

# Temposonics®

Magnetostrictive, Absolute, Non-contact  
Linear-Position Sensors



## R-Series Models RP and RH EtherCAT® Industrial Ethernet Interface

Data Sheet Part Number  
Reference: 551074



**Model RP Profile-style position sensor**  
Stroke length: 25 mm to 5080 mm (1 in. to 200 in.)



**Model RH Rod-style position sensor**  
Stroke length: 25 mm to 7620 mm (1 in. to 300 in.)



### FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Superior Accuracy, Resolution down to 1  $\mu\text{m}$
- Non-Contact Sensing Technology
- Non-Linearity Less Than 0.01%
- Repeatability Within 0.001%
- Direct EtherCAT Interface, Position + Velocity
- 100  $\mu\text{s}$  Position / Velocity Update Time, Regardless of Overall Stroke Length

### BENEFITS

- Rugged Industrial Sensor
- Position + Velocity Measurements For Up to 20 Magnets

### APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions
- For Accurate, High-Speed, Simultaneous Multi-Position and Velocity Measurements

### TYPICAL INDUSTRIES

- Factory Automation
- Fluid Power
- Plastic Injection and Blow Molding
- Material Handling and Packaging

R-Series  
EtherCAT®



EtherCAT® is a registered trademark and patented technology licensed by  
Beckhoff Automation GmbH, Germany

MTS Sensors

## Product Overview and Specifications

### Product overview

Temposonics R-Series EtherCAT sensors represent MTS Sensors' development and product offering in high-speed networked position feedback. EtherCAT (Ethernet for Control Automation Technology) is a unique interface developed by Beckhoff Automation and is supported by the EtherCAT Technology Group (ETG). This interface is used for industrial Ethernet, providing the fastest, most deterministic industrial networking solution possible using the base Ethernet

physical layer. By using this format, coupled with our high speed networked sensing capability, machine builders and automation engineers will be able to overcome bandwidth and node limitation issues found with other commercially available industrial networks.

### Product specifications

Parameters	Specifications
<b>OUTPUT</b>	
<b>Measured output variables:</b>	Simultaneous multi-position and velocity measurements up to 20 magnets or up to 5 magnets when using high-speed update (for EtherCAT distributed clock mode). Option for acceleration measurements up to 2 magnets.
<b>Resolution:</b>	1 to 1000 µm selectable
<b>Update time:</b>	100 µs min. (high speed update feature is active when the controller's loop time is less than the sensor's measurement cycle time)
<b>Non-linearity:</b>	< ± 0.01% full stroke (minimum ± 50 µm) (Linearity Correction Option (LCO) available)
<b>Repeatability:</b>	< ± 0.001% full stroke (minimum ± 2.5 µm)
<b>Hysteresis:</b>	< 4 µm
<b>Outputs:</b>	<b>Interface:</b> EtherCAT Data format: EtherCAT 100 Base-Tx, fast Ethernet Data transmission rate: 100 Mbit/s max.
<b>Stroke length:</b>	<b>Range (Profile style):</b> 25 mm to 5080 mm (1 in. to 200 in.) <b>Range (Rod style):</b> 25 mm to 7620 mm (1 in. to 300 in.) <b>Range (Flexible style):</b> 255 mm to 10,060 mm (10 in. to 396 in.) (Contact Factory for longer stroke lengths.)
<b>ELECTRONICS</b>	
<b>Operating voltage:</b>	<b>+24 Vdc nominal:</b> -15% or +20% <b>Polarity protection:</b> up to -30 Vdc <b>Over voltage protection:</b> up to 36 Vdc <b>Current drain:</b> 80 mA typical <b>Dielectric withstand voltage:</b> 500 Vdc (DC ground to machine ground)

