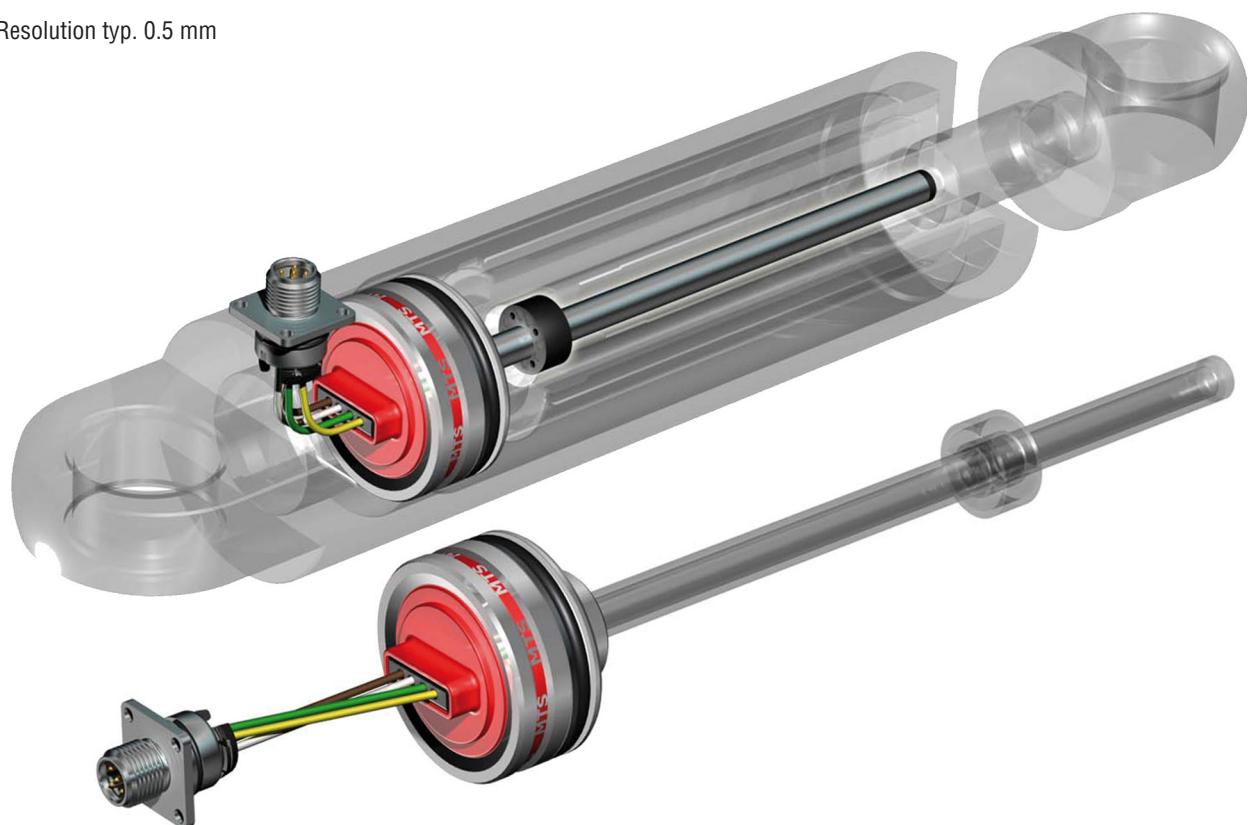


Temposonics®

Magnetostrictive Linear Position Sensors

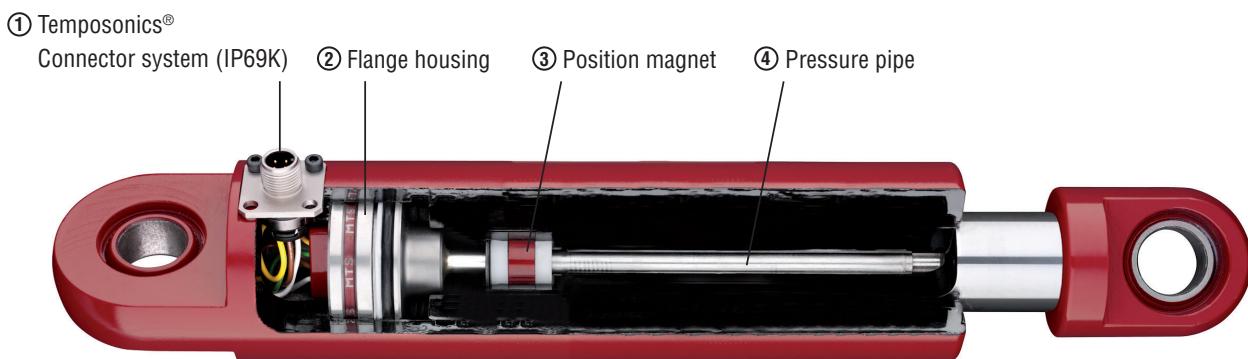
DATA SHEET MH-Series MH200

- Stroke range up to 5000 mm
- Linearity $\leq 0.04\% \text{ F.S.}$
- Resolution typ. 0.5 mm



1. Product description and technology

Tempsonics® 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 Tempsonics® sensors, thus enhancing the productivity, availability and quality of the working process of the machine. Insensitive to vibration, shocks, dust and weathering influence and electro-magnetic disturbances. Tempsonics® MH Series 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.



Simple Mechanics

The extremely robust sensor consists of the following main parts:

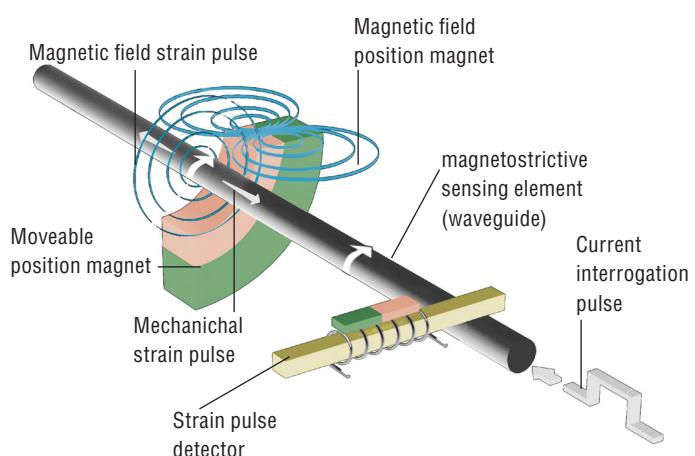
- ① The innovative connector system which is easy to install in a few seconds, any soldering or crimping needless, dust-and waterproof up to IP69K.
- ② The flange housing with built-in electronics and signal converter.
- ③ The position magnet as only moving part, which is assembled into the piston bottom. This permanent magnet travels wear-free and contactless along the pressure pipe and measures the actual position.
- ④ The pressure pipe placed within the drilled piston rod contains the protected magnetostrictive sensing element.

