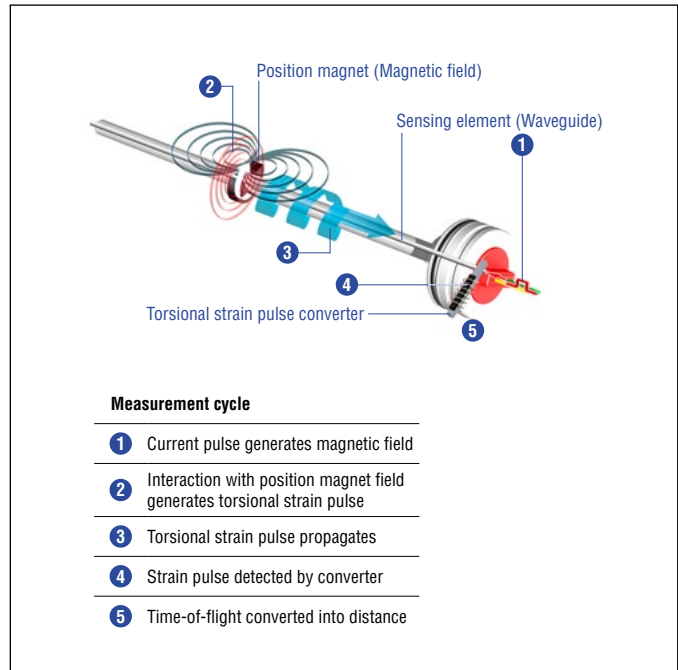


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

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.



