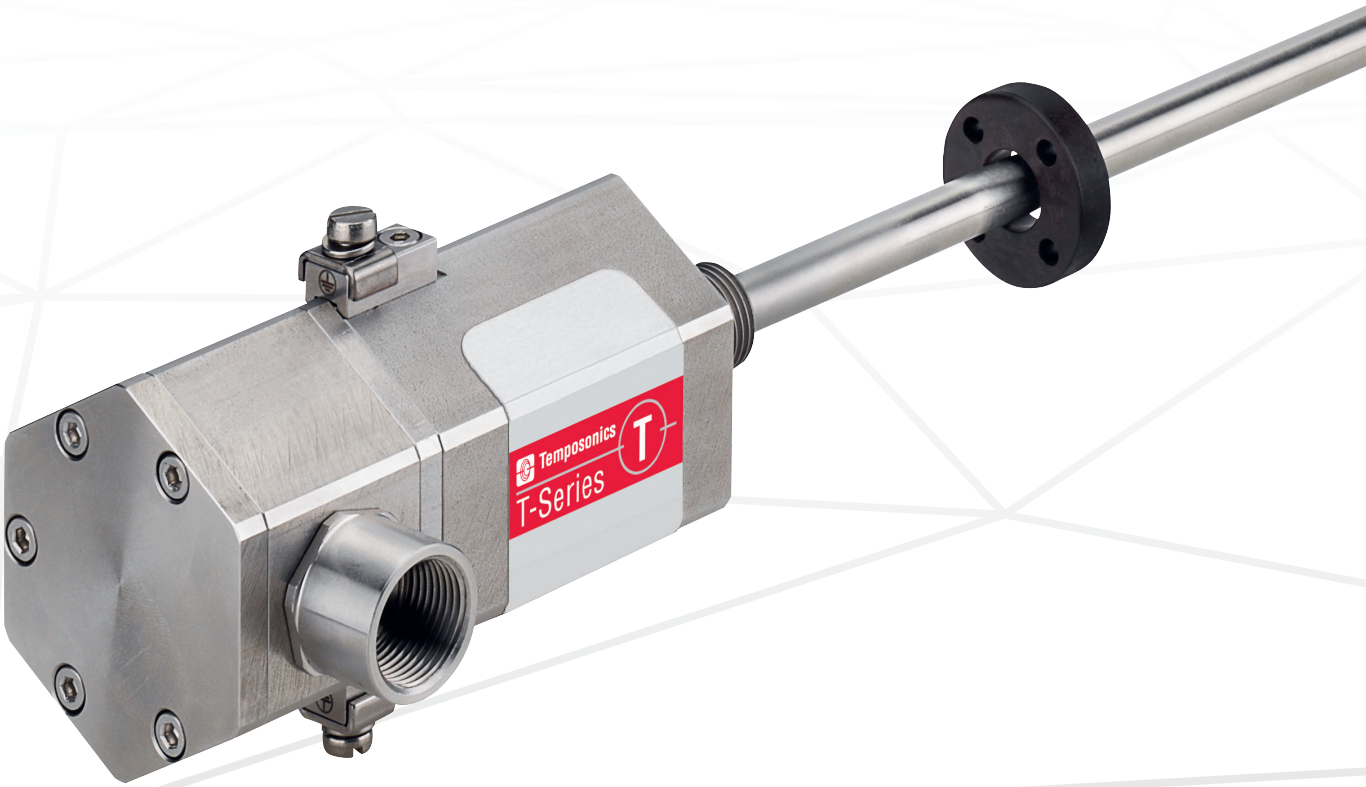
Temposonics
AN AMPHENOL COMPANY

Data Sheet

T-Series – TH CANbus

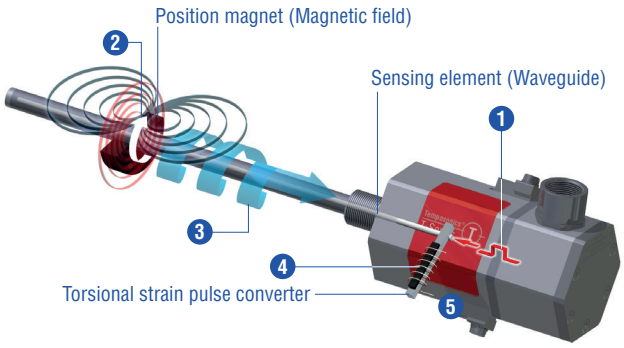
Magnetostrictive Linear Position Sensors

- ATEX/UK Ex/IECEx/CEC/NEC/CCC/PESO certified/Japanese approval
- Continuous operation under harsh industrial conditions
- Flameproof/Explosionproof/Increased safety



MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary 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 a 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 beginning 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.



