

# Temposonics®

Magnetostrictive Linear Position Sensors

## ET Analog Data Sheet

- High operating temperature
- Compact sensor housing
- ATEX / IECEx / CEC / NEC certified



## MEASURING TECHNOLOGY

The absolute, linear position sensors provided by MTS Sensors rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine positions 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.

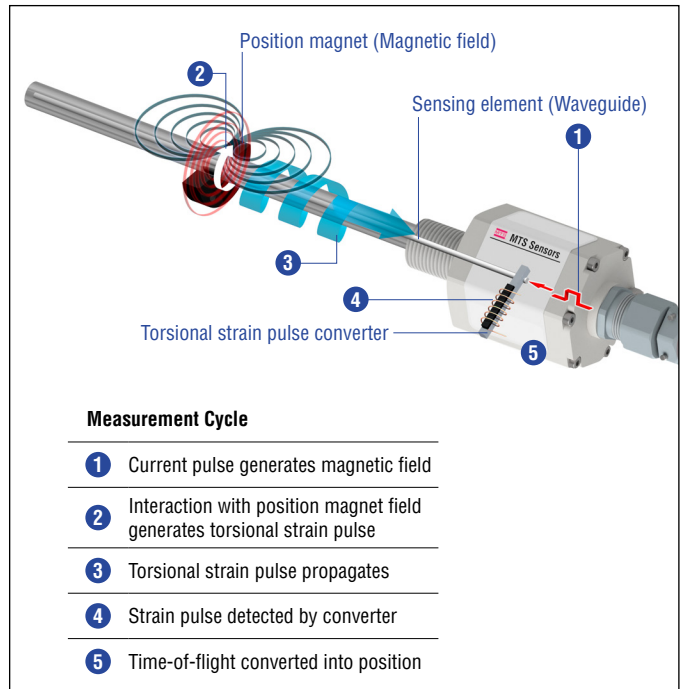


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

## ET 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 MTS Sensors. The position magnet is mounted on the moving machine part and travels contactlessly over the sensor rod/sensor profile with the built-in waveguide.

### ET sensor specifications:

- High operating temperature up to +85 °C (+185 °F)
- Compact sensor housing
- ATEX / IECEx / CEC / NEC certified
- Set points are programmable

Certification
ⓧ II 3G Ex nC IIC T4 Gc/Ex tD A22 IP66/IP68 T130°C ⓧ II 3D Ex tc IIIC T130 °C Dc IP66/IP68 Class I/II/III Div 2 T4 ABCDFG Class I Zone 2 T4 IIC Zone 22 AEx tc T4 IIIC Dc -40 °C ≤ Ta ≤ 85 °C, Type: 4X

Fig. 2: Certification of Temposonics® ET (version A and E)



Fig. 3: Typical application: Metal processing

## TECHNICAL DATA

Output			
Voltage	0...10 VDC and/or 10...0 VDC (minimum load controller: > 5 kΩ)		
Current	4(0)...20 mA and/or 20...4(0) mA (minimum/maximum load: 0/500 Ω)		
Measured value	Position		
Measurement parameters			
Resolution	16 bit (minimum 1 μm depending on stroke length) <sup>1</sup>		
Cycle time	Stroke length	≤ 1200 mm	≤ 2400 mm
	Cycle time	0.5 ms	1.0 ms
Linearity <sup>2</sup>	≤ ±0.02 % F.S. (minimum ±60 μm)		
Repeatability	≤ ±0.005 % F.S. (minimum ±20 μm) typical		
Operating conditions			
Operating temperature	-40...+85 °C (-40...+185 °F); option: -40...+75 °C (-40...+167 °C)		
Humidity	90 % relative humidity, no condensation		
Ingress protection	With Teflon® cable (part no. 530 112): IP66 With silicone cable (part no. 530 113): IP68 (2 bar (29 psi) @ 30 min)		
Shock test	100 g (single shock), IEC standard 60068-2-27		
Vibration test	20 g/10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)		
EMC test	Electromagnetic emission according to EN 61000-6-4		
	Electromagnetic immunity according to EN 61000-6-2 The sensor meets the requirements of the EU directives and is marked with <b>CE</b>		
Operating pressure (rod version only)	Up to 350 bar (5076 psi)		
Magnet movement velocity <sup>3</sup>	Any		
Design / Material			
Sensor electronics housing/Flange	Stainless steel 1.4305 (AISI 303); option: Stainless steel 1.4404 (AISI 316L)		
Sensor rod	Stainless steel 1.4306 (AISI 304L); option: Stainless steel 1.4404 (AISI 316L)		
Sensor profile	Aluminium		
Stroke length	50...3000 mm (1.97...118.11 in.)		
Mechanical mounting			
Mounting position	Any		
Mounting instruction	Please consult the technical drawings and the operation manual (document number: 551890)		
Electrical connection			
Connection type	Cable outlet		
Operating voltage	+24 VDC (-15 / +20 %); UL recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA)/ Canadian Electrical Code.		
Ripple	≤ 0.28 V <sub>pp</sub>		
Current consumption	100 mA typical, dependent on stroke length		
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 or voltage signal

