

Temposonics®

Magnetostrictive Linear Position Sensors

E-Series IO-Link Operation Manual



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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 ¹ 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 danger that might affect the life and health of operating or service personnel or cause material damage are highlighted by the preceding pictogram which is defined below.

Symbol	Meaning
NOTICE	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 MTS Sensors. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

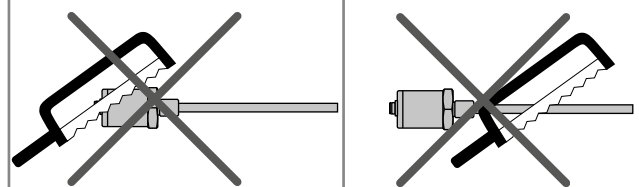
- The sensor systems of all Temposonics® series are intended exclusively for measurement tasks encountered in industrial, commercial and laboratory applications. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other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

- ^{1/} 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),
 - 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.

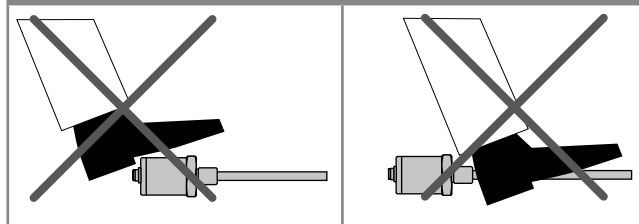
2.2 Forseeable misuse

Forseeable misuse	Consequence
Wrong sensor connection	The sensor will not work properly or will be destroyed
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 destroyed / sensor does not respond
Spacers are missing / are 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 certified by MTS Sensors	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.



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

MTS Sensors grants a warranty period for the Temposonics® position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application². The MTS Sensors 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 MTS Sensors 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. MTS Sensors 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 MTS Sensors. Any shipment cost is the responsibility of the sender². For a corresponding form, see chapter "10. Appendix" on page 38.

^{2/} See also applicable MTS Sensors terms of sales and delivery on www.mtssensors.com

3. Identification

3.1 Order code of Temposonics® E-Series EH

1	2	3	4	5	6	7	8	9	10	11	12	13
E	H							D	4	4	1	K
a		b	c					d			e	f

a	Sensor model
E H	Rod

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

c	Stroke length
X X X X M	0050...2540 mm
X X X X U	002.0...100.0 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
50 ...500 mm	5 mm
500 ...750 mm	10 mm
750...1000 mm	25 mm
1000...2540 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
2 ...20 in.	0.2 in.
20 ...30 in.	0.5 in.
30 ...40 in.	1.0 in.
40...100 in.	2.0 in.

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

e	Operating voltage
1	+24 VDC (±25 %)

f	Output
K	IO-Link

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

3.2 Order code of Temposonics® E-Series EP

1	2	3	4	5	6	7	8	9	10	11	12	13
E	P	0						D	4	4	1	K
a		b	c					d			e	f

a Sensor model

E	P	Compact profile
---	---	-----------------

b Design

0	Without position magnet
---	-------------------------

c Stroke length

X	X	X	X	M	0050...2540 mm
X	X	X	X	U	002.0...100.0 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
50...500 mm	25 mm
500...2540 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
2...20 in.	1.0 in.
20...100 in.	2.0 in.

d Connection type

D	4	4	M12 (4 pin) male connector
---	---	---	----------------------------

e Operating voltage

1	+24 VDC (±25 %)
---	-----------------

f Output

K	IO-Link
---	---------

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

3.3 Order code of Temposonics® E-Series EL

1	2	3	4	5	6	7	8	9	10	11	12	13
E	L	0						D	4	4	1	K
a		b	c					d			e	f

a	Sensor model											
E	L	Ultra low profile										

b	Design											
0	Without position magnet											

c	Stroke length											
X	X	X	X	M	0050...2540 mm							
X	X	X	X	U	002.0...100.0 in.							

Standard stroke length (mm)*

Stroke length	Ordering steps
50...500 mm	25 mm
500...2540 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
2...20 in.	1.0 in.
20...100 in.	2.0 in.

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

e	Operating voltage											
1	+24 VDC (±25 %)											

f	Output											
K	IO-Link											

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

3.4 Order code of Temposonics® E-Series EP2

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

a	Sensor model											
E	P	2	Smooth profile									

b	Stroke length											
X	X	X	X	M	0050...2540 mm							
X	X	X	X	U	002.0...100.0 in.							

Standard stroke length (mm)*

Stroke length	Ordering steps
50...500 mm	25 mm
500...2540 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
2...20 in.	1.0 in.
20...100 in.	2.0 in.

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

d	Operating voltage											
1	+24 VDC (±25 %)											

e	Output											
K	IO-Link											

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

3.5 Order code of Temposonics® E-Series ER

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

a	Sensor model
E R	Aluminum cylinder with a guided driving rod

b	Design
M	Inside thread M6 at end of rod (For metric stroke length measurement)
S	Inside thread 1/4"-28 UNF at end of rod (For US customary stroke length measurement)

c	Stroke length
X X X X M	0050...1500 mm
X X X X U	002.0...060.0 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
50...500 mm	25 mm
500...1500 mm	50 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
2...20 in.	1.0 in.
20...60 in.	2.0 in.

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

e	Operating voltage
1	+24 VDC (±25 %)

f	Output
K	IO-Link

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

3.6 Nameplate

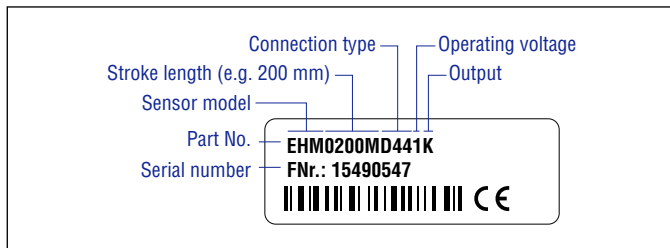


Fig. 1: Example of nameplate of an E-Series EH sensor

3.7 Approvals

CE certification

3.8 Scope of delivery

E-Series EH (rod sensor):

- Sensor
- O-ring

E-Series 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

E-Series 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

E-Series 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

E-Series 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 MTS Sensors rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics® position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

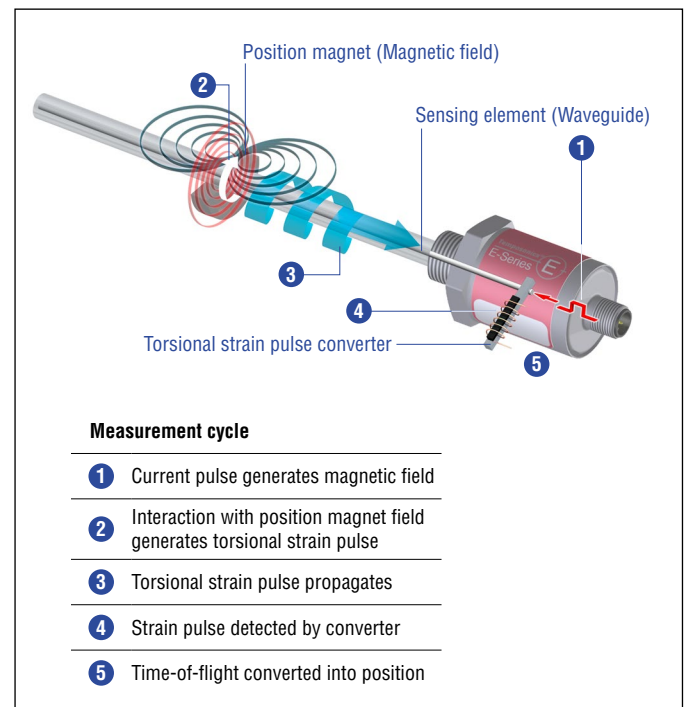


Fig. 2: Time-based magnetostrictive position sensing principle

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 E-Series EH

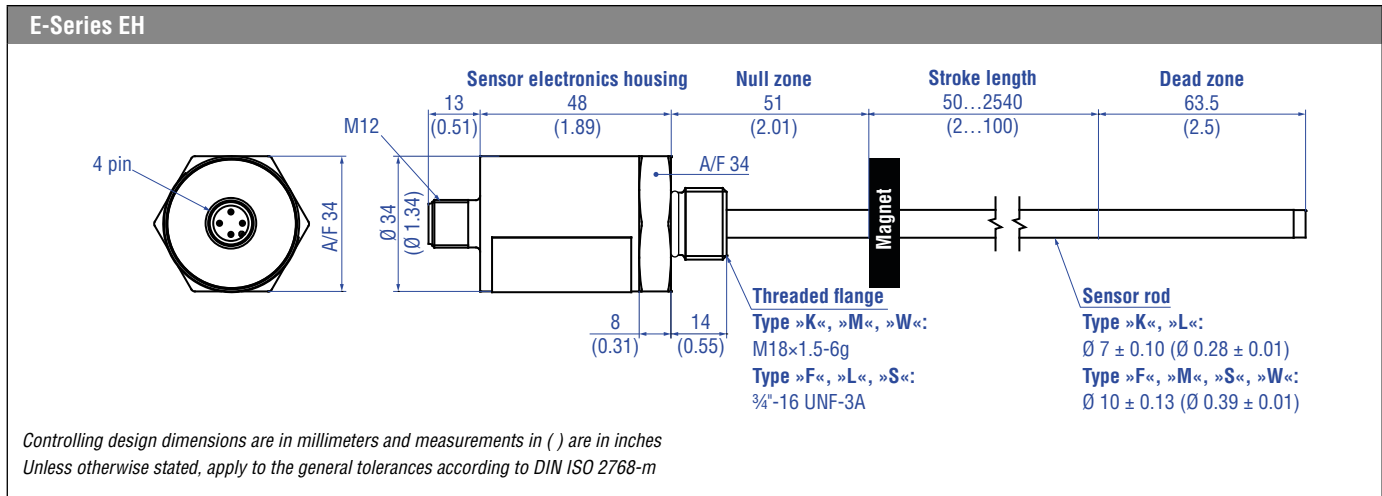


Fig. 3: Temposonics® EH sensor

Installation of EH with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A.