Parameters	Specifications
<b>ENVIRONMENTAL</b>	
<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>Temperature coefficient:</b> < 15 ppm/ °C
<b>EMC test:</b>	<b>Emissions:</b> IEC/EN 50081-1 <b>Immunity:</b> IEC/EN 50082-2 IEC/EN 61000-4-2/3/4/6, level 3/4 criterion A, CE qualified
<b>Shock rating:</b>	100 g (single hit)/IEC standard 68-2-27 (survivability)
<b>Vibration rating:</b>	15 g / 10 to 2000 Hz / IEC standard 68-2-6
<b>Wiring</b>	
<b>Connection type:</b>	D56 option: Two female 4-pin (M12-D) plus one 4-pin male (M8) connector
<b>PROFILE STYLE SENSOR (MODEL RP)</b>	
<b>Electronic head:</b>	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
<b>Sealing:</b>	IP 65
<b>Sensor extrusion:</b>	Aluminum (Temposonics profile style)
<b>Mounting:</b>	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove
<b>Magnet types:</b>	Captive-sliding magnet or open-ring magnet
<b>ROD STYLE SENSOR (MODEL RH)</b>	
<b>Electronic head:</b>	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
<b>Sealing:</b>	IP 67
<b>Sensor rod:</b>	304L stainless steel
<b>Operating pressure:</b>	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)
<b>Mounting:</b>	Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A
<b>Typical mounting torque:</b>	45 N-m (33 ft. - lbs.)
<b>Magnet types:</b>	Ring magnet, open-ring magnet, or magnet float

## Enhanced monitoring and diagnostics

### SENSOR STATUS AND DIAGNOSTIC DISPLAY



Integrated diagnostic LEDs (green/red), located beside sensor connectors (see 'Figure 1'), provide basic visual monitoring for normal sensor operation and troubleshooting. Diagnostic display LEDs indicate four modes described in 'Table 1. Diagnostic display indicator modes'

Figure 1. R-Series sensor Integrated diagnostic LEDs

<b>Status LED (Green)</b>	Off: On: Flashing:	Initializing Normal function Various flashing codes show different operational status
<b>Error LED (Red)</b>	Off: On: Flashing:	Normal function missing magnet Supply voltage beyond limits (high or low)
<b>IN Port LED (Green)</b>	Off: On: Flashing:	No link Link detected Traffic
<b>OUT Port LED (Green)</b>	Off: On: Flashing:	No link Link detected Traffic

Table 1. Diagnostic display indicator modes

## EtherCAT interface

EtherCAT is an open field bus system which is based on Ethernet technology, (IEEE 802.3), with a high data rate and short response time, resulting in very good real-time performance. It is standardized in the IEC/PAS 62407 and is part of the ISO 15745-4 standard. The EtherCAT protocol is also being integrated into the IEC 61158, IEC 61784, and IEC 61800-7 standards.

The Temposonics EtherCAT sensor is connected as a slave device, and as such, fulfils all the requirements of the EtherCAT field bus system. Adding the sensor to an EtherCAT bus system is very easy. The system manager (e.g. TwinCAT from Beckhoff Automation) gets all the parameters of the sensor from the XML file, available from the MTS website at <http://www.mtssensors.com>. There are no adjustments necessary on the sensor itself. For some applications, optimum system performance is obtained using the sensor's high speed updates, up to 10 kHz, by synchronizing to the EtherCAT's 'distributed clock mode' (available on the "E101" sensor output option).

## Operation modes and output

There are two operation modes available:

### E101 - Fast update position and velocity:

- Designed for high-speed motion control
- Up to 5 simultaneous magnet measurements
- 100  $\mu$ s update rate, (independent of stroke length)

### E102 Multi-magnet position and velocity:

- Designed for gauging systems having many magnet positions
- Up to 20 simultaneous magnet measurements
- Standard update rates, (stroke length dependent)

When using multiple magnets, the minimum allowed distance between magnets is 76 mm (3 in.) to maintain proper sensor output (see 'Figure 2').

