

Temposonics®

Magnetostrictive Linear Position Sensors

TH Analog SIL 2 Capable Data Sheet

- ATEX / IECEx & CEC / NEC certified
- Continuous operation under harsh industrial conditions
- Flameproof / Explosionproof / Increased safety



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.

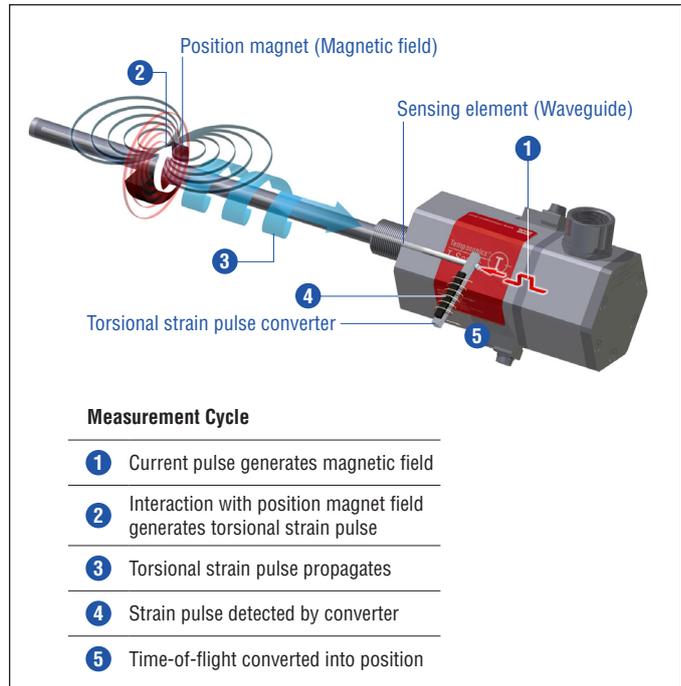


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

TH SENSOR

The TH sensor is extremely robust and ideal for continuous operation under harsh industrial conditions. T-Series sensors are ATEX, IECEx, CEC and NEC certified for use in Class I, II, III Division 1, Division 2 and Zone 0/1, Zone 1, Zone 2, Zone 21 and Zone 22 hazardous areas and meet the requirements for SIL 2. The T-Series is offered in a Ø 10 mm (Ø 0.39 in.) rod in lengths from 25...1500 mm (1...60 in.). The sensor rod is capable of withstanding high pressures such as those found in hydraulic cylinders. Furthermore the sensor is also suitable for petro chemical plants and caustic environments. The sensor head contains the active signal conditioning and a complete integrated electronics interface.



Fig. 2: Typical application: Tank systems

The Safety Function

The T-Series safety sensor will continuously output a position signal proportional to the magnet position, and the internal diagnostic function will check safety relevant parameters within the hardware. The sensor will report an output error signal in the event of a failure. The electronic control unit (ECU) receives the provided signals. In the event of a failure, the ECU must react in an appropriate manner in order to manage the emergency function. The system will shut off or operate in emergency mode. Refer to the SIL 2 safety manual (document no. [551504](#)) for more in-depth information on SIL 2.

T-Series (SIL 2: Analog Safety)	IEC 61508
Safety Level	SIL 2
Device type	B
MTTF _d	100 years @ 60 °C 44 years @ 80 °C
PFD _{avg}	3.49E-04 @ 60 °C 9.85E-04 @ 80 °C
Diagnostic Response Time (Fail Detection Time)	25 ms (max) 1 sec for CRC fault detection
% of SIL 2 range for PFD	3.5 % @ 60 °C; 9.9 % @ 80 °C
Hardware Fault Tolerance (HFT)	0
Useful lifetime	50 years @ 60 °C 18 years @ 80 °C
Device @ 1 % accuracy (60 °C / 80 °C / 85 °C)	SFF 93.6 %

