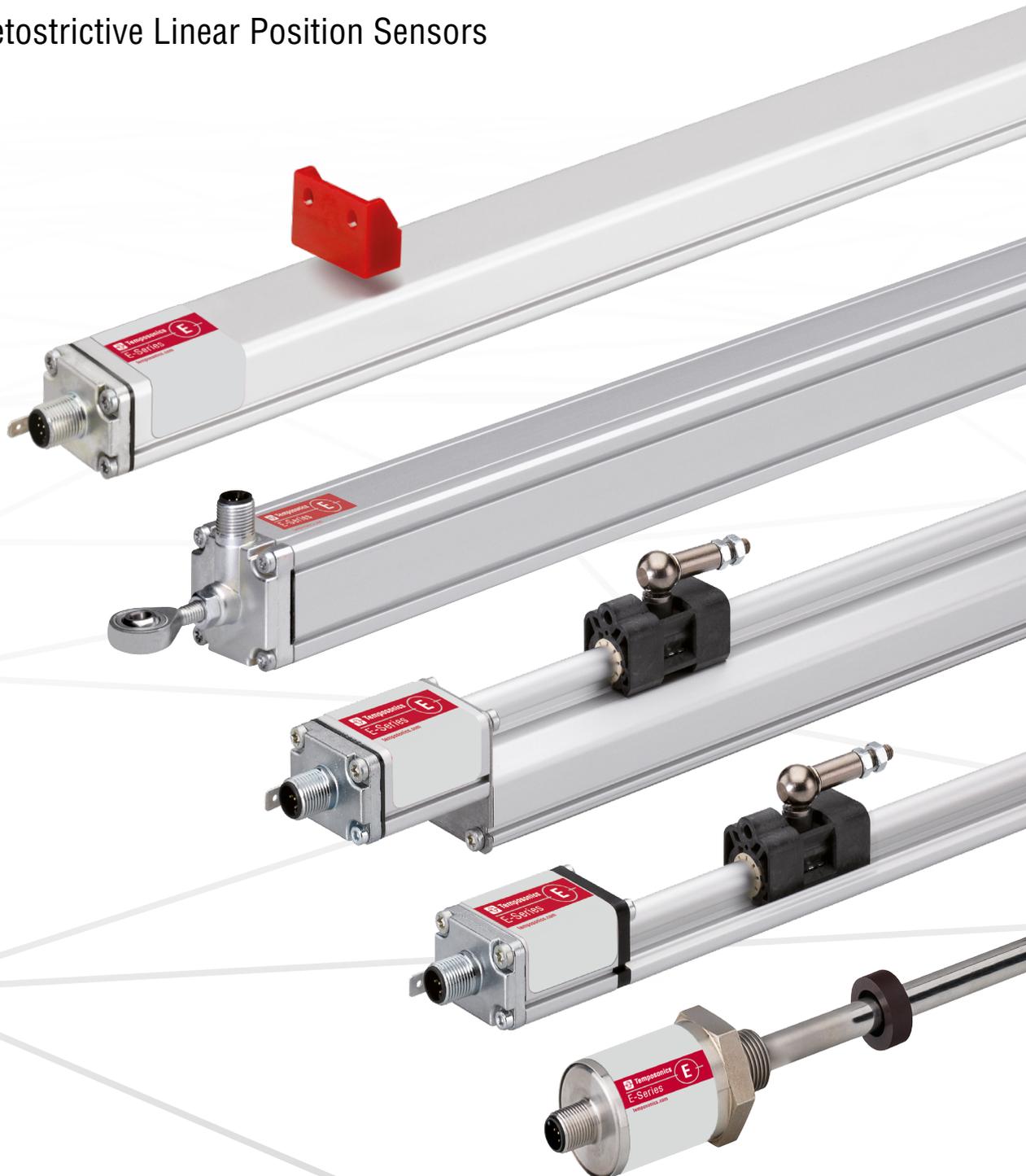


# Operation Manual

## **E-Series IO-Link**

Magnetostrictive Linear Position Sensors



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## 1. Introduction

### 1.1 Purpose and use of this manual

Before starting the operation of Temposonics position sensors, read this documentation thoroughly and follow the safety information. Keep the manual for future reference!

The content of this technical documentation and of its appendix is intended to provide information on mounting, installation and commissioning by qualified automation personnel <sup>1</sup> or instructed service technicians who are familiar with the project planning and dealing with Temposonics sensors.

### 1.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid dangers that might affect the life and health of operating or service personnel or cause material damage are highlighted by the pictogram defined below.

Symbol	Meaning
<b>NOTICE</b>	This symbol is used to point to situations that may lead to material damage, but not to personal injury.

## 2. Safety instructions

### 2.1 Intended use

This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

- The sensor systems of all Temposonics® series are intended exclusively for measurement tasks encountered in industrial, commercial and laboratory applications. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other electronic control unit.

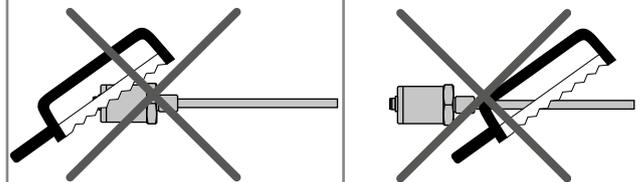
<sup>1/</sup> The term "qualified technical personnel" characterizes persons who:

- are familiar with the safety concepts of automation technology applicable to the particular project
- are competent in the field of electromagnetic compatibility (EMC)

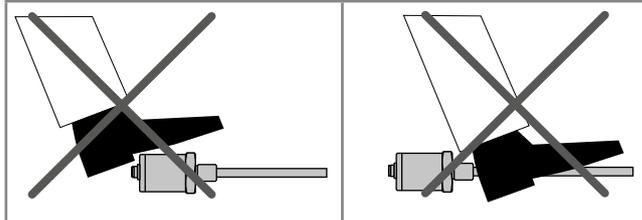
### 2.2 Forseeable misuse

Foreseeable misuse	Consequence
Wrong sensor connection	The sensor will not work properly or can be damaged
Operate the sensor out of the operating temperature range	No signal output – the sensor can be damaged
Power supply is out of the defined range	Signal output is wrong/ no signal output/ the sensor will be damaged
Position measurement is influenced by an external magnetic field	Signal output is wrong
Cables are damaged	Short circuit – the sensor can be damaged/sensor does not respond
Spacers are missing/ installed in a wrong order	Error in position measurement
Wrong connection of ground/shield	Signal output is disturbed – the electronics can be damaged
Use of a magnet that is not specified by Temposonics	Error in position measurement

Do not reprocess the sensor afterwards.  
→ The sensor might be damaged.



Do not step on the sensor.  
→ The sensor might be damaged.



- have received adequate training for commissioning and service operations
- are familiar with the operation of the device and know the information required for correct operation provided in the product documentation

## 2.3 Installation, commissioning and operation

The position sensors must be used only in technically safe condition. To maintain this condition and to ensure safe operation, installation, connection and service, work may be performed only by qualified technical personnel.

If danger of injury to persons or of damage to operating equipment is caused by sensor failure or malfunction, additional safety measures such as plausibility checks, limit switches, EMERGENCY STOP systems, protective devices etc. are required. In the event of trouble, shut down the sensor and protect it against accidental operation.

### Safety instructions for commissioning

To maintain the sensor's operability, it is mandatory to follow the instructions given below.

1. Protect the sensor against mechanical damage during installation and operation.
2. Do not open or dismantle the sensor.
3. Connect the sensor very carefully and pay attention to the polarity of connections and power supply.
4. Use only approved power supplies.
5. It is indispensable to ensure that the specified permissible limit values of the sensor for operating voltage, environmental conditions, etc. are met.
6. Check the function of the sensor regularly and provide documentation of the checks.
7. Before applying power, ensure that nobody's safety is jeopardized by starting machines.

## 2.4 Safety instructions for use in explosion-hazardous areas

The sensor is not suitable for operation in explosion-hazardous areas.

## 2.5 Warranty

Temposonics grants a warranty period for its position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application <sup>2</sup>. The Temposonics obligation is limited to repair or replacement of any defective part of the unit. No warranty can be provided for defects that are due to improper use or above average stress of the product, as well as for wear parts. Under no circumstances will Temposonics accept liability in the event of offense against the warranty rules, no matter if these have been assured or expected, even in case of fault or negligence of the company.

Temposonics explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to increase or change the scope of warranty.

## 2.6 Return

For diagnostic purposes, the sensor can be returned to Temposonics. Any shipment cost is the responsibility of the sender <sup>2</sup>. For a corresponding form, see chapter "9. Appendix" on page 34.

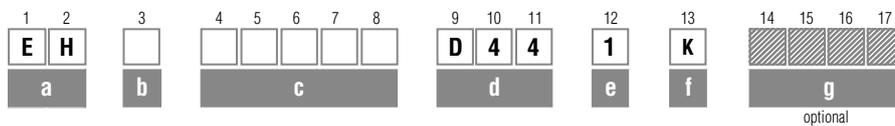
### NOTICE

When returning sensors, place protective caps on male and female connectors of the sensor. For pigtail cables, place the cable ends in a static shielding bag for electrostatic discharge (ESD) protection. Fill the outer packaging around the sensor completely to prevent damage during transport.

<sup>2/</sup> See also applicable Temposonics terms of sales and delivery on:  
[www.temposonics.com](http://www.temposonics.com)

### 3. Identification

#### 3.1 Order code of Temposonics® EH



a	Sensor model
E H	Rod

b	Design
<b>EH rod-style sensor with housing material 1.4305 (AISI 303) and rod material 1.4301 (AISI 304)</b>	
K	Threaded flange M18×1.5-6g, Ø 7 mm rod
L	Threaded flange ¾"-16 UNF-3A, Ø 7 mm rod
<b>EH rod-style sensor with housing material 1.4305 (AISI 303) and rod material 1.4306 (AISI 304L)</b>	
M	Threaded flange M18×1.5-6g, Ø 10 mm rod
S	Threaded flange ¾"-16 UNF-3A, Ø 10 mm rod
<b>EH rod-style sensor with housing material 1.4404 (AISI 316L) and rod material 1.4404 (AISI 316L)</b>	
F	Threaded flange ¾"-16 UNF-3A, Ø 10 mm rod
W	Threaded flange M18×1.5-6g, Ø 10 mm rod

c	Stroke length
X X X X M	0050...2540 mm
Standard stroke length (mm)	
Ordering steps	
50... 500 mm	5 mm
500... 750 mm	10 mm
750...1000 mm	25 mm
1000...2540 mm	50 mm
X X X X U	001.0...100.0 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.
Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.	

d	Connection type
D 4 4	M12 male connector (4 pin)

e	Operating voltage
1	+24 VDC (±25 %)

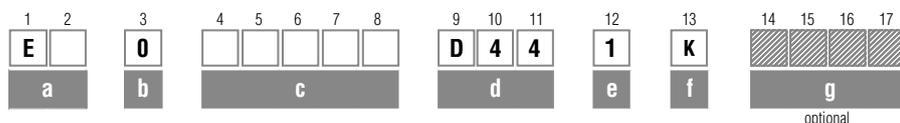
f	Output
K	IO-Link

g	Advanced single-position measurement or multi-position measurement (optional)
1 Z 0 X	Number of magnets 01...04 position and velocity (1...4 magnet(s)) 01...08 position (1...8 magnet(s))

**NOTICE**

- 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.

### 3.2 Order code of Temposonics® EP/EL



<b>a</b>	<b>Sensor model</b>	
E	P	Ultra low profile
E	L	Compact profile

<b>b</b>	<b>Design</b>	
0	Without position magnet	

<b>c</b>	<b>Stroke length</b>	
X	X	X
X	X	M
0050...2540 mm		
<b>Standard stroke length (mm)</b>		<b>Ordering steps</b>
50... 500 mm		25 mm
500... 2540 mm		50 mm
X	X	X
X	X	U
001.0...100.0 in.		
<b>Standard stroke length (in.)</b>		<b>Ordering steps</b>
1... 20 in.		1.0 in.
20... 100 in.		2.0 in.
Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.		

<b>d</b>	<b>Connection type</b>	
D	4	4
M12 male connector (4 pin)		

<b>e</b>	<b>Operating voltage</b>	
1	+24 VDC (±25 %)	

<b>f</b>	<b>Output</b>	
K	IO-Link	

<b>g</b>	<b>Advanced single-position measurement or multi-position measurement (optional)</b>	
1	Z	0
X	Number of magnets	
01...04 position and velocity (1...4 magnet(s))		
01...08 position (1...8 magnet(s))		

#### NOTICE

- 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.

