

Temposonics®

Magnetostrictive Linear Position Sensors

MH-Series MH CANbus 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.

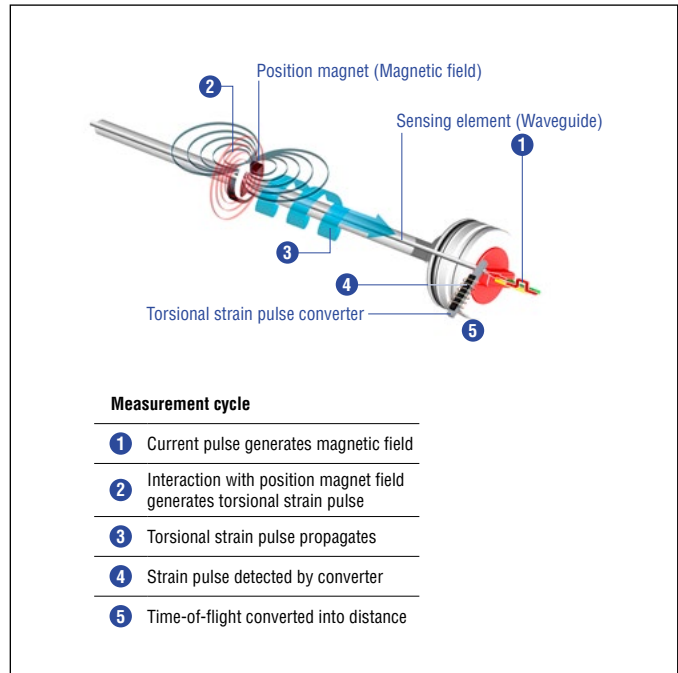


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

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

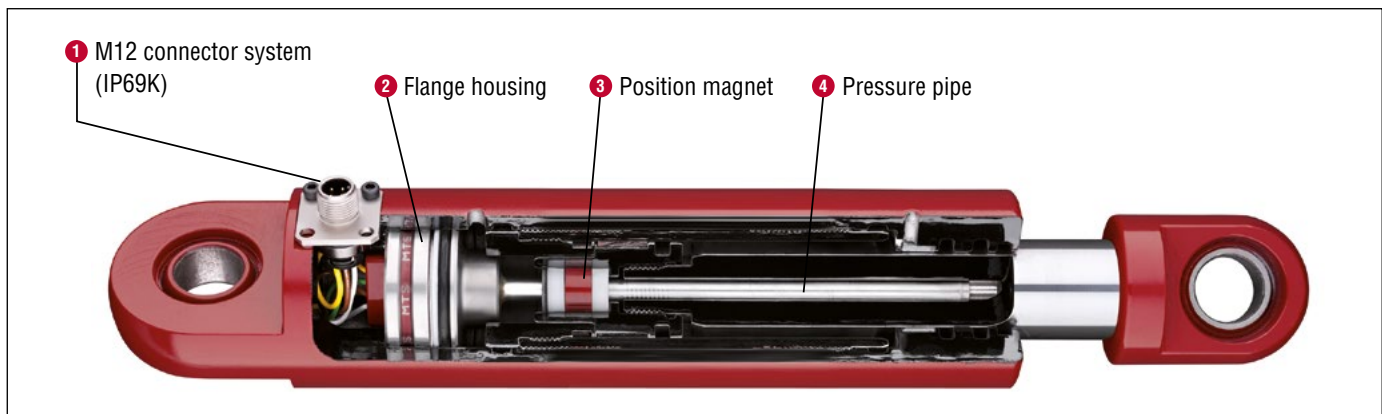


Fig. 3: IN cylinder installation

TECHNICAL DATA

Output				
Signal characteristic	Bus-protocol: SAE J1939, CANopen protocol according 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	Typ. 400 ms			
Cycle time	Output	CANopen	SAE J1939	
	Cycle time	1 ms	20 ms	
Linearity	Stroke length	50...250 mm	255...2000 mm	2005...2500 mm
	Linearity	≤ ±0.1 mm	±0.04 % F.S.	≤ ±0.8 mm
Internal sample rate	1 ms			
Setpoint tolerance	± 0.2 mm			
Operating conditions				
Operating temperature electronics	-40...+105 °C			
Storage temperature	-25...+ 65 °C			
Fluid temperature	-30...+ 85 °C			
Humidity	90 % relative humidity, no condensation, EN60068-2-30			
Ingress protection – M12 connector	IP67/IP69K (connectors correctly fitted), EN60529			
Ingress protection – Sensor housing	IP67, EN60529			
Shock test	100 g (6 ms) single shock, 50 g (11 ms) at 1000 shocks per axis, IEC 60068-2-27			
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