Fig. 2: Typical applications

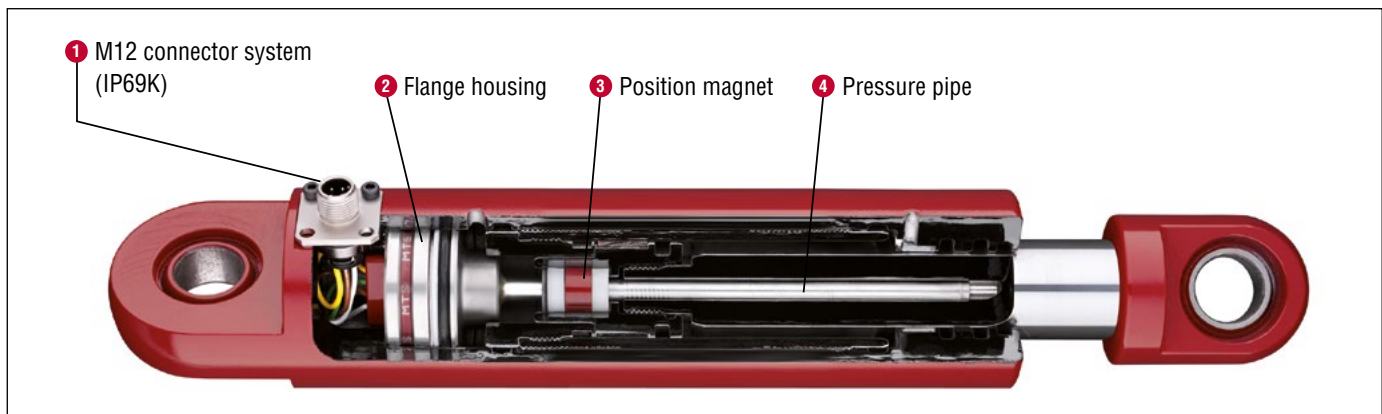


Fig. 3: IN cylinder installation

TECHNICAL DATA

Output			
Signal characteristic	Analog output restricted by noise or A/D converter of control unit		
Voltage	0.25...4.75 VDC / 0.5...4.5 VDC / 0.5...9.5 VDC / 4.75...0.25 VDC / 4.5...0.5 VDC		
Current	4...20 mA / 20...4 mA		
Measured value	Position		
Measurement parameters			
Stroke length	50...2500 mm		
Resolution	Typ. ±0.1 mm (restricted by noise or A/D converter of control unit)		
Power up time	Typ. 250 ms		
Linearity	0050...0250 mm	0255...2000 mm	2005...2500 mm
	≤ ±0.1 mm	±0.04 % (F.S.)	≤ ±0.8 mm
Internal sample rate	2 ms		
Setpoint tolerance	≤ 1 mm		
Operating conditions			
Operating temperature electronics	-40...+105 °C		
Storage temperature	-25...+ 65 °C		
Fluid temperature	-30...+ 85 °C		
Humidity	EN60068-2-30, 90 % rel. humidity, no condensation		
Ingress protection – M12 connector	IP67/IP69K (connectors correctly fitted), EN60529		
Ingress protection – Sensor housing	IP67, EN60529		
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)	Ø 7 mm sensor rod		Ø 10 mm sensor rod
	15 g (r.m.s.) (10...2000 Hz)		20 g (r.m.s.) (10...2000 Hz)
EMC test	2009/64/EG Road vehicles 2009/19/EG Agricultural and Forest machines ISO 14982 Emissions/Immunity ISO 7637-1/2 Transient Impulses ISO / TR 10605 Electrostatic Discharge (E.S.D.) The sensor meets the requirements of the EC directives and is marked with CE		
Operating pressure ratings	Pressure impulse test according DIN EN ISO 19879		
Pressure (according to DIN EN ISO 19879)*	Ø 7 mm sensor rod		Ø 10 mm sensor rod
PN (nominal operating)	300 bar		350 bar
P _{MAX} (max. overload)	400 bar		450 bar
P _{STATIC} (proof pressure)	525 bar		625 bar
Design / Material			
Sensor electronics housing	Stainless steel 1.4305 (AISI 303)		
Sealing	O-ring 40.87 × 3.53 mm H-NBR 70, back-up ring 42.6 × 48 × 1.4 PTFE		
Sensor rod – Ø 7 mm	Stainless steel 1.4301 (AISI 304)		
Sensor rod – Ø 10 mm	Stainless steel 1.4306 (AISI 304L)		
M12 connector insert	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		

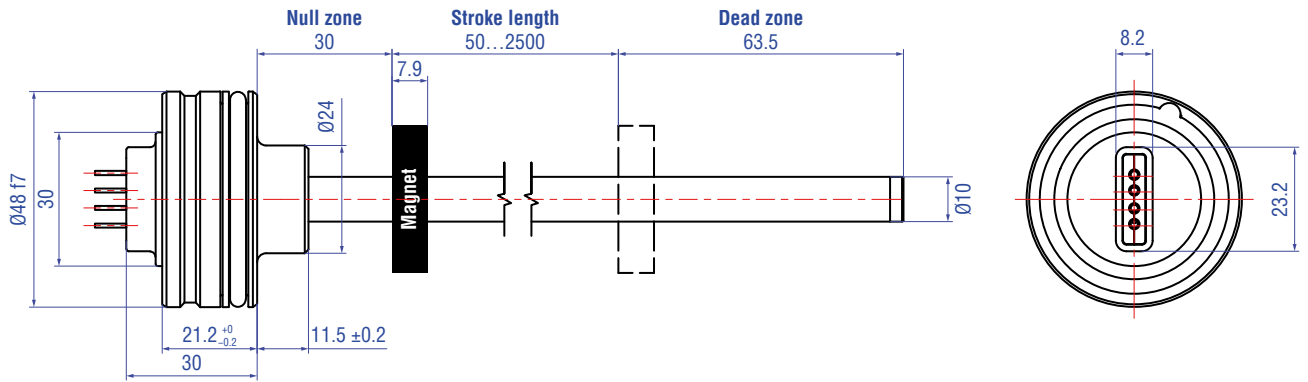
*/ According to calculations under use of the FKM guideline

Cycles	Ø 7 mm sensor rod	Ø 10 mm sensor rod
Dynamic pressure: < 2 × 10 ⁶ pressure cycles	300 bar	350 bar
Static pressure: < 2 × 10 ⁴ pressure cycles	400 bar	450 bar
Proof pressure: Maximum 5 minutes testing time for cylinder pressure test	525 bar	625 bar