- Due to small dimensions MH sensors require only little space
- Suitable for operating pressures up to 300 bar
- Unaffected by surrounding media such as ageing or foaming oil
- Insensitive to shock and vibration
- Designed for all current supply voltages (12/24 VDC)
- Tempsonics® sensors offer all common used output signals:
 - Analog: VDC/mA
 - Bus protocols: CANopen, SAE J1939

Magnetostriction

Tempsonics® linear sensors are based on the magnetostrictive technology. By measuring the actual position with a non-contact position magnet the sensor operates 100% wear-free. The absolute operating principle enables reliable readings without any reference point or recalibration. A mechanical strain pulse is triggered by the travelling position magnet. The runtime of this ultrasonic wave is measured precisely and compiled into standard electronic output signals.

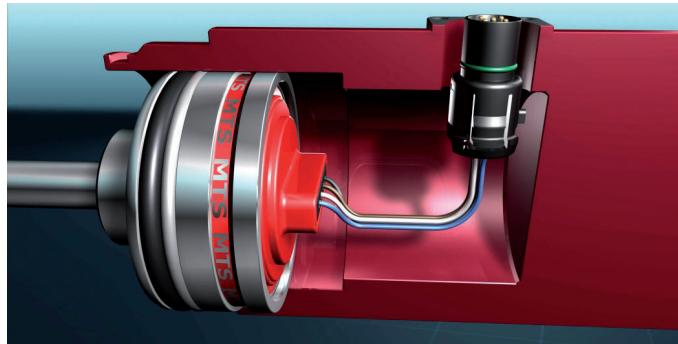
Measurement principle



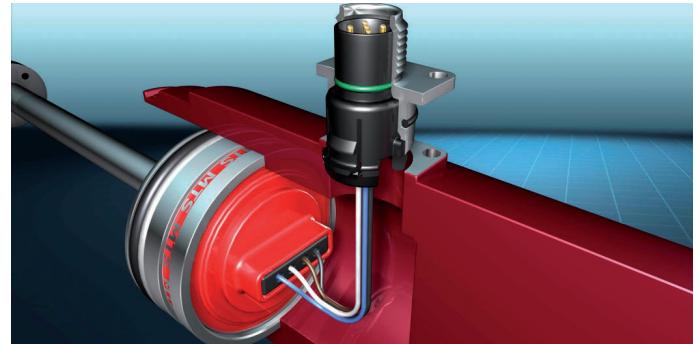
2. Tempsonics® connector system M12

MTS presents the innovative connector system for Tempsonics® MH-Series

The Tempsonics® Connector System meets the highest protection requirements important for a harsh environment in mobile hydraulic applications. Protection type IP69K performs water and dust proof. In addition it is even resistive against high pressure water cleaning.



- ① The MH sensor is delivered by MTS together with the new connector system:
The connector insert carrier is already connected to the sensor conductors, i.e. no soldering, any colour or connection mistake.



- ② The connector insert is taken out of the cylinder through a bore hole. The flange can easily be clicked in position from outside.



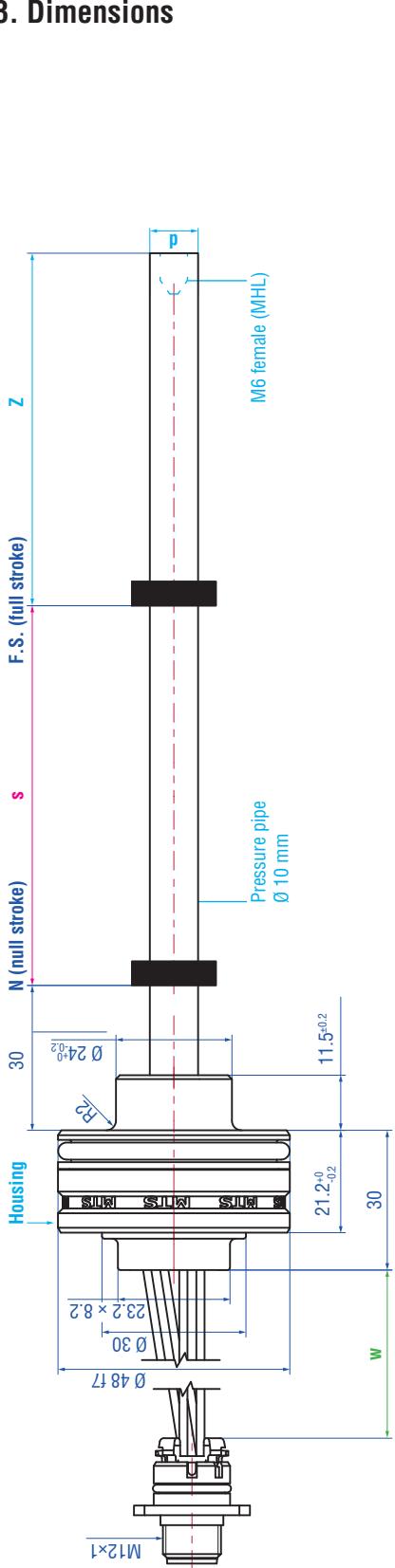
- ③ Four standard screws must be tightened to mount the connector system on the cylinder. In case of using angled type connectors the connector insert can be rotated inside the flange in 45° steps.



- ④ With a corresponding mating plug the connector system fulfills an IP rating of IP69K.

- Absolutely easy and safe installation.
- No brazing or crimping of connecting leads is required.

3. Dimensions



Mechanical configurations

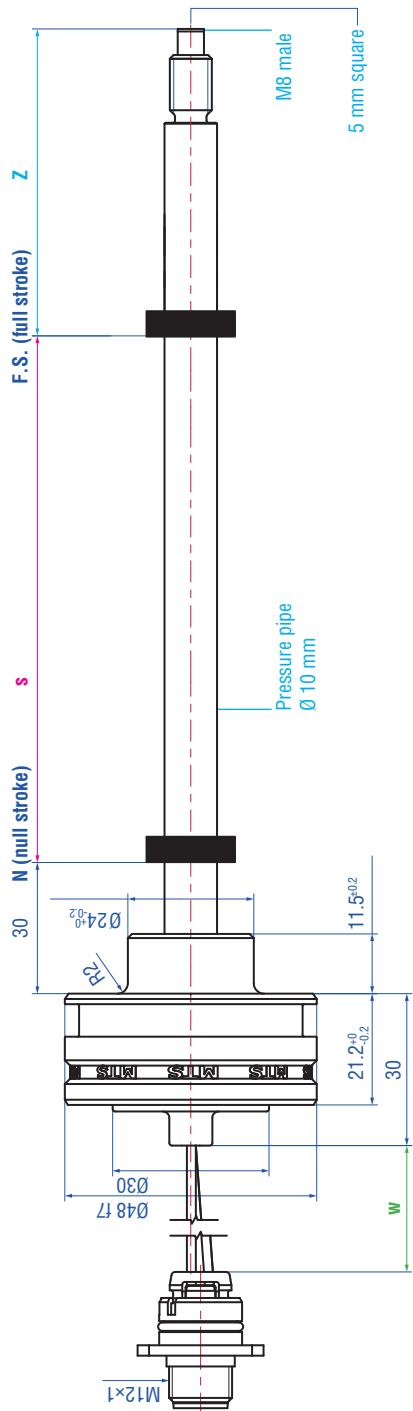
Form factor	C	Z = 63.5 mm (s < 5000 mm), Ø 10 mm pressure pipe
	L	Z = 69.5 mm (s < 5000 mm), Ø 10 mm pressure pipe
Stroke range	s	2520...5000 mm (in 5 mm steps)
Wire length	w	60...240 mm (in 20 mm steps)