### 3.3 Order code of Temposonics® EP2

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

a	<b>Sensor model</b>
E	P 2 Smooth profile

b	<b>Stroke length</b>
X	X X X M 0050...2540 mm

Standard stroke length (mm)	Ordering steps
50... 500 mm	25 mm
500...2540 mm	50 mm

X	X X X U 001.0...128.0 in.
---	---------------------------

Standard stroke length (in.)	Ordering steps
2... 20 in.	1.0 in.
20...100 in.	2.0 in.

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

c	<b>Connection type</b>
D	4 4 M12 (4 pin) male connector

d	<b>Operating voltage</b>
1	+24 VDC (±25 %)

e	<b>Output</b>
K	IO-Link

f	<b>Advanced single-position measurement or multi-position measurement (optional)</b>
1	Z 0 X Number of magnets 01...04 position and velocity (1...4 magnet(s)) 01...08 position (1...8 magnet(s))

#### NOTICE

- 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.

### 3.4 Order code of Temposonics® ER

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

<b>a</b>	<b>Sensor model</b>
E R	Aluminum cylinder with a guided driving rod

<b>b</b>	<b>Design</b>
M	Inside thread M6 at end of rod (For metric stroke length measurement)
S	Inside thread ¼"-28 UNF at end of rod (For US customary stroke length measurement)

<b>c</b>	<b>Stroke length</b>
X X X X M	0050...1500 mm
<b>Standard stroke length (mm)      Ordering steps</b>	
50...500 mm	25 mm
500...1500 mm	50 mm
X X X X U	002.0...060.0 in.
<b>Standard stroke length (in.)      Ordering steps</b>	
2...22 in.	1.0 in.
22...60 in.	2.0 in.
Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.	

<b>d</b>	<b>Connection type</b>
D 4 4	M12 (4 pin) male connector

<b>e</b>	<b>Operating voltage</b>
1	+24 VDC (±25 %)

<b>f</b>	<b>Output</b>
K	IO-Link

<b>g</b>	<b>Advanced single-position measurement</b>
1 Z 0 1	Number of magnets 1 position and velocity (1 magnet)

### 3.5 Nameplate

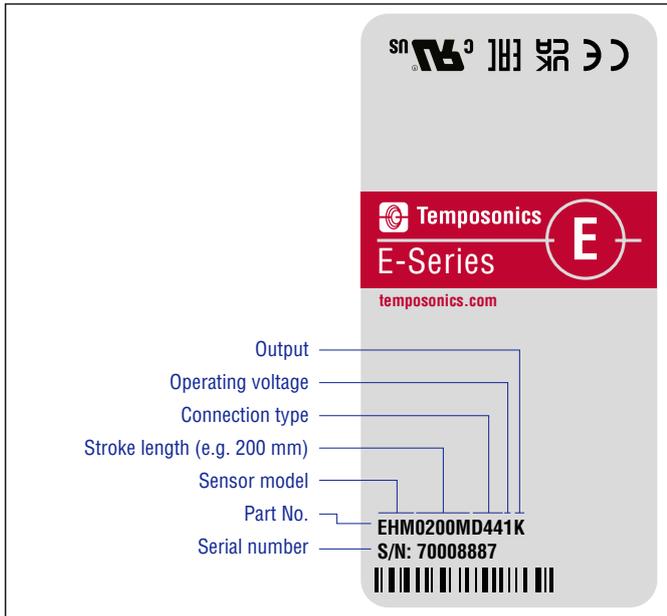


Fig. 1: Example of nameplate of an E-Series EH sensor

### 3.6 Approvals

- CE certified
- UKCA certified
- EAC certified
- UL certified
- Metrology certificate of Kazakhstan

#### NOTICE

For a detailed overview of the certifications, see  
[www.temposonics.com](http://www.temposonics.com)

### 3.7 Scope of delivery

#### EH (rod sensor):

- Sensor
- O-ring

#### EP (compact 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

#### EL (ultra low 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

#### EP2 (smooth 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

#### ER (aluminum cylinder with a guided driving rod sensor):

- Sensor

## 4. Product description and commissioning

### 4.1 Functionality and system design

#### Product designation

- Position sensor Temposonics® E-Series

#### Sensor model

- Temposonics® EH (rod sensor)
- Temposonics® EP (compact profile sensor)
- Temposonics® EP (ultra low profile sensor)
- Temposonics® EP2 (smooth profile sensor)
- Temposonics® ER (aluminum cylinder with a guided driving rod sensor)

#### Stroke length

- EH 50...2540 mm (2...100 in.)
- EP 50...2540 mm (2...100 in.)
- EL 50...2540 mm (2...100 in.)
- EP2 50...2540 mm (2...100 in.)
- ER 50...1500 mm (2...60 in.)

#### Output signal

- IO-Link

#### Application

The Temposonics position sensors are used for measurement and conversion of the length (position) variable in the fields of automated systems and mechanical engineering.

#### Principle of operation and system construction

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.

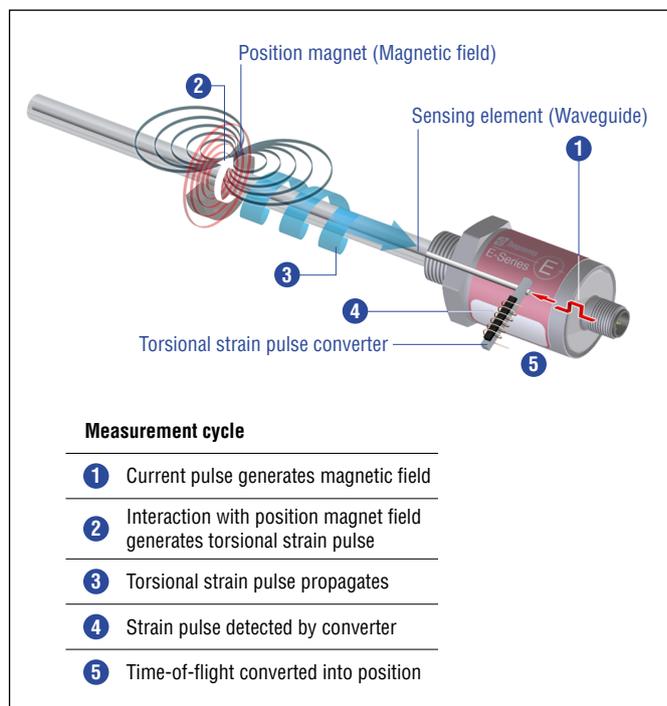


Fig. 2: Time-of-flight based magnetostrictive position sensing principle

#### Modular mechanical and electronic construction

- The sensor rod or profile protects the inner sensor element.
- The sensor electronics housing, a rugged construction, contains the complete electronic interface with active signal conditioning.
- The external position magnet is a permanent magnet. Mounted on the mobile machine part, it travels along the sensor rod or profile and triggers the measurement through the sensor rod wall.
- The sensor can be connected directly to a control system. Its electronics generates a strictly position proportional signal output between start and end position.

## 4.2 Styles and installation of Temposonics® EH

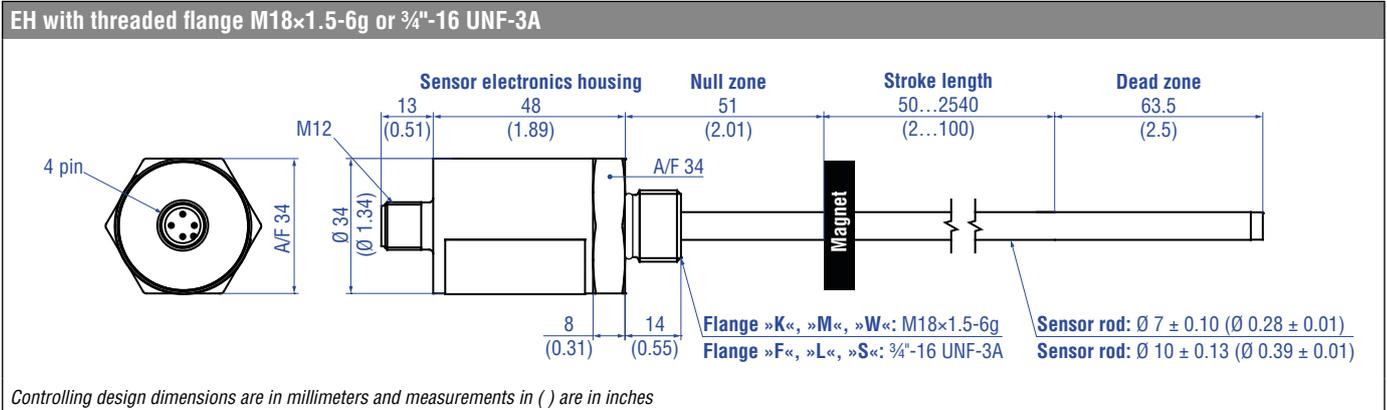


Fig. 3: Temposonics® EH sensor

### Installation of EH with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g or 3/4"-16 UNF-3A.

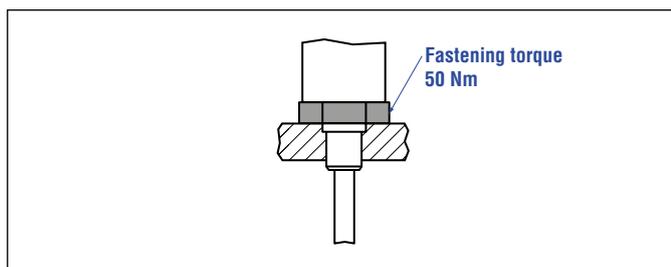


Fig. 4: Mounting example of threaded flange

### Installation of a rod-style sensor in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Mount the sensor via threaded flange or a hex nut.

- Mounted on the face of the piston, the position magnet travels over the rod without touching it and indicates the exact position through the rod wall – independent of the hydraulic fluid.
- The pressure resistant sensor rod is installed into a bore in the piston rod.

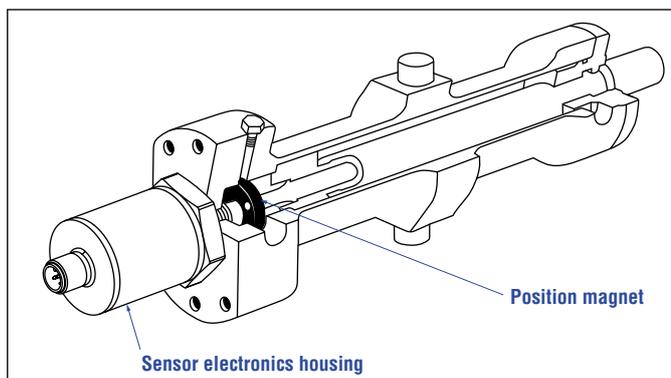


Fig. 5: Sensor in cylinder

### Hydraulics sealing

The flange contact surface is sealed via an O-ring in the undercut (Fig. 46).

For threaded flange (3/4"-16 UNF-3A) »F« / »L« / »S«:

O-ring 16.4 × 2.2 mm (0.65 × 0.09 in.) (part no. 560 315)

For threaded flange (M18×1.5-6g) »K« / »M« / »W«:

O-ring 15.3 × 2.2 mm (0.60 × 0.09 in.) (part no. 401 133)

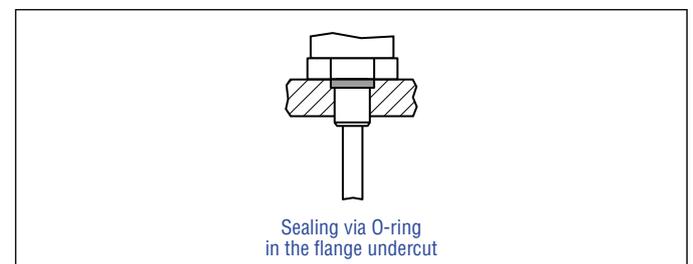


Fig. 6: Possibility of sealing

In the case of threaded flange M18×1.5-6g, a screw hole based on ISO 6149-1 (Fig. 7) must be provided. See ISO 6149-1 for further information.

- Note the fastening torque of 50 Nm.
- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling  
(EH-K/-L: Ø 7 mm rod: ≥ Ø 10 mm (≥ Ø 0.40 in.);  
EH-M/-S/-F/-W: Ø 10 mm rod: ≥ Ø 13 mm (≥ Ø 0.52 in.)) depends on the pressure and piston speed.
- Adhere to the information relating to operating pressure.
- Protect the sensor rod against wear.