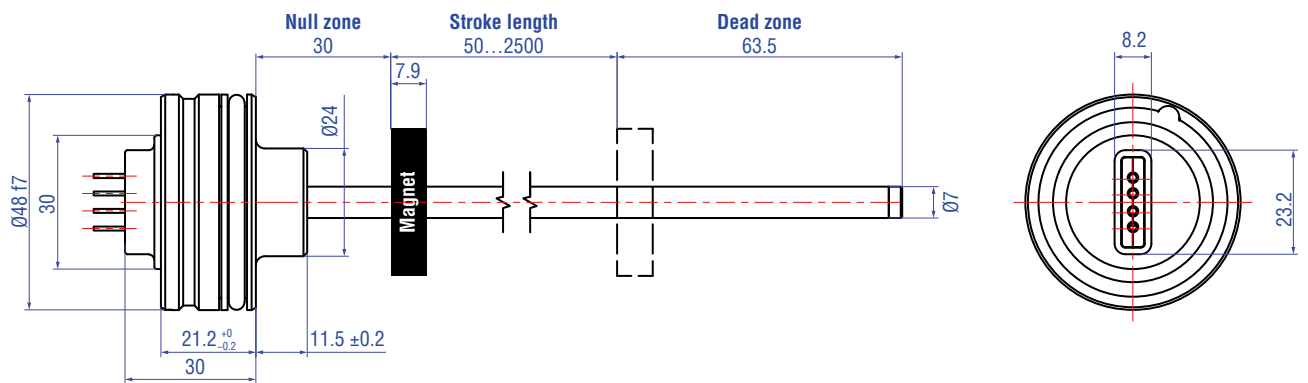
Mechanical mounting		
Mounting position	Any	
Mounting instruction	Please consult the technical drawings	
Electrical connection		
Connection type	1 × M12 male connector (4 pin) or single wires or cable outlet	
Operating voltage	12 VDC (8...32 VDC)	24 VDC (8...32 VDC)
Current consumption	Typ. ≤ 100 mA	Typ. ≤ 50 mA
Load (output VDC)	$R_L \geq 10 \text{ k}\Omega$	$R_L \geq 10 \text{ k}\Omega$
Load (output mA)	$R_L \leq 250 \Omega$	$R_L \leq 500 \Omega$
Inrush current	Max. 2.5 A/2 ms	Max. 4.5 A/2 ms
Supply voltage ripple	< 1 % _{pp}	
Power drain	< 1 W	
Over voltage protection (GND-VDC)	Up to +36 VDC	
Polarity protection (GND-VDC)	Up to -36 VDC	
Insulation Resistance	$R \geq 10 \text{ M}\Omega @ 60 \text{ sec}$	
Electric strength	500 VDC (DC GND to chassis GND)	

TECHNICAL DRAWING

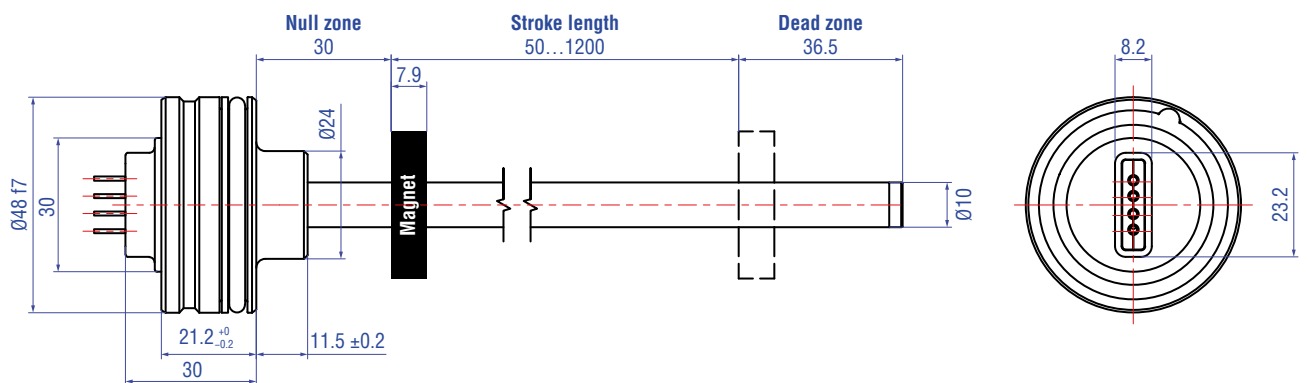
MH-C – Rod: Ø 10 mm / Dead zone: 63.5 mm / Stroke length: 50...2500 mm