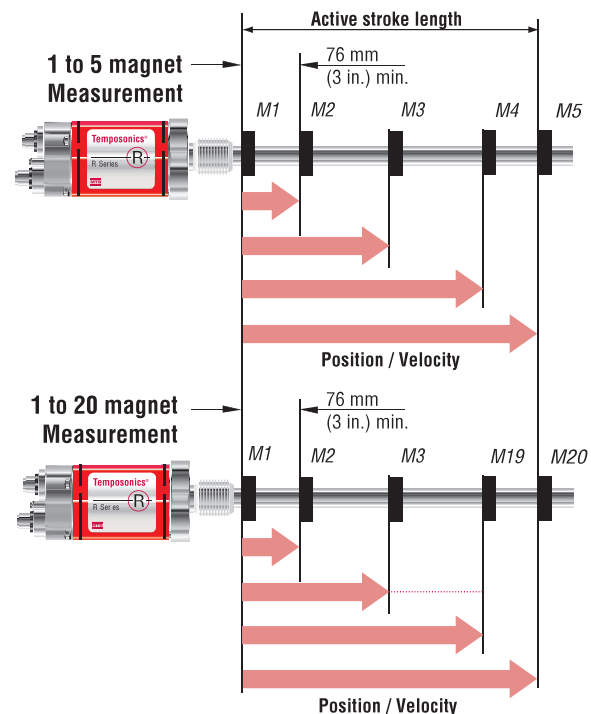


Figure 2. Single to multi-magnet output diagram

### LINEARITY CORRECTION OPTION (LCO)

The Linearity Correction Option (LCO) provides improved sensor output accuracy. For most stroke lengths linearity accuracy is improved up to a factor of 5 resulting in deviations from actual position of less than  $\pm 20 \mu$ m (0.0008 in.). For stroke lengths over 5000 mm (197 in.), the linearity accuracy is improved up to factor of 10. Selecting the sensor style and magnet is important (both must be matched together). Contact the factory for assistance when designing for the LCO in your application.

R-Series  
EtherCAT®

## Model RP Profile-Style Sensor

### Sensor Dimension References

#### Model RP profile-style sensor dimension references

##### MODEL RP, PROFILE-STYLE SENSOR WITH CAPTIVE-SLIDING MAGNET

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

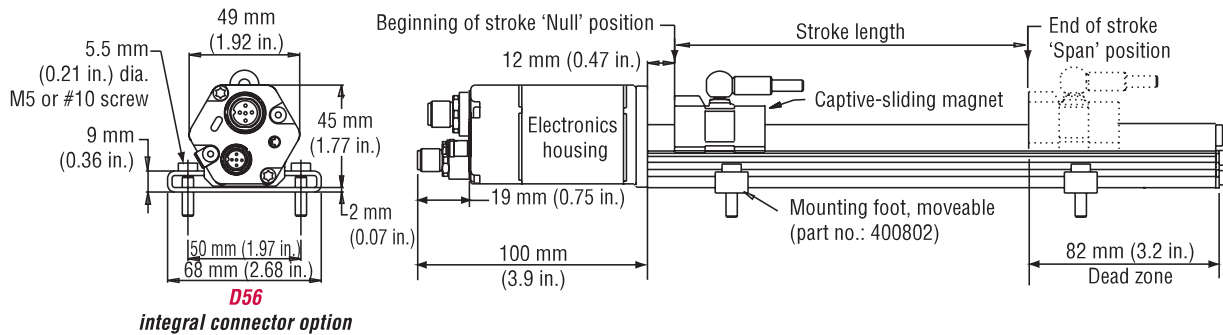


Figure 3. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

##### MODEL RP, PROFILE-STYLE SENSOR WITH OPEN-RING MAGNET

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

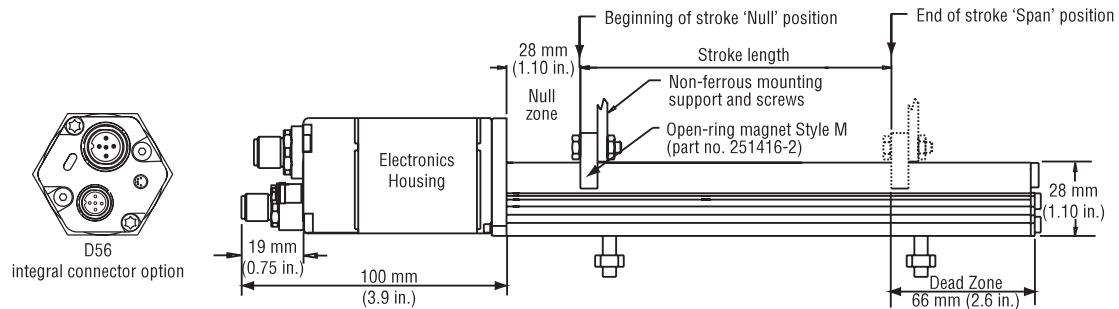


Figure 4. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

#### Standard magnet selections, mounting and installation (Model RP)

Temposonics model RP profile-style sensors offer two basic mounting methods; side grooves for use with mounting feet or a bottom groove that accepts special T-Slot nuts. Both the mounting feet and T-Slot nuts can be positioned along the sensor extrusion to best secure the sensor for each particular application.

