

# Temposonics®

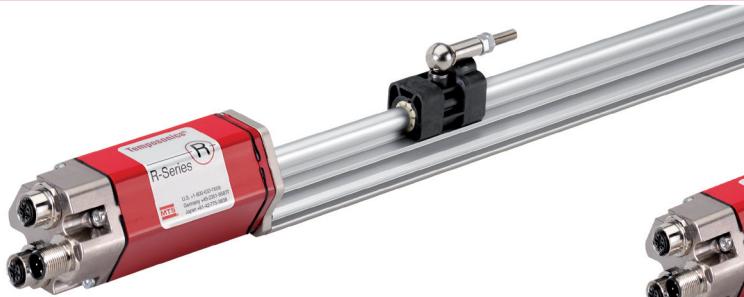
Magnetostrictive, Absolute, Non-contact  
Linear-Position Sensors



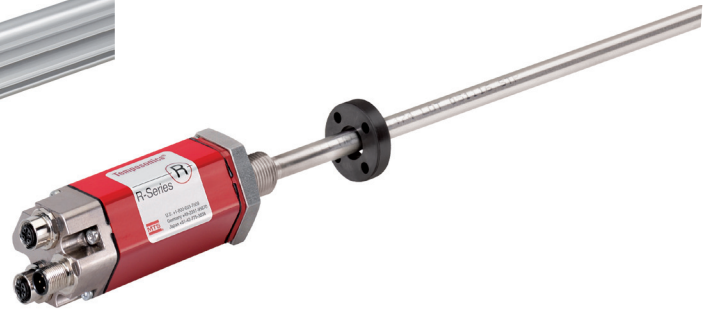
## R-Series Models RP and RH Profinet Interface

Document Part Number  
551451 Revision A

### Data Sheet



Model RP Profile-style position sensor



Model RH Rod-style position sensor

#### FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Superior Accuracy, Resolution down to 1  $\mu\text{m}$
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Intergrated Profinet IRT switch

#### BENEFITS

- Rugged Industrial Sensor
- Position + Velocity Measurements For Up to 19 Magnets

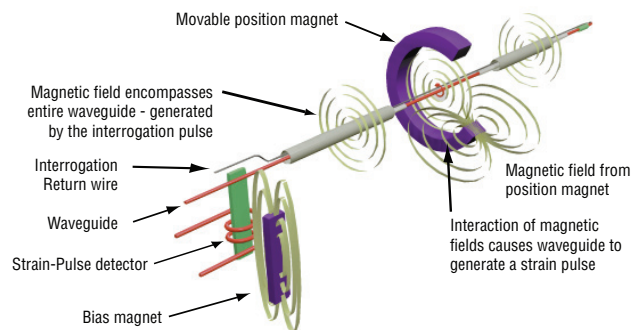
#### APPLICATIONS

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

#### TYPICAL INDUSTRIES

- Factory Automation
- Fluid Power
- Plastic Injection and Blow Molding
- 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.

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 and Specifications

### Product overview

The sensor meets the requirements of the Profinet IO industrial Ethernet standards and can be directly operating in a network with decentralized peripherals. Profinet is characterized by a high data transfer and high real-time capability. It's officially certified by the PNO (Profinet user organization).

### Product specifications

Parameters	Specifications
<b>OUTPUT</b>	
<b>Measured output variables:</b>	Simultaneous multi-position or velocity measurements up to 19 magnets.
<b>Resolution:</b>	1 to 100 µm selectable
<b>Update time:</b>	Dependent on stroke length
<b>Motion control cycle time:</b>	Minimum 1 ms
<b>Linearity deviation:</b>	< ± 0.01% full stroke (minimum ± 50 µm)
<b>Repeatability:</b>	< ± 0.001% full stroke (minimum ± 2.5 µm)
<b>Hysteresis:</b>	< 4 µm
<b>Outputs:</b>	<b>Interface:</b> Profinet IO RT <b>Data transmission rate:</b> 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>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> 110 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> 0 °C (32 °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>Electromagnetic emission:</b> EN 61000-6-4 (for industrial environments) <b>Electromagnetic immunity:</b> EN 61000-6-2 (The sensor meets the requirements of the EC directives and is marked with CE)
<b>Shock rating:</b>	100 g (single hit)/IEC standard 60068-2-27 (survivability)
<b>Vibration rating:</b>	15 g / 10 to 2000 Hz / IEC standard 60068-2-6 (resonance frequencies excluded)

<b>WIRING</b>	
<b>Connection type:</b>	D58 option: Two female 4-pin (M12-D) plus one 4-pin male (M12-A) 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 LED (green/red) provides basic visual feedback for normal sensor operation and troubleshooting.