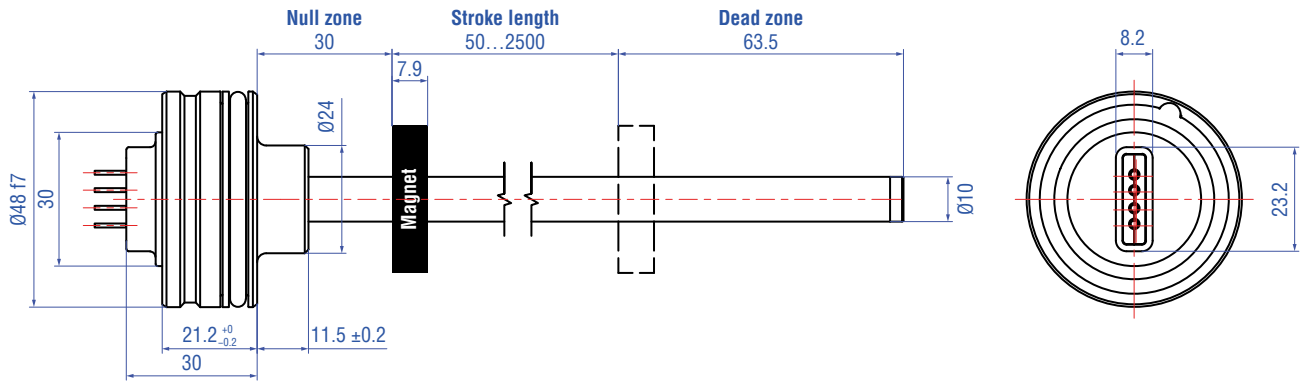
Cycles	Ø 7 mm sensor rod	Ø 10 mm sensor rod
Dynamic pressure: < 2 × 10 ⁶ pressure cycles	300 bar	350 bar
Static pressure: < 2 × 10 ⁴ pressure cycles	400 bar	450 bar
Proof pressure: Maximum 5 minutes testing time for cylinder pressure test	525 bar	625 bar

Temposonics® MH-Series MH CANbus
Data Sheet

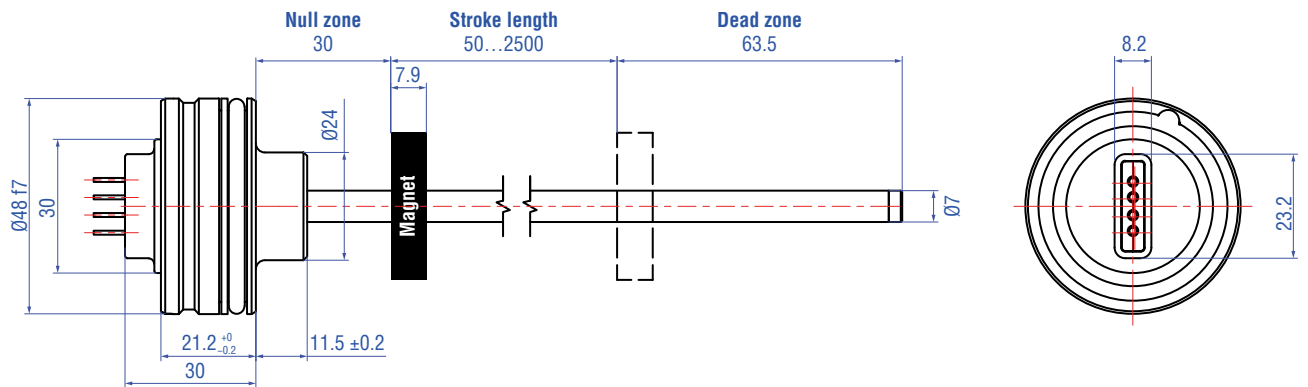
Mechanical mounting		
Mounting position	Any	
Mounting instruction	Please consult the technical drawings	
Electrical connection		
Connection type	1 × M12 male connector (5 pin) or single wires or cable outlet	
Operating voltage	12 VDC (8...32 VDC)	24 VDC (8...32 VDC)
Power consumption	Typ. < 100 mA	Typ. < 50 mA
Inrush current	Max. 1.0 A/2 ms	Max. 1.5 A/2 ms
Supply voltage ripple	< 1 % _{pp}	
Power drain	< 1.5 W	
Bus termination (HI-LO)	120 Ω	
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)	