 Refer to the Accessories section of this catalog for magnet selections and detailed mounting and installation information.

Model RH rod-style sensor dimension reference

The Temposonics R-Series rod-style sensor (Model RH) offers modular construction, flexible mounting configurations, and easy installation. The Model RH sensor is designed for mounting in applications where high pressure conditions exist (5000 psi continuous, 10,000 psi spike) such as inside hydraulic cylinders. The Model RH sensor (see 'Figure 5') may also be mounted externally in many applications.

Stroke-dependent Dead Zones:	
Stroke length:	Dead zone:
25 mm (1 in.) - 5000 mm (197 in.)	63.5 mm (2.5 in.)
5005 mm (197 in.) - 7620 mm (300 in.)	66 mm (2.6 in.)

MODEL RH, ROD-STYLE SENSOR WITH RING MAGNET (MAGNET ORDERED SEPARATELY)

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

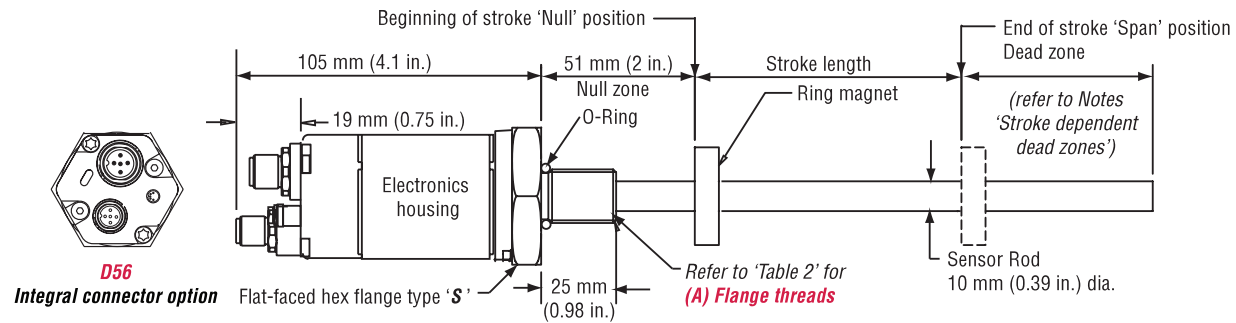


Figure 5. Model RH Rod-style sensor dimension reference (shown with **D56** integral connector options)

MODEL RH, ROD-STYLE SENSOR WITH RING MAGNET (MAGNET ORDERED SEPARATELY)

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

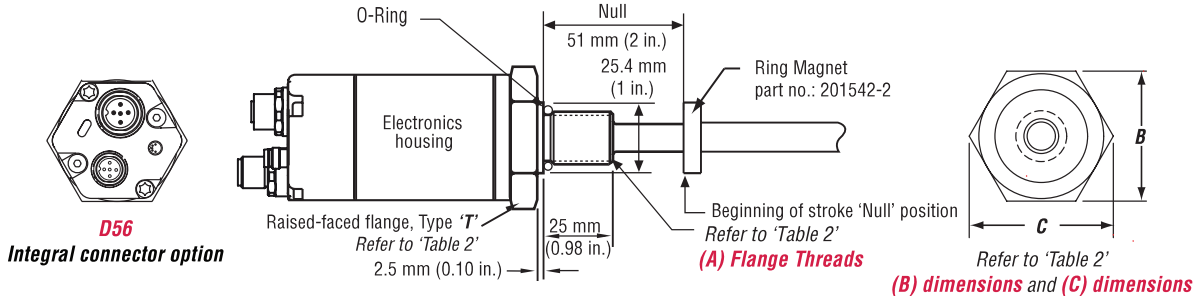



Figure 6. Model RH Rod-style sensor dimension reference (Shown with the **D56** Integral cable connection type option)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
<b>T</b>	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
<b>S</b>	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
<b>M</b>	Metric threads with flat-faced flange	M18 x 1.5	46 mm	53 mm

Table 2. Model RH Rod-style sensor housing style and flange type references

Standard magnets, mounting and installation (Model RH)

Magnets must be ordered separately with model RH position sensors (unless otherwise specified in the data sheet). The standard ring magnet (part number 201542-2) is suitable for most applications

 Refer to the Accessories section of this catalog for magnet, cable connector selections and detailed mounting and installation information.