2/ With position magnet # 251 416-2

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

TECHNICAL DRAWING

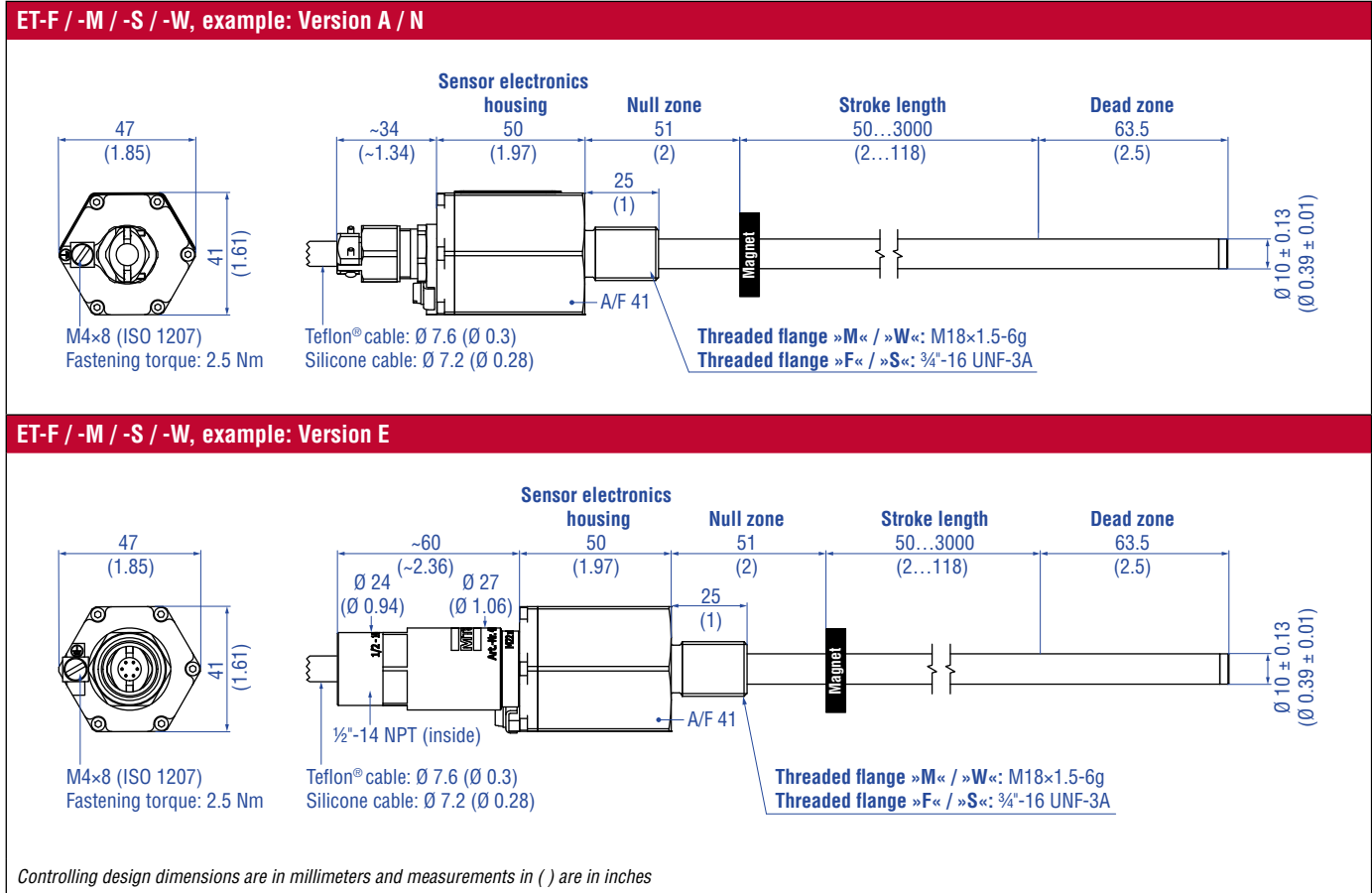


Fig. 4: Temposonics® ET with ring magnet

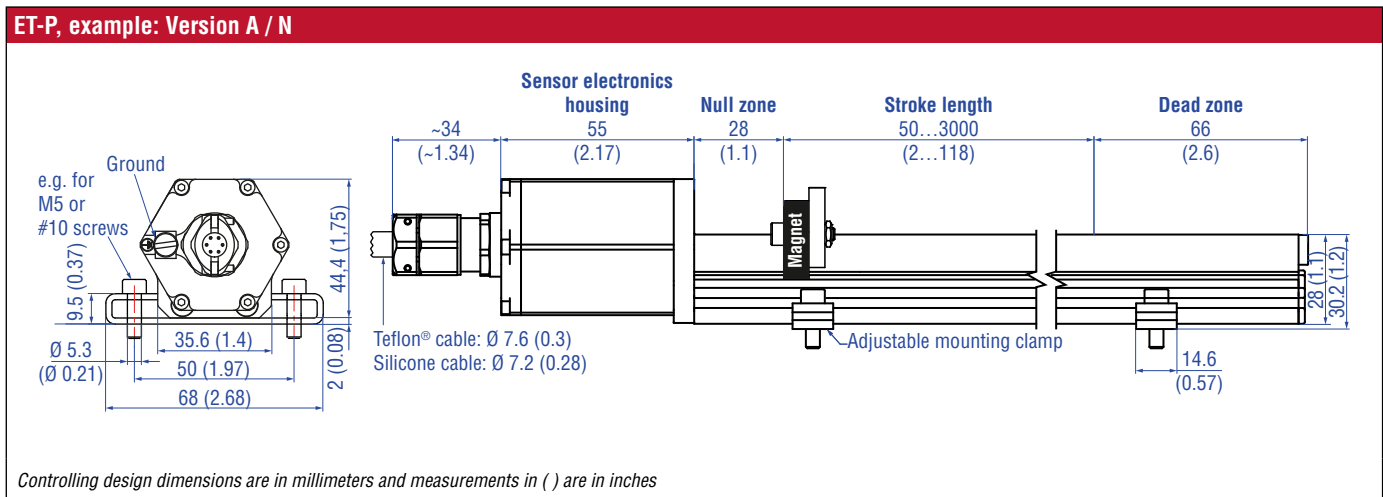


Fig. 5: Temposonics® ET-P with U-magnet

## CONNECTOR WIRING

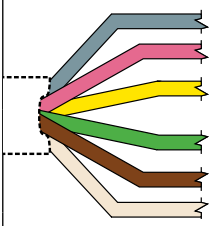
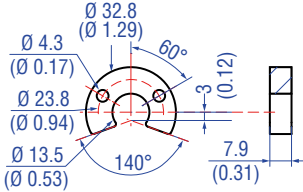
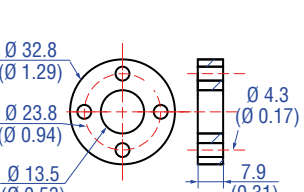
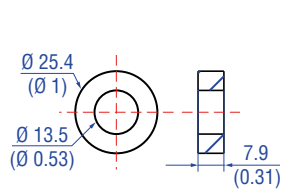
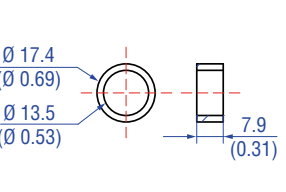
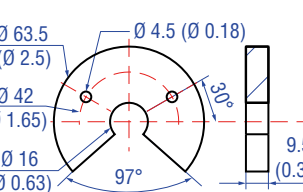
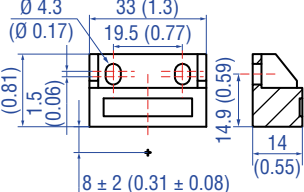
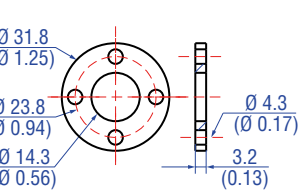
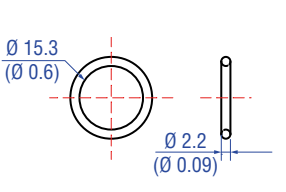
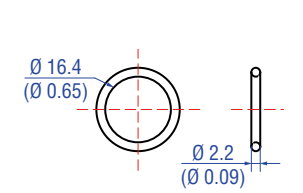
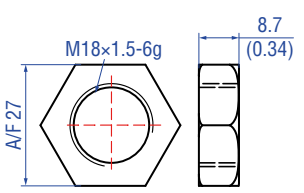
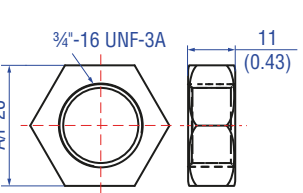
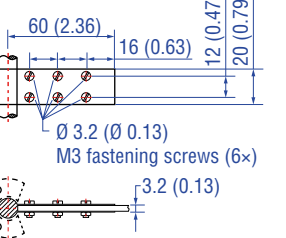
TXX / VXX			
Signal + power supply			
Cable	Color	Voltage	Current
	GY	Output 1: 0...10 VDC or 10...0 VDC	Output 1: 4(0)...20 mA or 20... 4(0) mA
	PK	DC Ground for output 1	DC Ground for output 1
	YE	Output 2: 0...10 VDC or 10...0 VDC	Output 2: 4(0)...20 mA or 20... 4(0) mA
