

Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors



E-Series Model ER
Analog / Digital-Pulse (Start/Stop) Output

Document Part Number
550996 Revision D

Data Sheet



Model ER position sensor, features a versatile rod-and-cylinder design with optional dual rod ends

FEATURES

- Linear, Absolute Measurement
- Non-Contact Sensing Technology
- Magnetostrictive Feedback in a Versatile Rod-and-Cylinder Sensor Package
- Non-Linearity Less Than 0.02%
- Repeatability Within 0.001%
- Two Outputs Available:
 - Analog (Voltage/Current) Forward or Reverse Acting
 - Digital Position Output: Start/Stop Pulse
- Simple Sensor Parameter Upload (Digital-Pulse Output)
- Measuring Range From 50 mm (2 in.) to 1500 mm (60 in.)
- EMI Shielded and CE Certified

BENEFITS

- Rugged, Cost Effective, Precise, and Durable Non-Wear Alternative to Linear Potentiometers
- Extendable and Retractable Dual Rod Ends
- The Magnet is Contained and Protected Inside The Sensor Housing
- Overvoltage Protection to 36 Vdc and Polarity Protection up to -30 Vdc

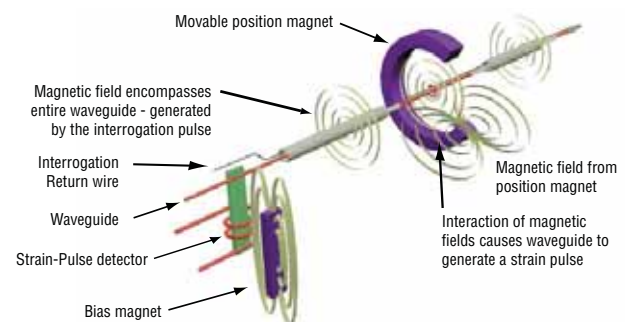
APPLICATIONS

- Continuous Operation in Harsh Industrial Conditions

TYPICAL INDUSTRIES

- Factory Automation
- Woodworking and Metalworking
- 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 moveable 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.

All specifications are subject to change. Contact MTS for specifications and engineering drawings that are critical to your application. Drawings contained in this document are for reference only. Go to <http://www.mtssensors.com> for the latest support documentation and related media.

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 innovative Temposonics model ER sensor brings proven benefits of magnetostrictive feedback to the versatile rod-and-cylinder sensor package. It is ideal for demanding industrial applications where high performance non-contact feedback is essential.

The model ER sensor's rod-and-cylinder design has a stainless steel rod that can extend from the sensor housing.

As the rod is extended and retracted, the sensing magnet remains completely contained and protected at all times, ensuring reliable sensor performance in the toughest industrial environments.

Product specifications

Parameters	Specifications
OUTPUT	
Measured output variables:	Position
Resolution:	Analog: Infinite, restricted by output ripple Digital: 0.1, 0.01 and 0.005 mm (controller dependent)
Non-linearity:	< ± 0.02% full stroke (minimum ± 60 µm)
Repeatability:	< ± 0.001% full stroke
Outputs:	Analog (voltage/current) Voltage: 0 to 10 Vdc and 10 to 0 Vdc (controller input resistance RL > 5k Ohm) Current 4 to 20 mA or 20 to 4 mA (min./max. load: 0/500 Ohm) Digital-pulse (start/stop): RS-422 differential signal Serial parameter upload available for: Measuring range, offset, gradient, status
Position measurement:	Measurement stroke lengths: 50 mm (2 in.) to 1500 mm (60 in.) Standard stroke lengths: Millimeters (mm): 75, 100, 150, 200, 300, 400, 500, 600, 750, 1000, 1250 and 1500 Inches (in.): 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 42, 48, 54 and 60 Contact factory for custom stroke lengths Update Frequency: Voltage or Current: > 1.5 kHz Start/Stop: Controller dependent