Model no.

Model no.	MH	C	1	5	0	0	M-N	1	2	G	-3-	V02	H	A01	C01	4	7F	FD
																J01	3	

Electrical configurations

MH Analog	G	1 = VDC	3 = GND	4 = Sig	2 = n.c.
	H	1 = VDC	3 = GND	2 = Sig	4 = n.c.
MH Digital	F	2 = VDC	3 = GND	4 = CAN HI	5 = CAN LO 1 = n.c.
	A01	4 ... 20 mA			
MH Analog	V02	0.5 ... 9.5 VDC			
	C01	CANopen			
MH Digital	J01	SAE J1939			
	3	250 kbit/sec			
Baudrate	4	125 kbit/sec			
7F	hex				
Node ID	FD	hex			



Mechanical configurations

Form factor	Q	Z = 85.5 mm (s < 5000 mm) Ø 10 mm pressure pipe
Stroke range	s	2520...5000 mm (in 5 mm steps)
Wire length	w	60...240 mm (in 20 mm steps)

Model no.

MH	Q	-1	5	0	0	M-N	1	2	G	-3-	V02	
A01	C01	4	7F	 	 	H	 	 	 	 	 	
J01	3	FD	 	 	 	F	 	 	 	 	 	
 	 	 	 	 	 	F	 	 	 	 	 	

Electrical configurations

MH Analog	G	1 = VDC	3 = GND	4 = Sig	2 = n.c.
	H	1 = VDC	3 = GND	2 = Sig	4 = n.c.
MH Digital	F	2 = VDC	3 = GND	4 = CAN HI	5 = CAN LO
	A01	4...20 mA			
MH Analog	V02	0.5...9.5 VDC			
	C01	CANopen			
	J01	SAE J1939			
Baudrate	3	250 kbit/sec			
	4	125 kbit/sec			
Node ID	7F	hex			
	FD	hex			

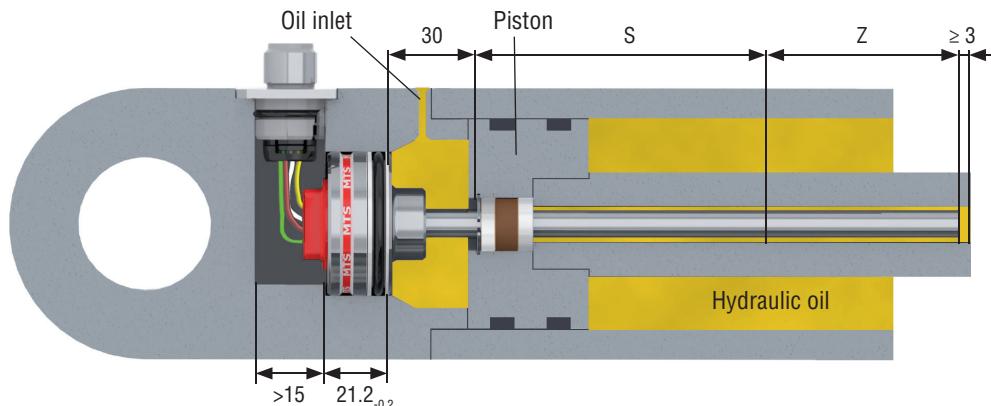
4. In Cylinder assembly

Mechanical installation

The robust Temposonics® model 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.

Example

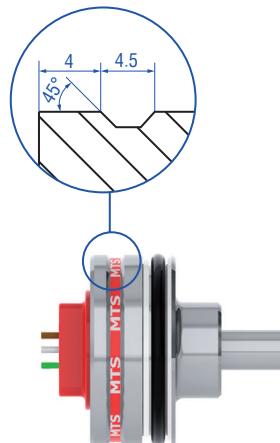


Sensor installation

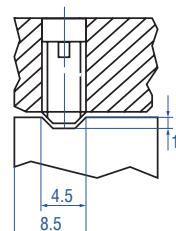
The method of installation is entirely dependent on the cylinder design. While the most common method of installation is from the rod side of the cylinder, an installation from the head side of the cylinder is also possible. In both installation methods, the hermetic sealing of the cylinder is given by an O-ring with additional back up ring.

Please pay attention:

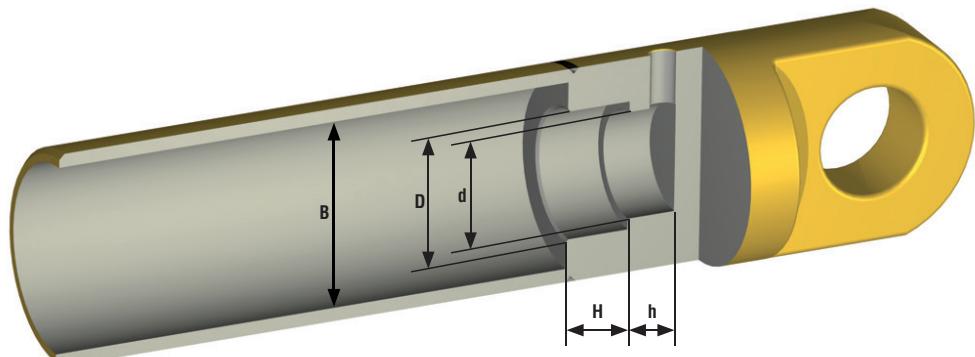
- The position magnet shall not touch the pressure pipe.
- Do not exceed operating pressure.
- Piston rod drilling:
Depth: $S + Z + 3$ mm
Diameter: Ø 13 mm minimum



Flange housing
with O-ring and
back-up ring



Example:
e.g. retaining with set screw
DIN 913 M5 x 10 (with flat point!)
max. torque 0.5 Nm



Type	B Ø Cylinder	D Ø min.	H Depth	d Ø min.	h Depth
MH	52	48	21.2	> 32.5 < 40	> 15

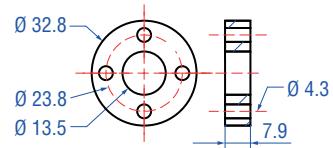
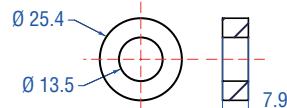
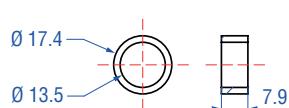


Please pay attention to installation manual!