Notice for metric threaded flanges									
Thread ( $d_1 \times P$ )	$d_2$	$d_3$	$d_4$	$d_5$ +0.1 0	$L_1$ +0.4 0	$L_2$	$L_3$	$L_4$	$Z^\circ$ $\pm 1^\circ$
<b>EH-K (Ø 7 mm rod)</b>									
M18×1.5-6g	55	≥ 10	24.5	19.8	2.4	28.5	2	26	15°
<b>EH-M/-W (Ø 10 mm rod)</b>									
M18×1.5-6g	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°

The figure contains two technical drawings of a metric threaded flange. The left drawing shows a cross-section with various dimensions:  $\leq R0.4$  for the chamfered edge,  $\leq R0.3$  and  $\leq R0.1$  for internal radii,  $45^\circ \pm 0.5^\circ$  for the chamfer angle,  $7^\circ$  for the thread angle, and  $\sqrt{Ra\ 3.2}$  for surface texture. It also indicates a tolerance of  $\sqrt{0.1\ A}$  for  $\varnothing d_5$  and a tolerance of  $\sqrt{0.2\ A}$  for  $\varnothing d_4$ . The right drawing shows a similar cross-section with a tolerance of  $\sqrt{0.2\ A}$  for  $\varnothing d_2$  and a tolerance of  $\sqrt{0.1\ A}$  for  $\varnothing d_4$  (Gauging). It also shows  $\varnothing d_3$  (Reference) and the thread specification  $\text{Thread } (d_1 \times P)$ . A note states: "This dimension applies when tap drill cannot pass through entire boss." A dimension 'A' is marked at the bottom of both drawings, labeled as 'Pitch diameter'.

Controlling design dimensions are in millimeters

Fig. 7: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

### 4.3 Styles and installation of Temposonics® EP/EL

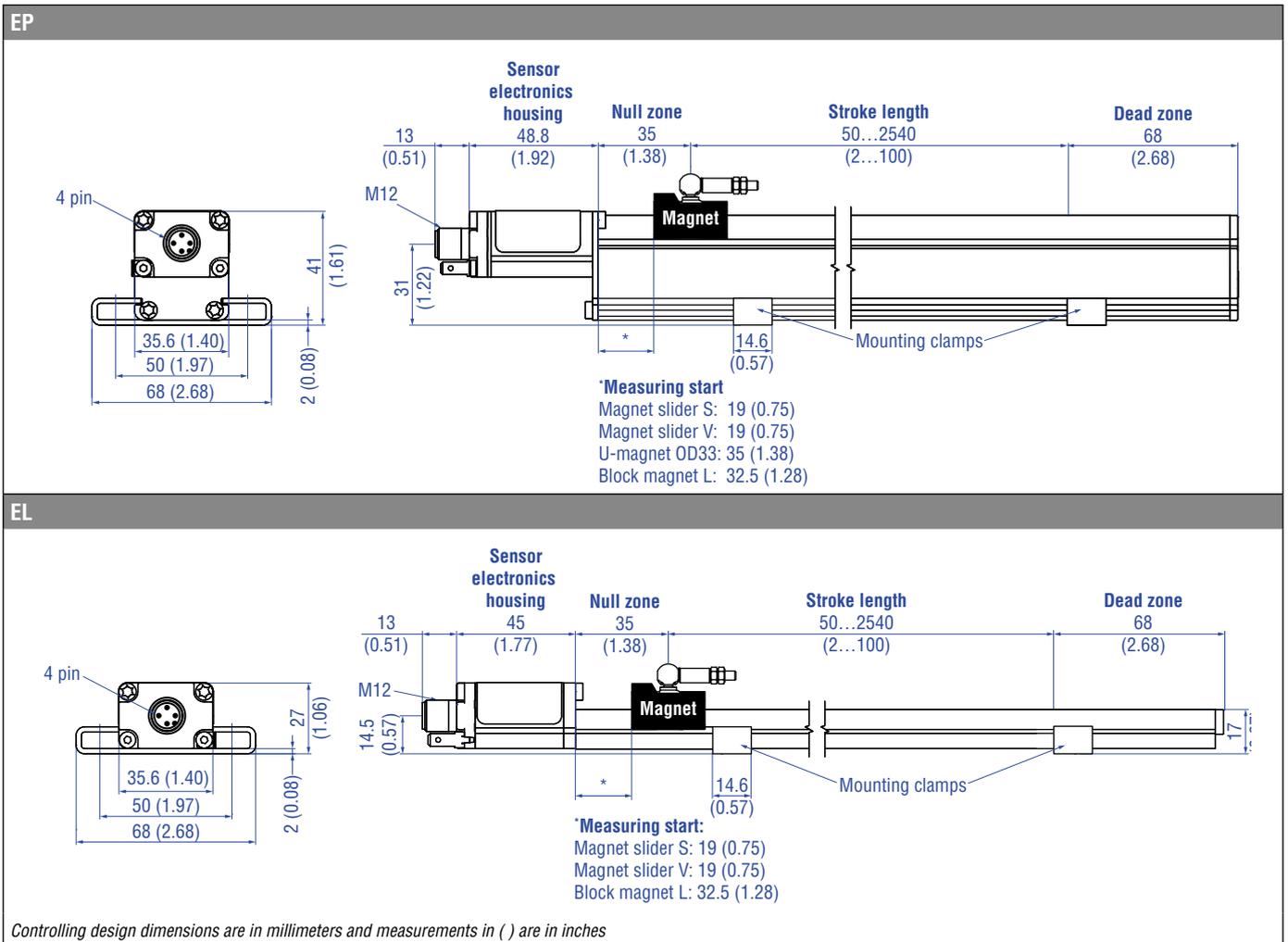


Fig. 8: E-Series EP and EL with magnet slider

#### Installation of EP/EL

The position sensor can be installed in any position. Normally, the sensor is firmly installed and the position magnet is fastened to the mobile machine part. Thus it can travel along the measuring rod without touching it. The sensor is fitted on a flat machine surface using the mounting clamps (Fig. 9). A length-dependent number of these clamps are delivered with the sensor and must be distributed over the profile at regular distances. For fastening use M5×20 screws to DIN 6912 that should be tightened with a fastening torque of 5 Nm.

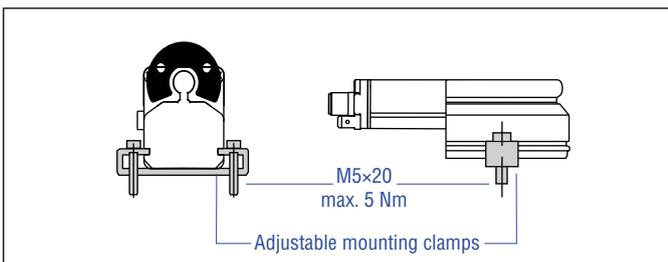


Fig. 9: EP with mounting clamps with cylinder screw M5×20 (part no. 403 508)

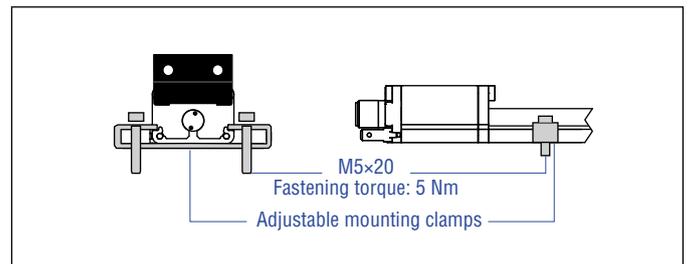


Fig. 10: EL with mounting clamps with cylinder screw M5×20 (part no. 403 508)

#### NOTICE

Take care to mount the sensor in an axially parallel position to avoid damage of the carriage, magnet and sensor rod.

#### 4.4 Styles and installation of Temposonics® EP2

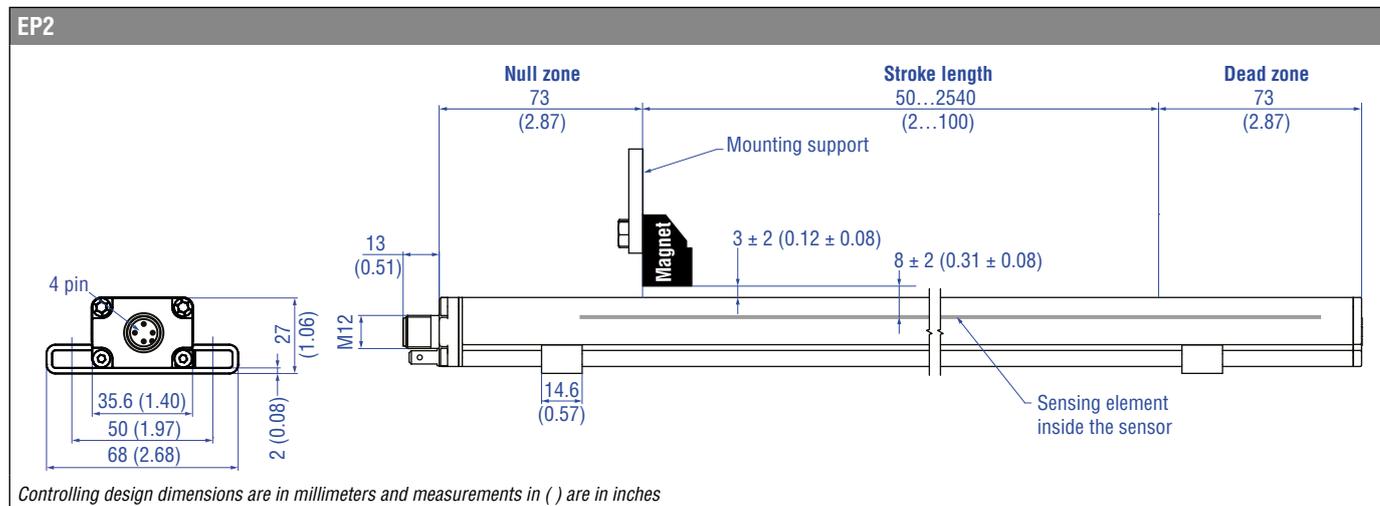


Fig. 11: Temposonics EP2

#### Installation of EP2

The position sensor can be installed in any position. Normally, the sensor is firmly installed and the position magnet is fastened to the mobile machine part. Thus it can travel along the measuring rod without touching it. The sensor is fitted on a flat machine surface using the mounting clamps (Fig. 12). A length-dependent number of these clamps are delivered with the sensor and must be distributed over the profile at regular distances. For fastening use M5×20 screws to DIN 6912 that should be tightened with a fastening torque of 5 Nm.

#### NOTICE

Take care to mount the sensor in an axially parallel position to avoid damage of the carriage, magnet and sensor rod.

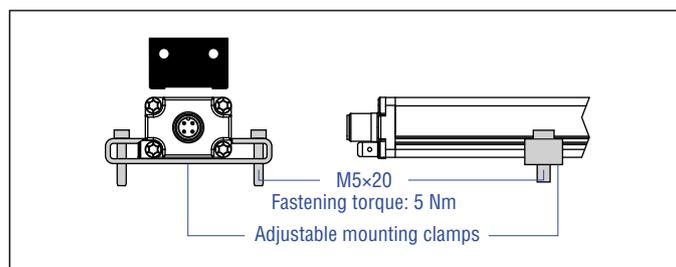


Fig. 12: Mounting clamps with cylinder screw M5×20 (part no. 403508)

#### 4.5 Styles and installation of Temposonics® ER

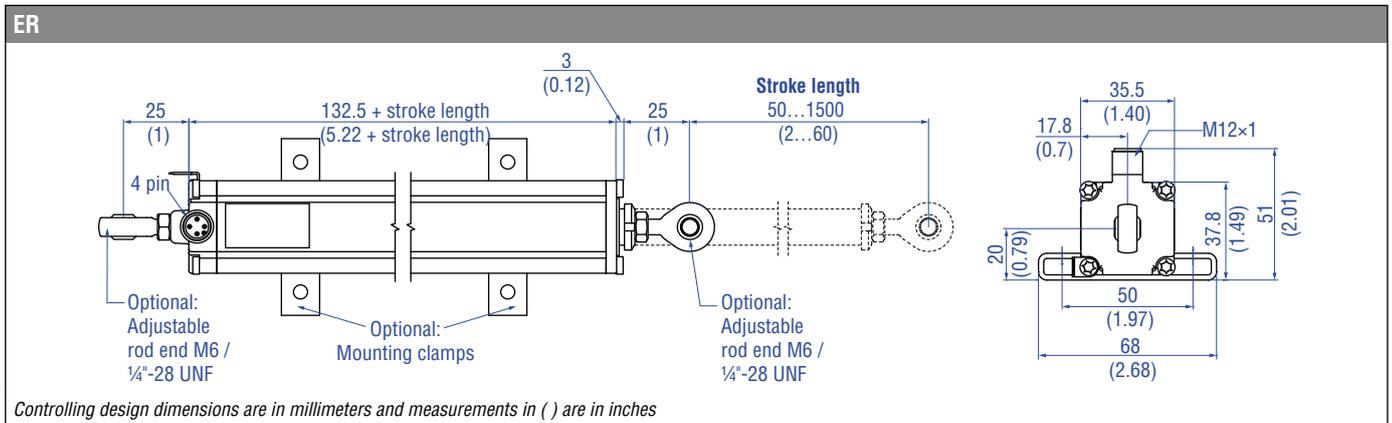


Fig. 13: Temposonics ER

#### There are two ways to install the sensor ER:

##### 1. Via the mounting clamps

The position sensor can be installed in any position. The sensor is fitted on a flat machine surface using the mounting clamps (Fig. 14). A length-dependent number of must be distributed over the profile at regular distances. For fastening use M5×20 screws to DIN 6912 that should be tightened with a fastening torque of 5 Nm.