	GN	DC Ground for output 2	DC Ground for output 2
	BN	+24 VDC (-15/+20 %)	+24 VDC (-15/+20 %)
	WH	DC Ground (0 V)	DC Ground (0 V)

Fig. 6: Connector wiring TXX / VXX

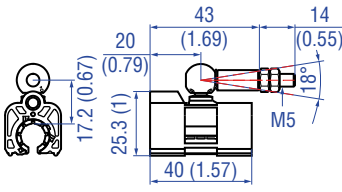
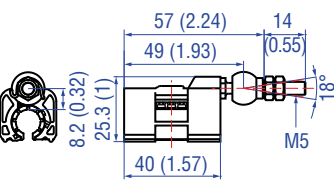
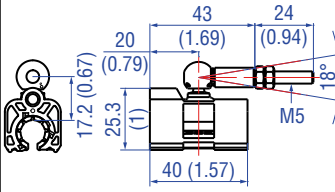
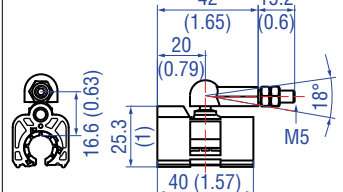
**FREQUENTLY ORDERED ACCESSORIES FOR ET-F/-W/-M/-S** – Additional options available in our [Accessories Guide](#) 551444

Position magnets					
					
<p><b>U-magnet OD33</b> Part no. 251 416-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD33</b> Part no. 201 542-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD25.4</b> Part no. 400 533</p> <p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm<sup>2</sup> Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD17.4</b> Part no. 401 032</p> <p>Material: PA neobond Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Operating temperature: -40...+105 °C (-40...+221 °F)</p>		
Position magnets		Magnet spacer		O-ring	
					
<p><b>U-magnet OD63.5</b> Part no. 201 553</p> <p>Material: PA 66-GF30, magnets compound-filled Weight: Approx. 26 g Surface pressure: 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p><b>Block magnet L</b> Part no. 403 448</p> <p>Material: Plastic carrier with hard ferrite magnet Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p> <p>This magnet may influence the sensor performance specifications for some</p>	<p><b>Magnet spacer</b> Part no. 400 633</p> <p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm</p>	<p><b>O-ring for threaded flange</b> M18×1.5-6g Part no. 401 133</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>		
O-ring		Mounting accessories			
					
<p><b>O-ring for threaded flange</b> ¾"-16 UNF-3A Part no. 560 315</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p><b>Hex jam nut M18×1.5-6g</b> Part no. 500 018</p> <p>Material: Steel, zinc plated</p>	<p><b>Hex jam nut ¾"-16 UNF-3A</b> Part no. 500 015</p> <p>Material: Steel, zinc plated</p>	<p><b>Fixing clip</b> Part no. 561 481</p> <p>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</p>		



