

Temposonics®

Magnetostrictive Linear Position Sensors

TH Analog Data Sheet

- ATEX / IECEx / CEC / NEC / EAC Ex certified / Japanese approval
- 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 Tempsonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Tempsonics® 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.

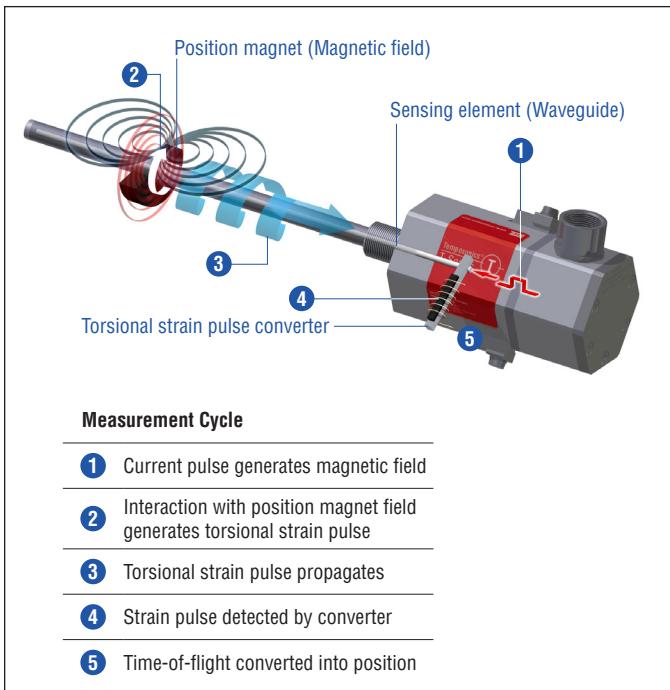


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

TH SENSOR

Robust, non-contact and wear free, the Tempsonics® linear position sensors provide best durability and accurate position measurement solutions in harsh industrial environments. The position measurement accuracy is tightly controlled by the quality of the waveguide which is manufactured by MTS Sensors. The position magnet is mounted on the moving machine part and travels contactlessly over the sensor rod with the built-in waveguide.

The TH sensor is extremely robust and ideal for continuous operation under harsh industrial conditions. T-Series sensors are certified for hazardous areas in Zone 0/1, Zone 1, Zone 2, Zone 21 and Zone 22 for Europe (ATEX), the global (IECEx), the Russian (EAC Ex) and the Japanese market, as well as for use in Class I, II, III, Division 1, Division 2 for Canada (CEC) and USA (NEC). The sensor electronics housing contains the active signal conditioning and a complete integrated electronics interface. 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.



Fig. 2: Typical application: Tank systems

TECHNICAL DATA

Output	
Current	4(0)...20 mA, 20...4(0) mA (minimum / maximum load 0 / 500 Ω)
Measured value	Position
Measurement parameters	
Resolution	16 bit; 0.0015 % (minimum 1 μm) ¹
Cycle time	0.5 ms up to 1200 mm stroke length 1.0 ms up to 2400 mm stroke length 2.0 ms up to 4800 mm stroke length 5.0 ms up to 7620 mm stroke length
Linearity ²	< ±0.01 % F.S. (minimum ±50 μm)
Repeatability	< ±0.001 % F.S. (minimum ±2.5 μm) typical
Hysteresis	< 4 μm typical
Temperature coefficient	< 30 ppm/K typical
Operating conditions	
Operating temperature	-40...+75 °C (-40...+167 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	Version D, G and E: IP66 / IP67 (if properly connected by means that support IP66 / IP67 (pipe, gland, etc.)) 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 55011 +A1 Class B Electromagnetic immunity according to IEC/EN 61000-6-2 The sensor meets the requirements of the EU directives and is marked with 
Operating pressure	350 bar static (5076 psi static)
Magnet movement velocity ³	Any
Design / Material	
Sensor electronics housing	Stainless steel 1.4305 (AISI 303); option: Stainless steel 1.4404 (AISI 316L)
Flange	See "Table 1: TH rod sensor threaded flange type references" on page 6
Sensor rod	Stainless steel 1.4306 (AISI 304L); option: Stainless steel 1.4404 (AISI 316L)
Stroke length	25...7620 mm (1...300 in.)
Mechanical mounting	
Mounting position	Any
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/ The internal digital value is transferred via a 16 bit D/A converter into a proportional, analog current signal