Measurement Cycle

1	Current pulse generates magnetic field
2	Interaction with position magnet field generates torsional strain pulse
3	Torsional strain pulse propagates
4	Strain pulse detected by converter
5	Time-of-flight converted into position

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

TH SENSOR

Robust, non-contact and wear free, the Temposonics® 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 Temposonics. 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 English, Welsh, Scottish (UK Ex), the global (IECEx), the South Korean (KCs), the Chinese (CCC), the Indian (PESO), 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. In addition the sensor meets the ingress protection IP66/IP67/IP68 (100 m for 7 days)/IP69 and NEMA 4 (for sensor assembly in stainless steel 1.4305 (AISI 303)) or NEMA 4x (for sensor assembly in stainless steel 1.4404 (AISI 316L)).

Fig. 2: Typical application: Tank systems

TECHNICAL DATA

Output	
Interface	CAN-Fieldbus System according to ISO 11898
Data protocol	Corresponds to encoder profile DS 406 V3.1 (CiA Standard DS 301 V3.0)
Baud rate, kBit/s Cable length, m	1000 800 500 250 125 50 20 < 25 < 50 < 100 < 250 < 500 < 1000 < 2500 The sensor will be supplied with ordered baud rate, which is changeable by customer
Measured value	Position/option: Multi-position measurement (2…4 positions)
Measurement parameters	
Resolution	2 µm, 5 µm; velocity step size: See following table

For stroke lengths	having a cycle time of		Velocity step size	
			at 5 µm position resolution	at 2 µm position resolution
Up to 2400 mm	1.0 ms	results in the following velocity step size	0.5 mm/s	0.2 mm/s
Up to 4800 mm	2.0 ms		0.25 mm/s	0.1 mm/s
Up to 7620 mm	4.0 ms		0.125 mm/s	0.05 mm/s

Cycle time	1.0 ms up to 2400 mm stroke length 2.0 ms up to 4800 mm stroke length 4.0 ms up to 7620 mm stroke length
Linearity [1]	< ±0.01 % F.S. (minimum ±40 µm)
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical
Hysteresis	< 4 µm typical
Temperature coefficient	< 15 ppm/K typical
Operating conditions	
Operating temperature	–40…+75 °C (–40…+167 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP66/IP67/IP68 (100 m for 7 days)/IP69 and NEMA 4 (for sensor assembly in stainless steel 1.4305 (AISI 303)) or NEMA 4X (for sensor assembly in stainless steel 1.4404 (AISI 316L)) (if appropriate pipes, glands, etc. are connected properly)
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 EN IEC 61000-6-3 Electromagnetic immunity according to EN IEC 61000-6-2 The TH sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091
Operating pressure	350 bar static (5076 psi static)
Magnet movement velocity [2]	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 7
Sensor rod	Stainless steel 1.4306 (AISI 304L); option: Stainless steel 1.4404 (AISI 316L)
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2012 No. 3032
Stroke length	25…7620 mm (1…300 in.)

See next page for “Mechanical mounting”

1/ With position magnet # 201 542-2

2/ 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])

Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings and the operation manual (document number: 551871)
Electrical connection	
Connection type	T-Series terminal
Operating voltage	+24 VDC (–15/+20 %)
Ripple	≤ 0.28 V_{PP}
Current consumption	90 mA typical
Dielectric strength	700 VDC (DC ground to machine ground)
Polarity protection	Up to –30 VDC
Overvoltage protection	Up to 36 VDC

CERTIFICATIONS

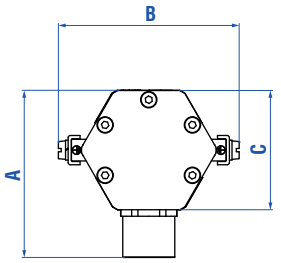
Certification required	Version E	Version D	Version G	Version N
IECEx/ATEX (IECEx: Global market; ATEX: Europe)	Ex db eb IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	Ex db IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	No hazardous area approval
UK Ex (England, Wales and Scotland)	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
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
CCC (China)	Ex d e IIC T4 Gb Ex tD A21 IP66/67 T130°C Zone 1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	Ex d IIC T4 Gb Ex tD A21 IP66/67 T130°C Zone 1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	Ex d IIC T4 Gb Ex tD A21 IP66/67 T130°C Zone 1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	No hazardous area approval
PESO (India)	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 eb IIC T4 Ga/Gb Ex tb IIIC T130°C Ga/Db Zone 0/1, Zone 21 –40 °C ≤ Ta ≤ 75 °C	Ex db eb 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