All dimensions in mm

4.1 Position magnets

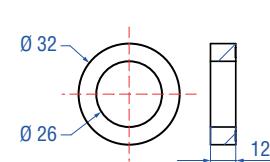
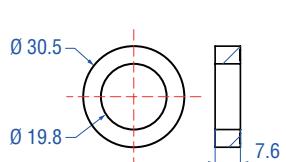
Position magnets (please order separately) for installation without support tube



Name	Ring magnet OD17.4	Ring magnet OD25.4	Ring magnet OD33
Part no.	401 032	400 533	201 542-2
Dimensions			
OD _M	17.4 mm	25.4 mm	32.8 mm
ID _M	13.5 mm	13.5 mm	13.5 mm
Height	7.9 mm	7.9 mm	7.9 mm
P _A *	10 N/mm ²	40 N/mm ²	40 N/mm ²
Characteristics			
Material	PA neobond	PA ferrite	PA ferrite
Weight	ca. 5 g	ca. 10 g	ca. 14 g
Operating temperature	-40...+100 °C	-40...+100 °C	-40...+100 °C
Surface pressure	max. 20 N/mm ²	max. 40 N/mm ²	max. 40 N/mm ²
Fastening torque for M4 screws	-	-	max. 1 Nm

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

Position magnets (please order separately) for installation with support tube



Name	Ring magnet	Ring magnet
Part no.	402 316	403 974
Dimensions		
OD _M	30.5 mm	32.0 mm
ID _M	20.0 mm	26.0 mm
Height	8.0 mm	12.0 mm
P _A *	40 N/mm ²	40 N/mm ²
Support tube		
	18 × 1.5 mm	22 × 2 mm
Characteristics		
Material	PA ferrite coated	NdFeB
Weight	ca. 13 g	ca. 70 g
Operating temperature	-40...+100 °C	-40...+100 °C
Surface pressure	20 N/mm ²	20 N/mm ²

4.2 Position magnet (M) and magnet assembly with spacer (S) in piston

4.2.1 Installation without support tube

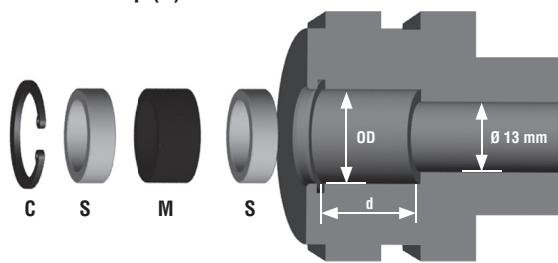
Magnet (M)	401 032	400 533	201 542-2
OD	17.5 mm ^{+0.2}	25.5 mm ^{+0.2}	32.9 mm ^{+0.2}
d	18 mm	18 mm	18 mm

Spacer (S)

Material: POM, PA, Aluminum (NON-MAGNETIC)

Dimensions: OD × 5 × ID_M

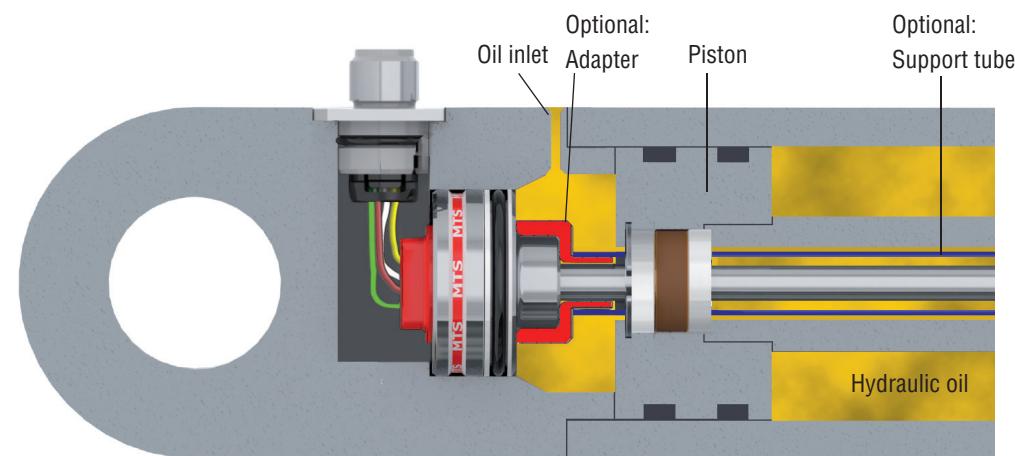
Standard Circlip (C)



4.2.2 Installation with support tube

Support tube	
Ø 18 × 1.5 mm	Ø 22 × 2 mm
Piston rod drilling	
Ø 22	Ø 26

Part no.	402 316	403 974
OD	30.6 mm	32.1 mm
d	18.0 mm	22.0 mm



Please pay attention to installation manual!

NOTICE

For correct sensor installation and technical support please contact our application team

4.3 Support tube assembly for MH model MHQ



Please note that the support tube assembly and the adapter accessories is a proposal by MTS.

For further design information please consult MTS application engineering who will consult and clarify as required.

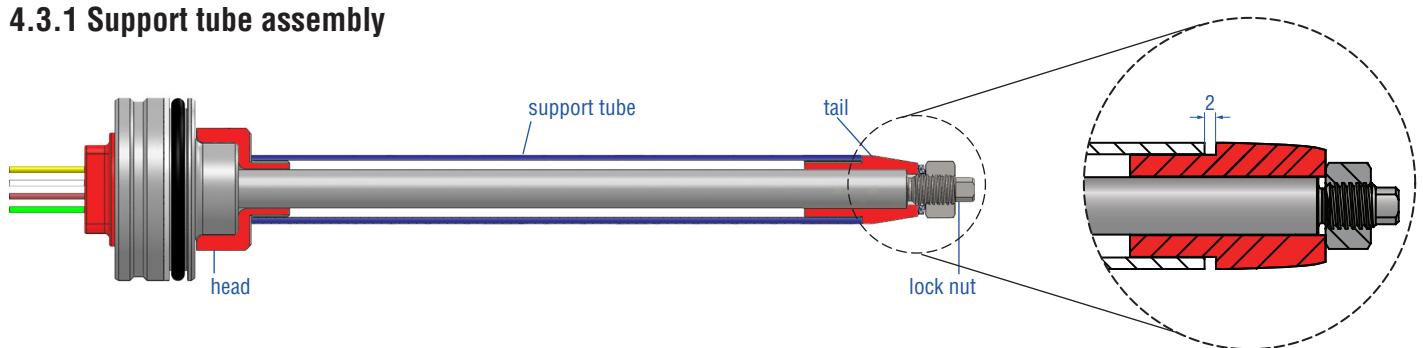
Please pay attention to:

- Support tube adapters must enable oilflow to get rid of air when cylinder gets oil filled
- Support tubes material is stainless steel 1.4301 (AISI 304) or 1.4305 (AISI 303).
If machining is conducted on stainless steel support tubes please make sure it does not induce magnetic properties to the material.
- Nut M8 to tighten with max. 4 Nm. Use glue to fix the nut
- Use a wrench 5 mm to hold the pressure pipe end when tighten the nut M8
- No torsional stress to apply on the pressure pipe
- Adapters material: stainless steel, aluminum, PA or POM
- Head and tail adapter: OD tolerances are applied in conjunction with the tolerances valid for the wall thickness of selected support tube



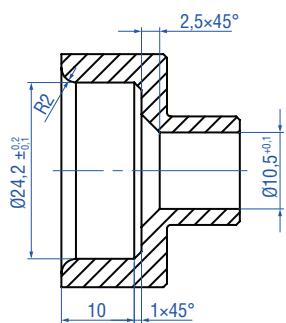
Adapters, support tube, locknuts, etc. are not part of MTS shipment.

4.3.1 Support tube assembly

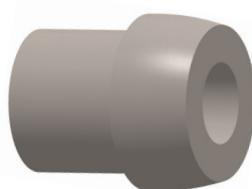
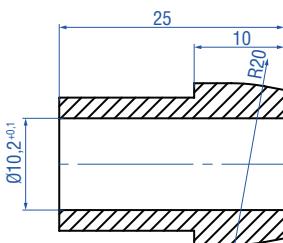


4.3.3 Assembly adapters

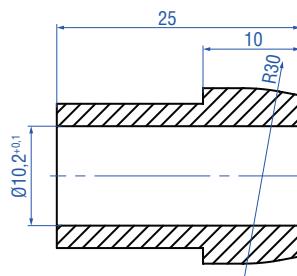
Head



Tail (for 18 x 1.5 mm support tube)



Tail (for 22 x 2 mm support tube)



NOTICE

For correct sensor installation and technical support please contact our application team

4.4 Operating conditions and load limits considering a sensor installation with support tube.

4.4.1 Vibration Ratings on Machines

Vibration ratings for machines are shown in the EU directive 2002/44/EC.

Real effective accelerations and forces within the hydraulic cylinder may exceed this level.

For the cylinder installation requiring a support tube an applied load collective has been defined in order to approve the design for the resonance frequency range.

Considering the results out of the load collective the operating grade for pressure and vibration loads has been conducted. The calculation follows the guideline published from Mechanical Engineering Research Community FKM Germany.

For pressurized hydraulic cylinders the operating grade is given wide below 100%.

Diagramm (operating grade in %)

100 % = Burst Level
50 % = 5.3 g Peak Acceleration
25 % = 1.5 g Effective Load Cycle, 2.15 g Peak Acceleration
0 % = without Load



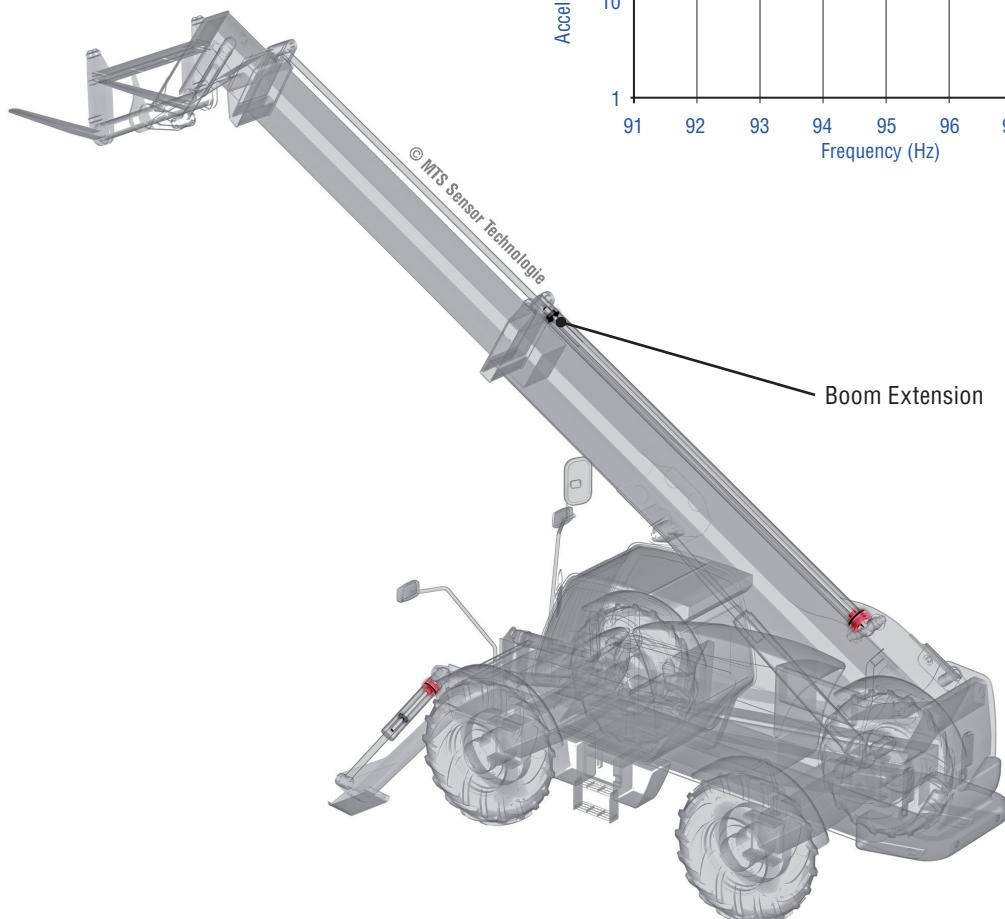
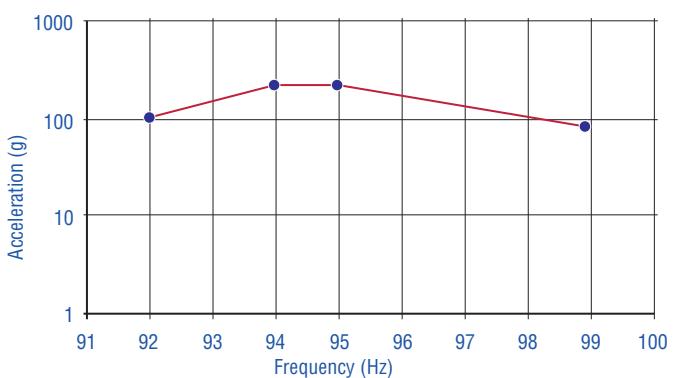
4.4.2 Load Cycle Test with Support Tube 22x2mm

Reference Cylinder- horizontal Installation.