2/ With position magnet # 201 542-2

3/ If there is contact between the moving magnet (including the magnet holder) and the sensor rod, make sure that the maximum speed of the moving magnet is ≤ 1 m/s (Safety requirement due to ESD [Electro Static Discharge])

CERTIFICATIONS

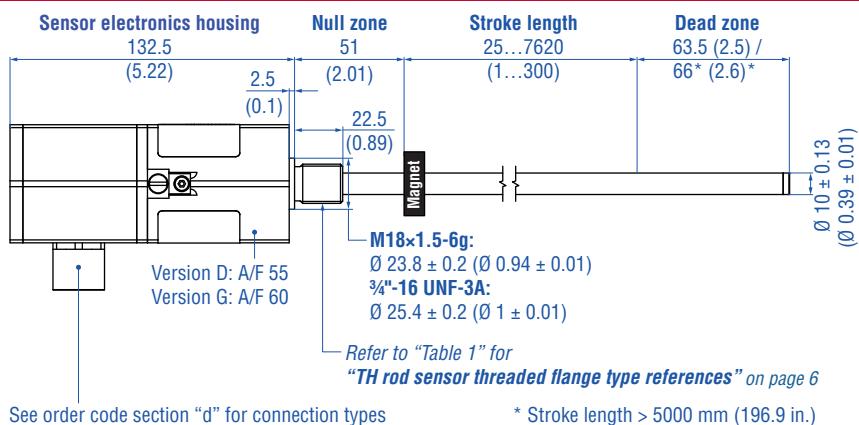
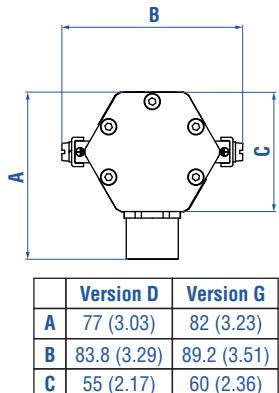
Certification required	Version E	Version D	Version G	Version N
IECEx / ATEX (IECEx: Global market; ATEX: Europe)	Ex db eb IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	No hazardous area approval
NEC (USA)	—	—	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 ≤ 75 °C Flameproof Class I Zone 0/1 AEx d IIC T4 Class II/III Zone 21 AEx tb IIIC T130°C -40 °C ≤ Ta ≤ 75 °C	No hazardous area approval
CEC (Canada)	—	—	Explosionproof Class I Div. 1 Groups B, C, D T4 Class II/III Div. 1 Groups E, F, G T130°C -40 °C ≤ Ta ≤ 75 °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 ≤ 75 °C	No hazardous area approval
EAC Ex (Russian market)	Ga/Gb Ex db eb IIC T4 X Da/Db Ex tb IIIC T130°C X Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ga/Gb Ex db IIC T4 X Da/Db Ex tb IIIC T130°C X Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ga/Gb Ex db IIC T4 X Da/Db Ex tb IIIC T130°C X Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	No hazardous area approval
Japanese approval	Ex d e IIC T4 Ga/Gb Ex t IIIC T130°C Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ex d IIC T4 Ga/Gb Ex t IIIC T130°C Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	Ex d IIC T4 Ga/Gb Ex t IIIC T130°C Db Zone 0/1, Zone 21 -40 °C ≤ Ta ≤ 75 °C	No hazardous area approval

Fig. 3: Certifications

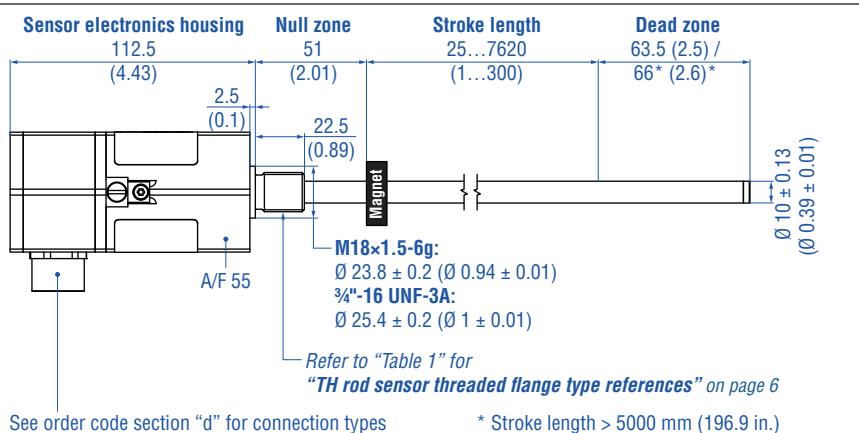
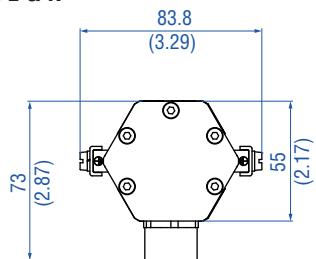
TECHNICAL DRAWINGS