MH-D – Rod: Ø 7 mm / Dead zone: 63.5 mm / Stroke length: 50...2500 mm



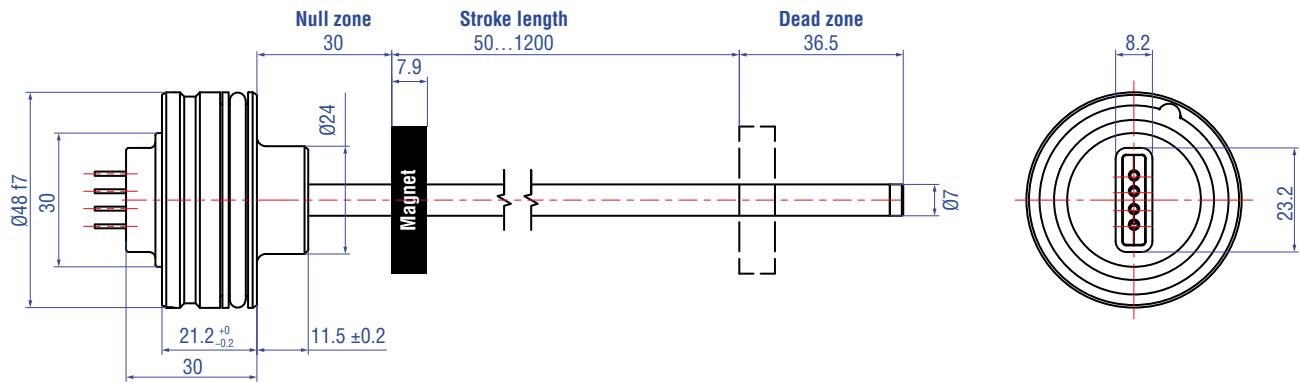
MH-E – Rod: Ø 10 mm / Dead zone: 36.5 mm / Stroke length: 50...1200 mm



Controlling design dimensions are in millimeters

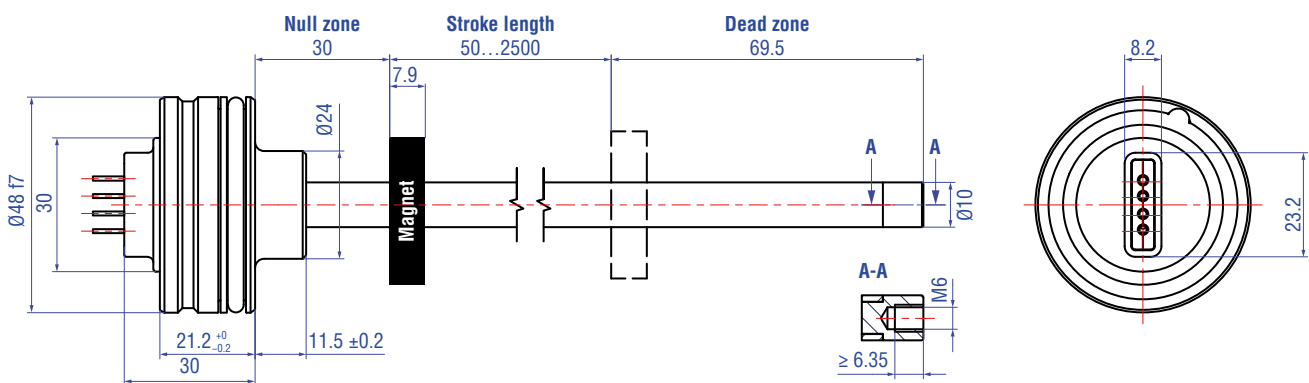
Fig. 4: Temposonics® MH-Series MH sensor, part 1