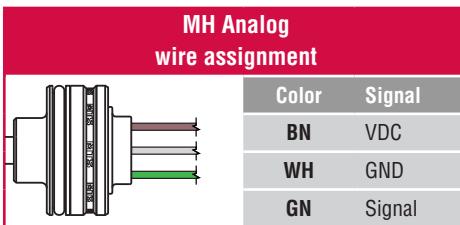
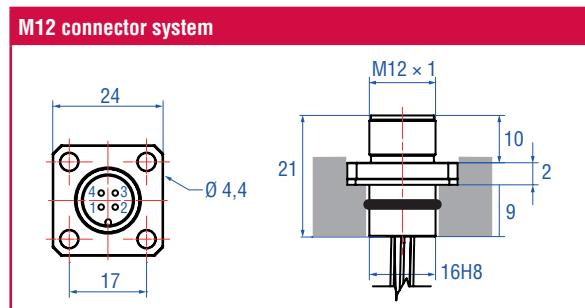
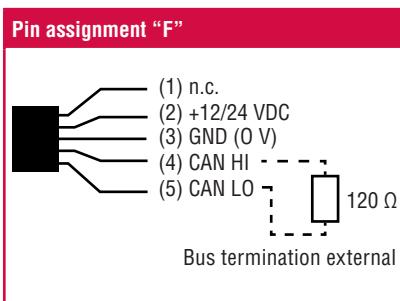
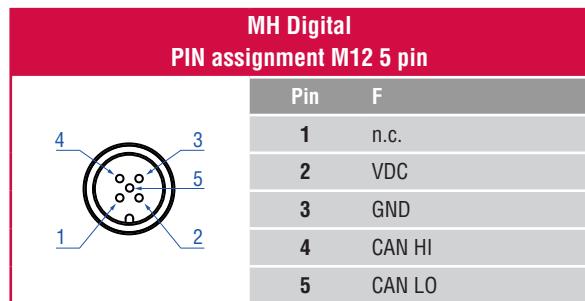
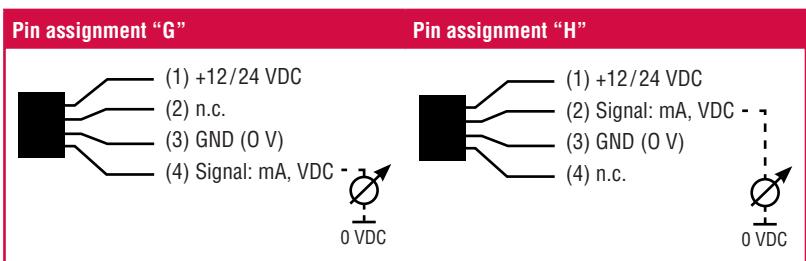
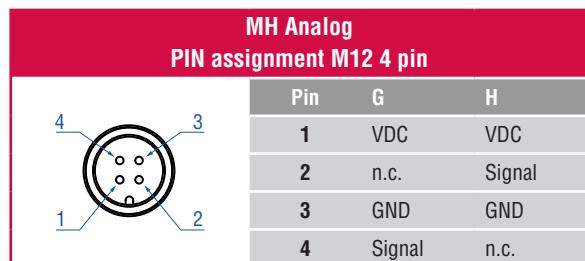
Resonance Endurance Test 2.5×10^6 Load Cycles with Sinus Wave Form.

To perform and approve the mechanical load within the resonance range (94 Hz to 95 Hz). The test was passed without any permanent damages observed after this test.

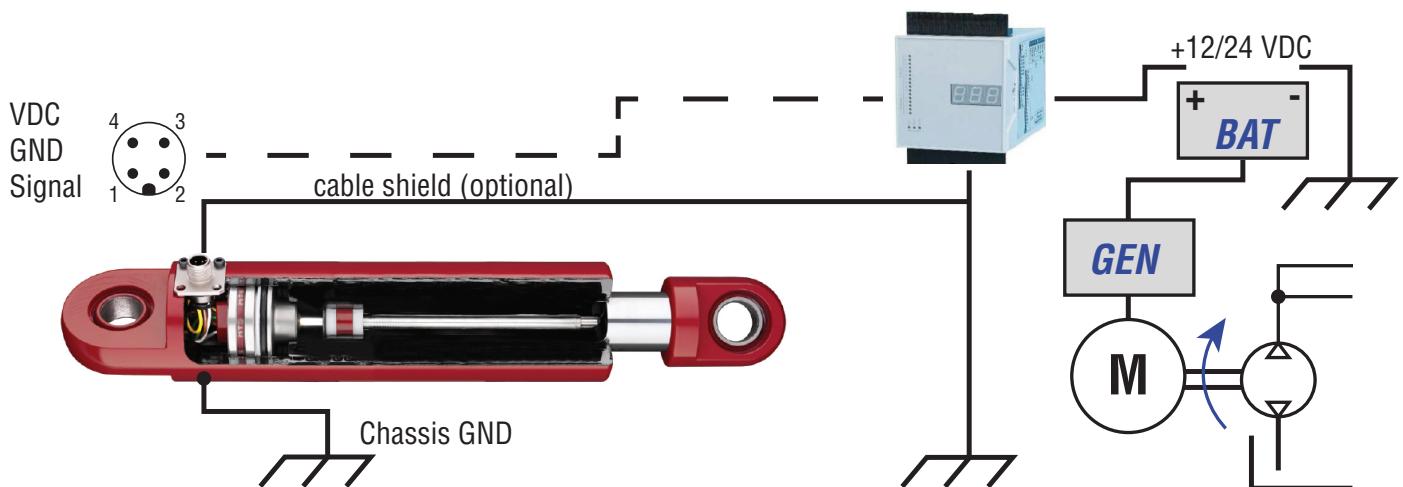
Resonance Endurance Test



5. Electrical installation



Please pay attention to installation manual!