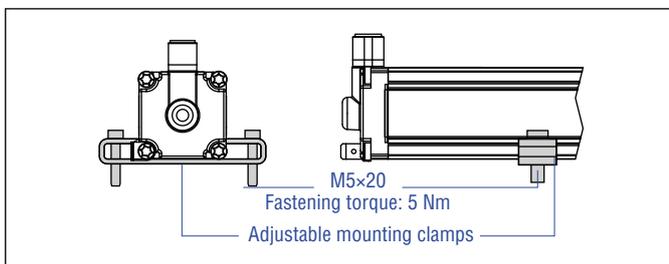


Fig. 14: Mounting clamps with cylinder screw M5×20 (part no. 403 508)

##### 2. Via the adjustable rod end

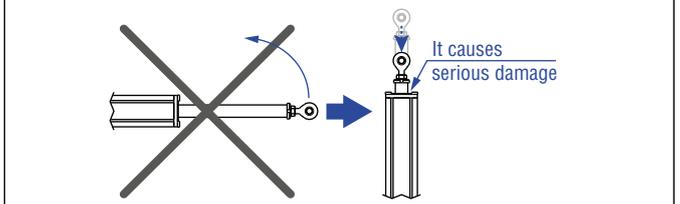
The position sensor can be installed in any position. The sensor is mechanically connected via adjustable rod ends (for ER-M: part no. 254 210 / for ER-S: part no. 254 235)

#### NOTICE

Take care to mount the sensor in an axially parallel position to avoid damage of the carriage and sensor rod.

#### NOTICE

Do not raise up the ER sensor, if the lifting rod is extended.



#### 4.6 Magnet installation

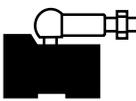
Magnet	Typical sensors	Benefits
 <b>Ring magnets</b>	<b>Rod model</b> (EH)	<ul style="list-style-type: none"> <li>Rotationally symmetrical magnetic field</li> </ul>
 <b>U-magnets</b>	<b>Profile &amp; rod models</b> (EH, EP)	<ul style="list-style-type: none"> <li>Height tolerances can be compensated, because the magnet can be lifted off</li> </ul>
 <b>Block magnets</b>	<b>Profile &amp; rod models</b> (EH, EP, EL, EP2)	<ul style="list-style-type: none"> <li>Height tolerances can be compensated, because the magnet can be lifted off</li> </ul>
 <b>Magnet sliders</b>	<b>Profile models</b> (EP, EL)	<ul style="list-style-type: none"> <li>The magnet is guided by the profile</li> <li>The distance between the magnet and the waveguide is strictly defined</li> <li>Easy coupling via the ball joint</li> </ul>

Fig. 15: Typical use of magnets

#### Mounting the ring magnets, U-magnets & block magnets

Install the magnet using non-magnetic material for mounting device, screws, spacers etc.. The magnet must not grind on the sensor rod. Alignment errors are compensated via the air gap.

- Permissible surface pressure: Max. 40 N/mm<sup>2</sup> (only for ring magnets and U-magnets)
- Fastening torque for M4 screws: 1 Nm; use washers, if necessary
- Minimum distance between position magnet and any magnetic material has to be 15 mm (0.6 in.) (Fig. 18).
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 18).

#### NOTICE

Mount ring magnets and U-magnets concentrically. Mount block magnets centrally over the sensor rod or the sensor profile. Do not exceed the maximum acceptable gap (Fig. 16, Fig. 17).

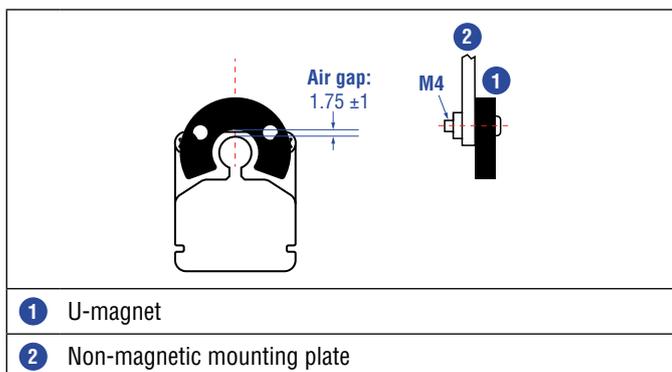


Fig. 16: Mounting of U-magnet (part no. 251416-2), example of EP sensor

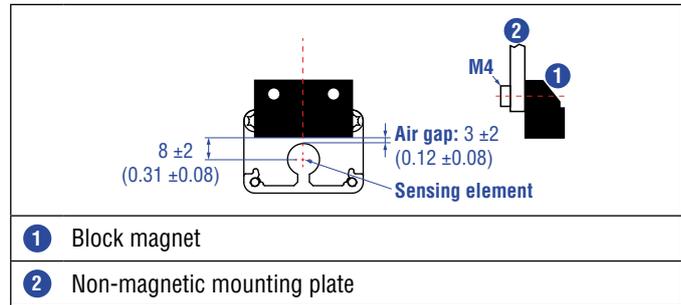


Fig. 17: Mounting of block magnet (part no. 403448), example of EL sensor

#### Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 18 must be observed.

- A If the position magnet aligns with the drilled piston rod
- B If the position magnet is set further into the drilled piston rod, install another non-magnetic spacer above the magnet.

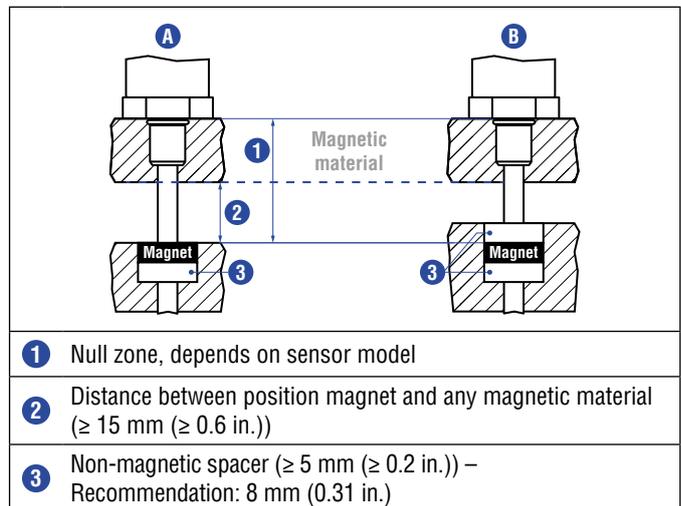


Fig. 18: Installation with magnetic material

#### Sensors with stroke lengths ≥ 1 meter (3.3 ft.)

Support horizontally installed sensors with a stroke length from 1 meter (3.3 ft.) mechanically at the rod end. Without the use of a support, rod and position magnet may be damaged. A false measurement result is also possible. Longer rods require evenly distributed mechanical support over the entire length (e.g. part no. 561481). Use an U-magnet (Fig. 19) for measurement.

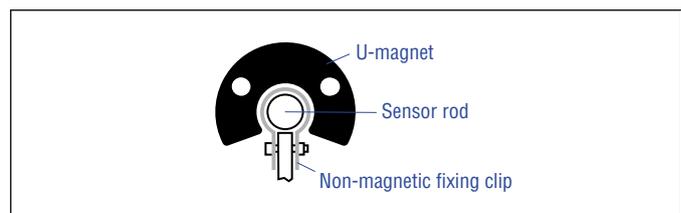


Fig. 19: Example of sensor support (part no. 561481)

### Start and end positions of the position magnets

Consider the start and end positions of the position magnets during the installation. To ensure that the entire stroke length is electrically usable, the position magnet must be mechanically mounted as follows.

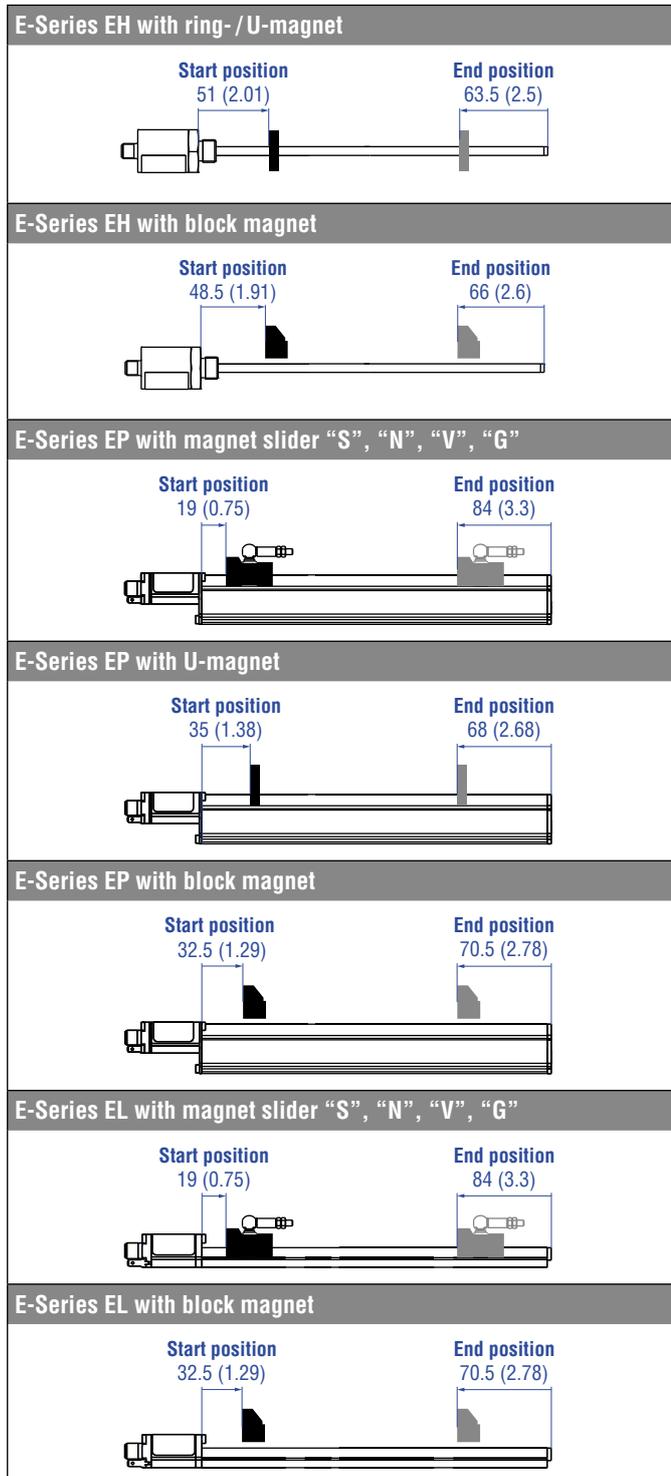


Fig. 20: Start- and end positions of magnets, part 1

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

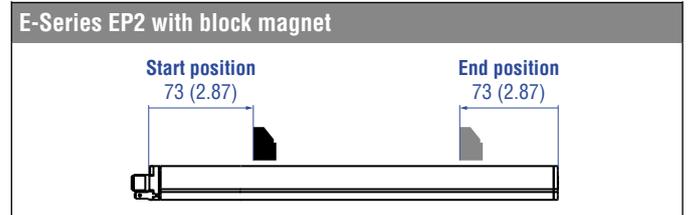


Fig. 21: Start- and end positions of magnets, part 2

### Multi-position measurement

The minimum distance between the magnets is 75 mm (3 in.).

