

# Temposonics®

Magnetostrictive, Absolute, Non-contact  
Linear-Position Sensors



## E-Series Models EP and EL CANopen Output Data Sheet

Document Part Number:  
551298 Revision B



**Model EP position sensor - Full Size Profile Housing**  
Stroke Length: 50 mm to 2500 mm (or 2 in. to 100 in.)

**Model EL position sensor - Low Height Profile Housing**  
Stroke Length: 50 mm to 2500 mm (or 2 in. to 100 in.)

### FEATURES

- Linear, Absolute Measurement
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.02% F.S.
- Repeatability Within 0.005% F.S.
- CANopen Interface, Direct Position and Velocity Outputs
- Single or Dual Magnet Position/Velocity Measurements
- Stroke Length Range:
  - 50 mm to 2500 mm (or 2 in. to 100 in.)
- EMI Shielded and CE Certified

### BENEFITS

- Rugged, Cost Effective, Precise and Durable
- Simultaneous Multi-position Measurements for 2 Magnets
- Over Voltage Protection to 36 Vdc and Polarity Protection up to -30 Vdc

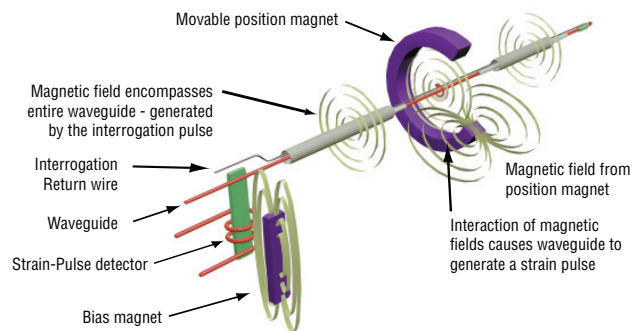
### APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions

### TYPICAL INDUSTRIES

- Factory Automation
- Woodworking and Metal Forming
- Material Handling and Packaging

### Time-based Magnetostrictive position sensing principle



### Benefits of Magnetostriction

Temposonics linear-position sensors use the time-based magnetostrictive position sensing principle developed by MTS. Within the sensing element, a sonic-strain pulse is induced in a specially designed magnetostrictive waveguide by the momentary interaction of two magnetic fields. One field comes from a movable permanent magnet that passes along the outside of the sensor. The other field comes from an “interrogation” current pulse applied along the waveguide. The resulting strain pulse travels at sonic speed along the waveguide and is detected at the head of the sensing element.

The position of the magnet is determined with high precision and speed by accurately measuring the elapsed time between the application of the interrogation pulse and the arrival of the resulting strain pulse with a high-speed counter. The elapsed time measurement is directly proportional to the position of the permanent magnet and is an absolute value. Therefore, the sensor's output signal corresponds to absolute position, instead of incremental, and never requires recalibration or re-homing after a power loss. Absolute, non-contact sensing eliminates wear, and guarantees the best durability and output repeatability.

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## E-Series Models EP and EL Sensors Product Overview/Specifications

### Product overview

MTS Sensors continues to establish new performance standards for low-cost, fully-industrial, durable position sensors using the widely preferred magnetostrictive technology. This principle for accurate and non-contact measurement of linear-position sensing was developed 30 years ago by MTS and is used with outstanding success in a large variety of industrial applications.

The Temposonics models EP and EL sensors consists of robust aluminum profile-style housings that offer flexible mounting configurations and easy installation. Sensor models EP and EL are ideal for demanding industrial applications where simple, reliable non-contact feedback is essential.