Figure 1. R-Series sensor Integrated diagnostic LEDs

Green	Red	Description
ON	OFF	Normal function
ON	ON	No master contact
ON	Flashing	Parametrization failed

Table 1. Diagnostic display indicator modes

## Profinet interface

### Profinet versions

The sensor can be ordered in following versions:

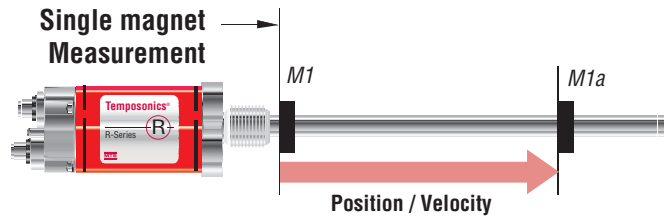
- a) Encoder Profile 4.1: PNO standardized profile
- b) MTS Communication Profile: It allows a simultaneous position measurement up to 19 positions. The configuration is similar to the sequence of Temposonics® Profibus sensors

## Operation modes and output

### Single and Multi-magnet position and velocity:

Up to 19 simultaneous magnet measurements are possible when using multiple magnets. The minimum allowed distance between magnets is 75 mm (3 in.) to maintain proper sensor output (see 'Figure 2').

#### U401



#### U402

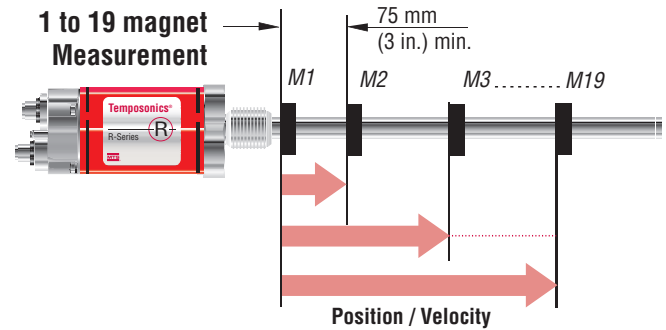


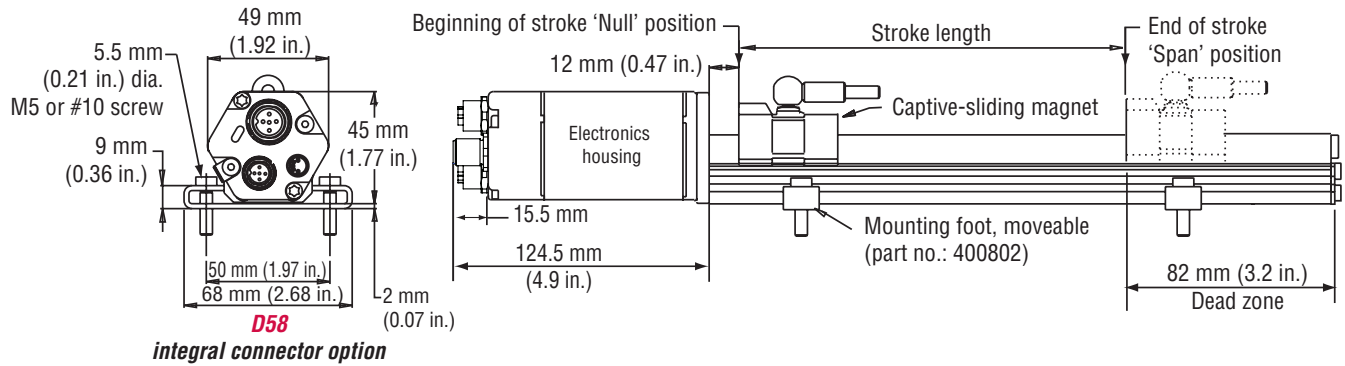
Figure 2. Single and multi-magnet output diagram