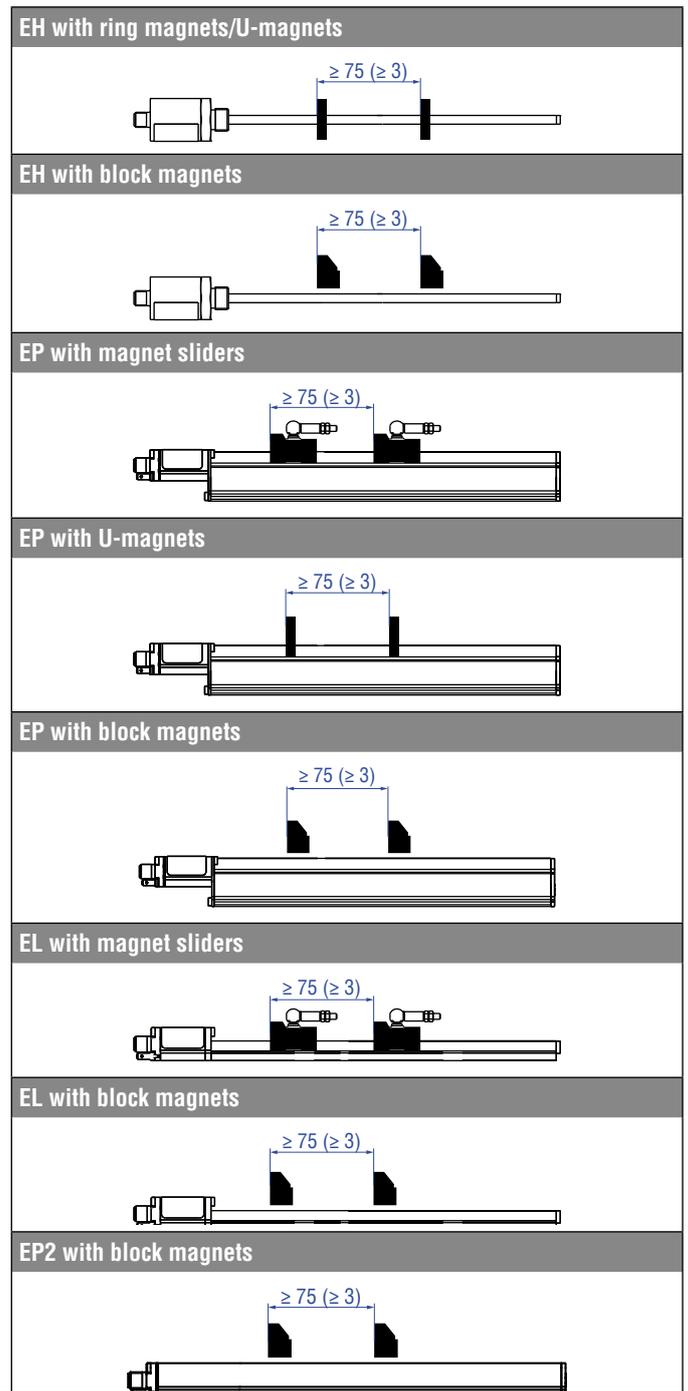


Fig. 22: Minimum distance for multi-position measurement

**NOTICE**

For multi-position measurement, use magnets of the same type. Do not fall below the minimum distance between the magnets of 75 mm (3 in.) for multi-position measurement. Contact Temposonics if you need a magnet distance < 75 mm (3 in.).

**4.7 Electrical connections**

Placement of installation and cabling have decisive influence on the sensor's electromagnetic compatibility (EMC). Hence correct installation of this active electronic system and the EMC of the entire system must be ensured by using suitable metal connectors, shielded\* cables and grounding. Overvoltages or faulty connections can damage its electronics despite protection against wrong polarity.

**NOTICE**

1. Do not mount the sensors in the area of strong magnetic or electric noise fields.
2. Never connect/disconnect the sensor when voltage is applied.

**Instructions for connection**

- Use low-resistant twisted pair and shielded cables. Connect the shield to ground externally via the controller equipment.
- Keep control and sign leads separate from power cables and sufficiently far away from motor cables, frequency inverters, valve lines, relays, etc..
- Use only connectors with metal housing and connect the shielding to the connector housing.
- Keep the connection surface at both shielding ends as large as possible. Connect the cable clamps to function as a ground.
- Keep all non-shielded leads as short as possible.
- Keep the earth connection as short as possible with a large cross section. Avoid ground loops.
- With potential differences between machine and electronics earth connections, no compensating currents are allowed to flow across the cable shielding.

Recommendation:

Install potential compensating leads with large cross section or use cables with separate double shielding, and connect only one end of the shield.

- Use only stabilized power supplies in compliance with the specified connecting values.

**Grounding of profile and rod sensors**

Connect the sensor electronics housing to machine ground. Ground sensor types EP, EL, EP2 and ER via ground lug as shown in Fig. 23. The sensor type EH is grounded via thread.

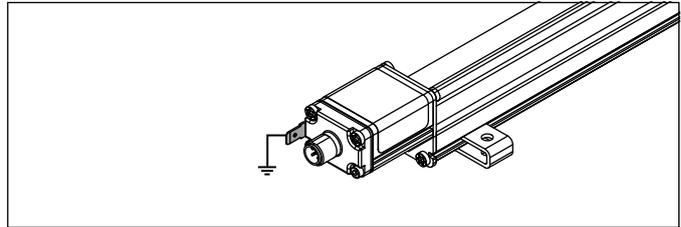


Fig. 23: Grounding via ground lug e.g. profile sensor

**D44**

**Signal + power supply**

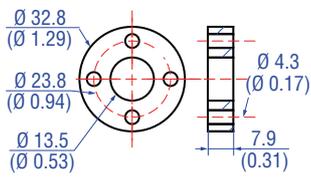
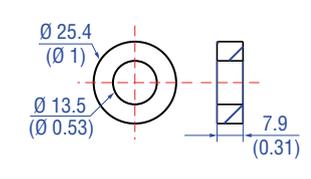
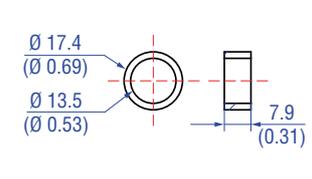
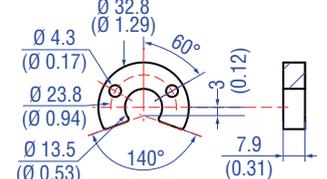
M12 male connector	Pin	Function
<p>View on sensor</p>	1	+24 VDC (-15/+20 %)
	2	DI/DQ
	3	DC Ground (0 V)
	4	C/Q

Fig. 24: Connector wiring D44

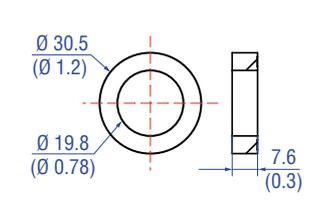
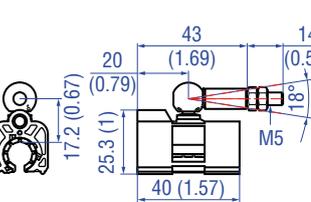
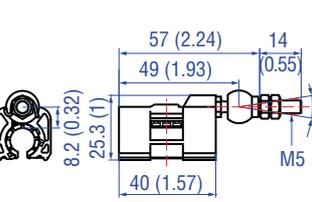
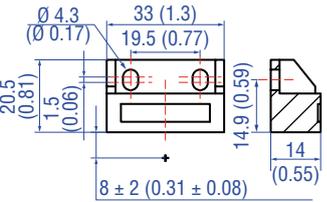
\*/ The use of shielded cables is a recommendation of Temposonics to afford a better protection against signal disturbances

4.8 Frequently ordered accessories – Additional options available in our [Accessories Guide](#) 551 444

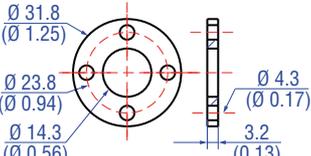
Position magnets

			
<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>	<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>

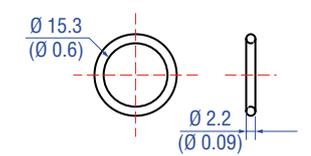
Position magnets

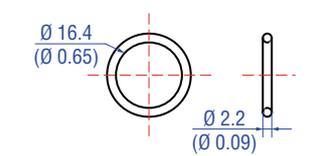
			
<p><b>Ring magnet</b> Part no. 402 316</p> <p>Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm<sup>2</sup> Operating temperature: -40...+100 °C (-40...+212 °F)</p>	<p><b>Magnet slider S, joint at top</b> Part no. 252 182</p> <p>Material: GRP, magnet hard ferrite Weight: 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>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>

Magnet spacer

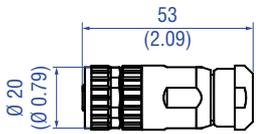
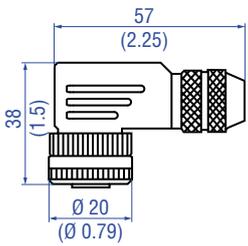

<p><b>Magnet spacer</b> Part no. 400 633</p> <p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm</p>

Sealing

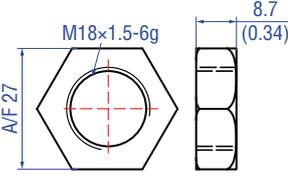
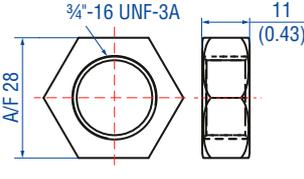
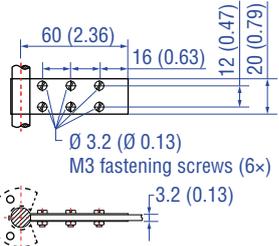
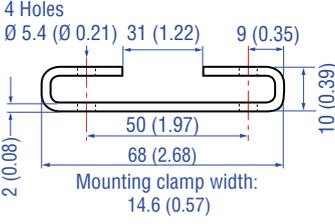

<p><b>O-ring for threaded flange</b> M18x1.5-6g Part no. 401 133</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>


<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>

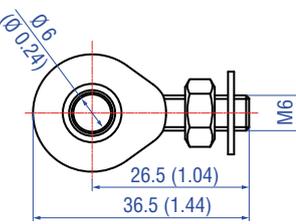
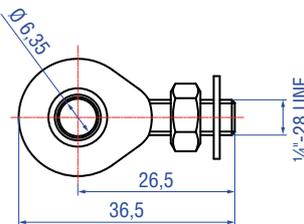
**Cable connectors<sup>3</sup>** **Cables**

			
<p><b>M12 A-coded female connector (4 pin/5 pin), straight</b> <b>Part no. 370 677</b></p> <p>Material: GD-Zn, Ni Termination: Screw Contact insert: CuZn Cable Ø: 4...8 mm (0.16...0.31 in.) Wire: 1.5 mm<sup>2</sup> Operating temperature: -30...+85 °C (-22...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm</p>	<p><b>M12 A-coded female connector (5 pin), angled</b> <b>Part no. 370 678</b></p> <p>Material: GD-Zn, Ni Termination: Screw; max. 0.75 mm<sup>2</sup> Contact insert: CuZn Cable Ø: 5...8 mm (0.2...0.31 in.) Wire: 0.75 mm<sup>2</sup> (18 AWG) Operating temperature: -25...+85 °C (-13...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.4 Nm</p>	<p><b>Cable with M12 A-coded female connector (5 pin), straight – pigtail</b> <b>Part no. 370 673</b></p> <p>Material: PUR jacket; black Features: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: -25...+80 °C (-13...+176 °F)</p>	<p><b>Cable with M12 A-coded female connector (5 pin), angled – pigtail</b> <b>Part no. 370 675</b></p> <p>Material: PUR jacket; black Features: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: -25...+80 °C (-13...+176 °F)</p>

**Hex nut** **Mounting hardware** **Mounting clamp**

			
<p><b>Hex jam nut M18x1.5-6g</b> <b>Part no. 500 018</b></p> <p>Material: Steel, zinc plated</p>	<p><b>Hex jam nut 3/4"-16 UNF-3A</b> <b>Part no. 500 015</b></p> <p>Material: Steel, zinc plated</p>	<p><b>Fixing clip</b> <b>Part no. 561 481</b></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>	<p><b>Mounting clamp</b> <b>Part no. 403 508</b></p> <p>Material: Stainless steel 1.4301/1.4305 (AISI 304/303)</p>

**Rod ends**

		<p><b>NOTICE</b></p> <p>The wiring of the cables is available in the accessories brochure (document no. <a href="#">551 444</a>)</p>
<p><b>Rod end with M6 thread</b> <b>Part no. 254 210</b></p> <p>Material: Galvanized steel</p>	<p><b>Rod end with 1/4"-28 UNF thread</b> <b>Part no. 254 235</b></p> <p>Material: Galvanized steel</p>	

<sup>3/</sup> Follow the manufacturer's mounting instructions  
Controlling design dimensions are in millimeters and measurements in ( ) are in inches  
Color of connectors and cable jacket may change. Colors of the cores and technical properties remain unchanged.