Fig. 3: Certifications

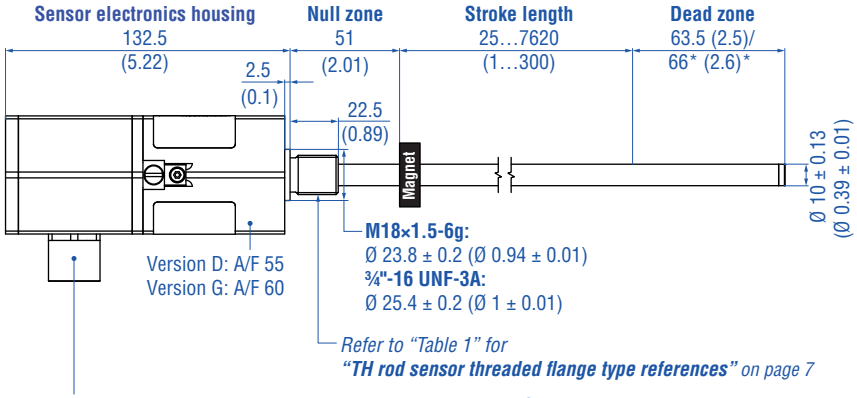
TECHNICAL DRAWING

Threaded flange with raised-face

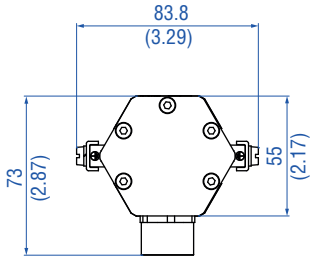
Version D & G

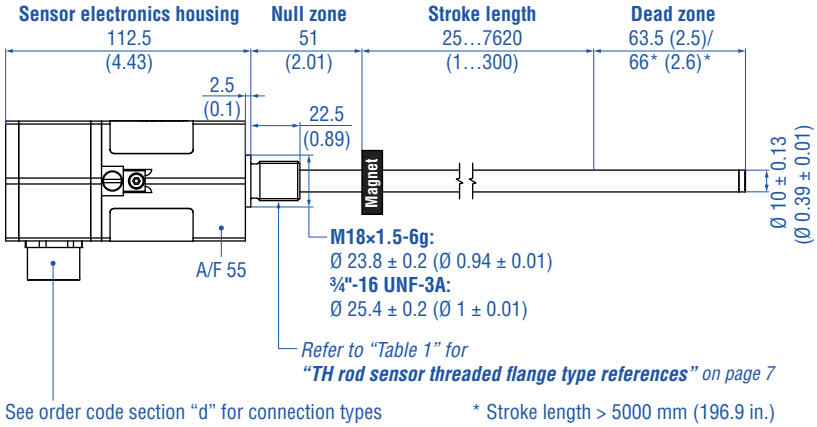


	Version D	Version G
A	77 (3.03)	82 (3.23)
B	83.8 (3.29)	89.2 (3.51)
C	55 (2.17)	60 (2.36)