Certification

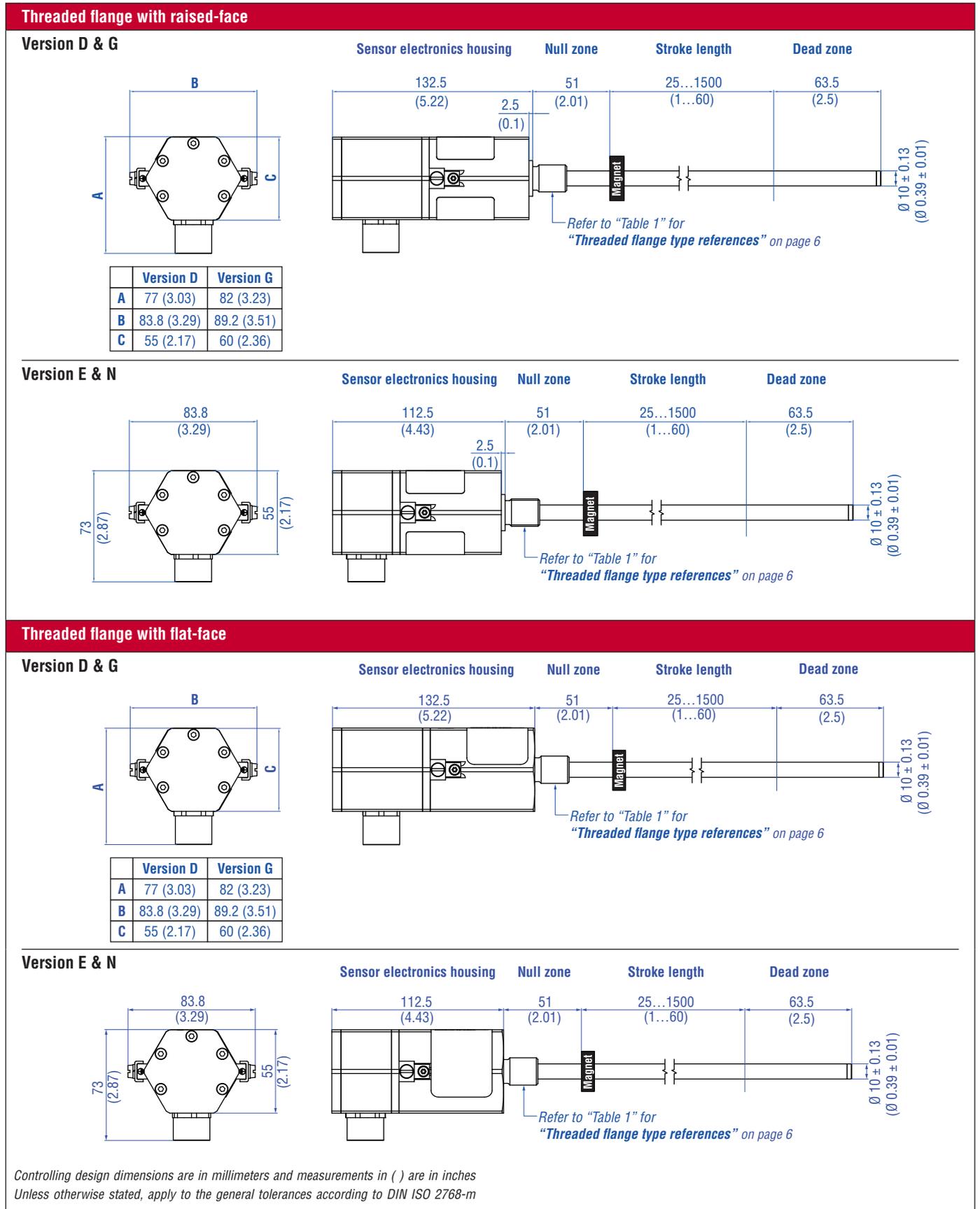
Certification Required	Version E	Version D	Version G	Version N
IECEX / ATEX	Ex db eb IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 85 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 85 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 85 °C	No hazardous area approval
NEC (USA)	Non-incendive Class I Div. 2 Groups A, B, C, D T4 Class II/III Div. 2 Groups E, F, G -40 °C ≤ Ta ≤ 80 °C Non-sparking Class I Zone 2 AEx nA IIC T4 Gc Class II/III Zone 22 AEx tc IIIC T130°C Dc -40 °C ≤ Ta ≤ 80 °C	—	Explosionproof Class I Div. 1 Groups A, B, C, D T4 Class II/III Div. 1 Groups E, F, G T130°C -40 °C ≤ Ta ≤ 85 °C Flameproof Class I Zone 0/1 AEx d IIC T4 Class II/III Zone 21 AEx tb IIIC T130°C -40 °C ≤ Ta ≤ 85 °C	No hazardous area approval
CEC (Canada)	Non-incendive Class I Div. 2 Groups A, B, C, D T4 Class II/III Div. 2 Groups E, F, G -40 °C ≤ Ta ≤ 80 °C Non-sparking Class I Zone 2 Ex nA IIC T4 Gc Class II/III Zone 22 Ex tc IIIC T130°C Dc -40 °C ≤ Ta ≤ 80 °C	—	Explosionproof Class I Div. 1 Groups B, C, D T4 Class II/III Div. 1 Groups E, F, G T130°C -40 °C ≤ Ta ≤ 85 °C Flameproof Class I Zone 0/1 Ex d IIC T4 Ga/Gb Class II/III Zone 21 Ex tb IIIC T130°C Db -40 °C ≤ Ta ≤ 85 °C	No hazardous area approval