## 5. Operation

### IO-Link

IO-Link is an open standard according to IEC 61131-9. It is a serial, bi-directional point-to-point connection for signal transmission and energy supply. The bi-directional communication enables consistent communication between sensors and the controller as well as consistent diagnostic information down to the sensor level.

The E-Series IO-Link sensor is an IO-Link device which is connected to an IO-Link master. Read the operation manual of the IO-Link master to which the IO-Link device is connected. The E-Series IO-Link parameters in the IO Device Description (IODD) file allow the identification of the sensor on the IO-Link master, adjustment of sensor parameters for the application and the output of warnings and errors.

### Variants of E-Series IO-Link

For the E-Series IO-Link, you can select one of the following three variants via the order code (chapter 3):

#### 1. Standard:

- Output of the position of 1 magnet (single-position measurement).
- Cycle time 1 ms for stroke  $\leq$  1000 mm or 2 ms for stroke  $>$  1000 mm.

#### 2. Advanced single-position measurement

- Output of position and velocity of 1 magnet (single-position measurement)
- Cycle time 4 ms

#### 3. Multi-position measurement

- Output of position of up to 8 magnets simultaneously or output of position and velocity of up to 4 magnets simultaneously (multi-position measurement)
- Cycle time 4 ms

### IO Device Description (IODD) file

The IODD file stores a variety of information about the device for system integration.

The IODD file for E-Series IO-Link is available at [www.temposonics.com](http://www.temposonics.com).

#### NOTICE

There are three IODD files available for the E-Series IO-Link sensors:

**Standard single-position measurement** (order code: Ex-x-xxxxx-D44-1-K):

1. IODD short (Temposonics-E-Series\_IOLink-xxxxxxx-IODD1.1.xml)\* for sensors with stroke length  $\leq$  1000 mm ( $\leq$  39 in.)
2. IODD long (Temposonics-E-Series\_IOLink2ms-xxxxxxx-IODD1.1.xml)\* for sensors with stroke length  $>$  1000 mm ( $>$  39 in.)

The difference between both files is the cycle time.

**Advanced single-position measurement and multi-position measurement** (order code: Ex-x-xxxxx-D44-1-K-x-Zxx):

3. IODD (Temposonics-E-Series\_IOLink\_Multimagnet-xxxxxxx-IODD1.1.xml)\*

Please choose the appropriate IODD file for your E-Series IO-Link. The E-Series IO-Link can be connected to IO-Link masters with a maximum master cycle time of 20 ms. Contact us if you use the E-Series IO-Link in an application with a master cycle time  $>$  20 ms.

\*/ ...xxxxxx... = date (e.g. 20211115)

## 5.1 Identification parameter

These parameters are used to identify the sensor when connected to an IO-Link master.

Index	Subindex	Parameter	Data type	Access	Value
0x10	0x00	Vendor name	string	ro	Temposonics GmbH and Co. KG
0x11	0x00	Vendor text	string	ro	www.temposonics.com
0x12	0x00	Product name	string	ro	E-Series IO-Link (short)/E-Series IO-Link (long)/E-Series IO-Link (multi-magnet)
0x13	0x00	Product ID	string	ro	Ex-x-xxxxx-D44-1-K/Ex-x-xxxxx-D44-1-K-x-Zxx
0x14	0x00	Product text	string	ro	Temposonics E-Series
0x15	0x00	Serial number	string	ro	e.g. 70008887
0x16	0x00	Hardware revision	string	ro	e.g. 10
0x17	0x00	Firmware revision	string	ro	V2.1.x
0x63	0x00	Order code	string	ro	e.g. EH-M-0500M-D44-1-K

Table 1: Identification parameters

The "Application specific tag" allows the user to assign the IO-Link device a random, 32-byte string. This can only be used for application-specific identification.

Index	Subindex	Parameter	Data type	Access	Length	Description
0x18	0x00	Application specific tag	string	rw	32 bytes	The user can assign the sensor with a random name

Table 2: Application specific tag

Additional tags for advanced single-position measurement and multi-position measurement (order code: Ex-x-xxxxx-D44-1-K-x-Zxx):

Index	Subindex	Parameter	Data type	Access	Length	Description
0x19	0x00	Function tag	string	rw	32 bytes	The user can assign the sensor with a short function description
0x1A	0x00	Location tag	string	rw	32 bytes	The user can assign the sensor with a short description, where the sensor is located

Table 3: Function and location tag

## 5.2 Standard commands

The following commands can be used to reset the device or reset all parameters to default settings.

Index	Subindex	Parameter	Access	Command	Description
0x02	0x00	Reset device	wo	0x80	Reset the device
0x02	0x00	Application reset	wo	0x81	Reset measuring parameters, offset, switch points and measurement range. In the case of advanced single-position measurement or multi-position measurement also the parameters at index 0x81 and index 0x80 will be reset.
0x02	0x00	Reset factory settings	wo	0x82	Reset all parameters to default settings
0x02	0x00	Back-to-box	wo	0x83	Reset all parameters to default and stop communication. Restart only after disconnecting and reconnecting to power supply (for advanced single-position measurement and multi-position measurement)

Table 4: Standard commands

### 5.3 Measuring parameter

These parameters allow the sensor to be adapted to the application. The resolution, a filter of the measured value and the measuring direction can all be configured.

Index	Subindex	Parameter	Data type	Access	Length	Default Value	Commands	Description
0x71		Resolution	unsigned integer	rw	4 bytes	5	5 = 5 $\mu\text{m}$ 10 = 10 $\mu\text{m}$ 20 = 20 $\mu\text{m}$ 50 = 50 $\mu\text{m}$ 100 = 100 $\mu\text{m}$	The resolution of measurement is the smallest difference between two position values. It is not related to the accuracy of the measurement. The position is reported in $\mu\text{m}$ steps.
0x72		Filter	unsigned integer	rw	4 bytes	0	0 = Filter off 2 = Filter grade 2 4 = Filter grade 4 8 = Filter grade 8	The filter of the current application is based on the principle of "moving average filter". The current position value is given out of the average of a previous amount of positions and the current measured position.
0x73		Measuring direction	bool	rw	1 byte	False	False = Forward True = Backwards	Forward: From sensor electronics housing to rod end Backwards: From rod end to sensor electronics housing
0x80	0x00	Velocity calculation window	integer	rw	4 bytes	1	1...8	Setting the number of position values for calculating the velocity of the magnet. The velocity is reported in the unit $\mu\text{m}/\text{s}$ (for advanced single-position and multi-position measurement).
0x81	0x01	Measurement mode	integer	rw	4 bytes	1	0: Position measurement for 1...8 magnets 1: Position and velocity measurement for 1...4 magnets	Setting the measurement mode (for advanced single-position and multi-position measurement) <b>Note: Set this parameter according to the number of magnets in the order code of the sensor.</b>
	0x02	Number of magnets	integer	rw	4 bytes	1	1...8	Specifying the number of magnets with which the sensor is to be operated (for advanced single-position and multi-position measurement)
	0x07	Wrong number of magnets	integer	rw	4 bytes	3	0: More or less magnets than configured 1: More magnets than configured 2: Less magnets than configured 3: Magnet detection alarm off	Setting of the alarm behavior when the actual number of position magnets differs from the specified number of position magnet (for advanced single-position and multi-position measurement)

Table 5: Measuring parameters

#### NOTICE

- Set the measurement mode via the IO-Link master according to the number of magnets you want to operate the sensor with. If you operate the sensor with more than 4 magnets, adjust the value of the measurement mode parameter. Otherwise, only values for the first 4 magnets are reported.
- You can use fewer magnets than specified in the order code.
- If you operate the sensor with more magnets than specified in the order code, the value 0 is output for the magnets that are too many.

### 5.4 Offset

The offset is added to the current position value. (Fig. 26)

#### Enter the offset via the graphical user interface of the IO-Link master

- Standard single-position measurement: Enter the offset via index 0x70 subindex 0x00
- Advanced single-position measurement and multi-position measurement: Enter the offset for magnet  $n$  via index 0x70 subindex  $n$  ( $n$  = magnet number)

In addition you can teach the offset:

#### Teach offset for single-position measurement

To teach a new offset move the position magnet to the position where the sensor should output the value 0. Click the appropriate button in the graphical user interface (GUI) of the IO-Link master to set the new offset (Fig. 27).

### Teach offset for advanced single-position measurement and multi-position measurement

- Select the magnet to be used for teaching the offset via the index 0x82 subindex 0x01.
- Move magnet to desired position.
- Enter the value to be output at this point via index 0x82 subindex 0x02.
- Trigger via write access to index 0x78 subindex 0 that the value is taken over.

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x70	0x00	Offset	integer	rw	4 bytes	<i>Value in <math>\mu\text{m}</math></i>	Write and read offset position (for standard single-position measurement)
	0x01	Magnet 1	integer	rw		<i>Value in <math>\mu\text{m}</math></i>	Write or read offset position of magnet $n$ ( $n$ = subindex (magnet number)) (for advanced single-position measurement and multi-position measurement)
	0x02	Magnet 2					
	...	...					
0x08	Magnet 8						
Index	Subindex	Function	Data type	Access	Length	Command/Value	Description
0x78	0x00	Teach offset	bool	wo	1 byte	True	Read the current position and set it as negative offset (Fig. 27)
0x82	0x01	Magnet to teach	integer	wo	1 byte	1...8	Selecting magnet to be used for teaching (for advanced single-position measurement and multi-position measurement)
	0x02	Value to teach	integer	wo	4 bytes	<i>Value in <math>\mu\text{m}</math></i>	Enter value to be output at current position (for advanced single-position measurement and multi-position measurement)

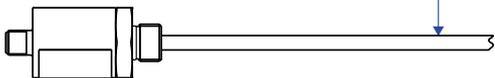
Table 6: Offset parameters

**How the offset works**

**Example 1:**

1. Offset: 0
2. Current position value: 80000  $\mu\text{m}$  (80 mm)
3. New offset is set: 120000  $\mu\text{m}$  (120 mm)
4. New position value: 80 mm + 120 mm = 200000  $\mu\text{m}$  (200 mm)

① Offset: 0  $\mu\text{m}$     ② Ex-position: 80000  $\mu\text{m}$     ③ Set offset: +120000  $\mu\text{m}$     ④ New read position: 200000  $\mu\text{m}$



**Example 2:**

1. Offset: 0
2. Current position value: 80000  $\mu\text{m}$  (80 mm)
3. New offset is set: -120000  $\mu\text{m}$  (-120 mm)
4. New position value: 80 mm - 120 mm = -40000  $\mu\text{m}$  (-40 mm)

① Offset: 0  $\mu\text{m}$     ② Ex-position: 80000  $\mu\text{m}$     ③ Set offset: -120000  $\mu\text{m}$     ④ New read position: -40000  $\mu\text{m}$

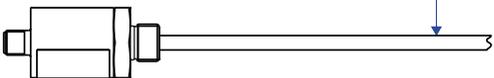


Fig. 25: How the offset works

**Teaching the offset**

1. Offset: 0
2. Current position value: 80000  $\mu\text{m}$  (80 mm)
3. Teach current position
4. Offset is set to: -80000  $\mu\text{m}$  (-80 mm)
5. New position value: 80 mm - 80 mm = 0 mm

① Offset: 0 mm    ② Current position: 80 mm    ③ Teach offset: 80 mm    ④ Set offset: -80 mm    ⑤ New read position: 0 mm

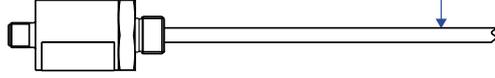


Fig. 26: Teaching the offset

## 5.5 Switch points

The digital output of the sensor on pin 2 (DI/DQ) can be configured as a switch point (see "4.7 Electrical connections" on page 18). This switch point is output in parallel to the position value. The switch point respectively the switch points and the switch logic can be adjusted.