Threaded flange with raised-face

Version D & G

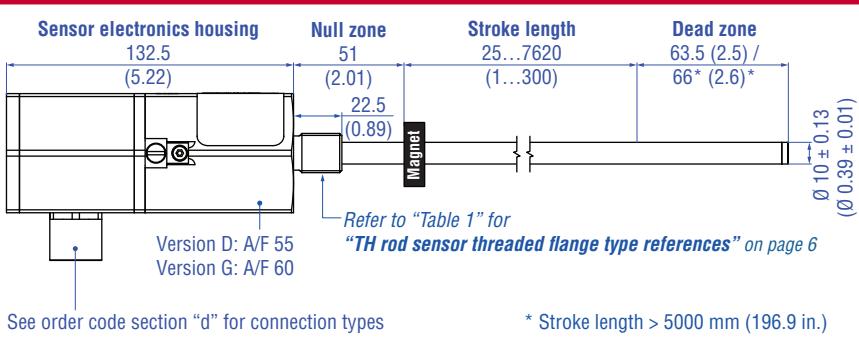
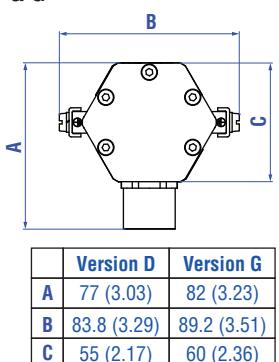


Version E & N

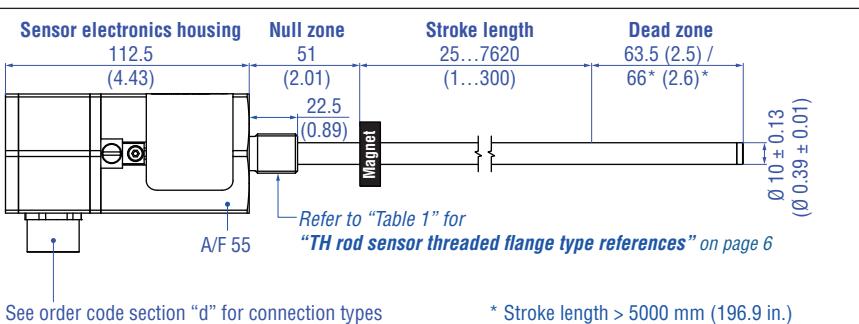
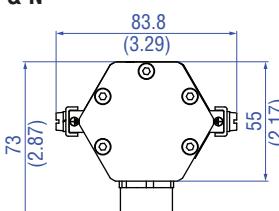


Threaded flange with flat-face

Version D & G



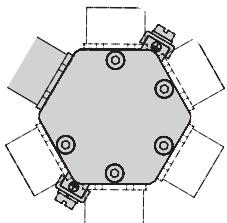
Version E & N



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

CONNECTION OPTIONS

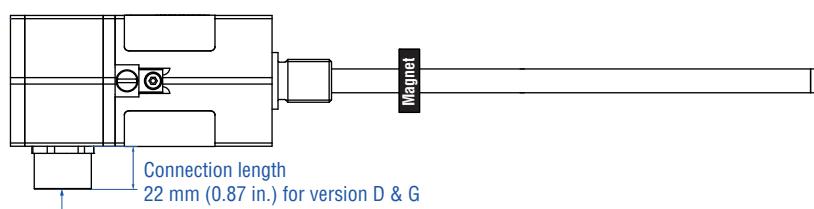
Side connection C01 / N01 / NF1 (with adapter) / M01 (without adapter)

**C01 / N01:**

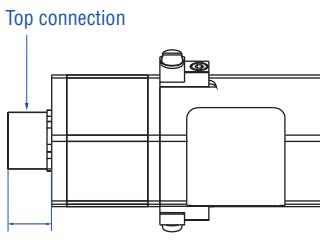
Connector on 6 different positions at 60° each