MH-F – Rod: Ø 7 mm / Dead zone: 36.5 mm / Stroke length: 50...1200 mm



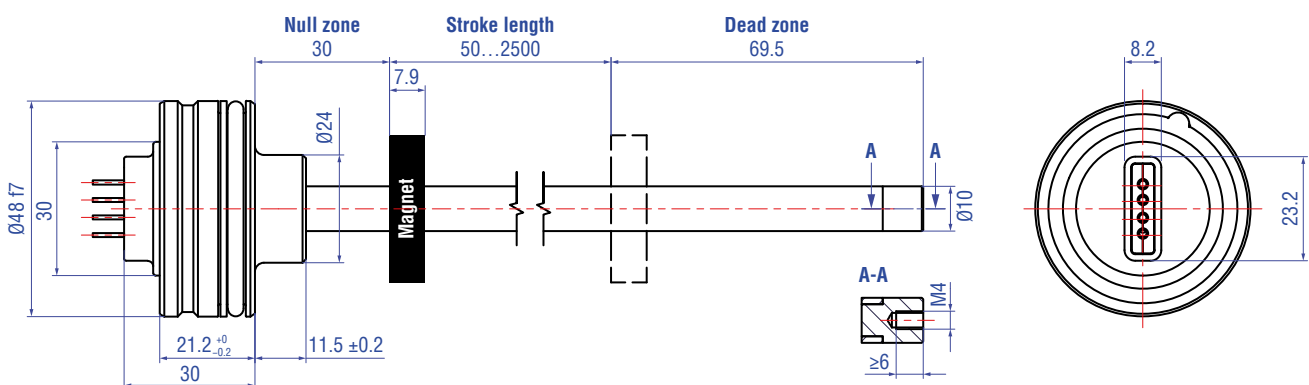
Controlling design dimensions are in millimeters

MH-L – Rod: Ø 10 mm + end plug with female M6 thread / Dead zone: 69.5 mm / Stroke length: 50...2500 mm



Controlling design dimensions are in millimeters

MH-R – Rod: Ø 10 mm + end plug with female M4 thread / Dead zone: 69.5 mm / Stroke length: 50...2500 mm



Controlling design dimensions are in millimeters

Fig. 5: Temposonics® MH-Series MH sensor, part 2

CONNECTOR WIRING

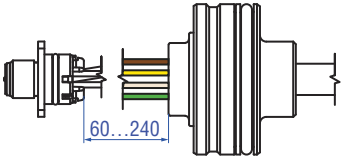

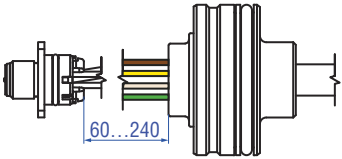

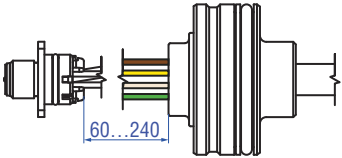

M12 connector (N...E)																
	<ul style="list-style-type: none"> • Single lead wires 0.22 mm² • Attached A-coded M12 connector attached • Toolless assembly • Sealing IP67, up to IP69K with plugged mating connector 															
	<p>Connector wiring</p> <table border="1"> <thead> <tr> <th>Pin</th> <th>Wire</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>YE</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>GN</td> <td>SIG</td> </tr> </tbody> </table>		Pin	Wire	Function	1	YE	not connected	2	BN	VDC	3	WH	GND	4	GN
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1	YE	not connected														
2	BN	VDC														
3	WH	GND														
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3	WH	GND														
4	GN	SIG														
 <p>View on connector</p>																
M12 connector (N...H)																
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Pin	Wire	Function														
1	BN	VDC														
2	GN	SIG														
3	WH	GND														
4	YE	not connected														
 <p>View on connector</p>																

Fig. 6: Connector wiring

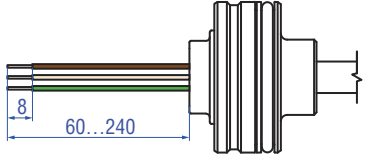
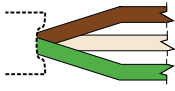
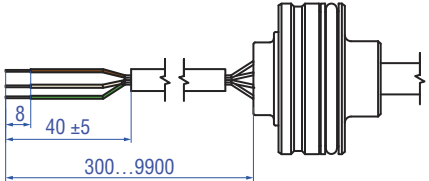