### Product specifications

Parameters	Specifications	Parameters	Specifications
<b>OUTPUT</b>		<b>ELECTRONICS</b>	
<b>Measured output variables:</b>	Position, Velocity for single or dual magnets	<b>Operating voltage:</b>	<b>+24 Vdc nominal:</b> -15% or +20% <b>Polarity protection:</b> $\geq -30$ Vdc <b>Over voltage protection:</b> $\leq 36$ Vdc <b>Current drain:</b> 90 mA Typical <b>Dielectric withstand voltage:</b> 500 Vdc (DC ground to machine ground)
<b>Resolution:</b>	<b>Position:</b> 10 $\mu$ m, 20 $\mu$ m <b>Velocity:</b> 1mm/s	<b>ENVIRONMENTAL</b>	
<b>Update times:</b>	1.0 ms up to 2400 mm	<b>Operating conditions:</b>	<b>Operating temperature:</b> -40 °C (-40 °F) to 75 °C (167 °F) <b>Relative humidity:</b> 90% no condensation <b>Ingress protection:</b> IP 67 (when appropriate mating connector is correctly fitted)
<b>Linearity deviation:</b>	$< \pm 0.02\%$ full stroke (minimum $\pm 60$ $\mu$ m)	<b>EMC test:</b>	<b>Electromagnetic emission:</b> EN 61000-6-4 (for use in industrial environment) <b>Electromagnetic immunity:</b> EN 61000-6-2 (The sensor meets the requirements of the EC directives and is marked with CE)
<b>Repeatability:</b>	$\pm 0.005\%$ full stroke (minimum $\pm 10$ $\mu$ m)	<b>Shock rating:</b>	100 g (single hit)/ IEC standard EN 60068-2-27
<b>Outputs:</b>	<b>Interface:</b> CAN-Fieldbus System according to ISO-DIS 11898 <b>Data protocol:</b> CANopen Encoder Profile DS 406 V3.1 CiA Standard DS 301 v3.0	<b>Vibration rating:</b>	15 g/10 to 2000 Hz, IEC standard EN 60068-2-6 (resonance frequencies causing excess of 15 g are excluded)
<b>Baud rate, kBit/s:</b>	1000    800    500    250    125	<b>WIRING</b>	
<b>Cable length, m:</b>	$< 25$ $< 50$ $< 100$ $< 250$ $< 500$	<b>Connection type:</b>	5-pin (M12) male integral connector
<b>Stroke length:</b>	<b>Range:</b> 50 mm to 2500 mm (2 in. to 100 in.)	<b>PROFILE-STYLE SENSOR</b>	
		<b>Electronic head:</b>	Aluminum housing
		<b>Sensor extrusion:</b>	Aluminum (Temposonics profile style)
		<b>Mounting positions:</b>	Adjustable mounting clamps, any orientation
		<b>Magnet types:</b>	Captive-sliding magnet, block magnet or open-ring magnet (for Model EP)

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## CANopen communication and functionality

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Temposonics linear-position sensors fulfill all requirements of CANbus (ISO 11898). The sensor's electronics convert the position measurements into bus oriented outputs and transfer this data directly to the controller. The CANbus interface is appropriate for serial data transfer up to 1 Mbps maximum. Sensor integrated software supports bus profile CANopen. This communication protocol allows for a comprehensive customized configuration of the sensor-bus system.

### TEMPOSONICS E-SERIES SENSORS WITH CANopen INTERFACE

E-Series sensors with CANopen protocol are based as bus-nodes on the OSI reference model and are available with application data for single or dual-magnet measurements:

#### Application data:

- Position measurement
- Velocity measurement
- Setpoints
- Status

CANopen corresponds to encoder profile 'DS-406 V3.1 (CIA Draft standard DS-301 V3.0)'. The CANopen functionality is described below in the following communication objects.

### CANopen CONFIGURATION TOOL

The EDS (Electronic Data Sheet) download is available at [www.mtssensors.com](http://www.mtssensors.com) for configuration.

### SERVICE DATA OBJECT (SDO)

The SDO is mainly used for sensor configuration. SDO messages are used for read and write access to all entries in the object directory.

#### Selectable parameters are as follows:

- Operational range setup for magnets 1 and 2
- Zero adjustmet preset for magnets 1 and 2
- 4 set points for each magnet

### PROCESS DATA OBJECT (PDO)

The PDO provides data transfer of sensor measurements in up to 8-byte data blocks. The sensor uses PDO's to relay parameters for each magnet in one or two PDO's

#### Data formats:

- Position
- Velocity
- Limit status
- Limit status of operational range

### PDO TRANSMISSION TYPES

- Asynchronous (cycle time of 1 to 65.535 ms) or synchronous
- Synchronization Object (SYNC) messages are sent from the controller to the sensor, the sensor then transmits measurement values

### SYNC OBJECT

Is responsible for synchronized bus communication

### EMERGENCY OBJECT

Emergency messages are transmitted as:

- Sensor signal breakdown
- Communication fault

**E-Series Models EP and EL Sensors**  
**Dual Magnet Outputs / Sensor Dimension References**

**Dual magnet outputs**

**MEASUREMENT OPTIONS**

E-Series sensors provide options for simultaneous multi-position measurements by using more than one magnet per sensor. When using the CANOpen output, the E-Series sensor is limited to a maximum of two magnets.