Two switch modes are possible:

1. One switch point (single point mode)
2. Two switch points (window mode)

The logic can also be changed between inverted and non-inverted.

### Enter switch point 1 and switch point 2 via the graphical user interface of the IO-Link master

- Enter position for switch point 1 via index 0x7B subindex 0x01
- Enter position for switch point 2 via index 0x7B subindex 0x02

In addition you can teach switch point 1 and switch point 2:

### Teach Switch Points for standard single-position measurement

For the teach procedure move the position magnet to the required position. Click the appropriate button in the graphical user interface (GUI) of the IO-Link master to define switch point 1 or switch point 2. The new position is stored in the sensor.

### Teach Switch Points for advanced single-position measurement and multi-position measurement

- Select the magnet to be used for teaching the switch point via the index 0x82 subindex 0x01.
- Move magnet to desired position.
- Trigger via the index 0x79 switch point 1 and via index 0x7A switch point 2.

### Monitoring switch points during advanced single-position measurement and multi-position measurement

By default, the magnet used to teach the switch points is also used for monitoring. To select another magnet for monitoring:

- Use index 0x81 subindex 0x05 to select a magnet for monitoring switch point 1.
- Use index 0x81 subindex 0x06 to select a magnet for monitoring switch point 2.

If a switch point is crossed, this is reported via the digital output DI/DQ.

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x7B	0x01	Switch point 1	integer	rw	4 bytes	<i>Value in <math>\mu\text{m}</math></i>	Write and read switch position 1
	0x02	Switch point 2	integer	rw	4 bytes	<i>Value in <math>\mu\text{m}</math></i>	Write and read switch position 2
Index	Subindex	Function	Data type	Access	Length	Command	Description
0x79	0x00	Teach switch point 1	bool	wo	1 byte	True	Read the current position and set it as switch point 1.
0x7A	0x00	Teach switch point 2	bool	wo	1 byte	True	Read the current position and set it as switch point 2.
0x7C	0x00	Switch logic	bool	rw	4 bytes	False = <i>Non-inverted</i> True = <i>Inverted</i>	Defines whether the switching information is inverted or non-inverted.
0x7D	0x00	Switch mode	unsigned integer	rw	4 bytes	0 = <i>Deactivate (default)</i> 1 = <i>Single point mode</i> 2 = <i>Window mode</i>	<u>Deactivate:</u> The switch function is out of function <u>Single point mode:</u> Only switch point 1 will be considered by the switch function. <u>Window mode:</u> Switch point 1 and switch point 2 will be considered by the switch function.
0x81	0x05	Switch point 1 magnet	integer	wo	1 byte	1...8	Selecting magnet for monitoring switch point 1 (for advanced single-position measurement and multi-position measurement)
	0x06	Switch point 2 magnet	integer	wo	1 byte	1...8	Selecting magnet for monitoring switch point 2 (for advanced single-position measurement and multi-position measurement)
0x82	0x01	Magnet to teach	integer	wo	1 byte	1...8	Selecting magnet to be used for teaching (for advanced single-position measurement and multi-position measurement)

Table 7: Switch point parameters

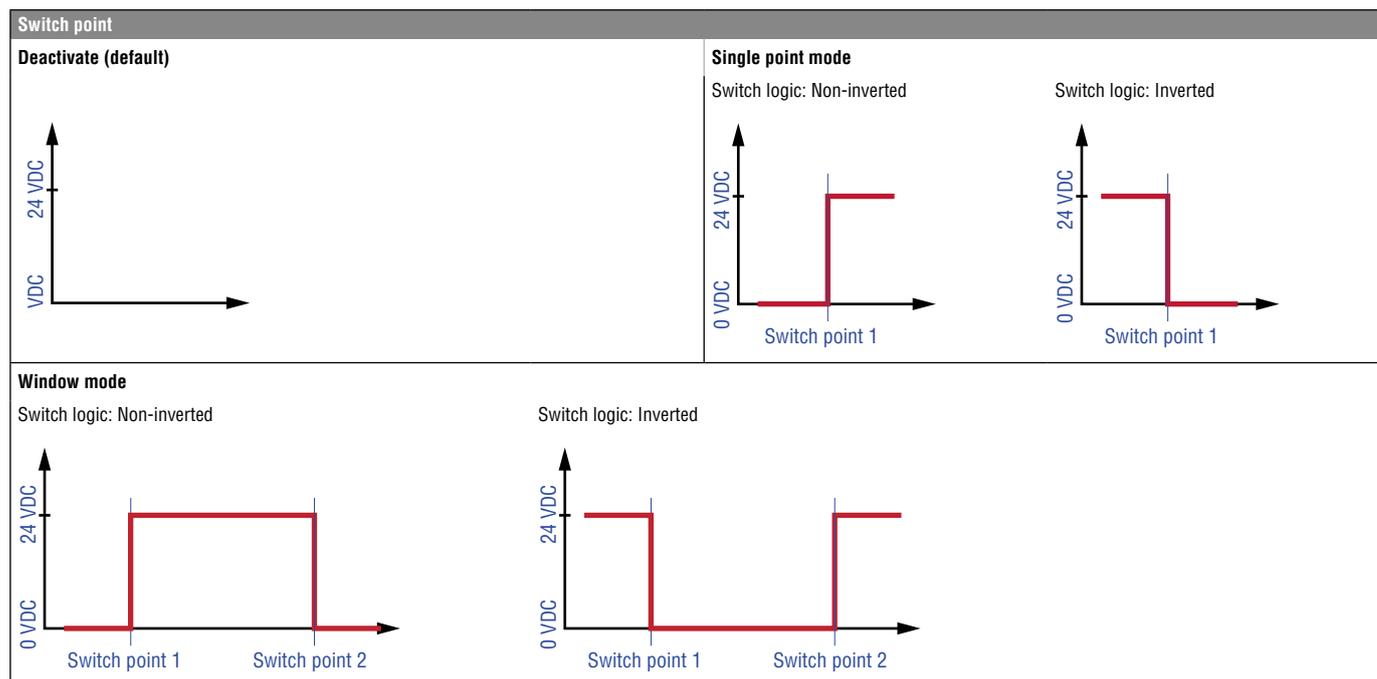


Fig. 27: Functionality of switch point parameters

**NOTICE**

The DI/DQ output must be limited to a current consumption of 100 mA.

**NOTICE**

For multi-position measurement both magnets used for monitoring have to be located between switch point 1 and switch point 2 to report a high level (24 VDC) for a non-inverted switch logic or a low level (0 VDC) for an inverted switch logic.

**5.6 Set measurement range**

You can set the start and end point of the measurement to customize the measuring range.

**Enter start and end point of the measurement range via the graphical user interface of the IO-Link master**

- Enter position for the start point via index 74 subindex 0x01
- Enter position for the end point via index 75 subindex 0x02

In addition you can teach the start and the end point of the measurement range:

**Teach measurement points for single-position measurement**

For the teach-in procedure move the position magnet to the required position. Click the appropriate button in the graphical user interface (GUI) of the IO-Link master to define set point 1 or set point 2. The new position is stored in the sensor.

**Teach measurement points for advanced single-position measurement and multi-position measurement**

- Select the magnet to be used for teaching the measurement points via the index 0x82 subindex 0x01.
- Move magnet to the desired position.
- Trigger the start position using the index 0x76 or the end position using index 0x77.

**Monitoring the measurement range during multi-position measurement**

By default, the magnet used to teach the start position or the end position is also used for monitoring. To select another magnet for monitoring:

- Use index 0x81 subindex 0x03 to select a magnet for monitoring the start position.
- Use index 0x81 subindex 0x04 to select a magnet for monitoring the end position.

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x74	0x00	Set start position	integer	rw	4 bytes	Value in $\mu\text{m}$	The start and end point of the measurement range can be set by the user in order to customize the measurement range. If those points are set, the sensor will give a warning whenever the position magnet is above (Error code: 0x8CA3) or under (Error code: 0x8CA4) the measurement range.
0x75	0x00	Set end position	integer	rw	4 bytes	Value in $\mu\text{m}$	
Index	Subindex	Function	Data type	Access	Length	Command	Description
0x76	0x00	Teach start position	bool	wo	1 byte	True	Read the current position and set it as the start measurement point
0x77	0x00	Teach end position	bool	wo	1 byte	True	Read the current position and set it as the end measurement point
0x81	0x03	Start point magnet	integer	wo	1 byte	1...8	Selecting magnet for monitoring start point (for advanced single-position measurement and multi-position measurement)
	0x04	End point magnet	integer	wo	1 byte	1...8	Selecting magnet for monitoring end point (for advanced single-position measurement and multi-position measurement)
0x82	0x01	Magnet to teach	integer	wo	1 byte	1...8	Selecting magnet to be used for teaching (for advanced single-position measurement and multi-position measurement)

Table 8: Setpoint parameters

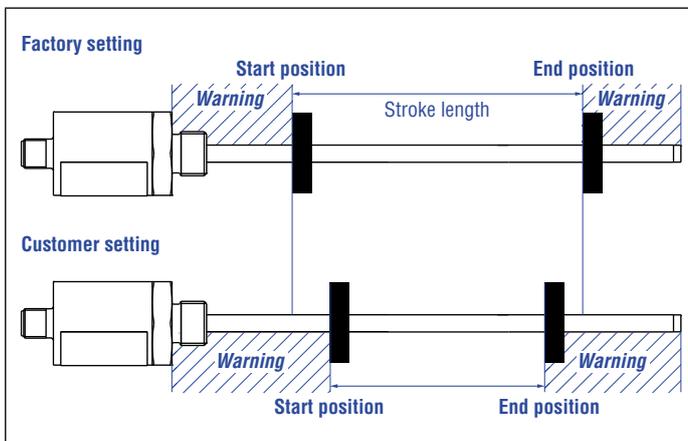


Fig. 28: How to set the measurement range

#### NOTICE

The default value of start position and end position are the factory default values of the start and end of the stroke length defined by the sensor model.

Use only the active stroke length for the definition of the start and end point (see chapter "4.6 Magnet installation" on page 16). Do not set the start or end position to in the null or dead zones.

## 5.7 Error/warning messages

If any issues happen, the following warnings and error messages will be issued.

Code	Mode	Type	Message
0x8CA1	(Dis)appear	Error	More than one magnet/Too many magnets (for multi-position measurement only)
0x8CA2	(Dis)appear	Error	No magnet/Too few magnets (for multi-position measurement only)
0x8CA3	(Dis)appear	Warning	Over range of measurement
0x8CA4	(Dis)appear	Warning	Under range of measurement

Table 9: Error codes specified by Temposonics

Code	Message
0x8011	Index not available
0x8012	Sub-index not available
0x8022	Service temporarily not available – local control
0x8023	Access denied
0x8030	Parameter value out of range
0x8031	Parameter value above the limit
0x8032	Parameter value below the limit
0x8033	Parameter length overrun
0x8034	Parameter length underrun
0x8035	Function not available

Table 10: Error codes defined by the IO-Link specification

## 5.8 Data storage mechanism

The data storage mechanism enables to save the parameters of an IO-Link device on a connected IO-Link master. Table 11 lists the parameters of the E-Series IO-Link which are buffered by the data storage mechanism:

Index	Subindex	Parameter
0x18	0x00	Application specific tag
0x70	0x00	Offset
0x71	0x00	Resolution
0x72	0x00	Filter
0x73	0x00	Measuring direction
0x74	0x00	Start measuring position
0x75	0x00	End measuring position
0x7B	0x01	Switch point 1
	0x02	Switch point 2
0x7C	0x00	Switch logic
0x7D	0x00	Switch mode

Table 11: Sensor parameters

Additional parameters for advanced single-position measurement and multi-position measurement:

Index	Subindex	Parameter
0x19	0x00	Function tag
0x1A	0x00	Location tag
0x70	0x01	Offset magnet 1
	0x02	Offset magnet 2
	0x03	Offset magnet 3
	0x04	Offset magnet 4
	0x05	Offset magnet 5
	0x06	Offset magnet 6
	0x07	Offset magnet 7
	0x08	Offset magnet 8
0x80	0x00	Velocity calculation window
0x81	0x01	Measurement mode
	0x02	Number of magnets
	0x03	Magnet to monitor start position
	0x04	Magnet to monitor end position
	0x05	Magnet to monitor switch point 1
	0x06	Magnet to monitor switch point 2
	0x07	Wrong number of magnets

Table 12: Additional sensor parameters for advanced single-position measurement and multi-position measurement

## 5.9 Device access lock

The parameter "Device access lock" allows the user to activate or deactivate data storage mechanism. Set bit 1 to "0" to unlock the data storage mechanism of the IO-Link device; so the IO-Link master can read the data storage of the IO-Link device and write to the data storage of the IO-Link device.