Parameters	Specifications
ELECTRONICS	
Operating voltage:	+24 Vdc nominal: -15% or +20% Polarity protection: up to -30 Vdc Overvoltage protection: up to 36 Vdc Current drain: Analog: 50 - 140 mA Start/Stop, 50 - 100 mA (Stroke length dependent) Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)
ENVIRONMENTAL	
Operating conditions:	Operating temperature: -40 °C (-40 °F) to 75 °C (167 °F) Relative humidity: 90% no condensation Ingress protection: IP 65 (when mating connector is correctly fitted)
EMC test:	Emissions: IEC/EN 50081-1 Immunity: IEC/EN 50082-2 IEC/EN 61000-4-2/3/4/6, criterium A, CE qualified
Shock rating:	100 g (single hit)/ IEC standard 68-2-27 (survivability)
Vibration rating:	10 g/10 to 2000 Hz, IEC standard 68-2-6 (operational)
Wiring	
Connection type:	6-pin DIN (M16) male D60 connector
Sensor rod:	Stainless steel type 303
Sensor housing:	Aluminum
Mounting options:	Adjustable mounting feet or Dual rod ends

Outputs

ANALOG (VOLTAGE/CURRENT) OUTPUTS

Analog outputs include voltage (0 to 10 Vdc, forward and reverse acting), and current (4 to 20 mA, forward or reverse acting). Since the outputs are direct, no signal conditioning electronics are needed when interfacing with controllers or meters (see 'Figure 1').

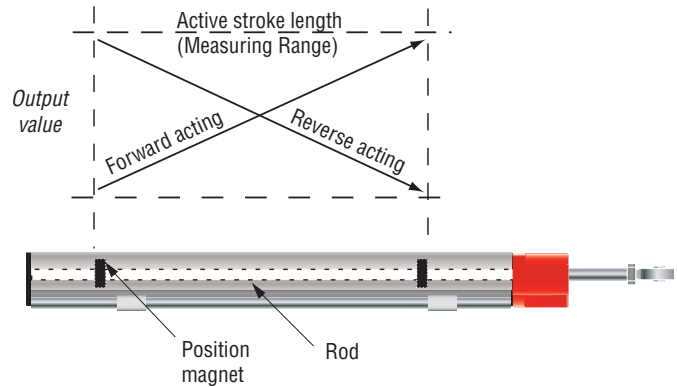


Figure 1. Analog output signals

DIGITAL (START/STOP) OUTPUT

The Temposonics E-Series Model ER digital-pulse (start/stop) output sensor requires a start signal from a controller or interface module to initiate the measurement cycle. The sensor generates a stop signal at the end of the measurement cycle that is used to stop the controller's counter clock.

The elapsed time between the Start and Stop signals is directly proportional to the magnet's position along the active stroke length. The controller can calculate the absolute position of the magnet from the time value and the sensor's unique gradient value (inverse of the speed for the sonic pulse traveling in the sensor's waveguide). (see 'Figure 2').

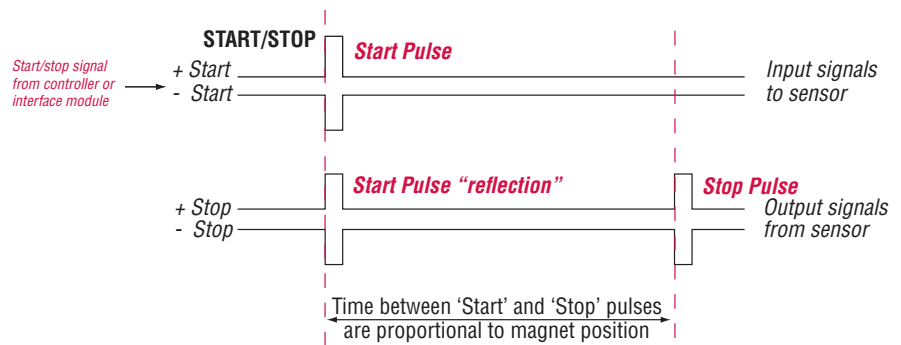


Figure 2. Start/stop output signals (RS-422 differential pairs)

Communication and programmability

SENSOR PARAMETER UPLOAD FEATURE

For applications using smart sensor interfaces, the E-Series Model ER with digital-pulse output (option R3) comes with the ability to perform sensor parameter uploads. This feature replaces the task of entering sensor data manually saving time and preventing possible entry errors during start-up or for system maintenance.

The sensor parameter upload feature requires a customer supplied RS-422 interface. The data format is serial 4800 Baud, 8-bit data length. Please contact the factory for additional parameter upload protocol details.

The upload feature supports the following sensor parameters:

- Measuring range
- Offset
- Gradient (Inverse speed of sensing pulse)
- Status

The sensor's specific parameters can be retrieved by the controller/ interface card at any time, via the sensor's start/stop signal lines.