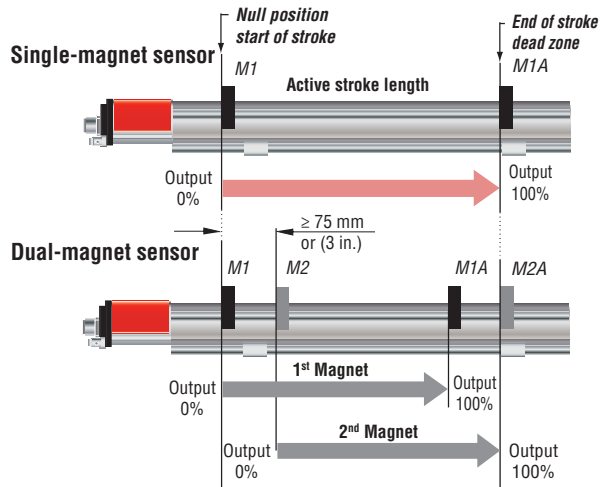
For single-magnet sensors the sensor’s full active stroke length is utilized by the one magnet. For example when using forward-acting outputs, the output is 0% of its value when the magnet is at the null position (start of stroke) and 100% of its value when at the edge of the dead zone (end of stroke), (see ‘Figure 1’).

However, for dual-magnet sensors the sensor’s active stroke length must be shared by the two magnets, and a separation  $\geq$  75 mm (3 in.) must be maintained between the two magnets (front side of the first magnet to front side of the second magnet). This minimum distance between magnets is needed to maintain proper sensor output. Therefore, for the second magnet the start of stroke (0% output) is set at 75 mm away from the sensor’s null position. Likewise, for the first magnet the end of stroke (100% output) is now set 75 mm away from the edge of the dead zone (see ‘Figure 1’).

The result of using the dual-magnet E-Series options is that the stroke length available for each magnet is 75 mm less (or 3 inches less when specifying stroke length in inches) than the sensor’s full active stroke length as indicated in the model number.

When ordering the single-magnet E-Series sensor the minimum stroke length available is 50 mm or 2 inches.

However, when ordering dual magnet E-Series sensors the minimum stroke length available is 125 mm (i.e. 50 mm minimum, plus 75 mm for the minimum distance between magnets). Likewise, when specifying stroke length in inches the minimum stroke length available is 5 inches (i.e. 2 inch minimum, plus 3 inches for the minimum distance between magnets).



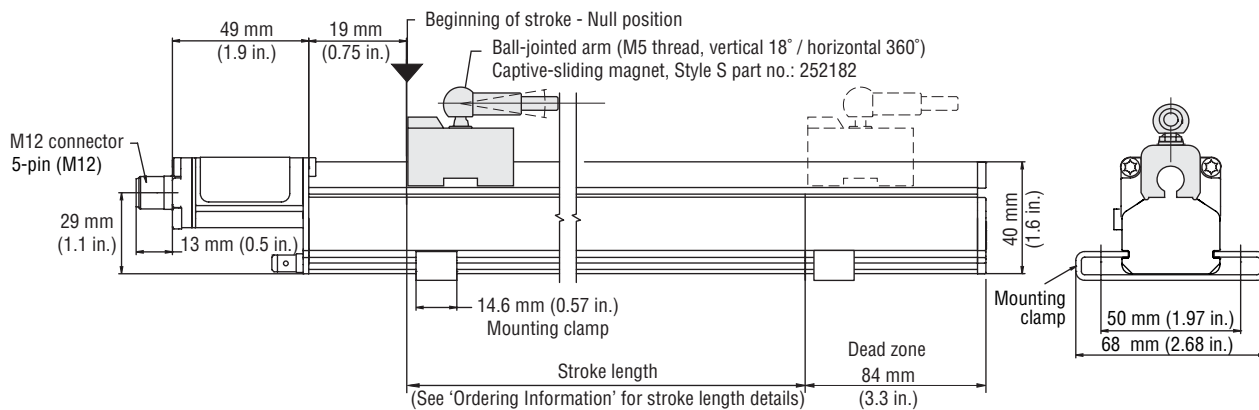
**Figure 1.** Single and dual magnet measurements