NF1:

Connector on 4 different positions at 60° each



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



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

Fig. 5: Tempsonics® TH connection options

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

Table 1: TH rod sensor threaded flange type references

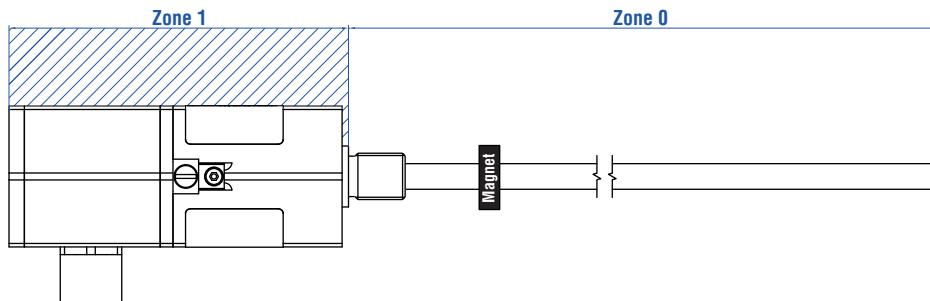
ZONE CLASSIFICATION

Version D & G (example: Threaded flange with raised-face)

Flameproof (explosionproof) housing with flameproof (explosionproof) connection chamber

Version D: ATEX / IECEx / EAC Ex / Japanese Approval

Version G: ATEX / IECEx / CEC / NEC / EAC Ex / Japanese Approval



Version E (example: Threaded flange with raised-face)

Flameproof housing with increased safety connection chamber

ATEX / IECEx / EAC Ex / Japanese Approval

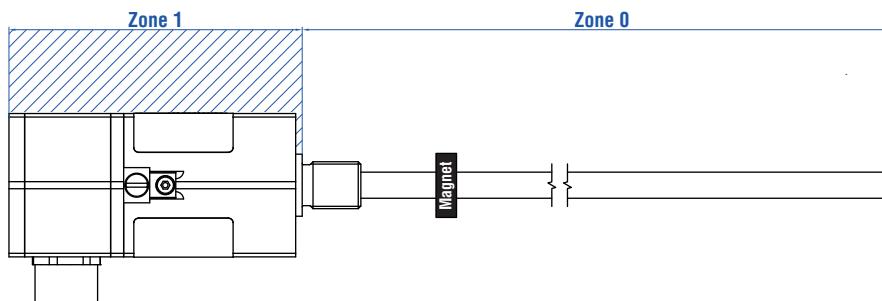


Fig. 6: Tempsonics® TH Zone classification

NOTICE

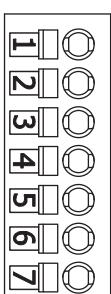
Seal sensor according to ingress protection IP67 between Zone 0 and Zone 1.

CONNECTOR WIRING

Version D & G
suitable for connection types: C01, C10, N01, N10

Signal + power supply

Terminal Pin Function



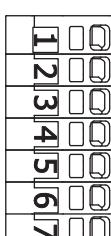
1	Output 1
2	DC Ground
3	Output 2
4	DC Ground
5	+24 VDC (-15 / +20 %)
6	DC Ground (0 V)
7	Cable shield

Fig. 7: TH (version D & G) wiring diagram (2.5 mm² conductor)

Version E & N
suitable for connection types: C01, C10, M01, M10, N01, N10

Signal + power supply

Terminal Pin Function



1	Output 1
2	DC Ground
3	Output 2
4	DC Ground
5	+24 VDC (-15 / +20 %)
6	DC Ground (0 V)
7	Cable shield

Fig. 8: TH (version E & N) wiring diagram (1.5 mm² conductor)

Version E & N
suitable for connection type: NF1

Signal + power supply

Terminal Pin Function

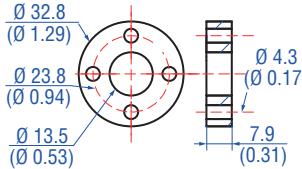
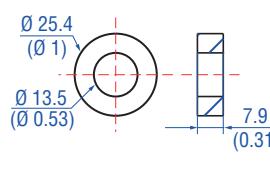
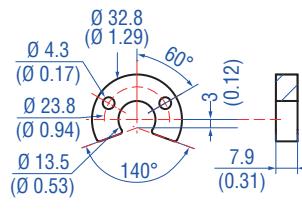
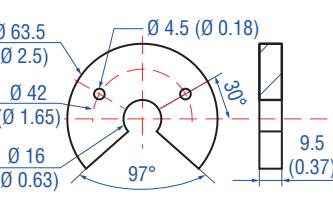