Model ER Rod-and-Cylinder sensor dimension references

MODEL ER ROD-AND-CYLINDER SENSOR

Drawing is for reference only, contact applications engineering for tolerance specific information.

Important Note:

To avoid possible sensor damage, the washer (or the locking nut for a rod end), must remain at the end of the rod to provide a mechanical stop when the rod is fully retracted.

A robust aluminum extrusion forms the sensor housing, containing the sensor rod, magnet, sensing element and electronics. The permanent magnet is mounted on a sliding carrier attached to the end of the stainless steel rod. As the rod moves in and out, the magnet travels above the sensing element inside the sensor housing.

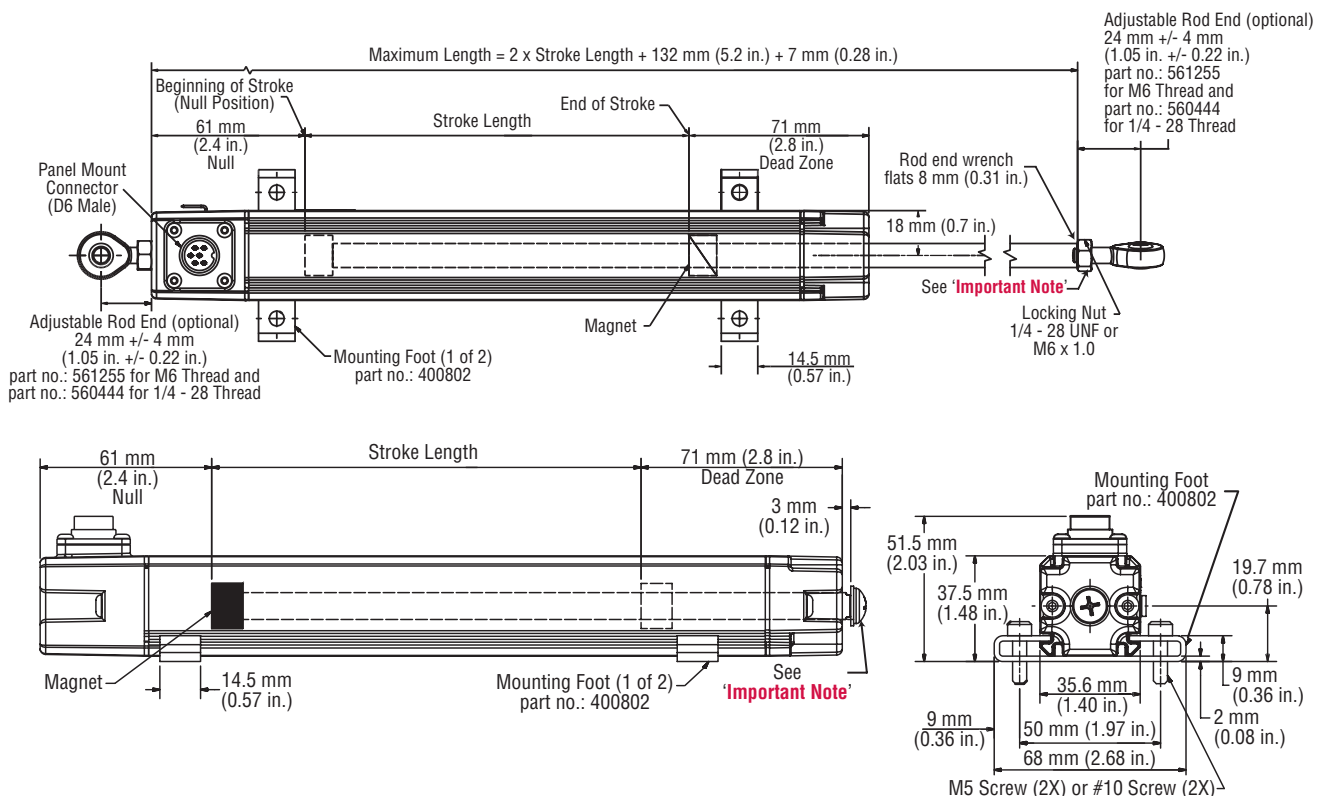


Figure 3. E-Series Model ER Rod-and-Cylinder sensor dimension reference (Shown with a D60 integral connector)

Sensor mounting

MODEL ER SENSOR MOUNTING

Temposonics model ER Rod-and-Cylinder sensors are mounted onto the machine with moveable mounting feet. Grooves for the mounting feet are available on three sides of the sensor housing, allowing versatile mounting orientations for the sensor connector and extension cable. The rod end is then attached to the moving machine part.