**Sensor dimension references**

*Drawings are for reference only, contact applications engineering for tolerance specific information.*

A robust aluminum extrusion forms the sensor housing containing the sensing element and electronics. The position magnet moves along the top of the profile extrusion housing.

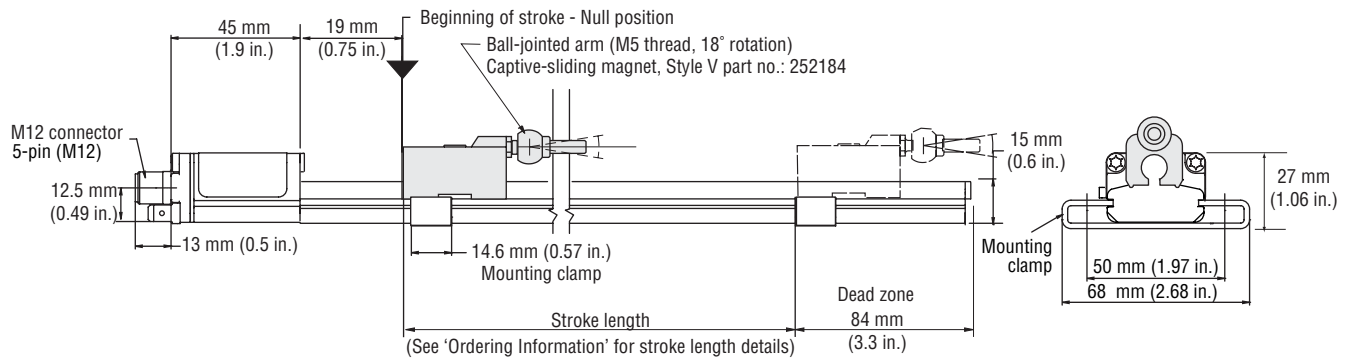
**MODEL EP**



**Figure 2.** E-Series model EP sensor dimension reference (Shown with Style S captive-sliding magnet)

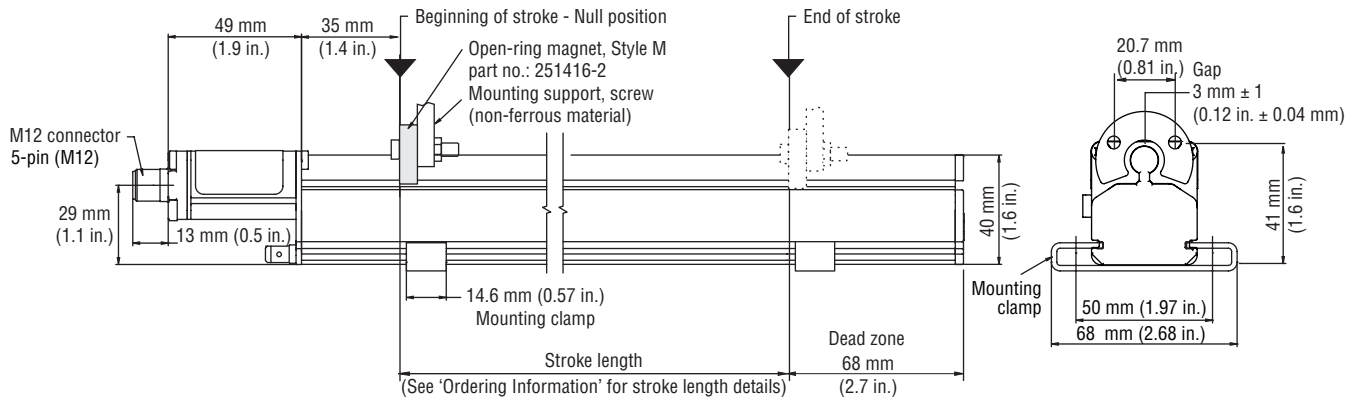
**E-Series Models EP and EL Sensors  
Sensor Dimension References**