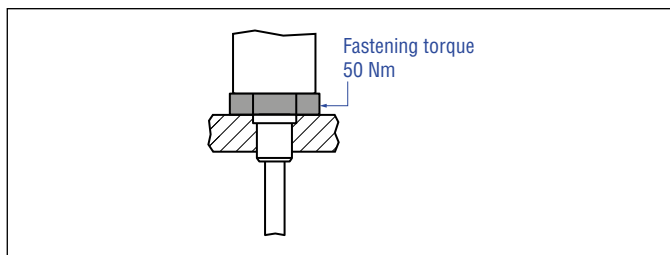


Fig. 4: Mounting example of threaded flange

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.

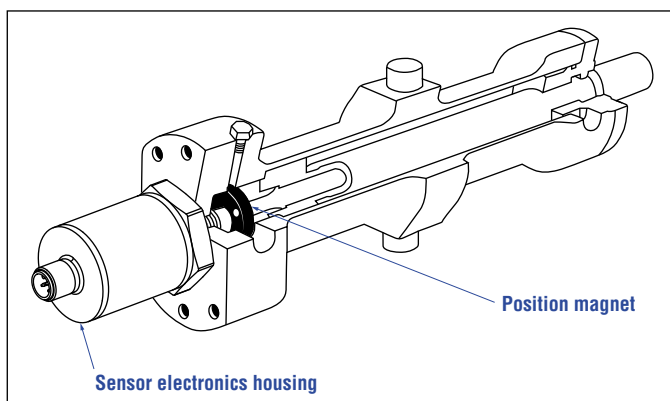


Fig. 5: Sensor in cylinder

Hydraulics sealing

The flange contact surface is sealed via an O-ring in the undercut (Fig. 4).

For threaded flange (¾"-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)

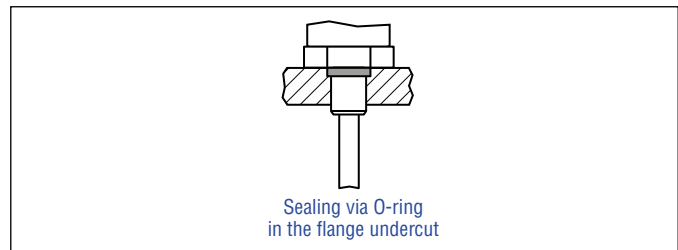


Fig. 6: Possibility of sealing

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° $\pm 1^\circ$
EH-K									
M18×1.5-6g	55	≥ 10	24.5	19.8	2.4	28.5	2	26	15°
EH-M / -W									
M18×1.5-6g	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°

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 E-Series EP

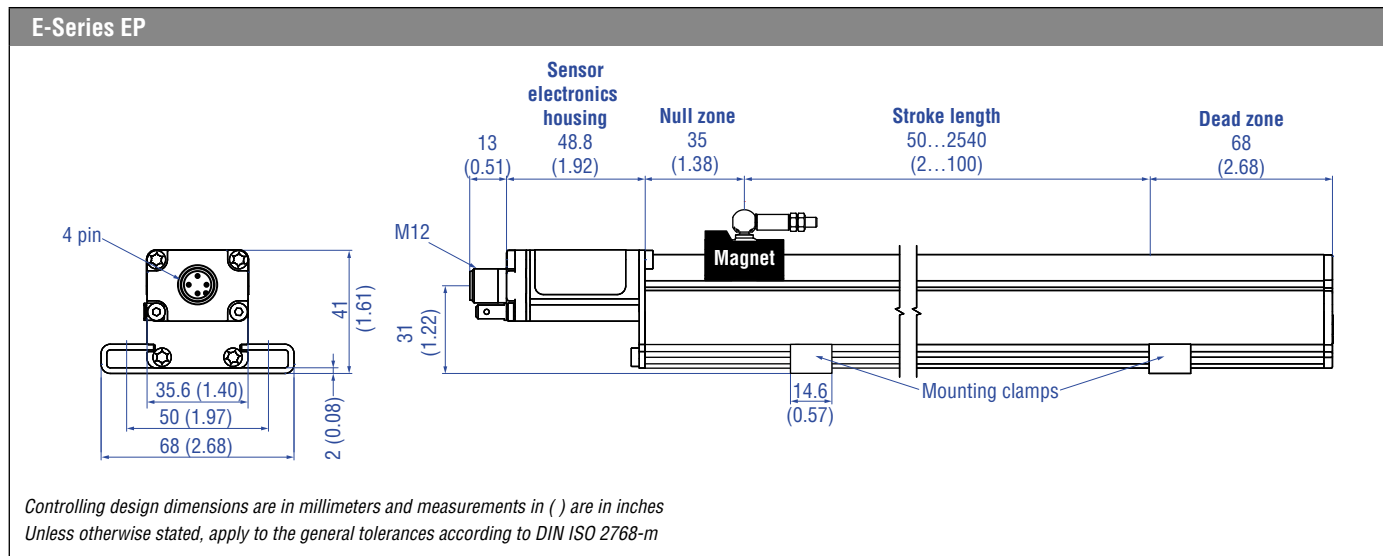


Fig. 8: Temposonics® EP sensor

Installation of EP

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.

NOTICE

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

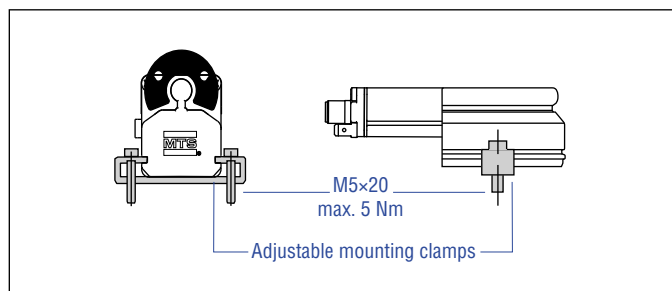


Fig. 9: Mounting clamps with cylinder screw M5×20 (part no. 403 508)

4.4 Styles and installation of E-Series EL

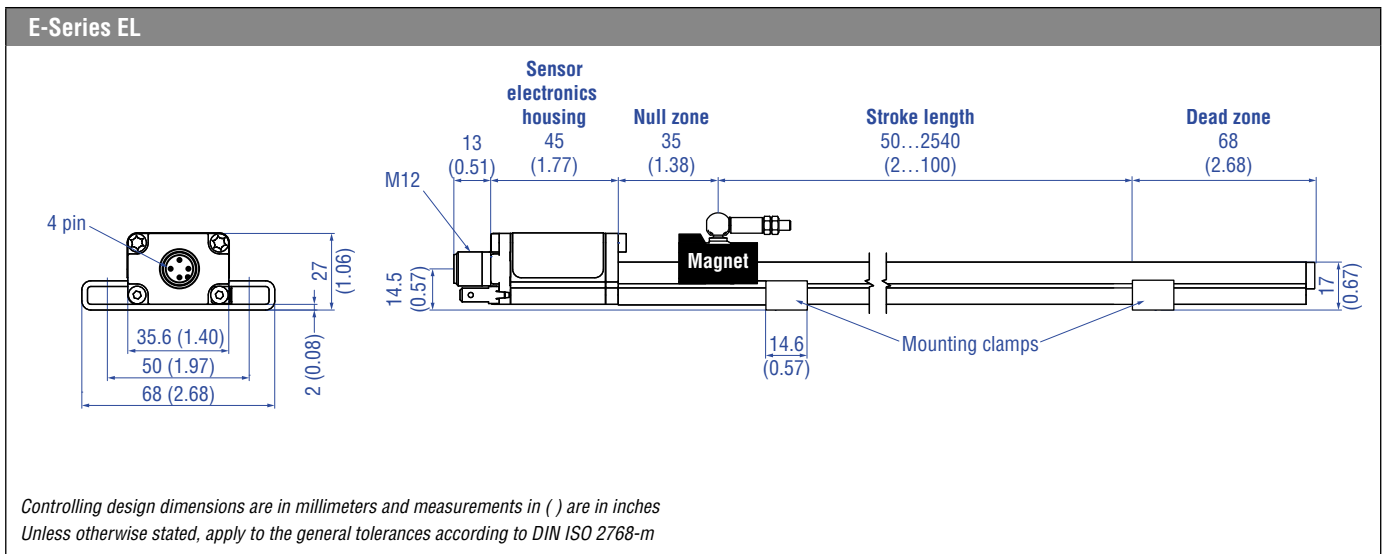


Fig. 10: Temposonics® EL sensor

Installation of 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. 11). 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.