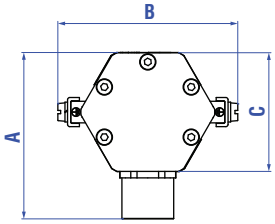
Version E & N



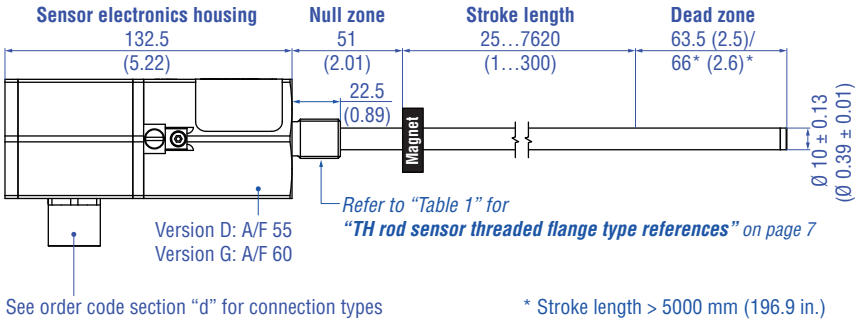


Threaded flange with flat-face

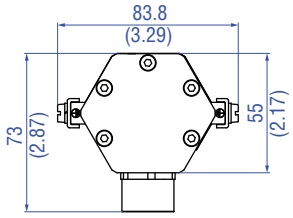
Version D & G

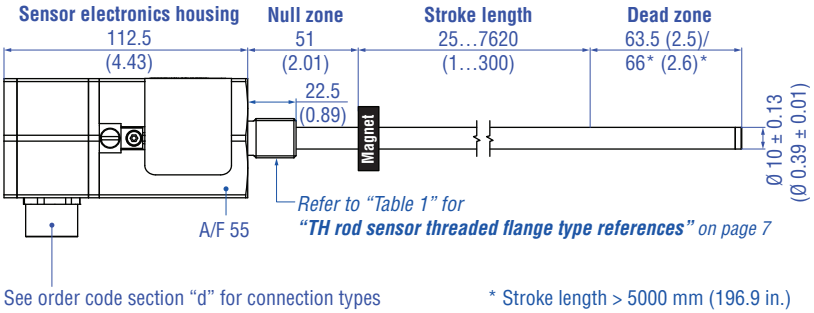


	Version D	Version G
A	77 (3.03)	82 (3.23)
B	83.8 (3.29)	89.2 (3.51)
C	55 (2.17)	60 (2.36)



Version E & N



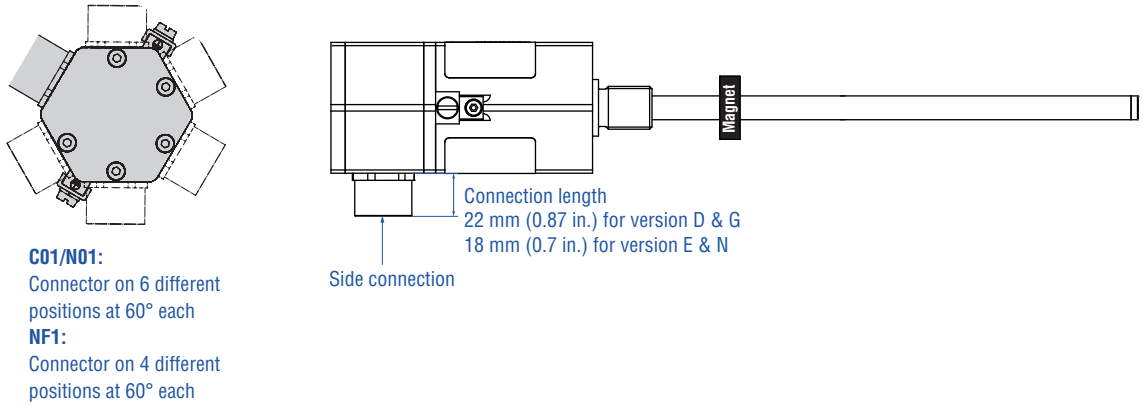


Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Fig. 4: Temposonics® TH with ring magnet