TECHNICAL DRAWING

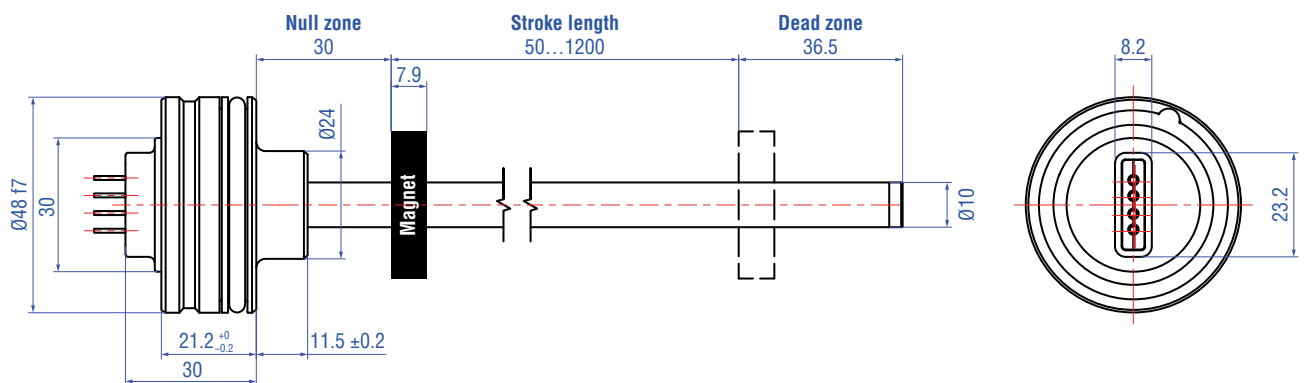
MH-C – Rod: Ø 10 mm / Dead zone: 63.5 mm / Stroke length: 50...2500 mm



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



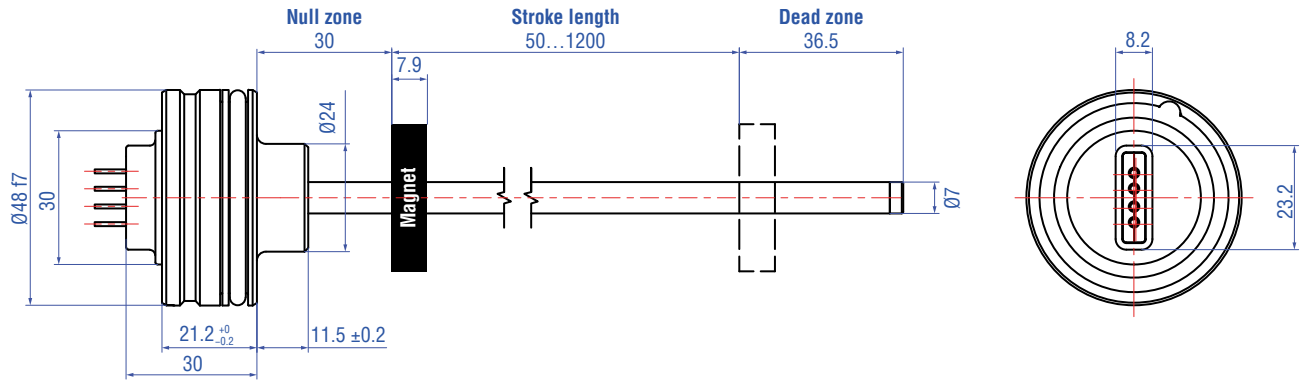
MH-E – Rod: Ø 10 mm / Dead zone: 36.5 mm / Stroke length: 50...1200 mm