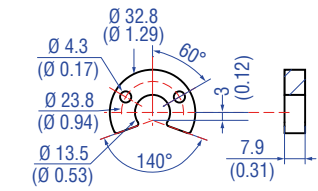
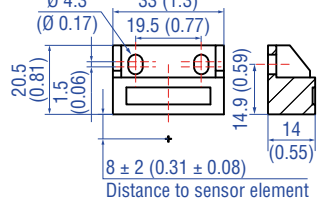
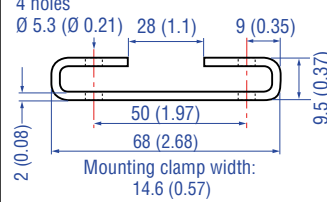
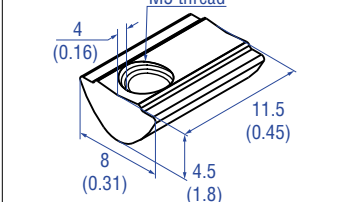
**FREQUENTLY ORDERED ACCESSORIES FOR ET-P** – Additional options available in our [Accessories Guide](#)  [551444](#)

**Position magnets**

			
<p><b>Magnet slider S, joint at top</b> Part no. 252 182</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p><b>Magnet slider V, joint at front</b> Part no. 252 184</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p><b>Magnet slider N longer ball-joint arm</b> Part no. 252 183</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p><b>Magnet slider G, backlash free</b> Part no. 253 421</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 25 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>

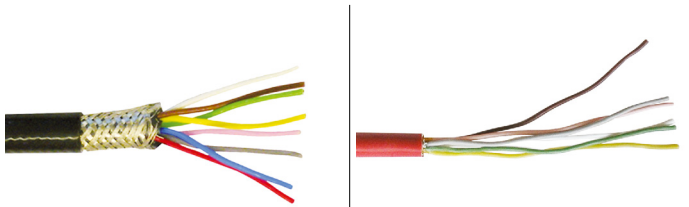
**Position magnets**

**Mounting accessories**

			
<p><b>U-magnet OD33</b> Part no. 251 416-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Block magnet L</b> Part no. 403 448</p> <p>Material: Plastic carrier with hard ferrite magnet Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	<p><b>Mounting clamp</b> Part no. 400 802</p> <p>Material: Stainless steel (AISI 304)</p>	<p><b>T-nut</b> Part no. 401 602</p> <p>Fastening torque for M5 screw: 4.5 Nm</p>

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

**Cables**



<p><b>Teflon® cable</b> Part no. 530 112</p>	<p><b>Silicone cable</b> Part no. 530 113</p>
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<p>Name of cable in order code: <b>T</b></p> <p>Material: Teflon® jacket; black Features: Twisted pair, shielded, flexible high thermal resistance, mostly oil &amp; acid resistant Cable Ø: 7.6 mm (0.3 in.) Cross section: 4 × 2 × 0.25 mm<sup>2</sup> Bending radius: 8 – 10 × D (fixed installation) Operating temperature: –100...+180 °C (–148...+356 °F)</p>	<p>Name of cable in order code: <b>V</b></p> <p>Material: Silicone jacket; red Features: Twisted pair, shielded, highly flexible, halogen free, high thermal resistance Cable Ø: 7.2 mm (0.28 in.) Cross section: 3 × 2 × 0.25 mm<sup>2</sup> Bending radius: 5 × D (fixed installation) Operating temperature: –50...+180 °C (–58...+356 °F)</p>
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**Programming tools (Not approved for use in hazardous environments)**



<p><b>Hand programmer for analog output</b> Part no. 253 124</p>	<p><b>Programming kit</b> Part no. 254 555</p>	<p><b>Cabinet programmer for analog output</b> Part no. 253 408</p>
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<p>Easy teach-in-setups of stroke length and direction on desired zero / span positions. For sensors with 1 magnet.</p>	<p>Kit includes: 1 × interface converter box 1 × power supply 1 × cable (60 cm) with M12 female connector (5 pin), straight – D-sub female connector (9 pin), straight 1 × cable (60 cm) with M16 female connector (6 pin), straight – D-sub female connector (9 pin), straight 1 × cable (60 cm) with 3 × terminal clamp – D-sub female connector (9 pin), straight 1 × USB cable</p> <p>Software is available at: <a href="http://www.mtssensors.com">www.mtssensors.com</a></p>	<p>Features snap-in mounting on standard DIN rail (35 mm). This programmer can be permanently mounted in a control cabinet and includes a program/run switch. For sensors with 1 magnet.</p>
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## ORDER CODE