Single wires pigtail (N...A)									
	<ul style="list-style-type: none"> • Single lead wires 0.5 mm² • Insulation PVC 								
Connector wiring									
	<table border="1"> <thead> <tr> <th>Color</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>BN</td> <td>VDC</td> </tr> <tr> <td>WH</td> <td>GND</td> </tr> <tr> <td>GN</td> <td>SIG</td> </tr> </tbody> </table>	Color	Function	BN	VDC	WH	GND	GN	SIG
Color	Function								
BN	VDC								
WH	GND								
GN	SIG								
Pigtail cable (T...A)									
	<ul style="list-style-type: none"> • PUR cable grey • Ø 5 mm, non-shielded, 3 × 0.5 mm² • Flexible, oil resistance 								
Connector wiring									
	<table border="1"> <thead> <tr> <th>Color</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>SIG</td> </tr> </tbody> </table>	Color	Function	BN	VDC	WH	GND	GN	SIG
Color	Function								
BN	VDC								
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Fig. 7: Connector wiring

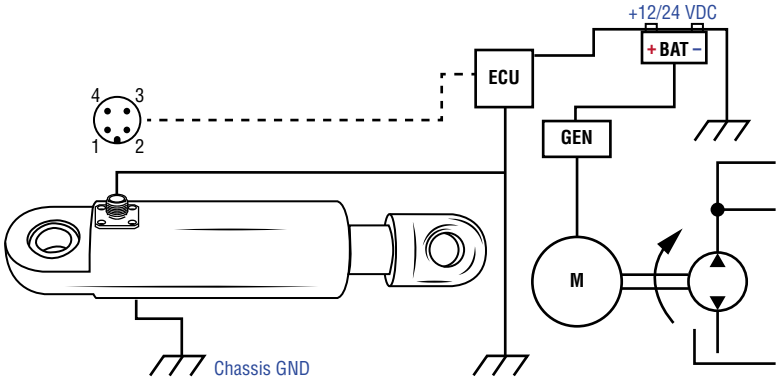
Connection schematics	
<p>To ensure proper operation of the sensor, the hydraulic cylinder must be connected to the machine ground. Grounding is often ensured by the mechanical contact between the cylinder and other machine elements. If the cylinder is connected with the machine separately, separate grounding, for example via a grounding strap directly on the cylinder must be ensured.</p>	

Fig. 8: Connection schematics

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.

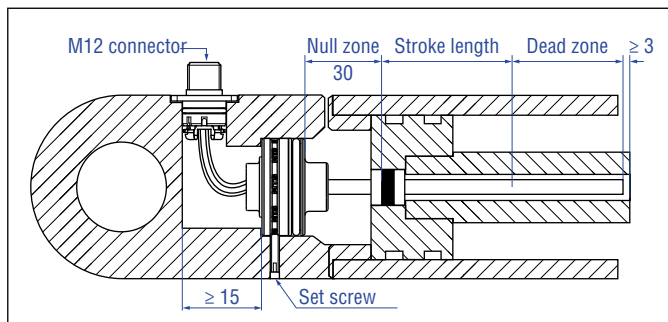


Fig. 9: Example of In-Cylinder assembly

NOTICE

- Use for cable outlet a cable gland with IP69K protection class.
- Take action against water ingress by sealing the cavity on the cover side
- The bore depth in piston:
Null zone + stroke length + dead zone + > 3 mm

- The position magnet shall not touch the pressure pipe.
- Do not exceed the operating pressure.
- Note the piston rod drilling:
 - Ø 7 mm rod: ≥ Ø 10 mm
 - Ø 10 mm rod: ≥ Ø 13 mm