TECHNICAL DATA

Output	
Current	4...20 mA, 20...4 mA (minimum / maximum load 0 / 500 Ω)
Measured value	Position
Measurement parameters	
Resolution	16 bit; 0.0015 % (minimum 1 μm)
Cycle time	2.0 ms
Linearity ¹	< ±0.01 % F.S. (minimum ±50 μm)
Repeatability	< ±0.001 % F.S. (minimum ±2.5 μm)
Hysteresis	< 4 μm
Temperature coefficient	< 30 ppm/K typical
Operating conditions	
Operating temperature	-40...+85 °C (-40...+185 °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection	Version D, G and E: IP66/IP67 Version N: IP66, IP67, IP68, IP69K, NEMA 4X depending on cable gland
Shock test	100 g (single shock) / IEC standard 60068-2-27
Vibration test	15 g / 10...2000 Hz, IEC standard 60068-2-6 (resonance frequencies excluded)
EMC test	Electromagnetic emission according to IEC/EN 61326-1 (Class B) Electromagnetic immunity according to IEC/EN 61326-2-3 (Class B)
Magnet movement velocity	Any
Design/Material	
Sensor electronics housing	1.4305 (AISI 303); option: 1.4404 (AISI 316L)
Sensor rod	1.4306 (AISI 304L); option: 1.4404 (AISI 316L)
Stroke length	25...1500 mm (1...60 in.)
Operating pressure	350 bar static (5076 psi static)
Mechanical mounting	
Mounting position	Any orientation
Mounting instruction	Please consult the technical drawings and the operation manual (document number: 551513)
Electrical connection	
Connection type	T-Series terminal
Operating voltage	+24 VDC (-15 / +20 %)
Ripple	≤ 0.28 V _{pp}
Current consumption	100 mA typical
Dielectric strength	700 VDC (DC ground to machine ground)
Polarity protection	Up to -30 VDC
Overvoltage protection	Up to 36 VDC

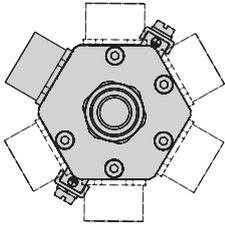
¹/ With position magnet # 201 542-2

TECHNICAL DRAWINGS

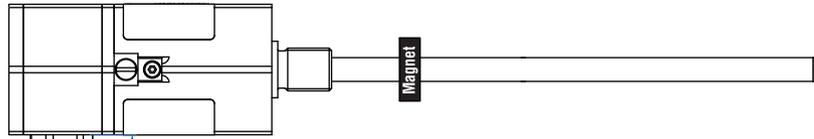


CONNECTION OPTIONS

Side connection C01 / N01 (with adapter) / M01 (without adapter)