CONNECTION OPTIONS

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



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

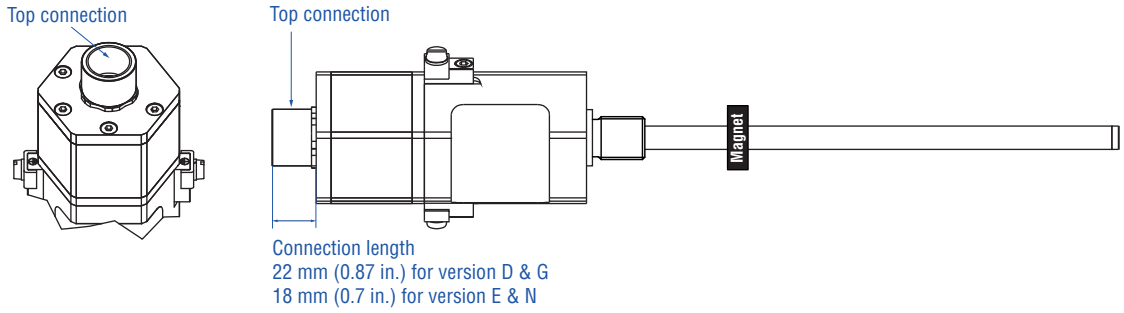


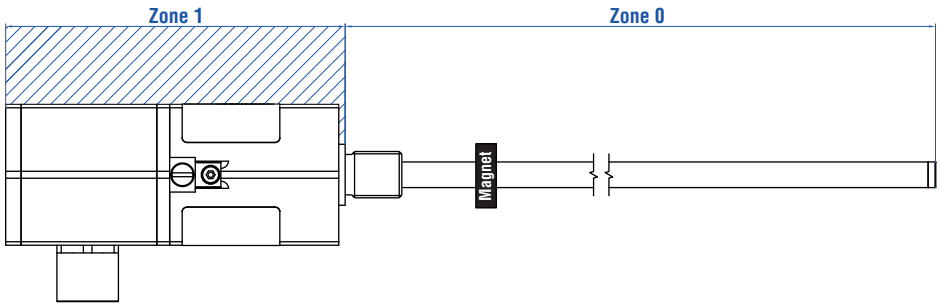
Fig. 5: Temposonics® TH connection options

Threaded flange type	Description	Threaded flange
F	Threaded flange with flat-face Stainless steel 1.4404 (AISI 316L)	¾"-16 UNF-3A
G	Threaded flange with raised-face Stainless steel 1.4404 (AISI 316L)	¾"-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)	¾"-16 UNF-3A
T	Threaded flange with raised-face Stainless steel 1.4305 (AISI 303)	¾"-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 / UK Ex / IECEx / CCC / PESO / Japanese Approval
Version G: ATEX / UK Ex / IECEx / CEC / NEC / CCC / PESO / Japanese Approval



Version E (example: Threaded flange with raised-face)
Flameproof housing with increased safety connection chamber
ATEX / UK Ex / IECEx / CCC / PESO / Japanese Approval

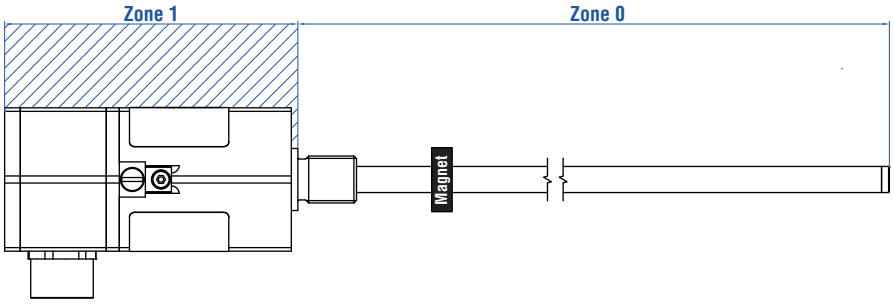


Fig. 6: Temposonics® TH Zone classification

NOTICE

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

CONNECTOR WIRING

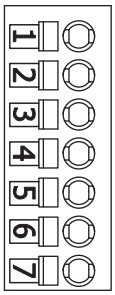
Version D & G suitable for connection types: C01, C10, N01, N10		
Signal + power supply		
Terminal	**Pin**	**Function**
	1	CAN_L
	2	CAN_H
	3	Not connected
	4	Not connected
	5	+24 VDC (–15/+20 %)
	6	DC Ground (0 V)
	7	Cable shield

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

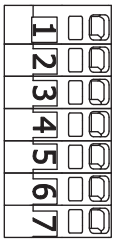
Version E & N suitable for connection types: C01, C10, M01, M10, N01, N10		
Signal + power supply		
Terminal	**Pin**	**Function**
	1	CAN_L
	2	CAN_H
	3	Not connected
	4	Not connected
	5	+24 VDC (–15/+20 %)
	6	DC Ground (0 V)
	7	Cable shield

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

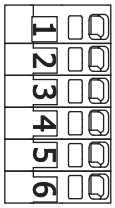
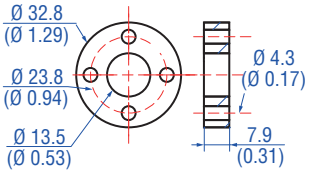
Version E & N suitable for connection type: NF1		
Signal + power supply		
Terminal	**Pin**	**Function**
	1	CAN_L
	2	CAN_H
	3	Not connected
	4	+24 VDC (–15/+20 %)
	5	DC Ground (0 V)
	6	Cable shield