All dimensions in mm

6. MH Analog: Technical data

Input		
Measured value	position	
Stroke range	2520...5000 mm (in 20 mm steps)	
Output		
Signal characteristic	analog output restricted by noise or A/D converter of control unit	
Voltage	0.5...9.5 VDC	
Current	4...20 mA	
Resolution	2520...3500 mm \leq 0.5 mm 3520...5000 mm \leq 1.0 mm	
Power up time	typ. 250 ms	
Mounting zone	30 mm	
Damping	63.5 mm 69.5 mm (M6 female) / 85.5 mm (M8 male)	
Accuracy		
Linearity	2520...3500 mm \leq \pm 1.0 mm 3520...5000 mm \leq \pm 2.0 mm	
Hysteresis	2520...3500 mm \leq \pm 0.5 mm 3520...5000 mm \leq \pm 1.0 mm	
Internal sample rate	2 ms	
Setpoint tolerance	\leq 1 mm	
Operating conditions		
Mounting position	any	
Operating temperature electronics	-40...+105 °C	
Storage temperature	-25...+ 65 °C	
Fluid temperature	-30...+ 85 °C	
Dew point, humidity	EN60068-2-30, 90 % rel. humidity, no condensation	
Pressure		
without considering support tube assembly		
Operating pressure ratings	pressure impulse test according DIN EN ISO 19879 (\varnothing 10 mm pressure pipe)	
PN	320 bar	
Pmax	400 bar	
Pstatic	550 bar	
IP rating		
M12 connector	EN60529 (IP69K) when plugged	
Sensor housing	EN60529 (IP67)	
Environmental testing		
Shock test	IEC 60068-2-27, 50 g (11 ms) single shock, 15 g (11 ms) at 1000 shocks per axis	
Vibration test	IEC 60068-2-64, 5 g (r.m.s.) \varnothing 10 mm pressure pipe (10...2000 Hz) - resonance frequencies excluded	
EMC test	ISO 14982 Agricultural and forest machines Immunity: ISO 11452-2 (200 V/m Antenna), ISO 11452-4 (200 mA BCI) Emissions: CISPR 25 Transiente Impulses: ISO 7637-1/2 E.S.D.: ISO/TR 10605	
Materials and dimensions		
Pressure pipe (\varnothing 10 mm)	stainless steel 1.4306 / AISI 304L	
Housing	stainless steel 1.4305 / AISI 303	
Sealing	O-ring 40.87 \times 3.53 mm NBR 80, back-up ring 42.6 \times 48 \times 1.4 PTFE	
Support tube	stainless steel 1.4301 / AISI 304	
Support tube adapter (head/tail)	stainless steel 1.4305 / AISI 303	
M12 connector insert	material: polyamide reinforces; O-ring 7 \times 1.35 mm NBR 70; pins: brass with gold plated pins	
M12 flange	brass nickel-plated with O-ring 13 \times 1.6 NBR 70	
Electrical installation		
Connector	M12 male plug	
Supply voltage	12 VDC (tolerance range 8...32 VDC)	24 VDC (tolerance range 8...32 VDC)
Current consumption	typ. \leq 100 mA	typ. \leq 50 mA
Load (output VDC)	$R_L \geq 10 \text{ k}\Omega$	$R_L \geq 10 \text{ k}\Omega$
Load current (output VDC)	typ. 1 mA	typ. 1 mA
Loud (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 % p-p	
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 sec	
Electric strength	500 VDC (DC GND to chassis GND)	

6.1 Model configurator

	M	H	a	b	c	d	3	e	f	
a	Sensor model									
M	H	Flange housing Ø 48 mm								
b	Form factor									
C	Pressure pipe Ø 10 mm, Damping: 63.5 mm									
L	Pressure pipe Ø 10 mm, Damping: 69.5 mm, M6 female									
Q	Pressure pipe Ø 10 mm, Damping: 85.5 mm, M8 male port									
c	Stroke range (mm)									
2520...5000 mm (in 20 mm steps)										
d	Electrical wiring									
M12 connector										
N		G	4 pin (1-3-4), 60...240 mm wire length (in 20 mm steps)							
N		H	4 pin (1-3-2), 60...240 mm wire length (in 20 mm steps)							
Pigtail										
T		A	3 wires, 300...9000 mm wire length (in 100 mm steps)							
Examples M12 connector										
N08G = 080 mm										
N10H = 100 mm										
Examples cable										
T10A = 1000 mm										
e	Supply voltage									
3	+12 / 24 VDC									
f	Output									
V	0	2	0.5...9.5 VDC							
A	0	1	4...20 mA							

Scope of delivery:

Position sensor, O-ring, backup-ring, M12 connector system

Please order M12 flange and magnets separately!

Adapters, support tube, locknuts, etc.
are not part of MTS shipment.
Please consult MTS for engineering support

Accessories (selection)	Part no.
OD17.4 Ring magnet, standard installation	401 032
OD25.4 Ring magnet, support tube installation	400 533
OD32 Ring magnet, support tube installation	403 974

MH Testkit	Part no.
Scope of delivery:	280 618
• MH-Series analog / PWM Tester	
• 12 VDC battery charger with adapter	
(adapter main plug EU, adapter main plug UK)	
• cable with M12 connector	
• cable with pigtailed wires	
• carrying case	
• CD-ROM with user's guide	