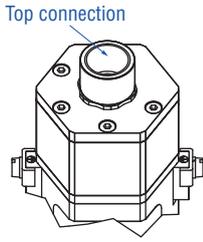


Connector on 6 different positions at 60° each

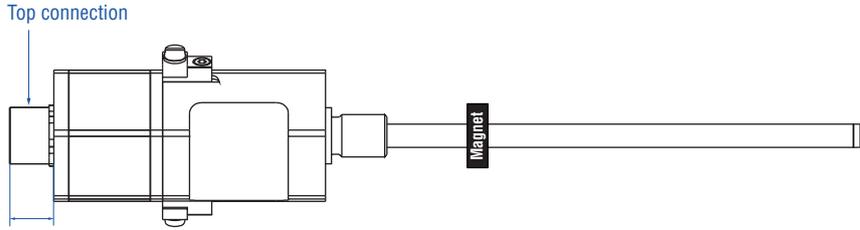


Side connection
Connection length
22 mm (0.87 in.) for version D & G
18 mm (0.7 in.) for version E & N

Top connection C10 / N10 (with adapter) / M10 (without adapter)



Top connection



Top connection
Connection length
22 mm (0.87 in.) for version D & G
18 mm (0.7 in.) for version E & N

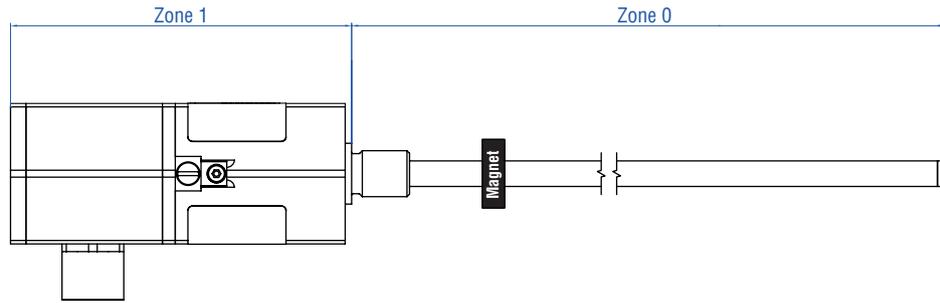
Controlling design dimensions are in millimeters and measurements in () are in inches
Unless otherwise stated, apply to the general tolerances according to DIN ISO 2768-m

Threaded flange type	Description	Threaded flange
F	Threaded flange with flat-face 1.4404 (AISI 316L)	3/4"-16 UNF-3A
G	Threaded flange with raised-face 1.4404 (AISI 316L)	3/4"-16 UNF-3A
M	Threaded flange with flat-face 1.4305 (AISI 303)	M18×1.5-6g
N	Threaded flange with raised-face 1.4305 (AISI 303)	M18×1.5-6g
S	Threaded flange with flat-face 1.4305 (AISI 303)	3/4"-16 UNF-3A
T	Threaded flange with raised-face 1.4305 (AISI 303)	3/4"-16 UNF-3A
W	Threaded flange with flat-face 1.4404 (AISI 316L)	M18×1.5-6g

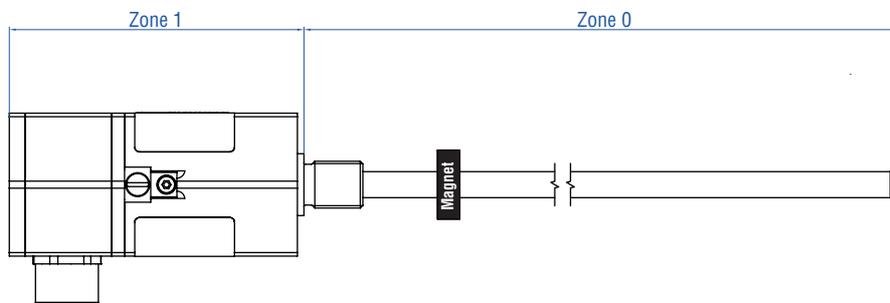
Table 1: Model TH rod-style threaded flange type references