Space requirements

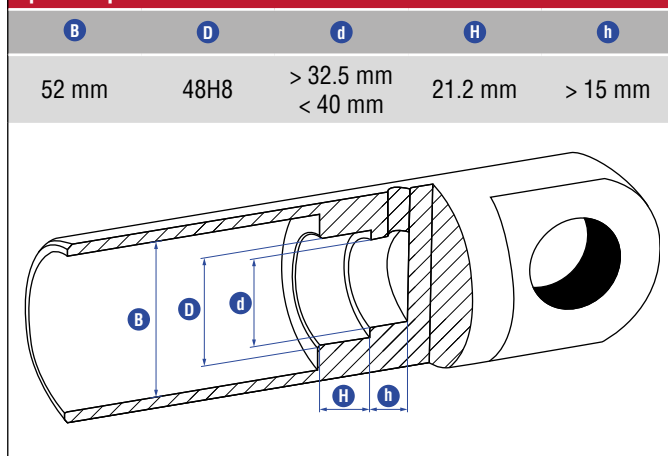


Fig. 10: Space requirements for cylinder

Controlling design dimensions are in millimeters

Set screw

e.g. retaining with set screw (with flat point) ISO 4026 M5x10 (DIN 913).
Fastening torque: ≤ 0.5 Nm

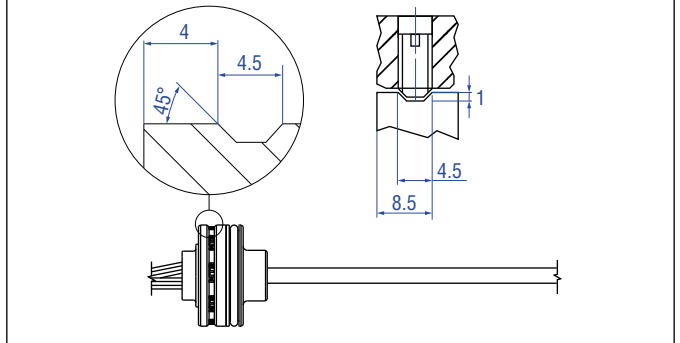


Fig. 11: Set screw

NOTICE

The screw may touch the sensor housing.
Tightening torque: ≤ 0.5 Nm.
Lock the set screw against falling out and consider a seal against water ingress (capillary effect). Make sure that the threads are free of oil, grease and dirt.

MECHANICAL INSTALLATION – POSITION MAGNET

Magnet installation

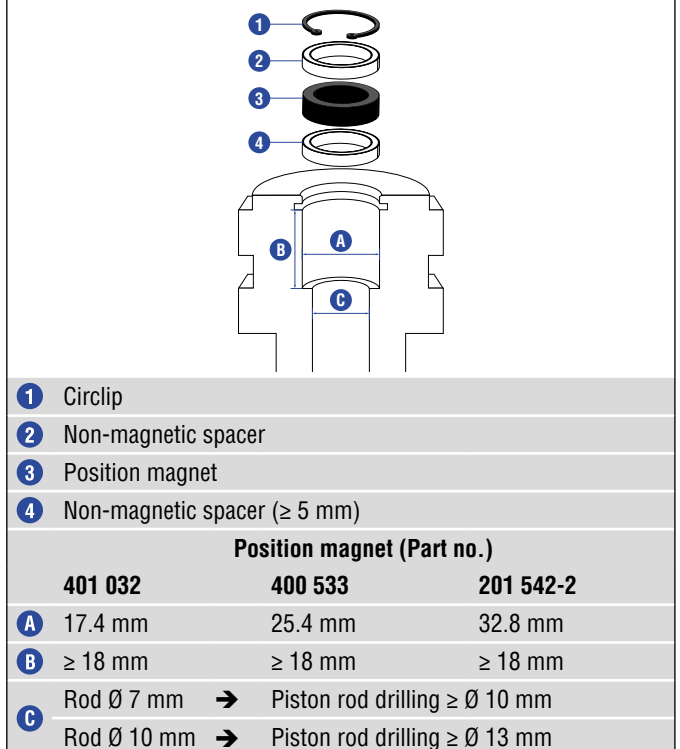


Fig. 12: Dimensions for magnet mounting

NOTICE

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

ORDER CODE

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

a	Sensor model	
M	H	Pressure fit flange

b	Design
C	Rod: Ø 10 mm + flat end plug / Dead zone: 63.5 mm / Stroke length: 50...2500 mm
D	Rod: Ø 7 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
F	Rod: Ø 7 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...2500 mm

c	Stroke length				
X	X	X	X	M	0050...2500 mm

d	Electrical wiring			
M12 connector (VDC – GND – SIG) incl. flange				
N			E	60...240 mm wire length (in 20 mm steps) Connector wiring E: 2-3-4
N			G	60...240 mm wire length (in 20 mm steps) Connector wiring G: 1-3-4
N			H	60...240 mm wire length (in 20 mm steps) Connector wiring H: 1-3-2
Single wires				
N			A	60...240 mm wire length (in 20 mm steps)
Cable outlet				
T			A	300...9900 mm cable length (in 100 mm steps)