**MODEL EL**



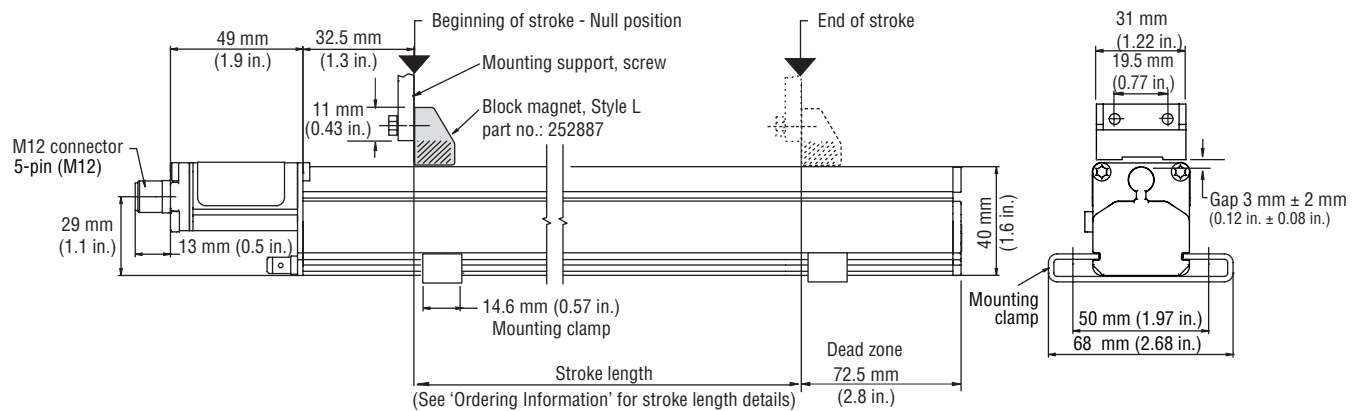
**Figure 3.** E-Series model EL sensor dimension reference (Shown with Style V captive-sliding magnet)

**MODEL EP**



**Figure 4.** E-Series model EP sensor dimension reference (Shown with Style M open-ring magnet)

**MODEL EP**



**Figure 5.** E-Series model EP sensor dimension reference (Shown with Style L block magnet)

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**E-Series Models EP and EL Sensors**  
**Standard Magnet and Accessory Selections**

**Standard magnet selections (Models EP and EL)**

**Selection of position magnets**

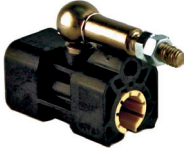
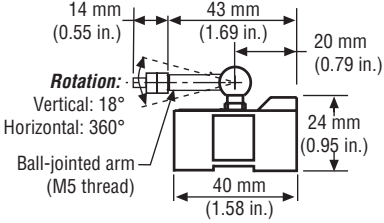

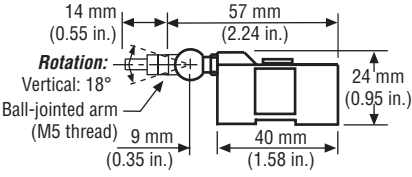

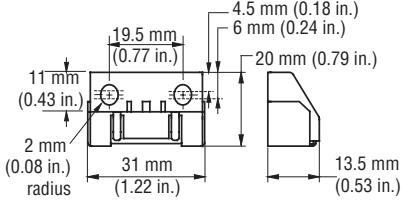

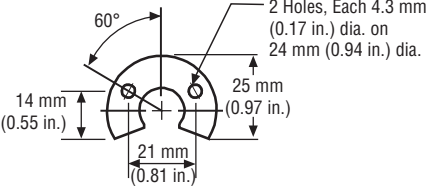
A choice of four standard magnet mounting configurations are available for E-Series models EP and EL sensors; A 'captive-sliding' magnet (Styles S or V), or an 'open-ring' magnet (Style M), or the 'block' magnet (Style L). Captive-sliding magnets utilize slide bearings of special material that reduce friction, and if required, help mitigate dirt build up. The slide bearings are designed to operate dry, requiring no external lubrication or maintenance.