ZONE CLASSIFICATION

Version D & G –
Flameproof (explosionproof) housing with flameproof (explosionproof) connection chamber
ATEX / IECEx / CEC / NEC
Ex db / Ex tb / AEx d / AEx tb



Version E –
Flameproof housing with increased safety connection chamber ATEX / IECEx
Ex db eb / Ex tb

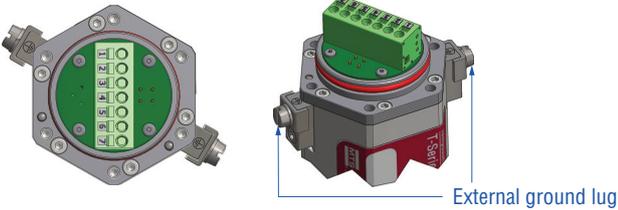


NOTICE

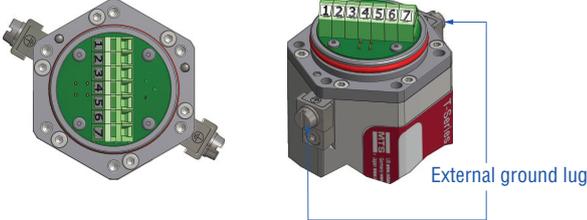
Seal sensor according to ingress protection IP67 between Zone 0 and Zone 1.

CONNECTOR WIRING

Model TH (version D & G) rod-style sensor wiring diagram (2.5 mm² conductor)

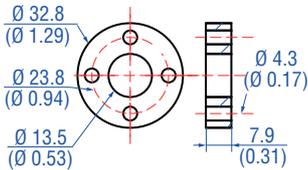
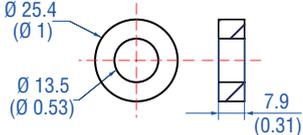
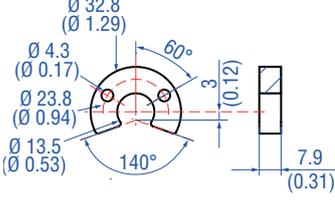
Suitable for connection types: C01, C10, N01, N10		Pin	Description
	1	Output	
	2	DC Ground	
	3	Not connected	
	4	Not connected	
	5	+24 VDC (-15 / +20 %)	
	6	DC Ground (0 V)	
	7	PE – Protective Earth Ground	

Model TH (version E & N) rod-style sensor wiring diagram (1.5 mm² conductor)

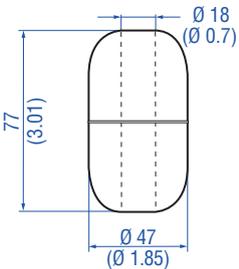
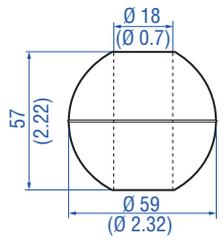
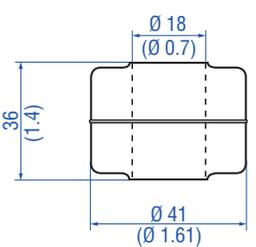
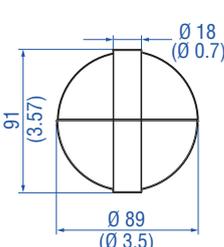
Suitable for connection types: C01, C10, M01, M10, N01, N10		Pin	Description
	1	Output	
	2	DC Ground	
	3	Not connected	
	4	Not connected	
	5	+24 VDC (-15 / +20 %)	
	6	DC Ground (0 V)	
	7	PE – Protective Earth Ground	

FREQUENTLY ORDERED ACCESSORIES – Additional options available in our [Accessories Guide](#)  [551444](#)