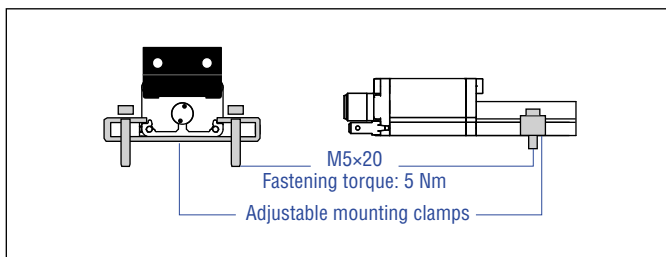


Fig. 11: Mounting clamps with cylinder screw M5×20 (part no. 403 508)

4.5 Styles and installation of E-Series EP2

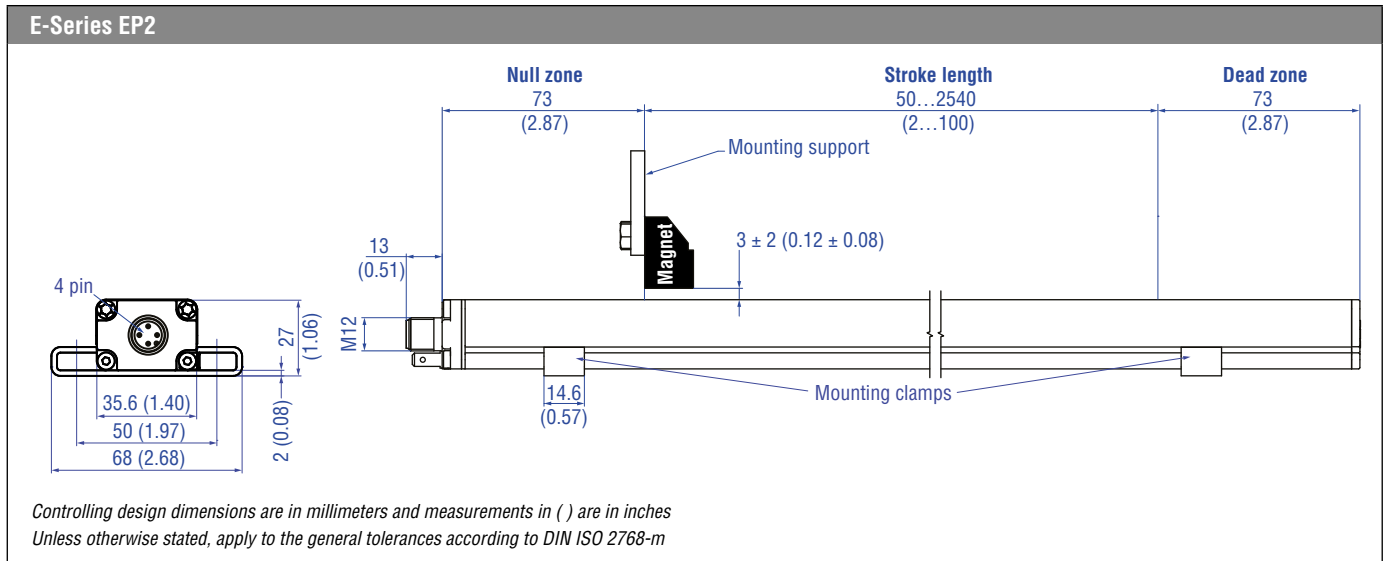


Fig. 12: Temposonics EP2

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. 13). 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.

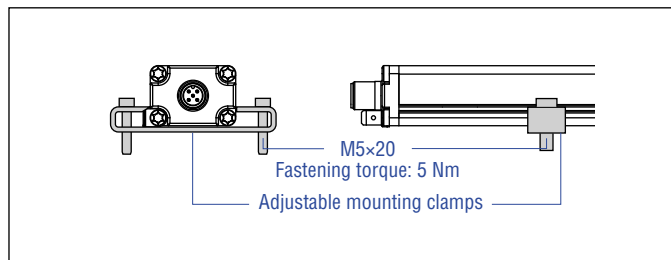


Fig. 13: Mounting clamps with cylinder screw M5×20 (part no. 403 508)

4.6 Styles and installation of E-Series ER

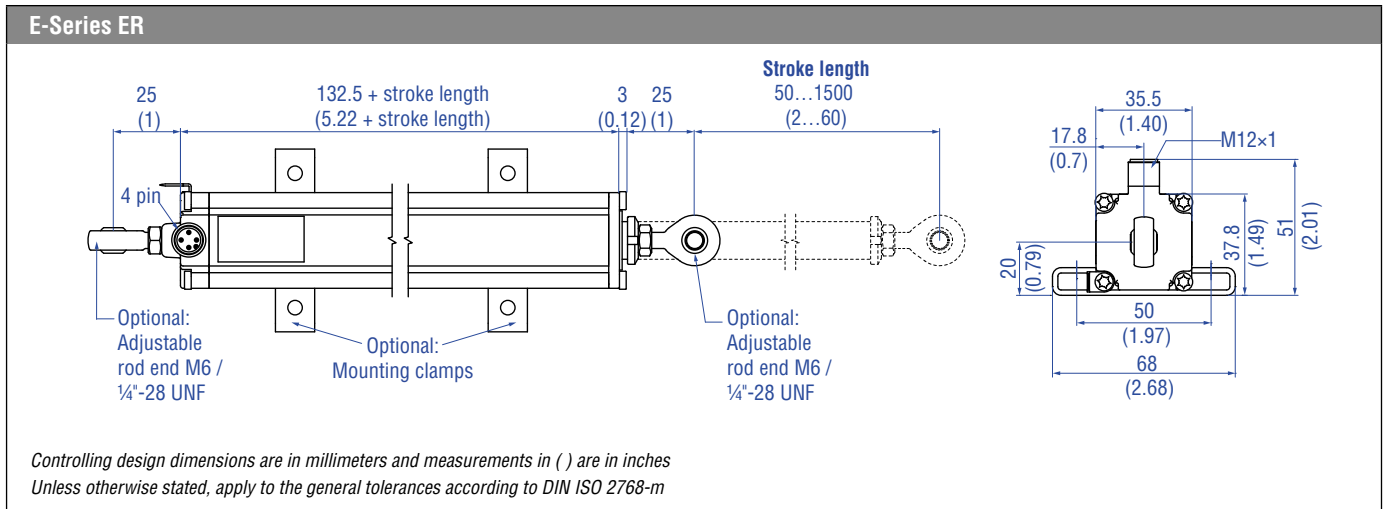


Fig. 14: Temposonics ER

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. 15). 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.

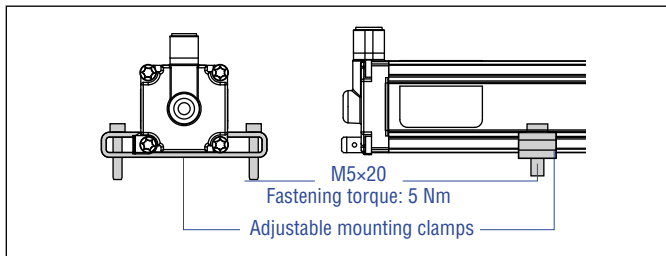


Fig. 15: Mounting clamps with cylinder screw M5×20 (part no. 403 508)

2. Via the adjustable rod end

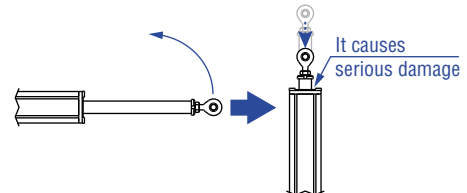
The position sensor can be installed in any position. The sensor is mechanically connected via adjustable rod ends (part no. 254 210 / part no. 254 235)

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.



4.7 Magnet installation




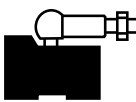
Magnet	Typical Sensors	Benefits
 Ring magnets	Rod model (EH)	<ul style="list-style-type: none"> Rotationally symmetrical magnetic field
 U-magnets	Profile & rod models (EH, EP)	<ul style="list-style-type: none"> Height tolerances can be compensated
 Block magnets	Profile & rod models (EH, EP, EL & EP2)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

Fig. 16: 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/mm² (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. 19).
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 19).

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. 17, Fig. 18).

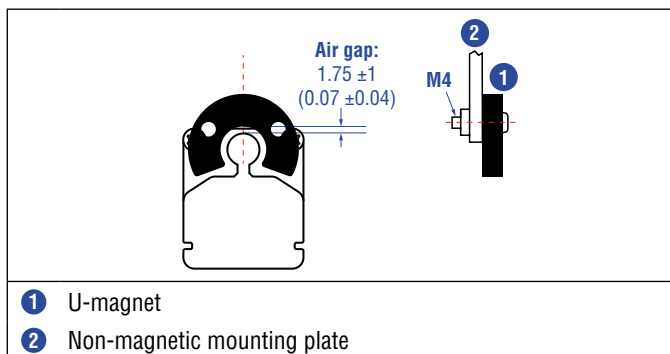


Fig. 17: Mounting of U-magnet (part no. 251 416-2), example of EP sensor

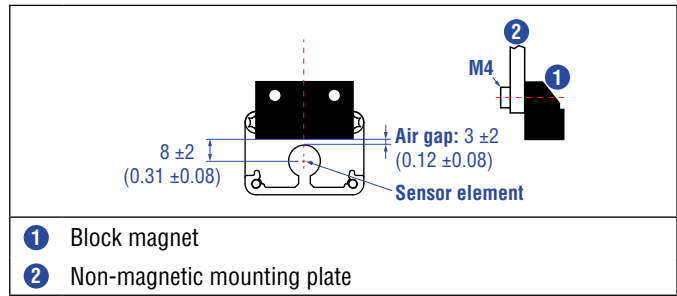


Fig. 18: Mounting of block magnet (part no. 403448), example of EL sensor

Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 19 must be observed.

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

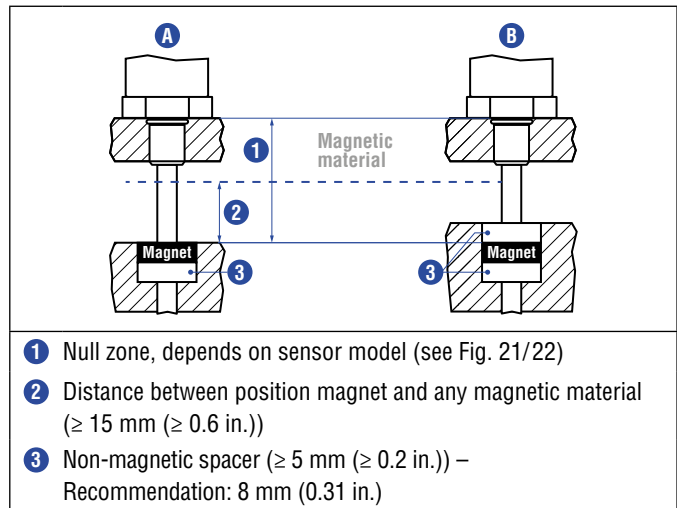


Fig. 19: Installation with magnetic material

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. 561 481). Use an U-magnet (Fig. 20) for measurement.