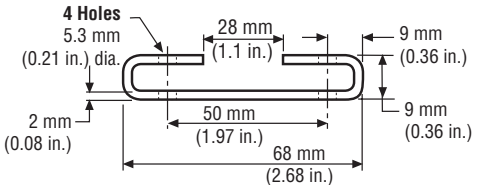
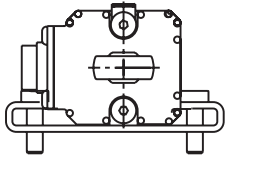
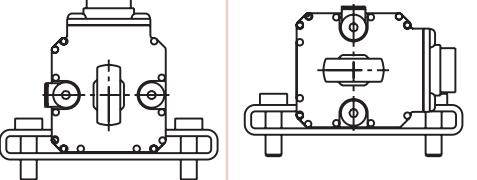

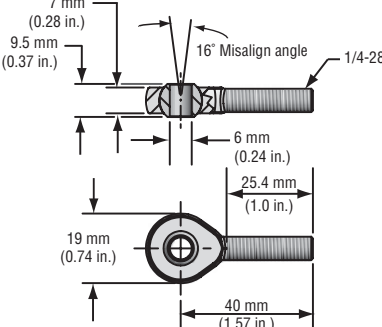

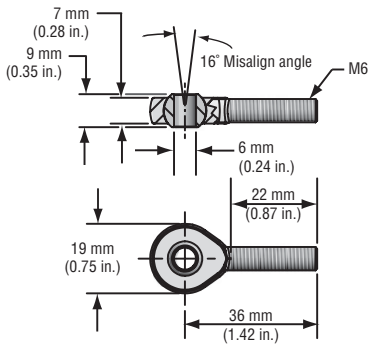

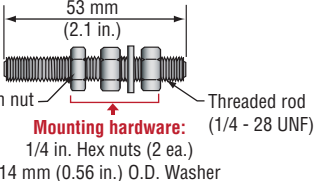
Optional rod ends can be used to simplify sensor installation design and facilitate articulated motion sensing. Using dual rod ends the model ER sensor can be mounted between two independent moving points, such as, swinging door applications. Please note that articulated or unsupported sensor applications must be limited to a maximum of 750 mm (30 in.) stroke length.


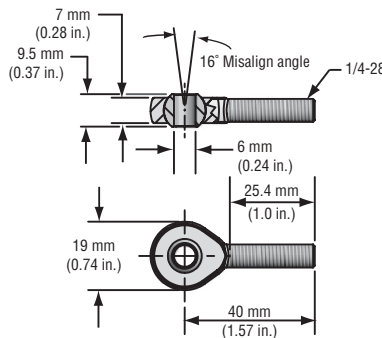

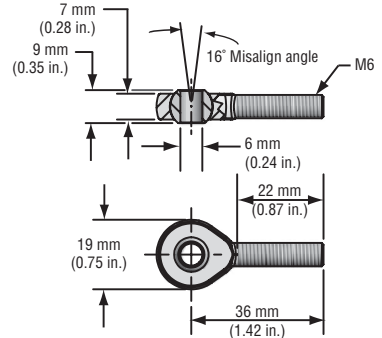

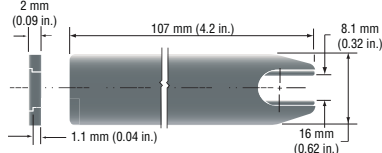
PRODUCT DATA SHEET

**E-Series Model ER Sensor, Analog / Digital-pulse (Start/Stop) Outputs
Mounting and Accessory References**

Notes:

1. Mounting feet are ordered separately.
2. MTS recommends using 10-32 cap screws (customer supplied) at a maximum torque of 44 in. lbs. when fastening mounting feet.