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

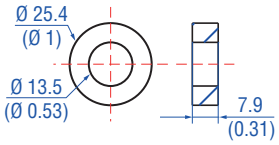
FREQUENTLY ORDERED ACCESSORIES – Additional options available in our Accessories Catalog 551444

Position magnets



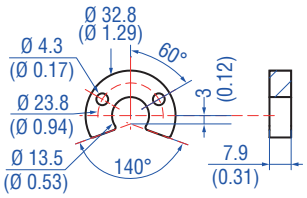
Ring magnet OD33
Part no. 201 542-2

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)



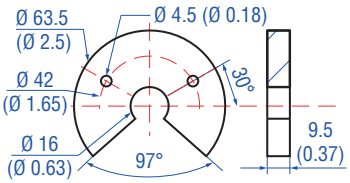
Ring magnet OD25.4
Part no. 400 533

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



U-magnet OD33
Part no. 251 416-2

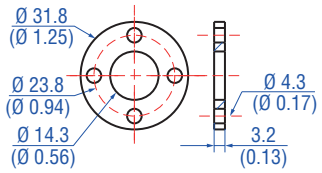
Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)



U-magnet OD63.5
Part no. 201 553

Material: PA 66-GF30,
magnets compound-filled
Weight: Approx. 26 g
Surface pressure: 20 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+75 °C (–40…+167 °F)

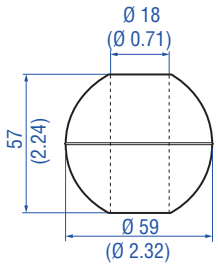
Magnet spacer



Magnet spacer
Part no. 400 633

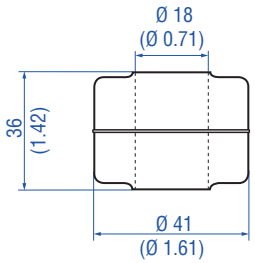
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

Floats [3]



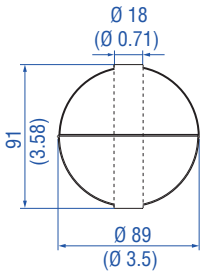
Float
Part no. 251 387-2

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)



Float
Part no. 200 938-2

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)



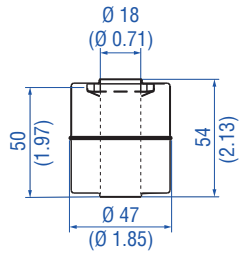
Float
Part no. 251 469-2

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

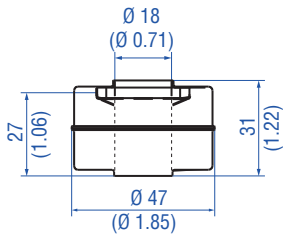
3/
- Be sure that the float specific gravity is at least 0.05 less than that of the measured liquid as a safety margin at ambient temperature
- For interface measurement: A minimum of 0.05 specific gravity differential is required between the upper and lower liquids
- When the magnet is not shown, the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

Floats [4]



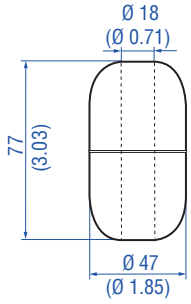
Float [5]
Part no. 201 605-2

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)



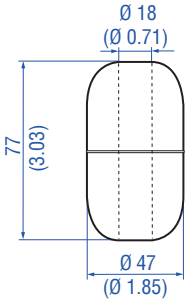
Float [5]
Part no. 201 606-2

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

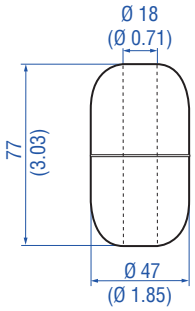
Material: Stainless steel (AISI 316L)
Weight offset: Yes
Pressure: 29.3 bar (425 psi)
Magnet offset: No
Specific gravity: 0.93 ± 0.01
Operating temperature: –40…+125 °C (–40…+257 °F)



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)

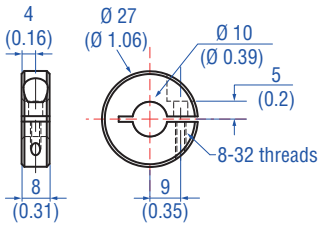
Float [4]