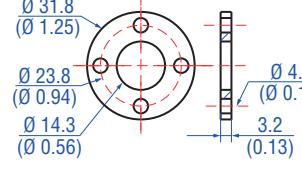
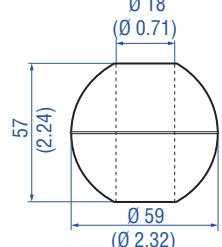
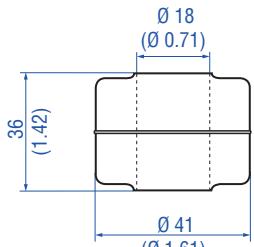
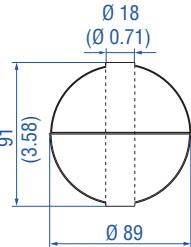
1	Output 1
2	DC Ground
3	Output 2
4	+24 VDC (-15 / +20 %)
5	DC Ground (0 V)
6	Cable shield

Fig. 9: TH (version E & N) wiring diagram (2.5 mm² conductor)

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

Position magnets

			
Ring magnet OD33 Part no. 201 542-2	Ring magnet OD25.4 Part no. 400 533	U-magnet OD33 Part no. 251 416-2	U-magnet OD63.5 Part no. 201 553
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)	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. 11 g Surface pressure: Max. 40 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)	Material: PA 66-GF30, magnets compound-filled Weight: Approx. 26 g Surface pressure: 20 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)

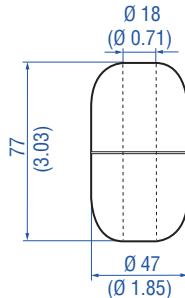
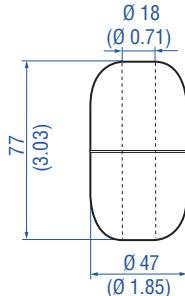
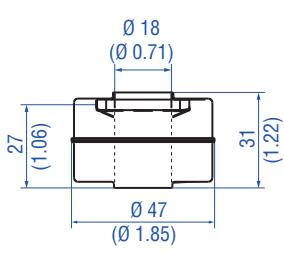
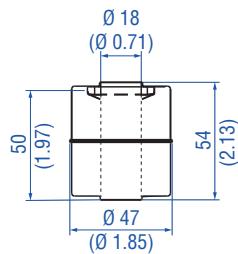
Magnet spacer	Floats⁴			
	  	Float Part no. 251 387-2	Float Part no. 200 938-2	Float Part no. 251 469-2
Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm ² Fastening torque for M4 screws: 1 Nm	Material: Stainless steel (AISI 316L) Weight offset: Yes Pressure: 22.4 bar (325 psi) Magnet offset: No Specific gravity: Max. 0.48 Operating temperature: -40...+125 °C (-40...+257 °F)	Material: Stainless steel (AISI 316L) Weight offset: Yes Pressure: 8.6 bar (125 psi) Magnet offset: No Specific gravity: Max. 0.74 Operating temperature: -40...+125 °C (-40...+257 °F)	Material: Stainless steel (AISI 316L) Weight offset: Yes Pressure: 29.3 bar (425 psi) Magnet offset: No Specific gravity: Max. 0.45 Operating temperature: -40...+125 °C (-40...+257 °F)	

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

- 4/ • 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

Floats⁵



Float⁶
Part no. 201 605-2

Material: Stainless steel 1.4571 (AISI 316 Ti)
Weight offset: Yes
Pressure: 4 bar (60 psi)
Magnet offset: Yes
Specific gravity: Max. 0.6
Operating temperature: -40...+125 °C (-40...+257 °F)

Float⁶
Part no. 201 606-2

Material: Stainless steel 1.4571 (AISI 316 Ti)
Weight offset: Yes
Pressure: 4 bar (60 psi)
Magnet offset: Yes
Specific gravity: 0.93 ± 0.01
Operating temperature: -40...+125 °C (-40...+257 °F)