Examples wire length

N06E = 60 mm

N08G = 80 mm

N10H = 100 mm

Example wire length

N20A = 200 mm

Example cable length

T10A = 1000 mm

e	Operating voltage
3	+12/24 VDC (8...32 VDC)

f	Output		
V	0	2	0.5...9.5 VDC
V	1	1	0.25...4.75 VDC
V	1	2	0.5...4.5 VDC
V	1	3	4.75... 0.25 VDC
V	1	4	4.5... 0.5 VDC
A	0	1	4...20 mA
A	0	4	20...4 mA

DELIVERY

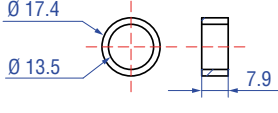
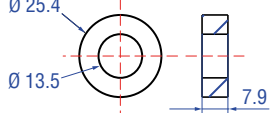
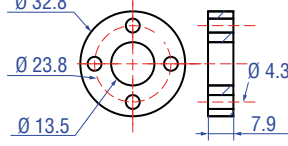



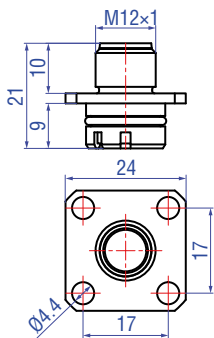






































- Position sensor
- O-ring
- backup-ring
- M12 connector system (optional)

Accessories have to be ordered separately

Manuals, Software & 3D models available at:
www.mtssensors.com

FREQUENTLY ORDERED ACCESSORIES

Position magnets			Test kit
			
Ring magnet OD17.4 Part no. 401 032	Ring magnet OD25.4 Part no. 400 533	Ring magnet OD33 Part no. 201 542-2	MH test kit (analog) Part no. 280 618
Material: PA neobond Weight: Approx. 5 g Surface pressure: Max. 20 N/mm ² Operating temperature: -40...+105 °C (-40...+221 °F)	Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm ² Operating temperature: -40...+105 °C (-40...+221 °F)	Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)	Kit includes: <ul style="list-style-type: none"> • 12 VDC battery charger with adapter (EU & UK) • Cable with M12 connector • Cable with pigtailed wires • Carrying case

M12 flange	Cables																					
		Wiring <table border="1"> <thead> <tr> <th>Wires</th> <th>Color</th> <th>Pin</th> <th>M12 A-coded female connector (5 pin)</th> </tr> </thead> <tbody> <tr> <td></td> <td>BN</td> <td>↔ 1</td> <td rowspan="5">  </td> </tr> <tr> <td></td> <td>WH</td> <td>↔ 2</td> </tr> <tr> <td></td> <td>BU</td> <td>↔ 3</td> </tr> <tr> <td></td> <td>BK</td> <td>↔ 4</td> </tr> <tr> <td></td> <td>GY</td> <td>↔ 5</td> </tr> </tbody> </table>	Wires	Color	Pin	M12 A-coded female connector (5 pin)		BN	↔ 1			WH	↔ 2		BU	↔ 3		BK	↔ 4		GY	↔ 5
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	BN	↔ 1																				
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	BU	↔ 3																				
	BK	↔ 4																				
	GY	↔ 5																				
M12 Flange Part no. 253 769	Cable with M12 A-coded female connector (5 pin), straight – pigtail Part no. 370 673	Material: Brass, nickel-plated Weight: Approx. 5 g Operating temperature: -40...+105 °C (-40...+221 °F)																				
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	BN	↔ 1																				
	WH	↔ 2																				
	BU	↔ 3																				
	BK	↔ 4																				
	GY	↔ 5																				
	Cable with M12 A-coded female connector (5 pin), angled – pigtail Part no. 370 675	Material: PUR jacket 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	Material: PUR jacket Features: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: -25...+80 °C (-13...+176 °F)																				

Controlling design dimensions are in millimeters

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