Position magnets

		
<p>Standard ring magnet Part no. 201 542-2</p>	<p>Ring magnet OD25,4 Part no. 400 533</p>	<p>U-magnet OD33 Part no. 251 416-2</p>
<p>Material: PA ferrite GF20 Weight: Ca. 14 g Operating temperature: –40...+105 °C (–40...+221 °F) Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm</p>	<p>Material: PA ferrite Weight: Ca. 10 g Operating temperature: –40...+105 °C (–40...+221 °F) Surface pressure: Max. 40 N/mm²</p>	<p>Material: PA ferrite GF20 Weight: Ca. 11 g Operating temperature: –40...+105 °C (–40...+221 °F) Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm</p>

Magnet floats²

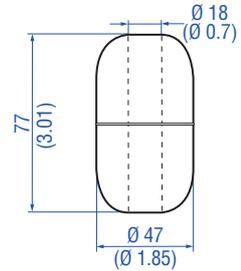
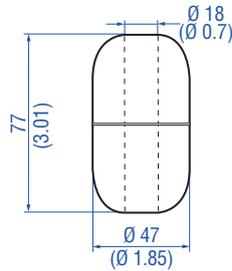
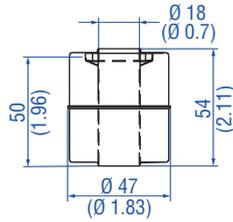
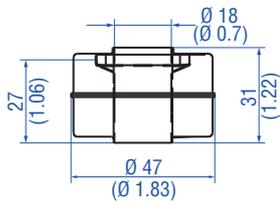
			
<p>Magnet float Part no. 251 981-2</p>	<p>Magnet float Part no. 251 387-2</p>	<p>Magnet float Part no. 200 938-2</p>	<p>Magnet float Part no. 251 469-2</p>
<p>Pressure: 29.3 bar (425 psi) Operating temperature: –40...+125 °C (–40...+257 °F) Magnet offset: No Specific gravity: 0.67 Material: Stainless steel Weight offset: Yes</p>	<p>Pressure: 22.4 bar (325 psi) Operating temperature: –40...+125 °C (–40...+257 °F) Magnet offset: No Specific gravity: 0.48 Material: Stainless steel Weight offset: Yes</p>	<p>Pressure: 8.6 bar (125 psi) Operating temperature: –40...+125 °C (–40...+257 °F) Magnet offset: No Specific gravity: 0.74 Material: Stainless steel Weight offset: Yes</p>	<p>Pressure: 29.3 bar (425 psi) Operating temperature: –40...+125 °C (–40...+257 °F) Magnet offset: No Specific gravity: 0.45 Material: Stainless steel Weight offset: Yes</p>

Controlling design dimensions are in millimeters and measurements in () are in inches

- 2/ – Be sure that the float specific gravity is at least 0.05 less than that of the measured liquid as a safety margin at ambient temperature.
- For interface measurement: A minimum of 0.05 specific gravity differential is required between the upper and lower liquids.

- When the magnet is not shown, the magnet is positioned at the center line of float.
- An offset weight is installed in the float to bias or tilt the float installed on the sensor tube. So the float remains in contact with the sensor tube at all times and guarantees permanent potential equalization of the float. The offset is required for installations that must conform to hazardous location standards.

Standard interface floats³



**Magnet float⁴
Part no. 201 606-2**

Pressure: 4 bar (60 psi)
Operating temperature:
-40...+125 °C (-40...+257 °F)
Magnet offset: Yes
Specific gravity: 0.93
Material: Stainless steel
Weight offset: Yes

**Magnet float⁴
Part no. 201 605-2**

Pressure: 4 bar (60 psi)
Operating temperature:
-40...+125 °C (-40...+257 °F)
Magnet offset: Yes
Specific gravity: 0.6
Material: Stainless steel
Weight offset: Yes

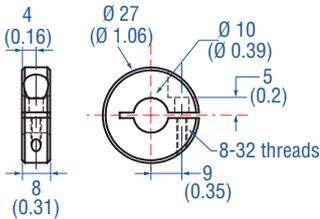
**Magnet float
Part no. 251 982-2**

Pressure: 29.3 bar (425 psi)
Operating temperature:
-40...+125 °C (-40...+257 °F)
Magnet offset: No
Specific gravity: 0.93
Material: Stainless steel
Weight offset: Yes