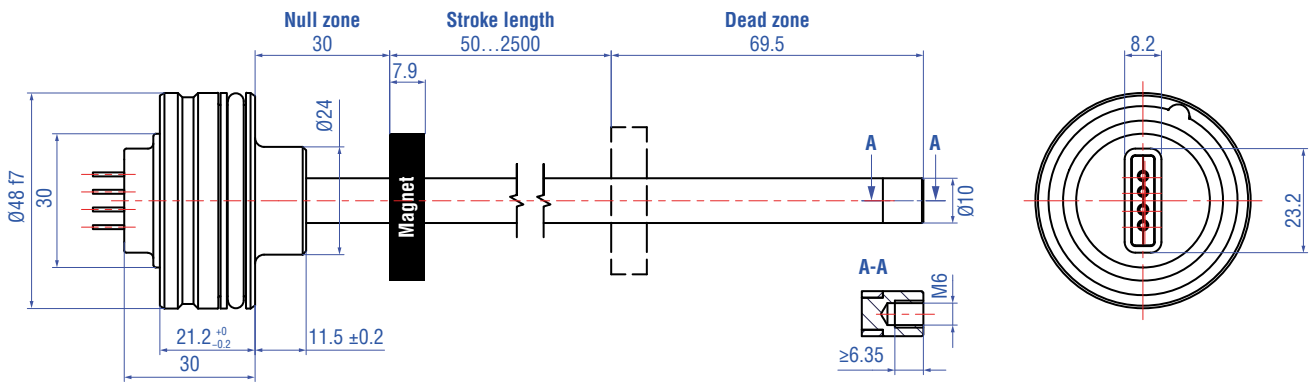
Controlling design dimensions are in millimeters

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

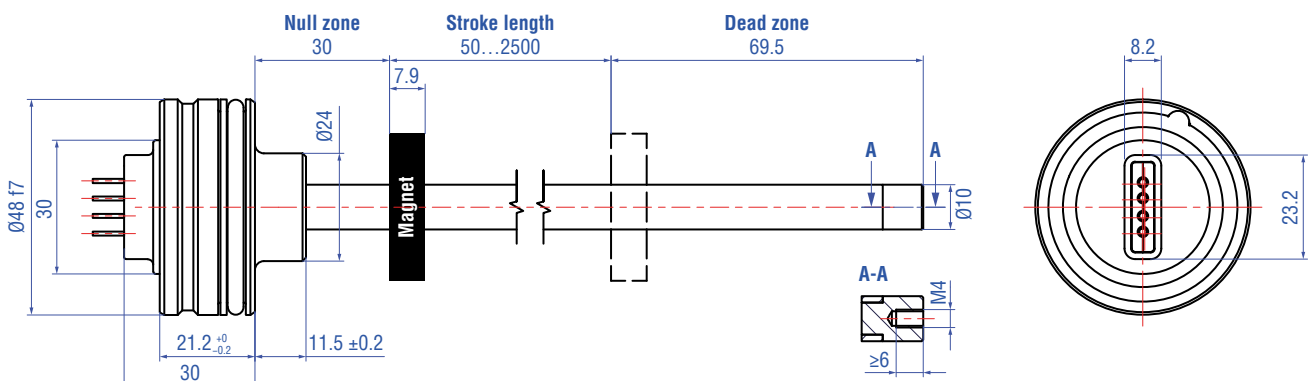
MH-F – Rod: Ø 7 mm / Dead zone: 36.5 mm / Stroke length: 50...1200 mm