Float
Part no. 251 981-2

Material: Stainless steel (AISI 316L)
Pressure: 29.3 bar (425 psi)
Specific gravity: Max. 0.67
Operating temperature: –40…+125 °C (–40…+257 °F)

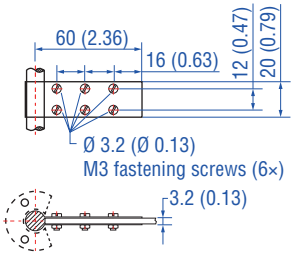
Collar



Stop collar for Ø 10 mm
Part no. 560 777

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

Optional installation hardware



Fixing clip
Part no. 561 481

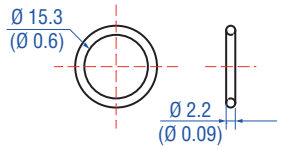
Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.)) when using an U-magnet or block magnet
Material: Brass, non-magnetic

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

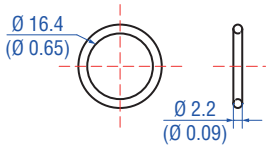
5/ Standard float that can be expedited

Sealings



O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Manuals, Software & 3D Models available at:
www.temposonics.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	19	20	21	22	23	24	25
T	H										1		N	N	C									
a		b	c					d			e	f	g	h	i							j		

Optional

a	Sensor model
T H	Rod

b	Design
Enclosure Type 4: **TH rod sensor with housing material stainless steel 1.4305 (AISI 303) and rod material stainless steel 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 4X: **TH rod sensor with housing material stainless steel 1.4404 (AISI 316L) and rod material stainless steel 1.4404 (AISI 316L)**	
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…7620 mm	
Standard stroke length (mm)	**Ordering steps**	
25 … 500 mm	5 mm	
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.)	**Ordering steps**	
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.		

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)
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)
N F 1	Side connection with thread M20×1.5-6H (Version E & N)

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

f	Version (see "Certifications" on page 5 for further information)
D	Ex db and Ex tb (A/F 55)
E	Ex db eb and Ex tb (A/F 55)
G	Ex db and Ex tb (A/F 60) US & CA approval: Explosionproof (XP) **(Note: Group A is not available for Canada)**
N	Not approved

g	Functional safety type
N	Not approved

h	Additional option type
N	None

i	See next page

i	Output
C (17) (18) (19) (20) (21) (22) = CANbus	
Protocol [6] (box no. 17, 18, 19)	
3 0 4	CANopen
Baud rate (box no. 20)	
1	1000 kBit/s
2	500 kBit/s
3	250 kBit/s
4	125 kBit/s
Resolution (box no. 21)	
1	5 µm
2	2 µm
Performance (box no. 22)	
1	Standard

Optional:

j	Magnet number for multi-position measurement [7]
Z 0 2	2 magnets
Z 0 3	3 magnets
Z 0 4	4 magnets

NOTICE

- Specify magnet numbers for your sensing application and order separately.
- The number of magnets is limited by the stroke length.
- The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.

DELIVERY

Sensor

Accessories have to be ordered separately

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

6/ Please contact Temposonics if you are interested in further CAN protocols

7/ Note: Specify magnet numbers for your sensing application and order separately

Temposonics
AN AMPHENOL COMPANY

UNITED STATES
Temposonics, LLC
Americas & APAC Region
3001 Sheldon Drive
Cary, N.C. 27513
Phone: +1 919 677-0100
E-mail: info.us@temposonics.com

GERMANY
Temposonics GmbH & Co. KG
EMEA Region & India
Auf dem Schüffel 9
58513 Lüdenscheid
Phone: +49 2351 9587-0
E-mail: info.de@temposonics.com

ITALY
Branch Office
Phone: +39 030 988 3819
E-mail: info.it@temposonics.com

FRANCE
Branch Office
Phone: +33 6 14 060 728
E-mail: info.fr@temposonics.com

UK
Branch Office
Phone: +44 79 21 83 05 86
E-mail: info.uk@temposonics.com

SCANDINAVIA
Branch Office
Phone: +46 70 29 91 281
E-mail: info.sca@temposonics.com

CHINA
Branch Office
Phone: +86 21 3405 7850
E-mail: info.cn@temposonics.com

JAPAN
Branch Office
Phone: +81 3 6416 1063
E-mail: info.jp@temposonics.com

temposonics.com

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