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

<b>a</b>	<b>Sensor model</b>
E T	Rod/Profile

<b>b</b>	<b>Design</b>
<b>ET rod-style sensor with housing and sensor rod material stainless steel 1.4404 (AISI 316L)</b>	
F	Threaded flange ¾"-16 UNF-3A
W	Threaded flange M18×1.5-6g
<b>ET rod-style sensor with housing material stainless steel 1.4305 (AISI 303) and sensor rod material stainless steel 1.4306 (AISI 304L)</b>	
M	Threaded flange M18×1.5-6g
S	Threaded flange ¾"-16 UNF-3A
<b>ET profile-style sensor with housing material stainless steel 1.4305 (AISI 303) and profile material aluminium</b>	
P	Profile

<b>c</b>	<b>Stroke length</b>
X X X X M	0050...3000 mm
<b>Standard stroke length (mm)</b>	
	<b>Ordering steps</b>
50... 500 mm	5 mm
500... 750 mm	10 mm
750...1000 mm	25 mm
1000...2500 mm	50 mm
2500...3000 mm	100 mm
X X X X U	002.0...118.0 in.
<b>Standard stroke length (in.)</b>	
	<b>Ordering steps</b>
2... 20 in.	0.2 in.
20... 30 in.	0.5 in.
30... 40 in.	1.0 in.
40...100 in.	2.0 in.
100...116 in.	4.0 in.
Non-standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments	

<b>d</b>	<b>Connection type</b>
T X X	XX m Teflon® cable (part no. 530 112) T01...T30 (1...30 m/3...99 ft.)* See "Frequently ordered accessories" for cable specifications
V X X	XX m silicone cable (part no. 530 113) V01...V30 (1...30 m/3...99 ft.)* See "Frequently ordered accessories" for cable specifications
*/ Encode in meters if using metric stroke length. Encode in feet if using US customary stroke length	

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

<b>f</b>	<b>Version (see "Certification of Temposonics® ET (version A and E)" on page 2 for further information)</b>
A	ATEX / IECEx / CEC / NEC
E	ATEX / IECEx / CEC / NEC with ½" NPT adapter
N	Not approved
Version E (section <b>f</b> ) is only available with design »M« and »S« (section <b>b</b> ).	

<b>NOTICE</b>
Version E (section <b>f</b> ) is only available with design »M« and »S« (section <b>b</b> ).

<b>g</b>	<b>Output</b>
<b>Voltage</b>	
<b>1 output with 1 position magnet</b>	
<b>Output 1 (position magnet 1)</b>	
V 0 1	0...10 VDC
V 1 1	10...0 VDC
<b>2 outputs with 1 position magnet</b>	
<b>Output 1 (position magnet 1) + output 2 (position magnet 1)</b>	
V 0 3	0...10 VDC      10...0 VDC
<b>2 outputs with 2 position magnets</b>	
<b>Output 1 (position magnet 1) + output 2 (position magnet 2)</b>	
V 0 2	0...10 VDC      0...10 VDC
V 1 2	10...0 VDC      10...0 VDC
<b>Current</b>	
<b>1 output with 1 position magnet</b>	
<b>Output 1 (position magnet 1)</b>	
A 0 1	4...20 mA
A 1 1	20...4 mA
<b>2 outputs with 1 position magnet</b>	
<b>Output 1 (position magnet 1) + output 2 (position magnet 1)</b>	
A 0 3	4...20 mA      20...4 mA
<b>2 outputs with 2 position magnets</b>	
<b>Output 1 (position magnet 1) + output 2 (position magnet 2)</b>	
A 0 2	4...20 mA      4...20 mA
A 1 2	20...4 mA      20...4 mA

<b>h</b>	<b>Operating temperature</b>
L	-40...+75 °C (-40...+167 °F)

## DELIVERY

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**ET-F/-W/-M/-S (rod sensor):**

- Sensor

Accessories have to be ordered separately.

**ET-P (profile sensor):**

- Sensor
- 2 mounting clamps up to 1250 mm (50 in.) stroke length + 1 mounting clamp for each 500 mm (20 in.) additional stroke length

### NOTICE

Use magnets of the same type for multi-position measurement, e.g. 2 × U-magnet (part no. 251 416-2).

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