Rod-and-Cylinder sensor mounting and installation reference	Mounting method	Part number
	 <p>(Width = 14.5 mm (0.57 in.))</p>	<p>Mounting feet, standard (304 SS) Rod-and-Cylinder sensor mounting</p> <p>400802</p>
		<p>Three mounting configurations possible using mounting feet and screws Rod-and-Cylinder sensor foot installation <i>Secure mounting feet with customer supplied 10-32 Cap screws. (recommended)</i></p> <p>Mounting feet, part number 400802</p>
		<p>Rod end US customary measurement Optional, Male 1/4 - 28 threads</p> <p>560444</p>
		<p>Rod end Metric measurement Optional, Male M6 threads</p> <p>561255</p>
	 <p>Mounting hardware: 1/4 in. Hex nuts (2 ea.) 14 mm (0.56 in.) O.D. Washer</p>	<p>Stud end Optional, Mounting hardware included: Hex nuts (2 pcs.) Jam nut and washer</p> <p>251975</p>

Rod-and-Cylinder sensor mounting and installation reference	Mounting method	Part number
		<p>Rod-end kit Male, 1/4 - 28 rod ends (2 pcs.) with nuts, plus special wrench (Standard US customary measurement)</p> <p>253346</p>
		<p>Rod-end kit Male, M6 rod ends (2 pcs.) with nuts, plus special wrench (Metric measurement)</p> <p>253347</p>
		<p>Rod-end kit, special wrench Metric and standard US customary measurement references</p> <p>included with rod-end kits 253346 / 253347</p>

Model ER connections and wiring

SENSOR INTEGRAL CONNECTOR (D60 MALE) PINOUT/WIRE COLOR CODE (FOR EXTENSION CABLE OPTION)

The E-Series Model ER sensor connects directly to a controller or interface module with the standard male, 6-pin integral connector. Wiring color and signal functions for the extension cable option are described in 'Table 1'.

Attention:
 The ER sensor's aluminum housing has an anodic coating which prevents the sensor's mounting feet (part no. 400802) from providing the appropriate grounding. A grounding lug (see 'Figure 3') is provided near the connector end of the sensor for a convenient connection to earth ground. The appropriate grounding of the cable shield is required at the controller end.



Integral D6 connector (male) as viewed from the end of the sensor

Pin no.	Wire color	Signal/Function Digital-pulse outputs	Signal/Function Analog outputs
1	Gray	(-) Stop	0 to 10 Vdc or 4 to 20 mA
2	Pink	(+) Stop	Return for pin 1
3	Yellow	(+) Start	10 to 0 Vdc or 20 to 4 mA
4	Green	(-) Start	Return for pin 3
5	Red or Brown	+24 Vdc (+20% / -15%)	+24 Vdc (+20% / -15%)
6	White	DC Ground (0 Vdc)	DC Ground (for supply)

Table 1. ER sensor connector pinout and extension cable wiring

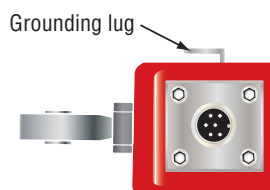



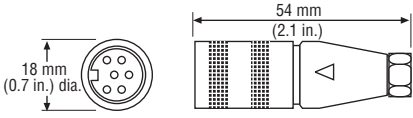

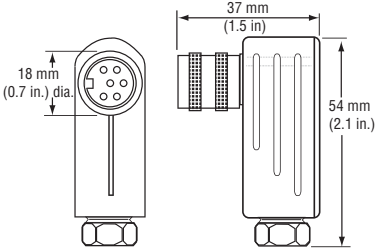
Figure 3. ER Sensor grounding lug location

PRODUCT DATA SHEET

E-Series Model ER Sensor, Analog / Digital-pulse (Start/Stop) Outputs, Wiring and Connections

CABLE CONNECTOR OPTIONS (FIELD INSTALLED) 6-PIN DIN (D60) FEMALE

(Drawing dimensions are for reference only)

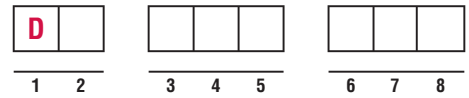
Connector	Connector dimensions	Description	Part number
		Female Cable Connector, Straight Exit (Field installed) 6-Pin DIN (D60) (Mates with standard male (M16) integral connector)	560700
		Female Cable Connector, 90° Exit (Field installed) 6-Pin DIN (D60) (Mates with standard male (M16) integral connector)	560778