The Style M 'open-ring' magnet can be used for the Model EP sensor, it mounts on the moving machine part and travels just above the sensor's profile extrusion. The open-ring magnet requires a minimum distance away from ferrous metals to allow proper sensor output. It must be mounted using non-ferrous screws and a non-ferrous support bracket, or utilize a non-ferrous spacer of at least 5 mm (0.2 in.) thickness.

The Style L 'block' magnet (part no.: 252887), mounts on the moving machine part and travels just above the sensor's extrusion. The magnet can be mounted using ferrous metal screws on a customer supplied mounting plate or flat surface of the machine's moving part. The mounting plate or machine's moving part can not extend beyond 11 mm (0.43 in.) from the top of the magnet, unless it is made of non-ferrous material. The magnet should be installed in a perpendicular orientation relative to the top surface of the sensor extrusion. Optimal performance is achieved when this orientation remains consistent throughout the full measurement stroke range.

**POSITION MAGNET SELECTIONS (All magnets must be ordered separately)**

(Drawing dimensions are for reference only)

Magnet / accessory dimensions	Description	Part number
 	<p><b>Captive-sliding magnet, Style S</b>            For models EP and EL profile-style sensors  <b>Material:</b>            GFK, magnet hard ferrite  <b>Weight:</b> Approx. 30 g  <b>Operating temperature:</b>            -40 °C to +75 °C</p>	252182
 	<p><b>Captive-sliding magnet, Style V</b>            For models EP and EL profile-style sensors  <b>Material:</b>            GFK, magnet hard ferrite  <b>Weight:</b> Approx. 30 g  <b>Operating temperature:</b>            -40 °C to +75 °C</p>	252184
 	<p><b>Block magnet, Style L</b>            For models EP and EL profile-style sensors</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	252887
 	<p><b>Open-ring magnet, Style M</b>  <b>I.D.:</b> 13.5 mm (0.53 in.)  <b>O.D.:</b> 33 mm (1.3 in.)  <b>Thickness:</b> 8 mm (0.31 in.)  <b>Operating temperature:</b>            -40 °C to 100 °C</p> <p>For model EP profile-style sensors</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	251416-2

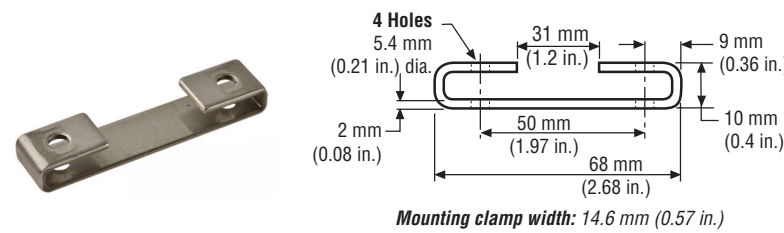
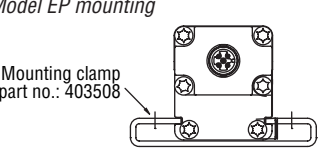
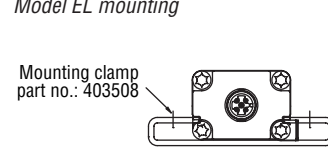
## Sensor mounting (Models EP and EL)

### SENSOR MOUNTING CLAMPS

E-Series models EP and EL sensors are mounted onto the machine with moveable mounting clamps. Mounting clamps slide into side grooves and should be evenly distributed along the sensor extrusion to best secure the sensor for each particular application.

#### Notes:

- Models EP and EL sensors include two mounting clamps, (part number 403508), for stroke lengths up to 1250 mm (50 in.). One additional mounting clamp is included for stroke lengths over 1250 mm (50 in.) and for each additional 500 mm (20 in.).
- MTS recommends using 10-32 cap screws (customer supplied) at a maximum torque of 44 in. lbs. when fastening mounting clamps.