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



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

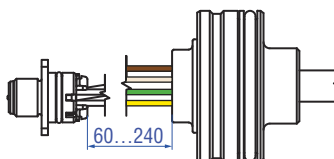

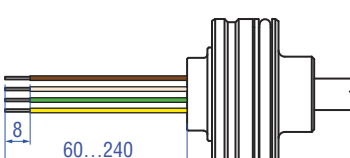

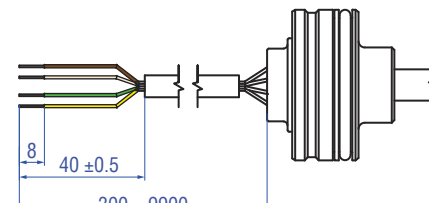
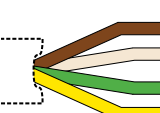
M12 connector (N...F)																		
	<ul style="list-style-type: none"> • Single lead wires 0.22 mm² • Attached A-coded M12 connector attached • Toolless assembly • Sealing IP67, up to IP69K with plugged mating connector 																	
	<p>Connector wiring</p>  <p>View on connector</p> <table border="1"> <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>	Pin	Wire	Function	1	–	not connected	2	BN	VDC	3	WH	GND	4	YE	CAN_H	5	GN
Pin	Wire	Function																
1	–	not connected																
2	BN	VDC																
3	WH	GND																
4	YE	CAN_H																
5	GN	CAN_L																
Single wires pigtail (N...A)																		
	<ul style="list-style-type: none"> • Single lead wires 0.5 mm² • Insulation PVC 																	
	<p>Connector wiring</p>  <table border="1"> <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>	Wire	Function	BN	VDC	WH	GND	GN	CAN_L	YE	CAN_H							
Wire	Function																	
BN	VDC																	
WH	GND																	
GN	CAN_L																	
YE	CAN_H																	
Pigtail cable (T...A)																		
	<ul style="list-style-type: none"> • PUR cable, black • Ø 5 mm, non-shielded, 3 × 0.5 mm² • Flexible, oil resistance 																	
	<p>Connector wiring</p>  <table border="1"> <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>	Wire	Function	BN	VDC	WH	GND	GN	CAN_L	YE	CAN_H							
Wire	Function																	
BN	VDC																	
WH	GND																	
GN	CAN_L																	
YE	CAN_H																	

Fig. 6: Connector wiring

Connection schematics

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.

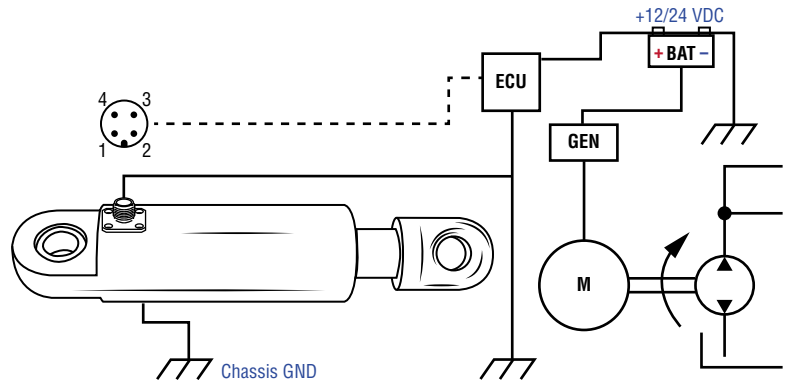


Fig. 7: Connection schematics

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.