## Models RP and RH Sensors Connections and Wiring

### Connections and wiring

#### (D56) BUS CONNECTOR OPTION

D56 connector option for 'daisy chain' topologies. A separate cable is used for the supply voltage. Unused connectors should be covered by a protective cap.



**D56**  
**Female**  
**4-pin Bus In**



**D56**  
**Female**  
**4-pin Bus Out**



**D56**  
**Male, 4-pin**  
**Input voltage**

#### BUS CONNECTIONS IN/OUT



**Female, 4-pin (M12-D) Integral connector  
pin-out as viewed from the end of the sensor**

Pin number	Cable color	Function
1	Yellow	Tx+
2	White	Rx+
3	Orange	Tx-
4	Blue	Rx-

#### INPUT VOLTAGE



**Input voltage, male, 4-pin (M8) integral  
connector pin-out as viewed from the end of  
the sensor**

Pin number	Cable color	Supply voltage
1	Brown	+24 Vdc (-15/+20%)
2	White	No connection
3	Blue	DC ground (for supply)
4	Black	No connection

## Models RP and RH Sensors Ordering Information

R																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

### SENSOR MODEL

**RP** = Profile style **RH** = Hydraulic rod style **RF** = Flexible style = **R** 1-2

(For more information about the model RF, refer to Industrial Product Catalog, part no.: 551075)

### HOUSING STYLE

=  3

#### Model RP profile-style sensor (includes one magnet):

**S** = Captive-sliding magnet with ball joint at top (part no. 252182) **V** = Captive-sliding magnet with ball joint at front (part no. 252184) **M** = Open-ring magnet (part no. 251416-2)

#### Model RH rod-style sensor (magnet(s) must be ordered separately):

**T** = US customary threads, raised-faced flange and pressure tube, standard **U** = Same as option "T", except uses fluoroelastomer seals for the electronics housing **B** = Sensor cartridge only (no flange or pressure tube, stroke length < 1830 mm (72 in.))  
**S** = US customary threads, flat-faced flange and pressure tube, standard **H** = Same as option "S", except uses fluoroelastomer seals for the electronics housing  
**M** = Metric threads, flat-faced flange and pressure tube, standard **V** = Same as option "M", except uses fluoroelastomer seals for the electronics housing

#### Model RF Flexible housing style sensor (magnet(s) must be ordered separately):

**S** = US customary threads, flat-faced flange **M** = Metric threads, flat-faced flange

### STROKE LENGTH

— — — — **M** = Millimeters (Encode in 5 mm increments) =  4-8

— — — — **U** = Inches and tenths (Encode in 0.1 in. increments)

#### Stroke Length Notes:

1. Profile-style sensor (model RP) stroke range = 25 mm (1 in.) - 5080 mm. (200 in.)
2. Rod-style sensor (model RH) stroke range = 25 mm (1 in.) - 7620 mm (300 in.)
3. Flexible housing style sensor (model RF) stroke range = 255 mm (10 in.) - 10,060 mm (396 in.) Contact factory for longer stroke lengths.

### CONNECTION TYPE

= **D 5 6** 9-11

#### Integral connector:

**D56** = Two 4-pin female (M12-D), plus one 4-pin male (M8)

### INPUT VOLTAGE

= **1** 12

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

### OUTPUT

= **E 1 0** 13-16

**E101** = EtherCAT, position and velocity, high speed updates, maximum 5 magnets

**E102** = EtherCAT, position and velocity, maximum 20 magnets

**E103** = Same as option 'E101' with Linearity Correction Option (LCO)

**E104** = Same as option 'E102' with Linearity Correction Option (LCO)

### NUMBER OF MAGNETS

= **Z** 17-19

For multi-position measurement only (Order additional magnets separately).

**Z** — — = Number of magnets for output **E101** (range 02 to 05), or for output **E102** (range 02 to 20)

**R-Series  
EtherCAT®**