Float
Part no. 251 982-2

Material: Stainless steel (AISI 316L)
Weight offset: Yes
Pressure: 29.3 bar (425 psi)
Magnet offset: No
Specific gravity: 0.93 ± 0.01
Operating temperature: -40...+125 °C (-40...+257 °F)

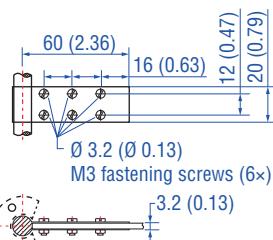
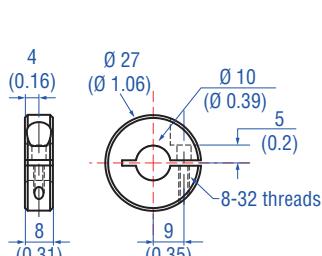
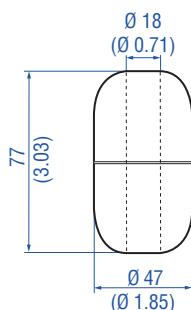
Float
Part no. 251 983-2

Material: Stainless steel (AISI 316L)
Weight offset: Yes
Pressure: 29.3 bar (425 psi)
Magnet offset: No
Specific gravity: 1.06 ± 0.01
Operating temperature: -40...+125 °C (-40...+257 °F)

Float⁵

Collar

Optional installation hardware



Float
Part no. 251 981-2

Material: Stainless steel (AISI 316L)
Weight offset: Yes
Pressure: 29.3 bar (425 psi)
Magnet offset: No
Specific gravity: Max. 0.67
Operating temperature: -40...+125 °C (-40...+257 °F)

Collar
Part no. 560 777

Provides end of stroke stops for float
Material: Stainless steel 1.4301 (AISI 304)
Weight: Approx. 30 g
Hex key $\frac{7}{64}$ " required

Fixing clip
Part no. 561 481

Application: Used to secure sensor rods (\varnothing 10 mm (\varnothing 0.39 in.)) when using an U-magnet
Material: Brass, non-magnetic

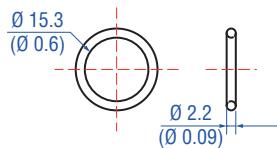
Controlling design dimensions are in millimeters and measurements in () are in inches

- 5/ • 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

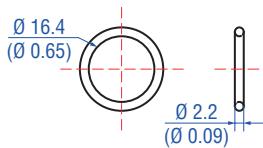
- 6/ Standard float that can be expedited

Sealings



O-ring for threaded flange M18x1.5-6g
Part no. 401 133

Material: Fluoroelastomer
 75 ± 5 durometer
 Operating temperature:
 $-40 \dots +204^\circ\text{C}$ ($-40 \dots +400^\circ\text{F}$)



O-ring for threaded flange 3/4"-16 UNF-3A
Part no. 560 315

Material: Fluoroelastomer
 75 ± 5 durometer
 Operating temperature:
 $-40 \dots +204^\circ\text{C}$ ($-40 \dots +400^\circ\text{F}$)

Programming tools



Hand programmer for analog output
Part no. 253 124

Easy teach-in-setups of stroke length and direction on desired zero / span positions. For sensors with 1 magnet.



Programming kit
Part no. 253 134-1

Kit includes: Interface converter box, power supply and cables.
 For sensors with 1 or 2 magnets.
 Software is available at:
www.mtssensors.com



Cabinet programmer for analog output
Part no. 253 408

Features snap-in mounting on standard 35 mm DIN rail. This programmer can be permanently mounted in a control cabinet and includes a program / run switch. For sensors with 1 magnet.