Models EP and EL sensor mounting and installation reference	Mounting method	Part number
	<p><b>Mounting clamp</b> Sensor mounting for sensor models EP and EL</p>	403508
<p><i>Model EP mounting</i></p> 	<p><i>Model EL mounting</i></p> 	<p><b>Mounting configuration using mounting clamp and screws</b></p> <p><i>Mounting clamp, part number 403508</i></p>

## Connections and wiring (Model EP and EL)

### SENSOR INTEGRAL CONNECTOR (D34) PINOUT/WIRE COLOR CODES

The E-Series models EP and EL sensors connect directly to a controller or interface module with a male, 5-pin integral connector and an extension cable as described in 'Table 1'.

#### Attention:

The sensors aluminum housing has an anodic coating which prevents the sensor's mounting clamps from providing the appropriate grounding. A grounding lug (see 'Figure 6') is provided near the connector end of the sensor for a convenient connection to earth ground. The appropriate grounding of the cable shield is also required at the controller end.

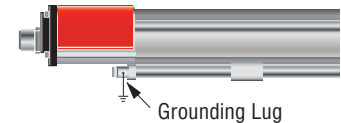


Figure 6. Grounding lug location.



Integral D34 connector (male) as viewed from the end of the sensor

Pin no.	Signal/function CANopen outputs
1	Shield
2	+24 Vdc
3	DC ground (for power return)
4	CAN (+)
5	CAN (-)

Table 1. Integral D34 sensor connector

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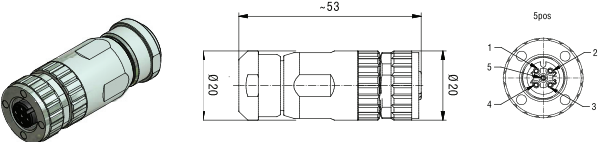
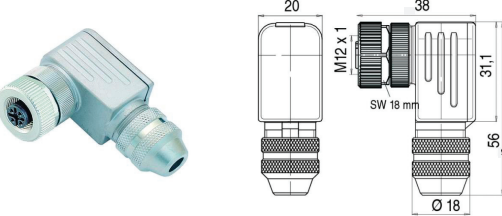
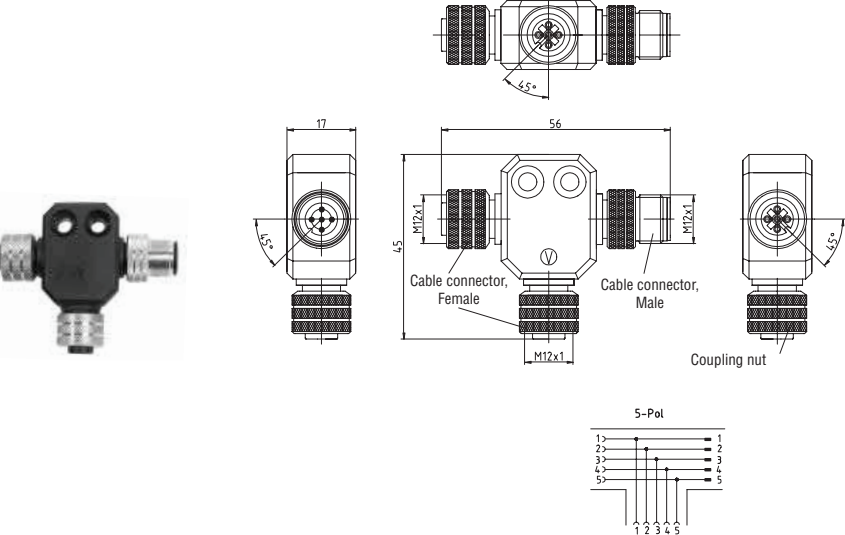
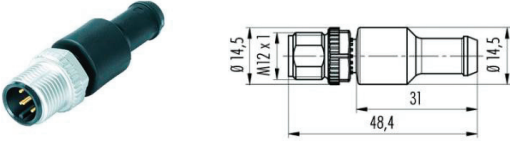
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**E-Series Model EP and EL Sensors**  
**Cable Connector Options**