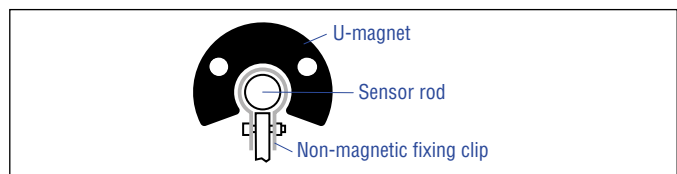


Fig. 20: Example of sensor support (part no. 561 481)

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.

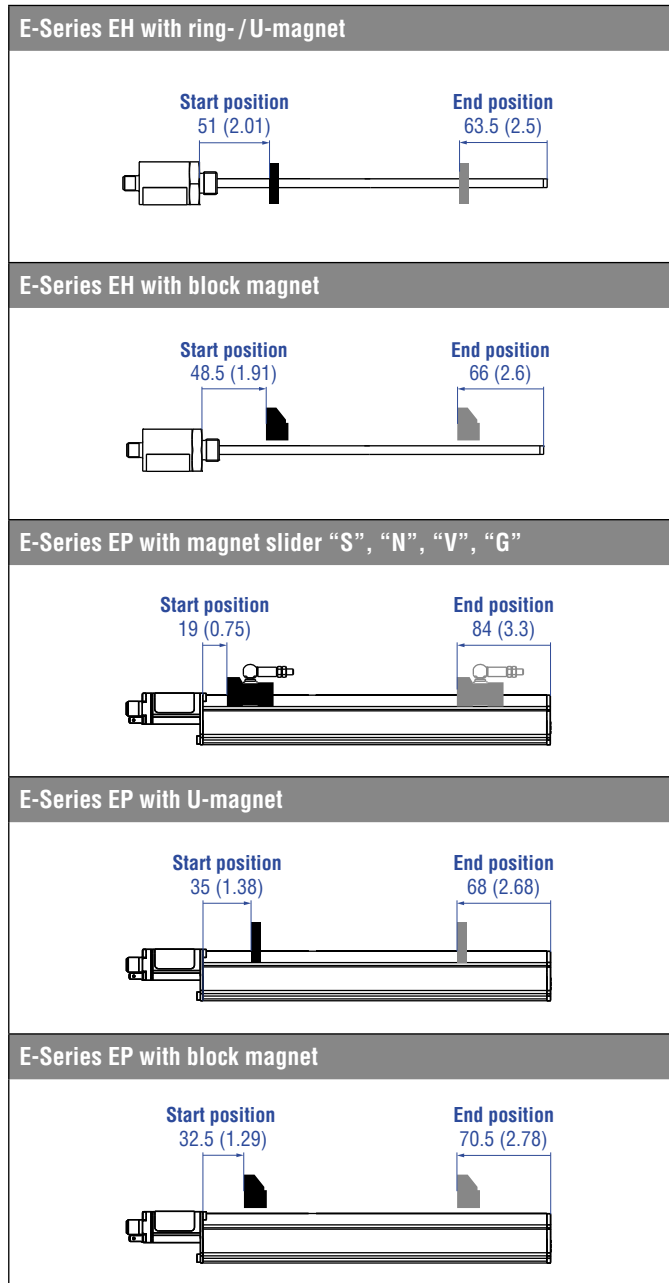


Fig. 21: Start- and end positions of magnets, part 1

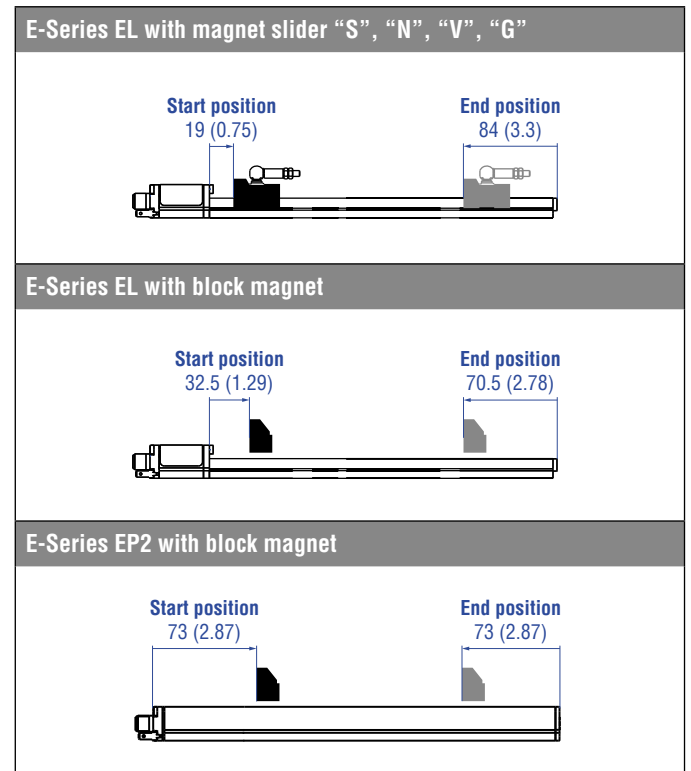


Fig. 22: Start- and end positions of magnets, part 2

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

4.8 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.

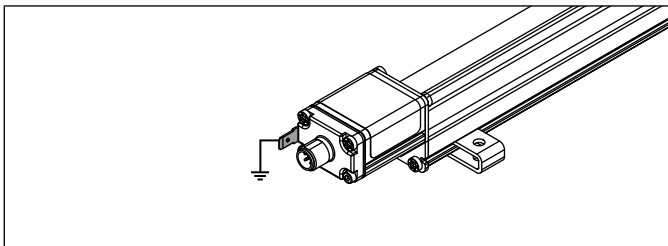


Fig. 23: Grounding via ground lug e.g. profile sensor

D44

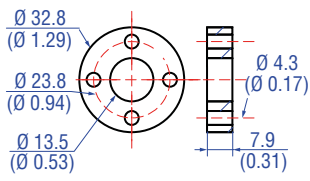
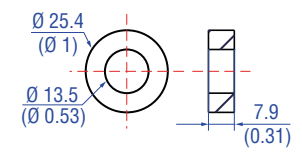
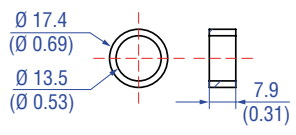
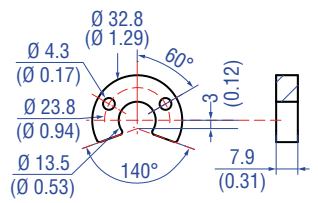
M12 A-coded	Pin	Function
	1	+24 VDC (±25 %)
	2	DI/DQ
	3	DC Ground (0 V)
	4	C/Q

Fig. 24: Connector wiring D44

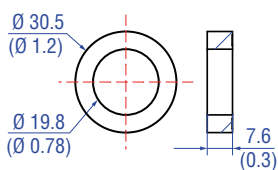
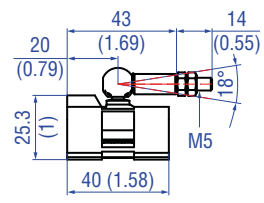
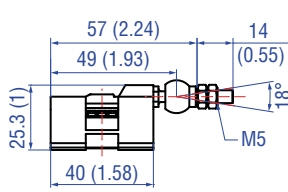
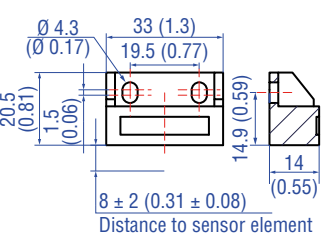
*/ The use of shielded cables is a recommendation of MTS Sensors to afford a better protection against signal disturbances

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

Position magnets

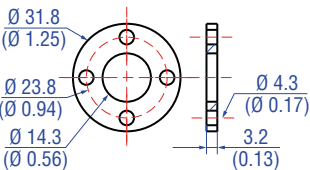
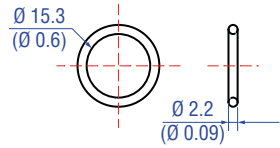
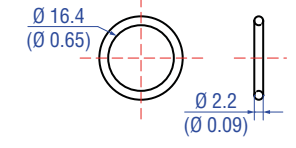
			
<p>Ring magnet OD33 Part no. 201 542-2</p>	<p>Ring magnet OD25.4 Part no. 400 533</p>	<p>Ring magnet OD17.4 Part no. 401 032</p>	<p>U-magnet OD33 Part no. 251 416-2</p>
<p>For: EH Material: PA ferrite GF20 Weight: Ca. 14 g Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>For: EH Material: PA ferrite Weight: Ca. 10 g Surface pressure: Max. 40 N/mm² Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>For: EH Material: PA neobind Weight: Ca. 5 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>For: EH, EP Material: PA ferrite GF20 Weight: Ca. 11 g Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>

Position magnets

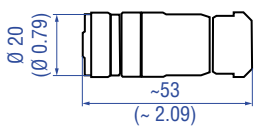
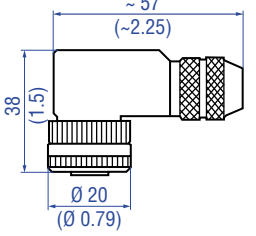
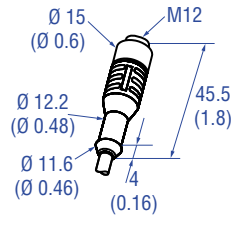
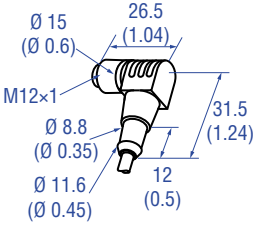
			