**Model RP Profile-Style Sensor**  
**Sensor Dimension References**

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

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

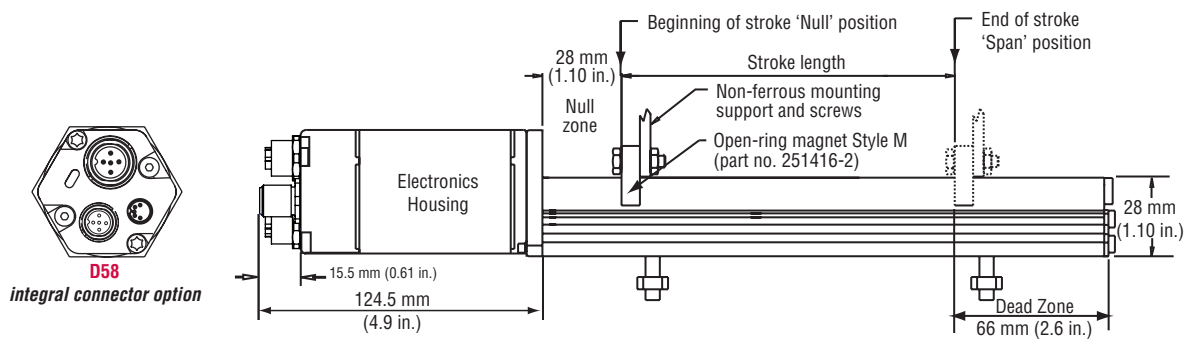
*Drawing is for reference only, contact applications engineering for tolerance specific information.*



**Figure 3.** R-Series Model RP Profile-style sensor dimension reference (Shown with the **D58** 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 **D58** connector option)

## Standard magnet selections (Model RP)

### SELECTION OF POSITION MAGNETS

A choice of two magnet mounting configurations are available with the profile-style sensor; A 'captive-sliding' magnet, *Styles S or V* or an 'open-ring' magnet, *Style M*. 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 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.

### POSITION MAGNET SELECTIONS *(Drawing dimensions are for reference only)*

Magnet dimensions and mounted magnet dimensions	Description	Part number
	<p><b>Captive-sliding magnet, Style S</b> For Model RP profile-style sensor</p>	<p>252182</p>
	<p><b>Captive-sliding magnet, Style V</b> For Model RP profile-style sensor</p>	<p>252184</p>
	<p><b>Open-ring magnet, Style M</b> I.D.: 13.5 mm (0.53 in.) O.D.: 33 mm (1.29 in.) Thickness: 8 mm (0.31 in.) Operating temperature: - 40 °C to 100 °C</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	<p>251416-2</p>

**Model RP Profile-Style Sensor  
Sensor Mounting Reference**

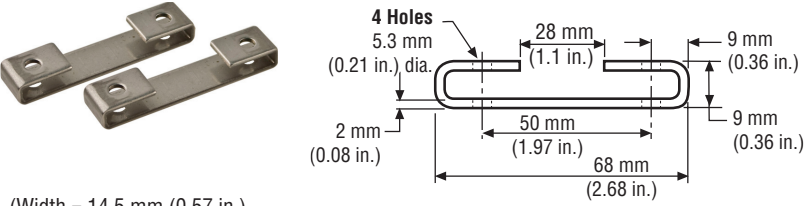
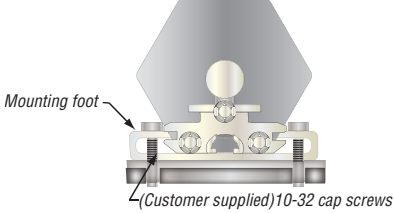
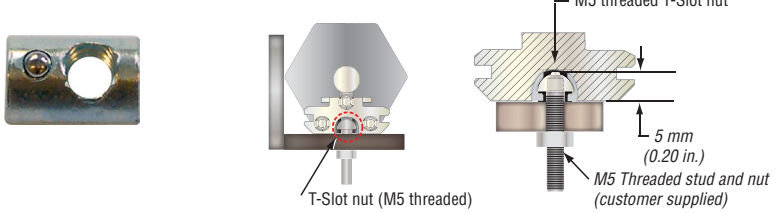
**Sensor mounting**

**Model RP profile-style sensor mounting flexible installation in any position!**

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.