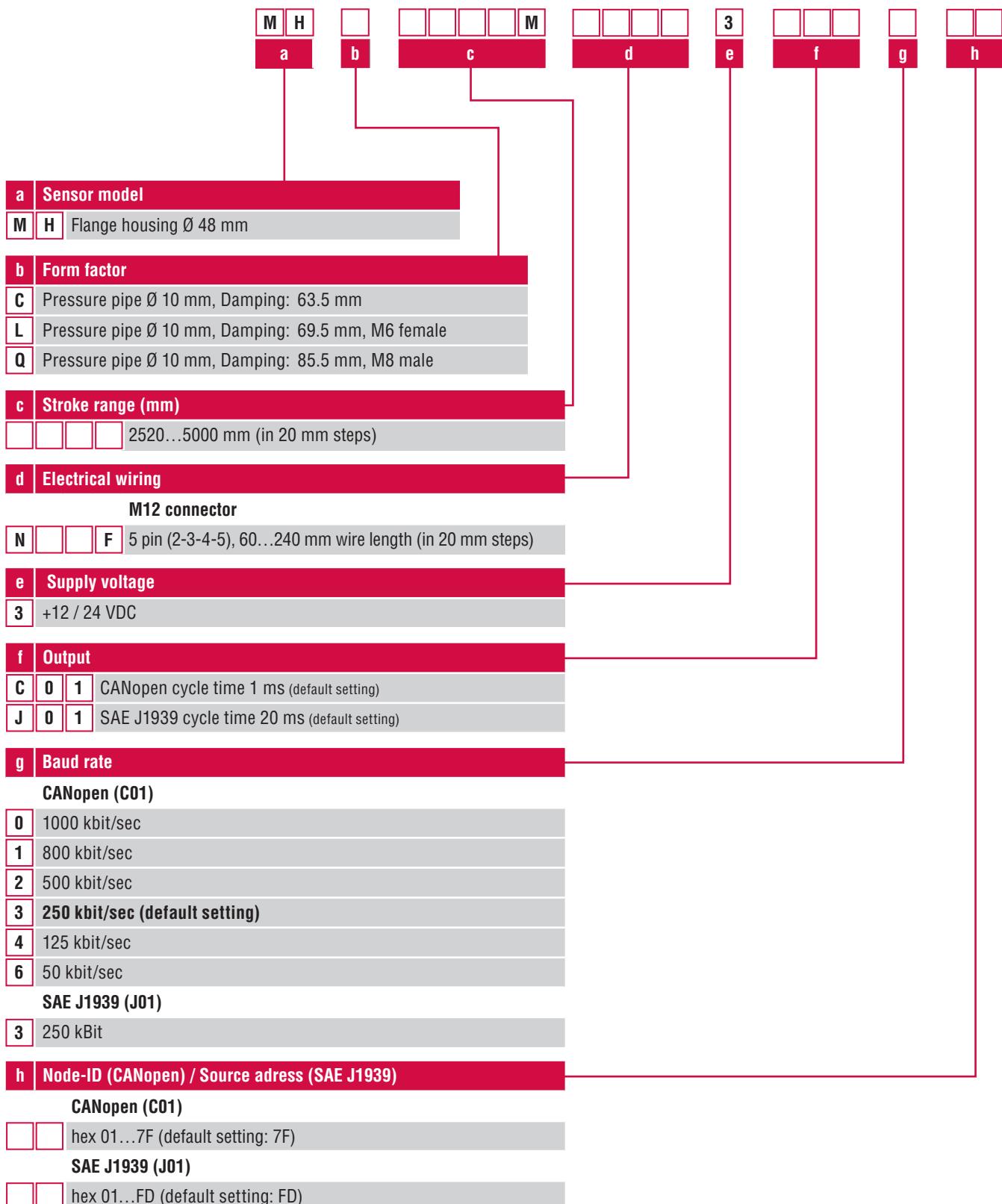


MH Test-Kit

7. MH Digital: Technical data

Input	
Measured value	position and velocity
Stroke range	2520...5000 mm (in 20 mm steps)
Velocity range	0...1000 mm/s
Output	
Signal characteristic	Bus-protocol: SAE J1939, CANopen protocol according to CiA DS-301 V4.1, device profile DS-406 V3.1
Resolution (position)	0.5 mm
Resolution (velocity)	1 mm/s
Boot up time	typ. 400 ms
Cycle time	CANopen: 2 ms SAE J1939: 20 ms
Mounting zone	30 mm
Damping	63.5 mm
	69.5 mm (M6 female) / 85.5 mm (M8 male)
Accuracy	
Linearity	2520...3500 mm $\leq \pm 1.0$ mm
	3520...5000 mm $\leq \pm 2.0$ mm
Hysteresis	± 0.5 mm
Internal sample rate	2 ms
Setpoint tolerance	± 0.2 mm
Operating conditions	
Mounting position	any
Operating temperature electronics	-40...+105 °C
Storage temperature	-25...+ 65 °C
Fluid temperature	-30...+ 85 °C
Dew point, humidity	EN60068-2-30, 90 % rel. humidity, no condensation
Pressure	
without considering support tube assembly	
Operating pressure ratings	pressure impulse test according to DIN EN ISO 19879 (\varnothing 10 mm pressure pipe)
PN	320 bar
Pmax	400 bar
Pstatic	550 bar
IP rating	
M12 connector	EN60529 (IP69K) when plugged
Sensor housing	EN60529 (IP67)
Environmental testing	
Shock test	IEC 60068-2-27, 50 g (11 ms) single shock, 15 g (11 ms) at 1000 shocks per axis
Vibration test	IEC 60068-2-64, 5 g (r.m.s.) \varnothing 10 mm pressure pipe (10...2000 Hz) - resonance frequencies excluded
EMC test	ISO 14982 Agricultural and forest machines Immunity: ISO 11452-2 (200 V/m Antenna), ISO 11452-4 (200 mA BCI) Emissions: CISPR 25 Transiente Impulses: ISO 7637-1/2 E.S.D.: ISO/TR 10605
Materials and dimensions	
Pressure pipe	stainless steel 1.4306 / AISI 304L
Housing	stainless steel 1.4305/AISI 303
Sealing	O-ring: 40.87 \times 3.53 mm NBR 80; back-up ring: 42.6 \times 48 \times 1.4 PTFE
Support tube	stainless steel 1.4301 / AISI 304
Support tube adapter (head/tail)	stainless steel 1.4305 / AISI 303
M12 connector insert	material: polyamide reinforces; O-ring 7 \times 1.35 mm NBR 70; pins: brass with gold plated pins
M12 flange	brass nickel-plated with O-ring 13 \times 1.6 NBR 70
Electrical installation	
Connector	M12 male plug
Supply voltage	12 VDC (8...32 VDC)
Current consumption	typ. \leq 100 mA
Inrush current	max. 1.0 A @ 2 ms
Bus termination (HI-LO)	120 Ω
Supply voltage ripple	< 1 % p-p
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 \geq 10 M Ω @ 60 sec.
Electric strength	500 VDC (DC GND to chassis GND)

7.1 Model configurator



Scope of delivery:

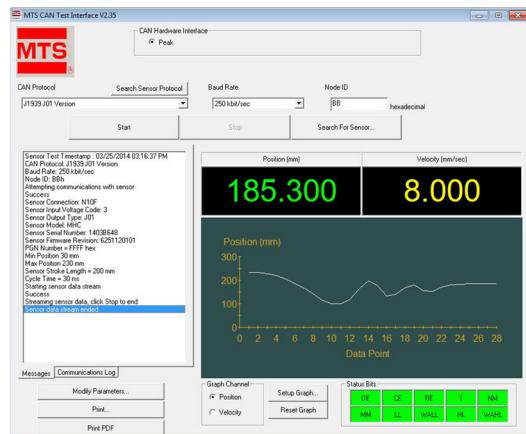
Position sensor, O-ring, backup-ring, M12 connector system

Please order M12 flange and magnets separately!

Adapters, support tube, locknuts, etc.
are not part of MTS shipment.
Please consult MTS for engineering support

Accessories

Accessories	Part no.
OD17.4 Ring magnet, standard installation	401 032
OD30.5 Ring magnet, support tube installation	402 316
OD32 Ring magnet, support tube installation	403 974
MH Testkit	Part no.
Software	625 129
Hardware	254 267
Scope of delivery:	
<ul style="list-style-type: none"> MH-Series CANopen / J1939 Test Software installation CD USB CAN-modul kit: <ul style="list-style-type: none"> USB CAN modul USB CAN modul utility CD (with drives and description) USB connector cable Cable with MTS M12 connector and RS232 connector Cable with core cable ends and RS232 connector Carrying case Installation manual on CD 12 V charger with adapter 	



MH Test-Software

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