<p>Ring magnet Part no. 402 316</p>	<p>Magnet slider S Part no. 252 182</p>	<p>Magnet slider V Part no. 252 184</p>	<p>Block magnet Part no. 403 448</p>
<p>For: EH Material: PA ferrite coated Weight: Ca. 13 g Surface pressure: 20 N/mm² Operating temperature: -40...+100 °C (-40...+212 °F)</p>	<p>For: EP, EL Material: GFK, magnet hard ferrite Weight: Ca. 35 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p>For: EP, EL Material: GFK, magnet hard ferrite Weight: Ca. 35 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p>For: EH, EP, EL, EP2 Material: Hard ferrite Weight: Ca. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p>

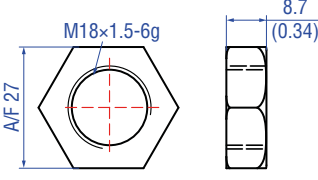
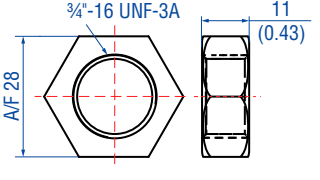
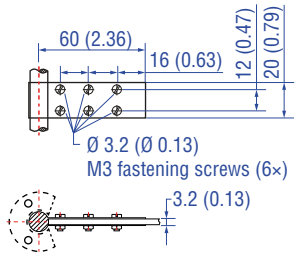
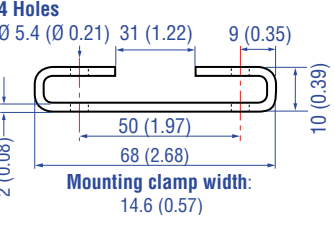
Magnet spacer

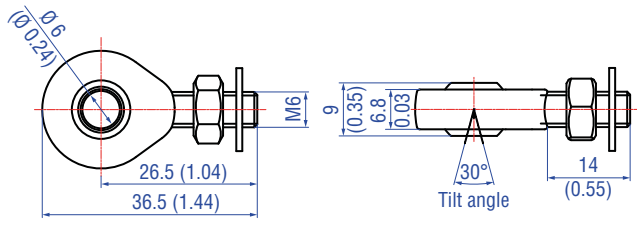
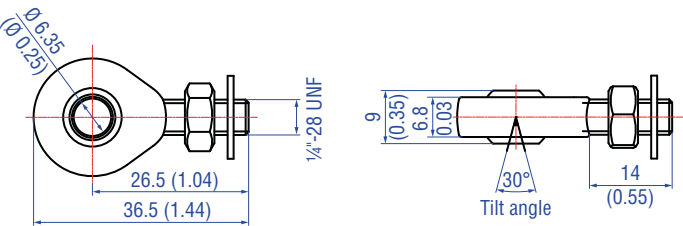
Sealing

		
<p>Magnet spacer Part no. 400 633</p>	<p>O-ring for flange M18x1.5-6g Part no. 401 133</p>	<p>O-ring for flange 3/4"-16 UNF-3A Part no. 560 315</p>
<p>For: EH Material: Aluminum Weight: Ca. 5 g Surface pressure: 20 N/mm² Fastening torque for M4 screws: 1 Nm</p>	<p>For: EH Application: Flange M18x1.5 Material: Fluoroelastomer 75 ± 5 durometer</p>	<p>For: EH Application: Flange 3/4"-16 UNF Material: Fluoroelastomer 75 ± 5 durometer</p>

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

Cable connectors ⁷		Cable	
			
M12 connector (5 pin) female, straight Part no. 370677	M12 connector (5 pin) female, angled Part no. 370678	M12 (5 pin) female, straight Part no. 370673	M12 (5 pin) female, angled Part no. 370675
Material: GD-Zn, Ni Termination: Screw; max. 1.5 mm ² Contact insert: CuZn Cable Ø: 4...8 mm (0.16...0.31 in.) Operating temperature: -30...+85 °C (-22...+185 °F) Ingress protection: IP67 Fastening torque: 0.6 Nm	Material: GD-Zn, Ni Termination: Screw; max. 0.75 mm ² Contact insert: CuZn Cable Ø: 5...8 mm (0.2...0.31 in.) Operating temperature: -25...+85 °C (-13...+185 °F) Ingress protection: IP67 Fastening torque: 1 Nm	Ingress protection: IP67 Cable: Shielded, pigtail end Cable length: 5 m (16.4 ft.)	Ingress protection: IP67 Cable: Shielded, pigtail end Cable length: 5 m (16.4 ft.)

Hex nut	Mounting hardware		Mounting clamp
			
Hex-jam nut M18 Part no. 500 018	Hex-jam nut 3/4" Part no. 500 015	Fixing clip Part no. 561 481	Mounting clamp Part no. 403 508
For: EH Application: M18x1.5 thread Material: Steel, 2 zinc, plated	For: EH Application: 3/4"-16 UNF thread Material: Zinc plated with nylon insert	For: EH Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.) when using U-magnet Material: Brass, non-magnetic	For: EP, EL, EP2, ER Material: Stainless steel 1.4301 / 1.4305 (AISI 304 / 303)

Rod ends	
	
Rod end with M6 thread (for metric stroke length measurement) Part no. 254 210	Rod end with 1/4"-28 thread (for US customary stroke length measurement) Part no. 254 235
For: ER-M	For: ER-S

Manuals & Software available at:
www.mtssensors.com

3/ Follow the manufacturer's mounting instructions
Controlling design dimensions are in millimeters and measurements in () are in inches

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 for 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 certain sensor parameters for the application and the output of warnings and errors.

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.mtssensors.com.

NOTICE

There are two IODD files available for the E-Series IO-Link sensors. Please choose the appropriate IODD file for your E-Series IO-Link:

1. IODD short (MTS-E-Series_IOLink-20160608-IODD1.1.xml) for sensors with stroke length ≤ 1000 mm (≤ 39 in.)
2. IODD long (MTS-E-Series_IOLink2ms-20160608-IODD1.1.xml) for sensors with stroke length > 1000 mm (> 39 in.)

The difference between both files is the cycle time.

The E-Series IO-Link can be connected to IO-Link masters with a maximum master cycle time of 20 ms. Contact MTS Sensors if you use the sensor E-Series IO-Link in an application with a master cycle time > 20 ms.

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	MTS Sensor Technologie GmbH and Co. KG
0x11	0x00	Vendor text	string	ro	www.mtssensors.com
0x12	0x00	Product name	string	ro	E-Series IO-Link (short) / E-Series IO-Link (long)
0x13	0x00	Product ID	string	ro	E-Series IO-Link (short) / E-Series IO-Link (long)
0x14	0x00	Product text	string	ro	MTS Sensors E-Series
0x15	0x00	Serial number	string	ro	e.g. 15490547
0x16	0x00	Hardware revision	string	ro	1.0
0x17	0x00	Firmware revision	string	ro	1.16

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

5.2 Standard commands

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

Index	Subindex	Parameter	Access	Command	Description
0x02	0x00	Reset device	wo	0xA0	Reset the device
0x02	0x00	Reset factory settings	wo	0x82	Reset all parameters to default settings

Table 3: Standard commands

5.4 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	0x00	Resolution	unsigned integer	rw	4 bytes	5	5 = 5 μm 10 = 10 μm 20 = 20 μm 50 = 50 μm 100 = 100 μm	The resolution of measurement is the smallest difference between two position values. It has no relation to the accuracy of the measurement. The output is in μm steps.
0x72	0x00	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	0x00	Measuring direction	bool	rw	1 byte	False	False = Forward True = Backwards	<u>Forward</u> : From sensor electronics housing to rod end <u>Backwards</u> : From rod end to sensor electronics housing

Table 4: Measuring parameters

5.3 Offset

The offset is added to the current position value.

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x70	0x00	Offset	integer	rw	4 bytes	Value in μm	Write and read the offset position

Index	Subindex	Function	Data type	Access	Length	Command	Description
0x78	0x00	Teach-In offset	bool	wo	1 byte	True	Read the current position and set it as the offset

Table 5: Offset parameters

For the teach-in procedure the user moves the position magnet to the required position. Click the appropriate button in the graphical user interface (GUI) of the IO-Link master in order to define the start or end position. The new position is stored in the sensor.

How the offset works

Example 1:

- Offset: 0
- Current position value: 80000 μm (80 mm)
- New offset is set: 120000 μm (120 mm)
- New position value: 80 mm + 120 mm = 200000 μm (200 mm)

1 Offset: 0 μm 2 Ex-position: 80000 μm 3 Set offset: +120000 μm 4 New read position: 200000 μm

Example 2:

- Offset: 0
- Current position value: 80000 μm (80 mm)
- New offset is set: -120000 μm (-120 mm)
- New position value: 80 mm - 120 mm = -40000 μm (-40 mm)

1 Offset: 0 μm 2 Ex-position: 80000 μm 3 Set offset: -120000 μm 4 New read position: -40000 μm

Fig. 25: How the offset works

5.5 Switch points

The switch point is output in parallel to the position value via pin 2 (DI/DQ) (see "4.8 Electrical connections" on page 20).
The switch point and switch point logic can be adjusted.

Two switch point modes are possible:

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

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

Teach-In

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

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x7B	0x01	Switch point 1	integer	rw	4 bytes	<i>Value in μm</i>	Write and read switch position 1
	0x02	Switch point 2	integer	rw	4 bytes	<i>Value in μm</i>	Write and read switch position 2
Index	Subindex	Function	Data type	Access	Length	Command	Description
0x79	0x00	Teach-In switch point 1	bool	wo	1 byte	True	Read the current position and set it as switch point 1.
0x7A	0x00	Teach-In switch point 2	bool	wo	1 byte	True	Read the current position and set it as switch point 2.
0x7C	0x00	Switch point 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 point mode	unsigned integer	rw	4 bytes	0 = <i>Deactivate (default)</i> 1 = <i>Single point mode</i> 2 = <i>Window mode</i>	<i>Deactivate:</i> The switch function is out of function <i>Single point mode:</i> Only switch point 1 will be considered by the switch function. <i>Window mode:</i> Switch point 1 and switch point 2 will be considered by the switch function.