**Notes:**

1. Model RP sensors include two mounting feet (part no. 400802) for sensors stroke lengths up to 1250 mm (50 in.)
2. One additional mounting foot is included for stroke lengths over 1250 mm (50 in.) and for each additional 500 mm (20 in.), thereafter.
3. MTS recommends using 10-32 cap screws (*customer supplied*) at a maximum torque of 44 in. lbs. when fastening mounting feet.

Profile-Style sensor mounting and installation reference	Mounting method	Part number
 <p>(Width = 14.5 mm (0.57 in.))</p>	<p><b>Mounting feet, standard (304 SS)</b> Profile-style sensor mounting for sensor model RP</p>	<p>400802</p>
<p>10 - 32 Cap screws Recommended (Customer supplied)</p>  <p>Mounting foot (Customer supplied) 10-32 cap screws</p>	<p><b>Mounting feet and screws</b> Profile-style sensor foot installation</p>	<p>See Mounting Feet part number: 400802</p>
 <p>T-Slot nut (M5 threaded) M5 threaded T-Slot nut 5 mm (0.20 in.) M5 Threaded stud and nut (customer supplied)</p>	<p><b>T-Slot nut Nut for mounting model RP sensor.</b> M5 thread (Optional, ordered separately)</p>	<p>401602</p>

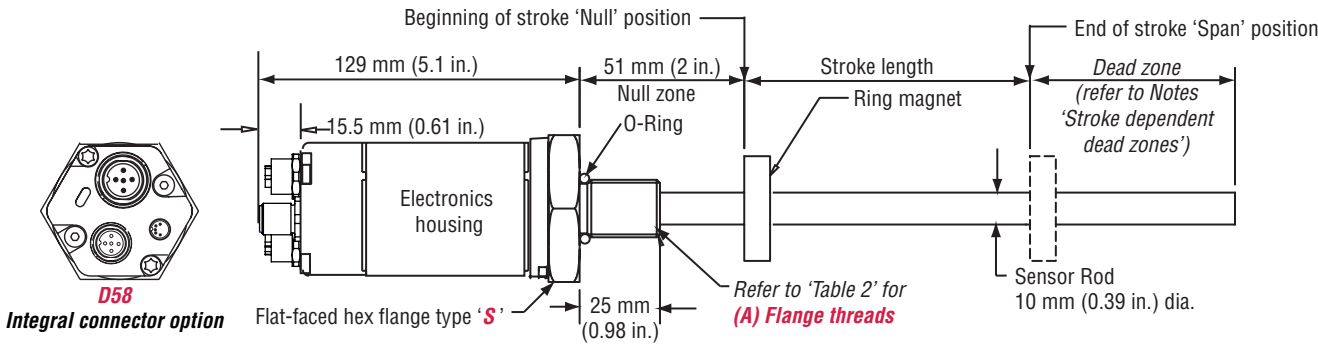
**Model RH rod-style sensor dimension reference**

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)**

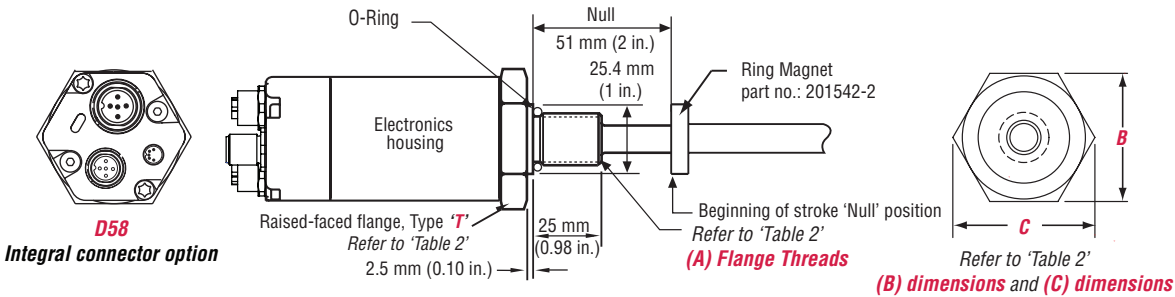
Drawing is for reference only, contact applications engineering for tolerance specific information.