**Magnet float
Part no. 251 983-2**

Pressure: 29.3 bar (425 psi)
Operating temperature:
-40...+125 °C (-40...+257 °F)
Magnet offset: No
Specific gravity: 1.06
Material: Stainless steel
Weight offset: Yes

Collar



**Collar
Part no. 560 777**

Material:
Stainless steel 1.4301 (AISI 304)
Weight: Ca. 30 g

Hex key 7/64" required

**Manuals & Software available at:
www.mtssensors.com**

Controlling design dimensions are in millimeters and measurements in () are in inches

- 3/ – Be sure that the float specific gravity is at least 0.05 less than that of the measured liquid as a safety margin at ambient temperature.
- For interface measurement: A minimum of 0.05 specific gravity differential is required between the upper and lower liquids.
 - When the magnet is not shown, the magnet is positioned at the center line of float.

– An offset weight is installed in the float to bias or tilt the float installed on the sensor tube. So the float remains in contact with the sensor tube at all times and guarantees permanent potential equalization of the float. The offset is required for installations that must conform to hazardous location standards.

4/ Standard float that can be expedited.

ORDER CODE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
T	H										1		S	N			
a		b	c					d			e	f	g	h	i		

a	Sensor model
T H	Rod

b	Design
Enclosure Type 3: Model TH rod-style sensor with housing material 1.4305 (AISI 303) and rod material 1.4306 (AISI 304L)	

M	Threaded flange with flat-face (M18×1.5-6g)
N	Threaded flange with raised-face (M18×1.5-6g)
S	Threaded flange with flat-face (¾"-16 UNF-3A)
T	Threaded flange with raised-face (¾"-16 UNF-3A)

Enclosure Type 3X: Model TH rod-style sensor with housing material 1.4404 (AISI 316L) and rod material 1.4404 (AISI 316L)	
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F	Threaded flange with flat-face (¾"-16 UNF-3A)
G	Threaded flange with raised-face (¾"-16 UNF-3A)
W	Threaded flange with flat-face (M18×1.5-6g)

c	Stroke length
X X X X M	0025...1500 mm
X X X X U	001.0...060.0 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
25 ... 500 mm	5 mm
500 ... 750 mm	10 mm
750...1000 mm	25 mm
1000...1500 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
1...20 in.	0.2 in.
20...30 in.	0.4 in.
30...40 in.	1.0 in.
40...60 in.	2.0 in.

d	Connection type
C 0 1	Side connection with thread ½"-14 NPT (All versions)
C 1 0	Top connection with thread ½"-14 NPT (All versions)
M 0 1	Side connection with thread M16×1.5-6H (Version E & N)
M 1 0	Top connection with thread M16×1.5-6H (Version E & N)

d	Connection type (continued)
N 0 1	Side connection with thread M20×1.5-6H (All versions)
N 1 0	Top connection with thread M20×1.5-6H (All versions)

e	Operating voltage
1	+24 VDC (-15 / +20 %)

f	Version (see "Technical data" for further information)
D	Ex db and Ex tb (AF55)
E	Ex db eb and Ex tb (AF55) US & CA approvals: Ex nA /NI (for Zone 2 and 22)
G	Ex db and Ex tb (AF60) US & CA approvals: Explosionproof (XP) (Note: Group A is not available for Canada)
N	Not approved

g	Functional safety type
S	SIL 2 (with certificate and manual)

h	Additional option type
N	None

i	Output
1 output with 1 magnet Output 1 (position magnet 1)	
A 0 1	4...20 mA
A 1 1	20...4 mA

DELIVERY



Sensor

Accessories have to be ordered separately

Operation manuals & software are available at:
www.mtssensors.com

* / Non Standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments

Document Part Number:
551603 Revision C (EN) 05/2016

LOCATIONS

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