Table 6: Switch point parameters

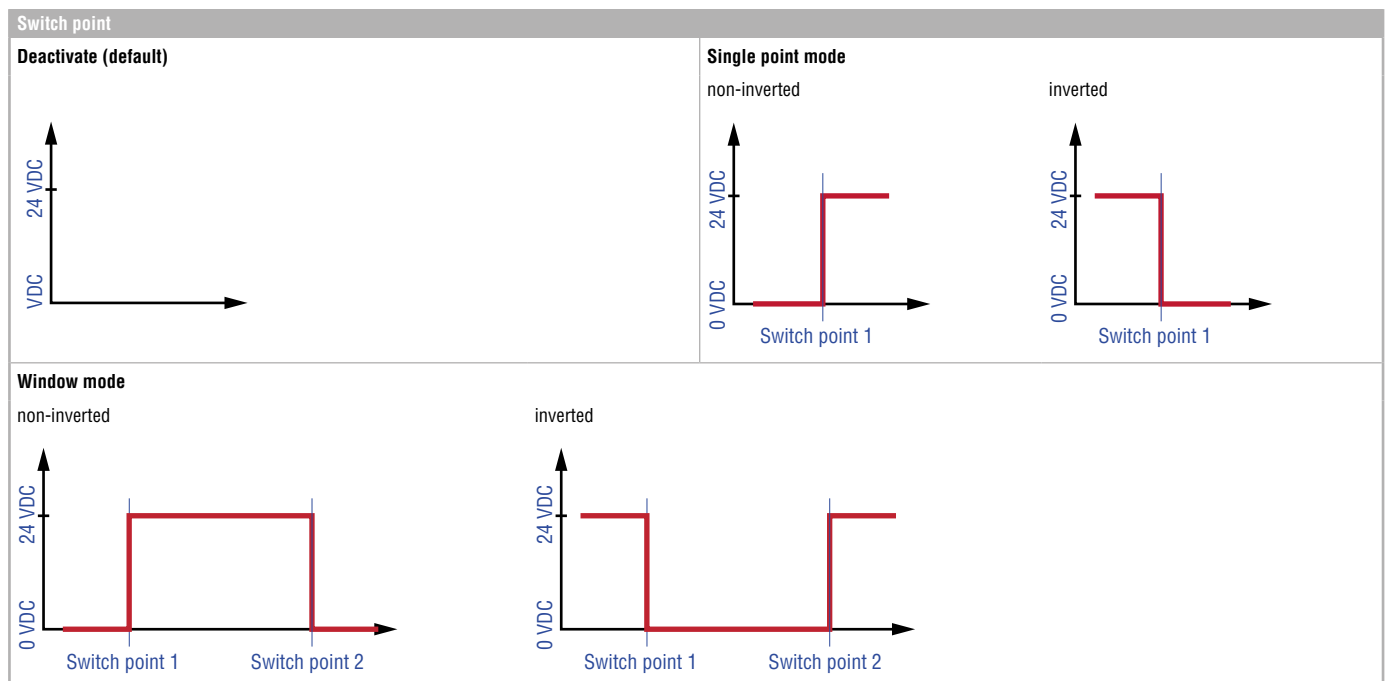


Fig. 26: Functionality of switch point parameters

NOTICE

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

5.6 Set points

The start and end point of the measurement can be set by the user in order to customize the measuring range.

Teach-In

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

Index	Subindex	Parameter	Data type	Access	Length	Value	Description
0x74	0x00	Set point 1 (Start)	integer	rw	4 bytes	Value in μm	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 point 2 (End)	integer	rw	4 bytes	Value in μm	
Index	Subindex	Function	Data type	Access	Length	Command	Description
0x76	0x00	Teach-In Set point 1 (Start)	bool	wo	1 byte	True	Read the current position and set it as the start measurement point
0x77	0x00	Teach-In Set point 2 (End)	bool	wo	1 byte	True	Read the current position and set it as the end measurement point

Table 7: Setpoint parameters

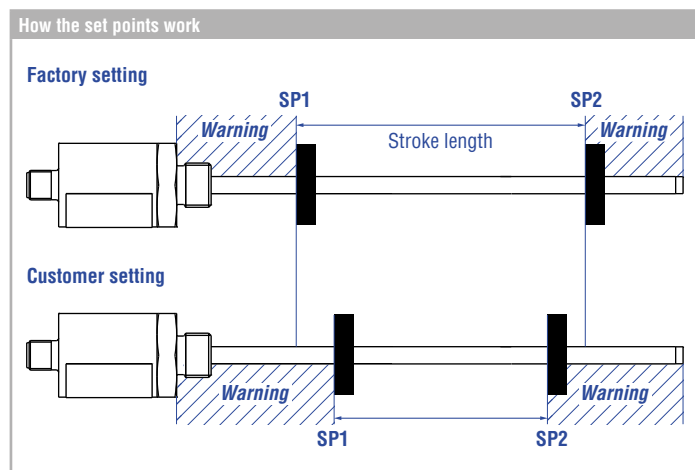


Fig. 27: How the set points work

NOTICE

The default value of SP1 and SP2 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 "4.7 Magnet installation" on page 18). 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
0x8CA2	(Dis)appear	Error	No magnet
0x8CA3	(Dis)appear	Warning	Over range of measurement
0x8CA4	(Dis)appear	Warning	Under range of measurement

Table 8: Error codes specified by MTS Sensors

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 9: Error codes defined by the IO-Link specification

5.8 Device Access Lock

The parameter "Device Access Lock" allows the user to activate or deactivate parameter management. Set bit 1 to "0" to unlock the parameter management 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	
0	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	0	1	0	0x02	Data storage access locked

Table 10: Device access lock parameter

6. Integration into Automation Studio

6.1 Introduction of "Automation Studio"

The following is a description how to integrate a Temposonic® E-Series sensor with IO-Link output using "Automation Studio" by B&R (Bernecker + Rainer Industrie-Elektronik Ges.m.b.H.). The PLC is a X20CP1584 with connected interface card X20DS438A.

6.2 Import IODD files

Visit www.mtssensors.com and download the IO Device Description (IODD) file.

NOTICE

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

1. IODD short (MTS-E-Series_IOLink-20160608-IODD1.1.xml) for sensors with stroke length ≤ 1000 mm (≤ 39 in.)
2. IODD long (MTS-E-Series_IOLink2ms-20160608-IODD1.1.xml) for sensors with stroke length > 1000 mm (> 39 in.)

The difference between both files is the cycle time.

Select the appropriate file for your sensor. You can check loaded IODD files at sensor identification (Fig. 38).

When the download is finished, open Automation Studio and import the downloaded IODD file (Fig. 28). The DTM catalog will update automatically.

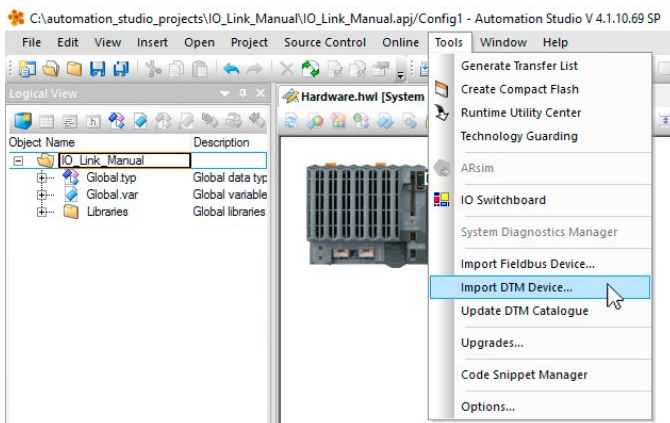


Fig. 28: Import DTM Device

After successful file import the IODD file will be shown in the column "Toolbox - Hardware Catalog" (Fig. 29).

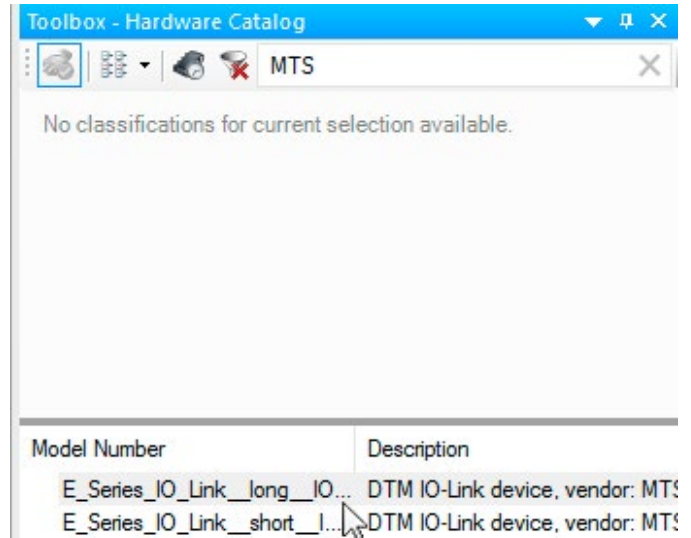


Fig. 29: Import DTM Device

Choose the correct IODD file ("short" for stroke lengths ≤ 1000 mm (≤ 39 in.) or "long" for stroke lengths > 1000 mm (> 39 in.). Link the E-Series IO-Link sensor with the IO-Link master card (X20DS438A) (Fig. 30) and activate the DTM server in the settings of the PLC (X20CP1584) (Fig. 31).