EXTENSION CABLE WITH CONNECTORS FOR D6 (D60) CONNECTION TYPES

Extension Cable and Connector	Description	Connection type
	Female Connector, Straight Exit with Standard PVC Jacket Cable <i>(Assembly Includes D6 Connector, Part No.: 560700 and Cable, Part No.:530026)</i>	D6
	Female Connector, 90° Exit with Standard PVC Jacket Cable <i>(Assembly Includes D6 Connector, Part No.: 560778 and Cable, Part No.:530026)</i>	DA
	Female Connector, Straight Exit with Black Polyurethane Jacket Cable (for higher resistance to moisture, oil and cold temperatures) <i>(Assembly Includes D6 Connector, Part No.: 560700 and Cable, Part No.:530045)</i>	DJ
	Female Connector, 90° Exit with Black Polyurethane Jacket Cable (for higher resistance to moisture, oil and cold temperatures) <i>(Assembly Includes D6 Connector, Part No.: 560778 and Cable, Part No.:530045)</i>	DK

Extension Cable with Connector for D6 (D60) Connection Types
Ordering Information

PRODUCT DATA SHEET



SENSOR CONNECTION TYPES

- D6** = Female connector, straight exit (part no. 560700), and PVC jacket cable (part no. 530026)
- DA** = Female connector, 90° exit (part no. 560788), and PVC jacket cable (part no. 530026)
- DJ** = Female connector, straight exit (part no. 560700), and black polyurethane jacket cable (part no. 530045)
- DK** = Female connector, 90° exit (part no. 560788), and black polyurethane jacket cable (part no. 530045)

D **1 - 2**

CABLE LENGTHS

For standard length cables up to 100 ft

- 005** = 5 ft.
- 015** = 15 ft.
- 025** = 25 ft.
- 050** = 50 ft.
- 100** = 100 ft.

3 - 5

For custom length cables over 100 ft.

--- = Cable length (maximum cable length is dependent on the output selected; consult MTS Applications Engineering)

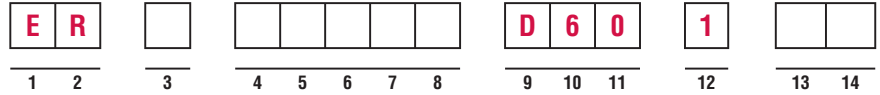
CABLE TERMINATION

- P0** = Pigtail cable without connector (2 digit code)
- D6M** = D6 male connector (straight exit). Only available with the **D6** option above.
- D6F** = D6 female connector (straight exit). Only available with the **D6** option above.
- DAF** = D6 female connector (90° exit). Only available with the **DA** option above.

6 - 8

Note:
Articulated or unsupported sensor applications using dual rod ends must be limited to a maximum of 750 mm (30 in.) stroke length. If mounting feet are used, they must be ordered separately. Two mounting feet are required for sensors up to 750 mm (30 in.). At least one additional mounting foot is recommended for longer lengths.

Use the order matrix below to configure your Model ER sensor order number. Contact the factory for custom sensor stroke lengths.



SENSOR MODEL _____ = E R		1 - 2
E-Series model ER sensor rod-and-cylinder style		
TYPE OF THREAD _____ = <input type="text"/>		3
S = Inside thread 1/4 - 28 (For model ER sensors using US customary stroke length measurement)		
M = Inside thread M6 (For model ER sensors using metric stroke length measurement)		
MEASURING STROKE LENGTH _____ = <input type="text"/>		4 - 8
----- M = Millimeters (Encode in 5 mm increments for custom stroke lengths)		
----- U = Inches (Encode in 0.1 in. increments for custom stroke lengths)		
<p>Stroke Length Notes:</p> <ol style="list-style-type: none"> Standard US Customary stroke lengths are 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 42, 48, 54, and 60 in. Standard metric stroke lengths are 75, 100, 150, 200, 300, 400, 500, 600, 750, 1000, 1250 and 1500 mm. Contact the factory for custom stroke lengths. 		
SENSOR CONNECTION TYPE _____ = D 6 0		9 - 11
D60 = 6-Pin DIN (M16), male, standard		
INPUT VOLTAGE _____ = 1		12
1 = +24 Vdc (+20%, -15%), standard		
OUTPUT (VOLTAGE) _____ = <input type="text"/>		13 - 14
V0 = 0 to +10 Vdc and +10 to 0 Vdc		
(CURRENT)		
A0 = 4 mA to 20 mA	A1 = 20 mA to 4 mA	
(DIGITAL-PULSE)		
R0 = Start/Stop	R3 = Start/Stop with parameters upload	
SYSTEM OPTION _____ = K <input type="text"/>		
Kxx = Available on request (specify at time of order)		



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All Temposonics sensors are covered by US patent number 5,545,984. Additional patents are pending.
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