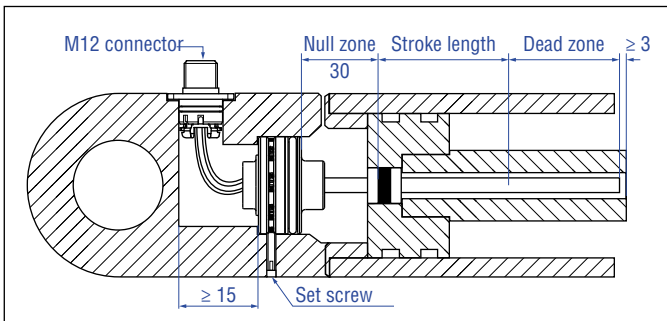


Fig. 8: Example of In-Cylinder assembly

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

Controlling design dimensions are in millimeters

Space requirements

B	D	d	H	h
52 mm	48H8	> 32.5 mm < 40 mm	21.2 mm	> 15 mm

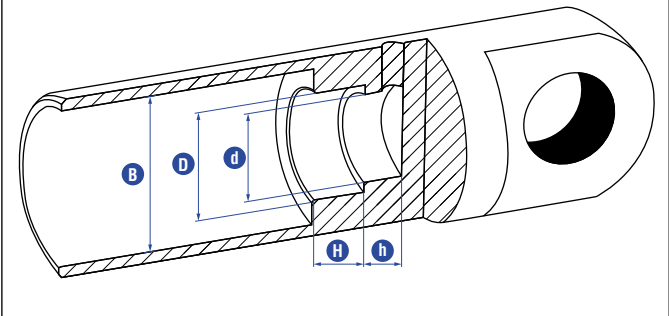


Fig. 9: Space requirements for cylinder

Set screw

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

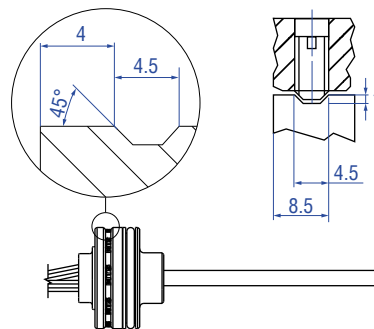


Fig. 10: Set screw

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

1	Circlip		
2	Non-magnetic spacer		
3	Position magnet		
4	Non-magnetic spacer (≥ 5 mm)		
Position magnet (Part no.)			
	401 032	400 533	201 542-2
A	17.4 mm	25.4 mm	32.8 mm
B	≥ 18 mm	≥ 18 mm	≥ 18 mm
C	Rod Ø 7 mm →	Piston rod drilling ≥ Ø 10 mm	
	Rod Ø 10 mm →	Piston rod drilling ≥ Ø 13 mm	

Fig. 11: 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	17	18	19	
M	H						M					3							
a		b	c					d					e	f			g	h	

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 (in 5 mm steps)

d	Electrical wiring
M12 connector (VDC – GND – HI – LO) incl. flange	
N	60...240 mm wire length (in 20 mm steps)
Single wires	
N	60...240 mm wire length (in 20 mm steps)
Cable outlet	
T	300...9900 mm cable length (in 100 mm steps)

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
6	50 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)

Examples wire length

N06F = 60 mm

Example wire length

N20A = 200 mm

Example cable length

T10A = 1000 mm

DELIVERY



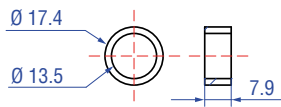
- Position sensor
- O-ring
- backup-ring
- M12 connector system (optional)

Accessories have to be ordered separately

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

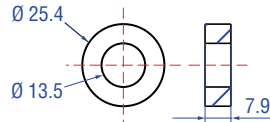
FREQUENTLY ORDERED ACCESSORIES

Position magnets



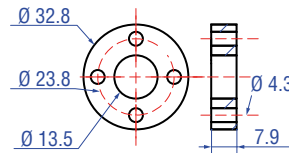
Ring magnet OD17.4
Part no. 401 032

Material: PA neobond
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
-40...+105 °C (-40...+221 °F)



Ring magnet OD25.4
Part no. 400 533

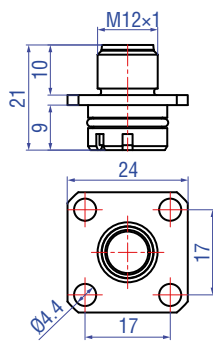
Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
-40...+105 °C (-40...+221 °F)



Ring magnet OD33
Part no. 201 542-2

Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
-40...+105 °C (-40...+221 °F)

M12 flange



M12 Flange
Part no. 253 769

Material: Brass, nickel-plated
Weight: Approx. 5 g
Operating temperature:
-40...+105 °C (-40...+221 °F)

Test kit



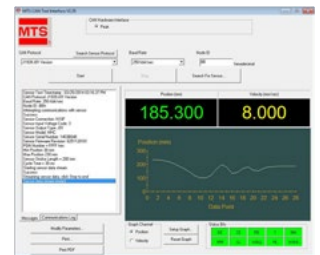
Testkit CANbus for EU
Part no. 254 267

Kit includes:
1 × USB CAN-Modul
1 × Manual
1 × USB cable
cable with MTS M12 connector
and RS232 connector
1 × cable with D-SUB connector
1 × carrying case
1 × 12 VDC power supply



Testkit CANbus for US
Part no. 253 879

Kit includes:
1 × USB CAN-Module
1 × Manual
1 × USB cable
cable with MTS M12 connector and
RS232 connector
1 × cable with D-SUB connector
1 × carrying case
1 × 12 VDC power supply



Testsoftware 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

Wires	Color	Pin	M12 A-coded female connector (5 pin)
	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)

Wiring

Wires	Color	Pin	M12 A-coded female connector (5 pin)
	BN	↔ 1	
	WH	↔ 2	
	BU	↔ 3	
	BK	↔ 4	
	GY	↔ 5	

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