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

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

ORDER CODE

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

a	Sensor model	d	Connection type
T	H	Rod	C 0 1 Side connection with thread 1/2"-14 NPT (All versions)
b	Design	C 1 0	Top connection with thread 1/2"-14 NPT (All versions)
Enclosure Type 3: TH rod sensor with housing material stainless steel 1.4305 (AISI 303) and rod material stainless steel 1.4306 (AISI 304L)		M 0 1	Side connection with thread M16×1.5-6H (Version E & N)
M	Threaded flange with flat-face (M18×1.5-6g)	M 1 0	Top connection with thread M16×1.5-6H (Version E & N)
N	Threaded flange with raised-face (M18×1.5-6g)	N 0 1	Side connection with thread M20×1.5-6H (All versions)
S	Threaded flange with flat-face (3/4"-16 UNF-3A)	N 1 0	Top connection with thread M20×1.5-6H (All versions)
T	Threaded flange with raised-face (3/4"-16 UNF-3A)	N F 1	Side connection with thread M20×1.5-6H (Version E & N)
Enclosure Type 3X: TH rod sensor with housing material stainless steel 1.4404 (AISI 316L) and rod material stainless steel 1.4404 (AISI 316L)		e	Operating voltage
F	Threaded flange with flat-face (3/4"-16 UNF-3A)	1	+24 VDC (-15 / +20 %)
G	Threaded flange with raised-face (3/4"-16 UNF-3A)	f	Version (see "Certifications" on page 4 for further information)
W	Threaded flange with flat-face (M18×1.5-6g)	D	Ex db and Ex tb (A/F 55)
c		E	Ex db eb and Ex tb (A/F 55)
X X X M	0025...7620 mm	G	Ex db and Ex tb (A/F 60) US & CA approval: Explosionproof (XP) (Note: Group A is not available for Canada)
Standard stroke length (mm)*		N	Not approved
25 ... 500 mm	5 mm	g	See next page
500 ... 750 mm	10 mm		
750...1000 mm	25 mm		
1000...2500 mm	50 mm		
2500...5000 mm	100 mm		
5000...7620 mm	250 mm		
X X X X U	001.0...300.0 in.		
Standard stroke length (in.)*			
1 ... 20 in.	0.2 in.		
20 ... 30 in.	0.4 in.		
30 ... 40 in.	1.0 in.		
40...100 in.	2.0 in.		
100...200 in.	4.0 in.		
200...300 in.	10.0 in.		

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

g	Functional safety type			
N	Not approved			
h	Additional option type			
N	None			
i	Output			
	1 output with 1 position magnet			
	Output 1 (position magnet 1)			
A	0	1	4...20 mA	
A	1	1	20...4 mA	
A	2	1	0...20 mA	
A	3	1	20...0 mA	
	2 outputs with 1 position magnet			
	Output 1 (position magnet 1) + output 2 (position magnet 1)			
A	0	3	4...20 mA	20...4 mA
	2 outputs with 2 position magnets			
	Output 1 (position magnet 1) + output 2 (position magnet 2)			
A	0	2	4...20 mA	4...20 mA
A	1	2	20...4 mA	20...4 mA
A	2	2	0...20 mA	0...20 mA
A	3	2	20...0 mA	20...0 mA

NOTICE

Use magnets of the same type (e.g. 2 ring magnets with part no. 201 542-2) for multi-position measurement.

DELIVERY



Sensor

Accessories have to be ordered
separately

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

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LOCATIONS

USA
MTS Systems Corporation
Sensors Division
 3001 Sheldon Drive
 Cary, N.C. 27513, USA
 Tel. +1 919 677-0100
 Fax +1 919 677-0200
 info.us@mtssensors.com
 www.mtssensors.com

JAPAN
MTS Sensors Technology Corp.
 737 Aihara-machi,
 Machida-shi,
 Tokyo 194-0211, Japan
 Tel. +81 42 775-3838
 Fax +81 42 775-5512
 info.jp@mtssensors.com
 www.mtssensors.com

FRANCE
MTS Systems SAS
 Zone EUROPARC Bâtiment EXA 16
 16/18, rue Eugène Dupuis
 94046 Creteil, France
 Tel. +33 1 58 4390-28
 Fax +33 1 58 4390-03
 info.fr@mtssensors.com
 www.mtssensors.com

GERMANY
MTS Sensor Technologie
GmbH & Co. KG
 Auf dem Schüffel 9
 58513 Lüdenscheid, Germany
 Tel. +49 2351 9587-0
 Fax +49 2351 56491
 info.de@mtssensors.com
 www.mtssensors.com

CHINA
MTS Sensors
 Room 504, Huajing Commercial Center,
 No. 188, North Qinzhou Road
 200233 Shanghai, China
 Tel. +86 21 6485 5800
 Fax +86 21 6495 6329
 info.cn@mtssensors.com
 www.mtssensors.com

ITALY
MTS Systems Srl
Sensor Division
 Via Camillo Golgi, 5/7
 25064 Gussago (BS), Italy
 Tel. +39 030 988 3819
 Fax +39 030 982 3359
 info.it@mtssensors.com
 www.mtssensors.com

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