Index	Subindex	Parameter	Data type	Access	Length	Default value	Description										
0x000C	0x00	Device access lock	RecordT of BooleanT	rw	2 bytes	false	Standardized device locking functions										
Bits							Hex	Description									
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Hex	Description
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0x00	Data storage access unlocked (default value)
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0x02	Data storage access locked

Table 13: Device access lock parameter

## 6. Maintenance and troubleshooting

### 7.1 Error conditions, troubleshooting

See chapter "5. Operation" on page 21.

### 7.2 Maintenance

The sensor is maintenance-free.

### 7.3 Repair

Repairs of the sensor may be performed only by Temposonics or a repair facility explicitly authorized by Temposonics.

### 7.4 List of spare parts

No spare parts are available for this sensor.

### 7.5 Transport and storage

The conditions of transport and storage of the sensor match the operating conditions mentioned in this document.

## 7. Removal from service/dismantling

The product contains electronic components and must be disposed of in accordance with the local regulations.

## 8. Technical data

### 8.1 Technical data of Temposonics® EH

Output	
Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	Standard single-position measurement: 32 bit signed (position in $\mu\text{m}$ ) Advanced single-position measurement and multi-position measurement: 8 × 32 bit signed (position in $\mu\text{m}$ , velocity in $\mu\text{m/s}$ )
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	Standard single-position measurement: 4 bytes Advanced single-position measurement and multi-position measurement: 32 bytes
Process data master – device	0 bytes
Measured value	Standard single-position measurement: Position Advanced single-position measurement and multi-position measurement: Position and velocity
Measurement parameters	
Resolution <sup>4</sup>	5 $\mu\text{m}$ , 10 $\mu\text{m}$ , 20 $\mu\text{m}$ , 50 $\mu\text{m}$ or 100 $\mu\text{m}$
Cycle time	Standard single-position measurement: Sensors with stroke length $\leq 1000$ mm ( $\leq 39$ in.): 1 ms Sensors with stroke length $\geq 1000$ mm ( $\geq 39$ in.): 2 ms Advanced single-position measurement and multi-position measurement: 4 ms
Linearity <sup>5</sup>	$\leq \pm 0.02$ % F.S. (minimum $\pm 60$ $\mu\text{m}$ )
Repeatability	$\leq \pm 0.005$ % F.S. (minimum $\pm 20$ $\mu\text{m}$ )
Operating conditions	
Operating temperature	$-40 \dots +75$ °C ( $-40 \dots +167$ °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP67/IP69K (connector correctly fitted)
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 61000-6-3 Electromagnetic immunity according to EN 61000-6-2
Operating pressure	$\varnothing 7$ mm rod: 300 bar (4351 psi), 450 bar (6527 psi) peak $\varnothing 10$ mm rod: 350 bar (5076 psi), 530 bar (7687 psi) peak
Magnet movement velocity	Any
Design/Material	
Sensor electronics housing	Stainless steel 1.4305 (AISI 303); option: Stainless steel 1.4404 (AISI 316L)
Sensor rod	$\varnothing 7$ mm rod: Stainless steel 1.4301 (AISI 304) $\varnothing 10$ mm rod: Stainless steel 1.4306 (AISI 304L); option: Stainless steel 1.4404 (AISI 316L)
Stroke length	50...2540 mm (2...100 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings
Electrical connection	
Connection type	M12 male connector (4 pin)
Operating voltage	+24 VDC ( $\pm 25$ %)
Ripple	$\leq 0.28 V_{pp}$
Current consumption	< 50 mA
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to $-30$ VDC
Overvoltage protection	Up to 36 VDC

## 8.2 Technical data of Temposonics® EP/EL

Output	
Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	Standard single-position measurement: 32 bit signed (position in $\mu\text{m}$ ) Advanced single-position measurement and multi-position measurement: 8 × 32 bit signed (position in $\mu\text{m}$ , velocity in $\mu\text{m/s}$ )
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	Standard single-position measurement: 4 bytes Advanced single-position measurement and multi-position measurement: 32 bytes
Process data master – device	0 bytes
Measured value	Standard single-position measurement: Position Advanced single-position measurement and multi-position measurement: Position and velocity
Measurement parameters	
Resolution <sup>6</sup>	5 $\mu\text{m}$ , 10 $\mu\text{m}$ , 20 $\mu\text{m}$ , 50 $\mu\text{m}$ or 100 $\mu\text{m}$
Cycle time	Standard single-position measurement: Sensors with stroke length $\leq 1000$ mm ( $\leq 39$ in.): 1 ms Sensors with stroke length $\geq 1000$ mm ( $\geq 39$ in.): 2 ms Advanced single-position measurement and multi-position measurement: 4 ms
Linearity <sup>7</sup>	Magnet slider: $\leq \pm 0.02$ % F.S. (minimum $\pm 60$ $\mu\text{m}$ ), U-magnet: $\leq \pm 0.02$ % F.S. (minimum $\pm 60$ $\mu\text{m}$ ), block magnet: $\leq \pm 0.03$ % (minimum $\pm 90$ $\mu\text{m}$ )
Repeatability	$\leq \pm 0.005$ % F.S. (minimum $\pm 20$ $\mu\text{m}$ )
Operating conditions	
Operating temperature	$-40 \dots +75$ °C ( $-40 \dots +167$ °F)
Humidity	90 % relative humidity, no condensation
Ingress protection <sup>8</sup>	IP67 (connector correctly fitted)
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 61000-6-3 Electromagnetic immunity according to EN 61000-6-2
Magnet movement velocity	Magnet slider: $\leq 5$ m/s; U-magnet: Any; block magnet: Any
Design/Material	
Sensor electronics housing	Aluminum
Sensor profile	Aluminum
Stroke length	50...2540 mm (2...100 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings
Electrical connection	
Connection type	M12 male connector (4 pin)
Operating voltage	+24 VDC ( $\pm 25$ %)
Ripple	$\leq 0.28$ V <sub>pp</sub>
Current consumption	< 50 mA
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to $-30$ VDC
Overvoltage protection	Up to 36 VDC

6/ Selectable via IO-Link master

7/ Magnet slider # 252 182 and # 252 184, U-magnet #251 416-2, block magnet # 403 448

8/ The IP rating IP67 is only valid for the sensors electronics housing, as water and dust can get inside the profile.

### 8.3 Technical data of Temposonics® EP2

Output	
Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	Standard single-position measurement: 32 bit signed (position in $\mu\text{m}$ ) Advanced single-position measurement and multi-position measurement: 8 × 32 bit signed (position in $\mu\text{m}$ , velocity in $\mu\text{m/s}$ )
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	Standard single-position measurement: 4 bytes Advanced single-position measurement and multi-position measurement: 32 bytes
Process data master – device	0 bytes
Measured value	Standard single-position measurement: Position Advanced single-position measurement and multi-position measurement: Position and velocity
Measurement parameters	
Resolution <sup>9</sup>	5 $\mu\text{m}$ , 10 $\mu\text{m}$ , 20 $\mu\text{m}$ , 50 $\mu\text{m}$ or 100 $\mu\text{m}$
Cycle time	Standard single-position measurement: Sensors with stroke length $\leq 1000$ mm ( $\leq 39$ in.): 1 ms Sensors with stroke length $\geq 1000$ mm ( $\geq 39$ in.): 2 ms Advanced single-position measurement and multi-position measurement: 4 ms
Linearity	$\leq \pm 0.02$ % F.S. (minimum $\pm 90$ $\mu\text{m}$ )
Repeatability	$\leq \pm 0.005$ % F.S. (minimum $\pm 20$ $\mu\text{m}$ )
Operating conditions	
Operating temperature	$-40 \dots +75$ °C ( $-40 \dots +167$ °F)
Humidity	90 % relative humidity, no condensation
Ingress protection <sup>10</sup>	IP67 (connector correctly fitted)
Shock test	100 g (single shock), IEC standard 60068-2-27
Vibration test	8 g/10...2000 Hz, IEC standard 60068-2-6 (resonance frequencies excluded)
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2
Magnet movement velocity	Any
Design/Material	
Sensor lid	Zinc die cast
Sensor profile	Aluminum
Stroke length	50...2540 mm (2...100 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings
Electrical connection	
Connection type	M12 male connector (4 pin)
Operating voltage	+24 VDC ( $\pm 25$ %)
Ripple	$\leq 0.28$ V <sub>pp</sub>
Current consumption	< 50 mA
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to $-30$ VDC
Overvoltage protection	Up to 36 VDC

<sup>9</sup>/ Selectable via IO-Link master

<sup>10</sup>/The IP rating IP67 is only valid for the sensors electronics housing, as water and dust can get inside the profile.

#### 8.4 Technical data of Temposonics® ER

Output	
Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	Standard single-position measurement: 32 bit signed (position in $\mu\text{m}$ ) Advanced single-position measurement: 8 × 32 bit signed (position in $\mu\text{m}$ , velocity in $\mu\text{m/s}$ )
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	Standard single-position measurement: 4 bytes Advanced single-position measurement: 32 bytes
Process data master – device	0 bytes
Measured value	Standard single-position measurement: Position Advanced single-position measurement: Position and velocity
Measurement parameters	
Resolution <sup>11</sup>	5 $\mu\text{m}$ , 10 $\mu\text{m}$ , 20 $\mu\text{m}$ , 50 $\mu\text{m}$ or 100 $\mu\text{m}$
Cycle time	Standard single-position measurement: Sensors with stroke length $\leq 1000$ mm ( $\leq 39$ in.): 1 ms Sensors with stroke length $\geq 1000$ mm ( $\geq 39$ in.): 2 ms Advanced single-position measurement: 4 ms
Linearity	$\leq \pm 0.02$ % F.S. (minimum $\pm 60$ $\mu\text{m}$ )
Repeatability	$\leq \pm 0.005$ % F.S. (minimum $\pm 20$ $\mu\text{m}$ )
Operating conditions	
Operating temperature	$-40 \dots +75$ °C ( $-40 \dots +167$ °F)
Humidity	90 % relative humidity, no condensation
Ingress protection <sup>12</sup>	IP67 (connector correctly fitted)
Shock test	100 g (single shock), IEC standard 60068-2-27
Vibration test	5 g/10...2000 Hz, IEC standard 60068-2-6 (resonance frequencies excluded)
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2
Magnet movement velocity	$\leq 5$ m/s
Design/Material	
Sensor electronics housing	Aluminum
Sensor profile	Aluminum
Stroke length	50...1500 mm (2...60 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings
Electrical connection	
Connection type	M12 male connector (4 pin)
Operating voltage	+24 VDC ( $\pm 25$ %)
Ripple	$\leq 0.28$ V <sub>pp</sub>
Current consumption	< 50 mA
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to $-30$ VDC
Overvoltage protection	Up to 36 VDC

<sup>11</sup>/Selectable via IO-Link master

<sup>12</sup>/The IP rating IP67 is only valid for the sensors electronics housing, as water and dust can get inside the profile.

## 9. Appendix

### Safety declaration

Dear Customer,

If you return one or several sensors for checking or repair, we need you to sign a safety declaration. The purpose of this declaration is to ensure that the returned items do not contain residues of harmful substances and/or that people handling these items will not be in danger.

Temposonics order number: \_\_\_\_\_

Sensor type(s): \_\_\_\_\_

Serial number(s): \_\_\_\_\_

Sensor length(s): \_\_\_\_\_

#### The sensor has been in contact with the following materials:

Do not specify chemical formulas.  
Please include safety data sheets of the substances, if applicable.

In the event of suspected penetration of substances into the sensor, consult Temposonics to determine measures to be taken before shipment.

#### Short description of malfunction:

#### Corporate information

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

#### Contact partner

Phone: \_\_\_\_\_

Fax: \_\_\_\_\_

Email: \_\_\_\_\_

We hereby certify that the measuring equipment has been cleaned and neutralized.  
Equipment handling is safe. Personnel exposure to health risks during transport and repair is excluded.

Stamp

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

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