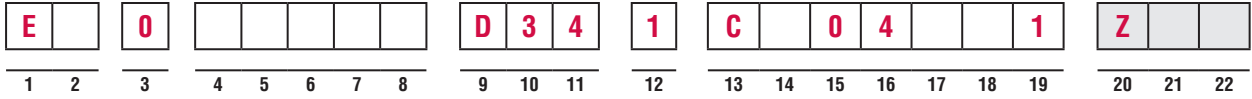
**FIELD INSTALLABLE CABLE CONNECTOR OPTIONS FOR 5-PIN (D34) CONNECTOR TYPES**

*(Photo and drawing dimensions are for reference only)*

Connector and dimensions	Description	Part number
	<p><b>Female cable connector, straight exit (Field installable)</b>                      5-Pin (D34) connector  <b>Termination:</b>                      Screw terminals  <b>Cable gland:</b>                      for 4 to 8 mm dia cable</p>	<p>370677</p>
	<p><b>Female cable connector, 90° exit (Field installable)</b>                      5-Pin (D34) connector.  <b>Termination:</b>                      Screw terminals  <b>Cable gland:</b>                      for 6 to 8 mm dia cable</p>	<p>370678</p>
	<p><b>T connector, shielded</b>                      5-Pin M12 connector                      IP 67</p>	<p>370691</p>
	<p><b>Male CANbus termination connector, straight exit</b>                      5-Pin M12 connector</p>	<p>370700</p>



## E-Series Models EP and EL Sensors, CANopen Output Ordering Information



(Use the order matrix above to configure your Model EP or EL sensor order number)

**SENSOR MODEL** \_\_\_\_\_ = E  **1 - 2**

**EP** = E-Series model EP profile-style sensor (Magnet(s) must be ordered separately)

**EL** = E-Series model EL low-height profile-style sensor (Magnet(s) must be ordered separately)

**HOUSING STYLE** \_\_\_\_\_ = 0 **3**

**0** = (Zero) EP and EL sensors do not have housing options or magnet types included in the standard model number. Magnets must be purchased separately by part number. Refer to 'Standard magnet selections (Models EP and EL)' in this document for part numbers.

**STROKE LENGTH** \_\_\_\_\_ =             **4 - 8**

\_\_\_\_\_ **M** = Millimeters (Encode in 25 or 50 mm increments as indicated in 'Stroke length notes' below).

\_\_\_\_\_ **U** = Inches (Encode in 1 or 2 in. increments as indicated in 'Stroke length notes' below).  
(Digit for tenths of inches is always '0').

**Stroke Length Notes:**

**Stroke length ranges:**  
**M** = 50 mm to 2500 mm  
**U** = 2 in. to 100 in.

**The increment size between standard stroke lengths vary as shown below:**

Stroke length (mm)	Ordering increment
≤ 500 mm	25 mm
> 500 mm and ≤ 2500 mm	50 mm
Stroke length (IN)	Ordering increment
≤ 20 in.	1 in.
> 20 in. and ≤ 100 in.	2 in.

**SENSOR CONNECTION TYPES** \_\_\_\_\_ = D 3 4 **9 - 11**

**D34** = 5-Pin (M12), male, (CANopen output)

**INPUT VOLTAGE** \_\_\_\_\_ = 1 **12**

**1** = + 24 Vdc (+20%, -15%), standard

**OUTPUT** \_\_\_\_\_ = C   0 4     1 **13-19**

**C** \_\_\_\_\_ = CANopen output - Enter the 6-digit output code (1-6) defined by the selections below:

[1] [2] [3] <b>Protocol</b>	[4] <b>Baud rate</b>	[5] <b>Resolution</b>	[6] <b>type</b>
<b>304</b> = CANopen 1 or 2 magnets	<b>1</b> = 1000 kBit/s <b>2</b> = 500 kBit/s	<b>4</b> = 10 μm <b>5</b> = 20 μm	<b>1</b> = Standard
<b>404</b> = CANopen 1 or 2 magnets with integrated bus terminator resistor (120 Ohms)	<b>3</b> = 250 kBit/s <b>4</b> = 125 kBit/s		

**NUMBER OF MAGNETS (20-22) FOR MULTI-POSITION MEASUREMENT ONLY** \_\_\_\_\_ = Z     **20-22**

**Z** \_\_\_\_\_ = Enter a 2-digit code

**Z** \_\_\_\_\_ = Enter 02 for 2 magnets