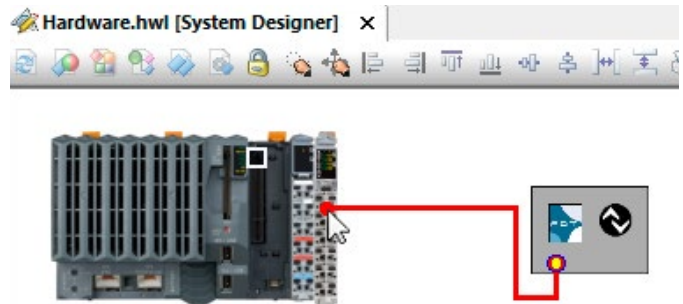


Fig. 30: Link sensor to PLC

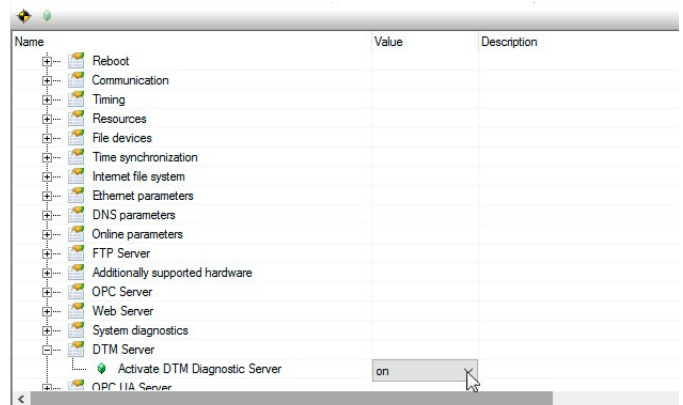


Fig. 31: Activate DTM server

Configure the settings of the IO-Link master (X20DS438A) and set the operating mode of the IO-Link interface to "Operate" (Fig. 32).

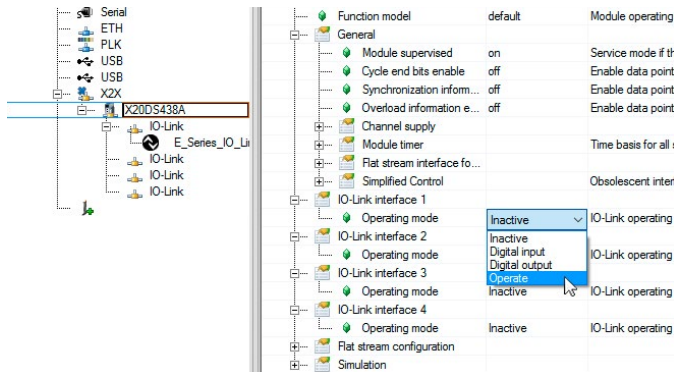


Fig. 32: Operating mode: Operate

6.3 Configure process data

Configure the input process data of the sensor (Fig. 33). The process data of the sensor consists of 4 bytes and contains the measurement.

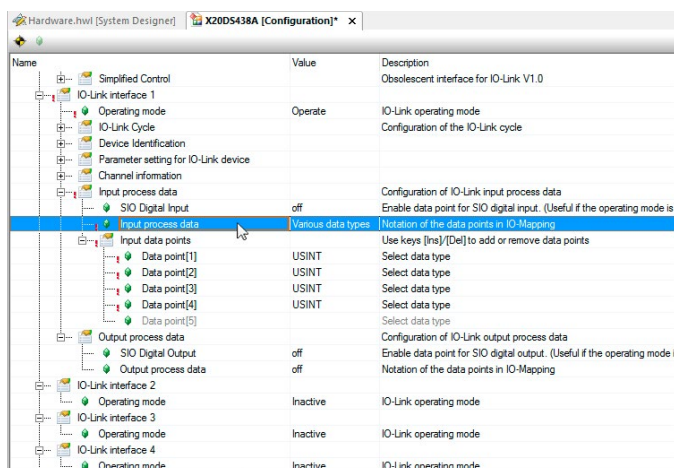


Fig. 33: Process data

Create 4 single byte variables (PositionByte0...PositionByte3) ("USINT" – unsigned short integer) which linked to the data of the sensor process data in the logical view of "Global.var".

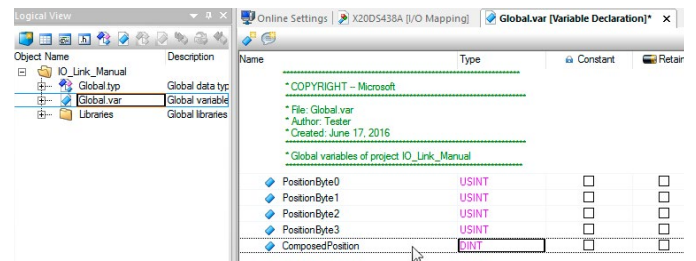


Fig. 34: Configuration of "Global.var"

In addition create a variable ("DINT" – double integer) to store the composed position (ComposedPosition).

Open the I/O Mapping of the IO-Link master card (X20DS438A) and link the Input Data01_1...Input Data01_4 with the single byte variables (PositionByte3...PositionByte0).

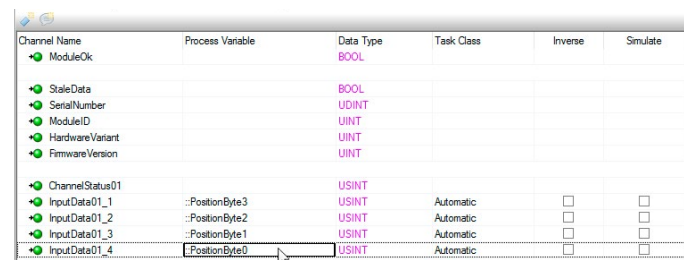


Fig. 35: Link the input data with single byte variables

To compose the position from the position bytes create a program (in this example it is called "ComposePosition") with following code:

Initialization method

Initialization of variables PositionByte0...PositionByte3 and ComposedPosition. The variable ComposedPosition stores the measured position value.

```
#include <bur/plctypes.h>

#ifdef _DEFAULT_INCLUDES
    #include <AsDefault.h>
#endif

void _INIT ComposePositionInit(void)
{
    /* initialize variables */
    PositionByte0 = 0;
    PositionByte1 = 0;
    PositionByte2 = 0;
    PositionByte3 = 0;
    ComposedPosition = 0;
}
```

Cyclic Method

Cyclical program call to shift the variables (PositionByte0...PositionByte3) into the variable "ComposedPosition" in the correct position. The "ComposedPosition" contains the measured value.

```
#include <bur/plctypes.h>

#ifdef _DEFAULT_INCLUDES
    #include <AsDefault.h>
#endif

void _CYCLIC ComposePositionCyclic(void)
{
    /* compose position out of input bytes */
    ComposedPosition =
        (PositionByte3 << 24) |
        (PositionByte2 << 16) |
        (PositionByte1 << 8) |
        PositionByte0;
}
```

With that code running, you can observe how the position is composed out of the input bytes using the variable watch window.

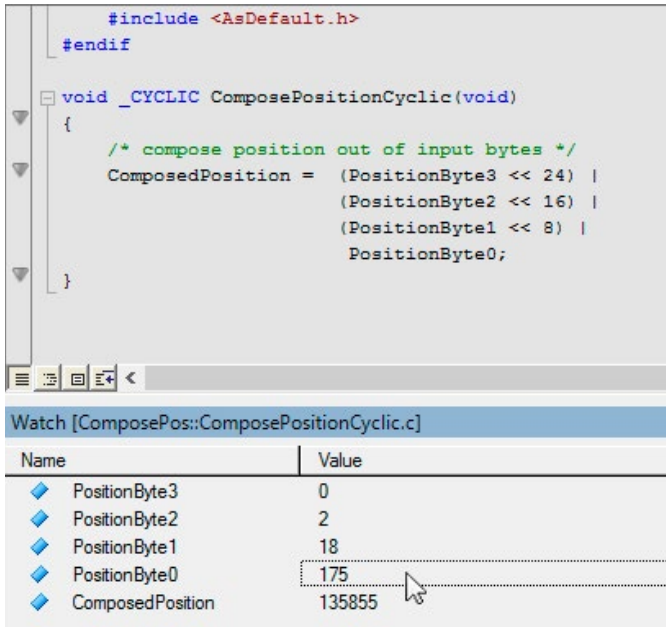


Fig. 36: Variable watch window

With the device configuration UI the sensor configuration can be done in a convenient way. For detailed descriptions about the parameters see chapter "5. Operation" on page 23.

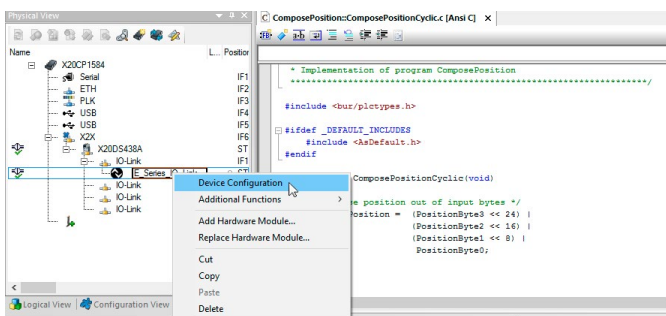


Fig. 37: Device configuration

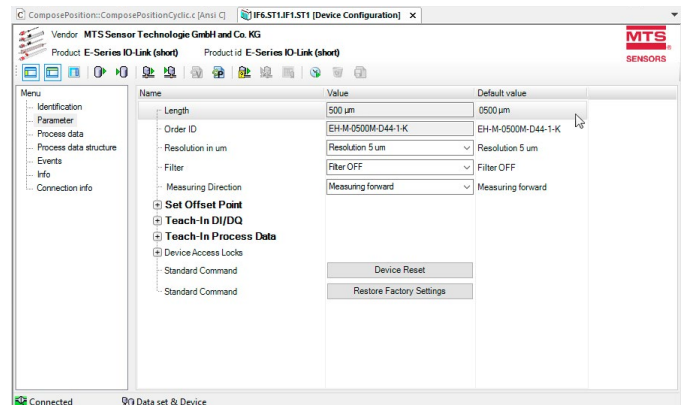


Fig. 39: Sensor parameter

NOTICE

The parameter "Teach-In DI/DQ" = Switch points
The parameter "Teach-In Process Data" = Set points

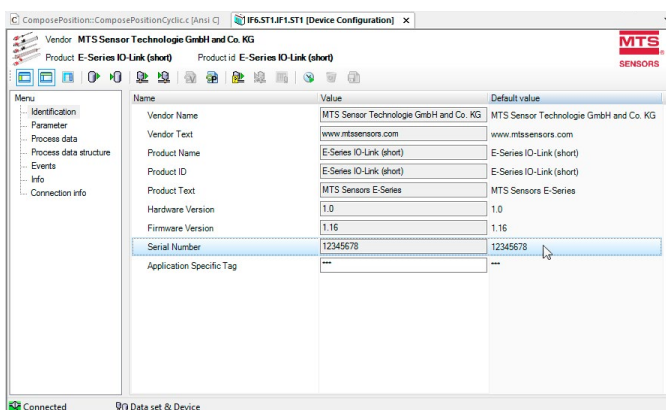


Fig. 38: Sensor identification

7. Maintenance and troubleshooting

7.1 Error conditions, troubleshooting

See chapter "5. Operation" on page 23.

7.2 Maintenance

The sensor is maintenance-free.

7.3 Repair

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

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.

8. Removal from service / dismantling

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

9. Technical data

9.1 Technical data E-Series EH

Output

Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	32 bit signed (position in μm)
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	4 bytes
Process data master – device	0 bytes
Error value	0
Measured value	Position

Measurement parameters

Resolution ⁴	5 μm , 10 μm , 20 μm , 50 μm or 100 μm
Cycle time	Sensors with stroke length \leq 1000 mm (\leq 39 in.): 1 ms / Sensors with stroke length $>$ 1000 mm ($>$ 39 in.): 2 ms
Linearity ⁵	$\leq \pm 0.02$ % F.S. (minimum ± 60 μm)
Repeatability	$\leq \pm 0.005$ % F.S. (minimum ± 20 μm)

Operating conditions

Operating temperature	$-40 \dots +75$ °C ($-40 \dots +167$ °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection	IP67 (if mating cable connector is 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 The sensor meets the requirements of the EC directives and is marked with CE .
Magnet movement velocity	Any

Design / Material

Sensor electronics housing	Stainless steel 1.4305 (AISI 303); option: Stainless steel 1.4404 (AISI 316L)
Sensor rod	7 mm (0.28 in.) rod- \emptyset : Stainless steel 1.4301 (AISI 304) 10 mm (0.39 in.) rod- \emptyset : Stainless steel 1.4306 (AISI 304L); option: Stainless steel 1.4404 (AISI 316L)
Stroke length	50...2540 mm (2...100 in.)
Operating pressure	7 mm (0.28 in.) rod- \emptyset : 300 bar (4351 psi), 450 bar (6527 psi) peak 10 mm (0.39 in.) rod- \emptyset : 350 bar (5076 psi), 530 bar (7687 psi) peak

Mechanical mounting

Mounting position	Any
Mounting instruction	Please consult the technical drawings

Electrical connection

Connection type	M12 (4 pin) male connector
Operating voltage	+24 VDC (± 25 %)
Ripple	≤ 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

4/ Selectable via IO-Link master

5/ With position magnet # 251 416-2

9.2 Technical data E-Series EP

Output

Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	32 bit signed (position in μm)
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	4 bytes
Process data master – device	0 bytes
Error value	0
Measured value	Position

Measurement parameters

Resolution ⁶	5 μm , 10 μm , 20 μm , 50 μm or 100 μm
Cycle time	Sensors with stroke length ≤ 1000 mm (≤ 39 in.): 1 ms / Sensors with stroke length > 1000 mm (> 39 in.): 2 ms
Linearity ⁷	Magnet slider: $\leq \pm 0.02$ % F.S. (minimum ± 60 μm), U-magnet: $\leq \pm 0,02$ % F.S. (minimum ± 60 μm), block magnet: $\leq \pm 0.03$ % (minimum ± 90 μm)
Repeatability	$\leq \pm 0.005$ % F.S. (minimum ± 20 μm)

Operating conditions

Operating temperature	$-40 \dots +75$ °C ($-40 \dots +167$ °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection ⁸	IP67 (if mating cable connector is 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 The sensor meets the requirements of the EC directives and is marked with CE .
Magnet movement velocity	Magnet slider: ≤ 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 (4 pin) male connector
Operating voltage	+24 VDC (± 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

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 sensor electronics housing, as water and dust can get inside the profile.

9.3 Technical data E-Series EL

Output

Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	32 bit signed (position in μm)
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	4 bytes
Process data master – device	0 bytes
Error value	0
Measured value	Position

Measurement parameters

Resolution ⁹	5 μm , 10 μm , 20 μm , 50 μm or 100 μm
Cycle time	Sensors with stroke length ≤ 1000 mm (≤ 39 in.): 1 ms / Sensors with stroke length > 1000 mm (> 39 in.): 2 ms
Linearity ¹⁰	Magnet slider: $\leq \pm 0.02$ % F.S. (minimum ± 60 μm), block magnet: $\leq \pm 0.03$ % (minimum ± 90 μm)
Repeatability	$\leq \pm 0.005$ % F.S. (minimum ± 20 μm)

Operating conditions

Operating temperature	$-40\dots+75$ °C ($-40\dots+167$ °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection ¹¹	IP67 (if mating cable connector is 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 The sensor meets the requirements of the EC directives and is marked with CE .
Magnet movement velocity	Magnet slider: ≤ 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 (4 pin) male connector
Operating voltage	+24 VDC (± 25 %)
Ripple	≤ 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

^{9/} Selectable via IO-Link master

^{10/} Magnet slider # 252 182 and # 252 184, block magnet # 403 448

^{11/} The IP rating IP67 is only valid for the sensor electronics housing, as water and dust can get inside the profile.

9.4 Technical data E-Series EP2

Output

Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	32 bit signed (position in μm)
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	4 bytes
Process data master – device	0 bytes
Error value	0
Measured value	Position

Measurement parameters

Resolution ¹²	5 μm , 10 μm , 20 μm , 50 μm or 100 μm
Cycle time	Sensors with stroke length ≤ 1000 mm (≤ 39 in.): 1 ms / Sensors with stroke length > 1000 mm (> 39 in.): 2 ms
Linearity ¹³	$\leq \pm 0.02$ % F.S. (minimum ± 90 μm)
Repeatability	$\leq \pm 0.005$ % F.S. (minimum ± 20 μm)

Operating conditions

Operating temperature	$-40 \dots +75$ °C ($-40 \dots +167$ °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection ¹⁴	IP67 (if mating cable connector is 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 The sensor meets the requirements of the EC directives and is marked with CE .
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 (4 pin) male connector
Operating voltage	+24 VDC (± 25 %)
Ripple	≤ 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

¹²Selectable via IO-Link master

¹³Block magnet # 403 448

¹⁴The IP rating IP67 is only valid for the sensor electronics housing, as water and dust can get inside the profile.

9.5 Technical data E-Series ER

Output

Interface	Digital
Transmission protocol	IO-Link V1.1
Data format	32 bit signed (position in μm)
Data transmission rate	COM3 (230.4 kBaud)
Process data device – master	4 bytes
Process data master – device	0 bytes
Error value	0
Measured value	Position

Measurement parameters

Resolution ¹⁵	5 μm , 10 μm , 20 μm , 50 μm or 100 μm
Cycle time	Sensors with stroke length \leq 1000 mm (\leq 39 in.): 1 ms / Sensors with stroke length $>$ 1000 mm ($>$ 39 in.): 2 ms
Linearity	$\leq \pm 0.02$ % F.S. (minimum ± 60 μm)
Repeatability	$\leq \pm 0.005$ % F.S. (minimum ± 20 μm)

Operating conditions

Operating temperature	$-40 \dots +75$ °C ($-40 \dots +167$ °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection ¹⁶	IP67 (if mating cable connector is 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 The sensor meets the requirements of the EC directives and is marked with CE .
Magnet movement velocity	\leq 5 m/s

Design / Material

Sensor housing	Aluminum
Guided driving rod	Aluminum
Stroke length	50...1500 mm (2...60 in.)

Mechanical mounting

Mounting position	Any
Mounting instruction	Please consult the technical drawings

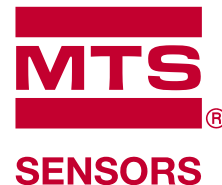
Electrical connection

Connection type	M12 (4 pin) male connector
Operating voltage	+24 VDC (± 25 %)
Ripple	≤ 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

¹⁵Selectable via IO-Link master

¹⁶The IP rating IP67 is only valid for the sensor electronics housing, as water and dust can get inside the profile.

10. 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 / people handling these items will not be in danger.

MTS Sensors 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 MTS Sensors to determine measures to be taken before shipment.

Short description of malfunction:

Corporate information

Company: _____

Address: _____

Contact partner

Name: _____

Phone: _____

E-Mail: _____

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

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

GERMANY
MTS Sensor Technologie
GmbH & Co.KG
Auf dem Schüffel 9
58513 Lüdenscheid, Germany
Tel. +49-23 51-95 87 0
Fax. +49-23 51-5 64 91
info.de@mtssensors.com
www.mtssensors.com

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

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LOCATIONS

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

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

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

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

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

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

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