**Figure 5.** Model RH Rod-style sensor dimension reference (shown with **D58** 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 **D58** 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

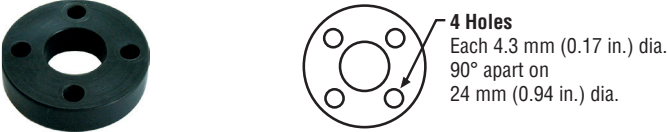
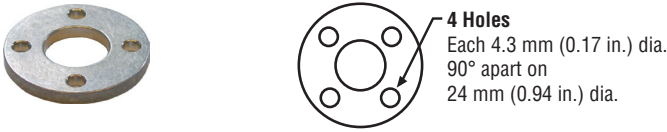

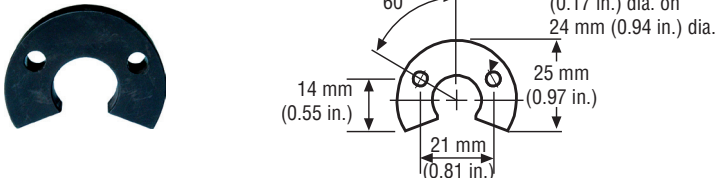
**Table 2.** Model RH Rod-style sensor housing style and flange type references

**Model RH Rod-Style Sensor  
Standard Magnet Selections**

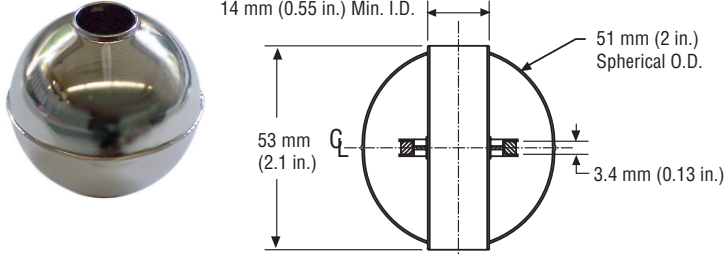
**Standard magnet selections (Model RH)**

Magnets must be ordered separately with Model RH position sensors. The standard ring magnet (part number 201542-2) is suitable for most applications.

**POSITION MAGNET SELECTIONS (Magnet must be ordered separately)** *(Drawing dimensions are for reference only)*

Magnet and magnet dimensions	Description	Part number
 <p><b>4 Holes</b> Each 4.3 mm (0.17 in.) dia. 90° apart on 24 mm (0.94 in.) dia.</p>	<p><b>Standard ring magnet</b> I.D.: 13.5 mm (0.53 in.) O.D.: 33 mm (1.3 in.) Thickness: 8 mm (0.3 in.) Operating temperature: - 40 °C to 100 °C</p>	201542-2
 <p><b>4 Holes</b> Each 4.3 mm (0.17 in.) dia. 90° apart on 24 mm (0.94 in.) dia.</p>	<p><b>Magnet spacer</b> (Non-ferrous, use with ring magnet Part number: 201542-2) I.D.: 14 mm (0.56 in.) O.D.: 32 mm (1.25 in.) Thickness: 3.2 mm (0.125 in.)</p>	400633
	<p><b>Ring magnet</b> I.D.: 13.5 mm (0.53 in.) O.D.: 25.4 mm (1 in.) Thickness: 8 mm (0.3 in.) Operating temperature: - 40 °C to 100 °C</p>	400533
 <p><b>2 Holes</b> Each 4.3 mm (0.17 in.) dia. on 24 mm (0.94 in.) dia.</p> <p>60° 14 mm (0.55 in.) 25 mm (0.97 in.) 21 mm (0.81 in.)</p>	<p><b>Open-ring magnet, Style M</b> I.D.: 13.5 mm (0.53 in.) O.D.: 33 mm (1.3 in.) Thickness: 8 mm (0.3 in.) Operating temperature: - 40 °C to 100 °C</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	251416-2

**MAGNET FLOAT SELECTION** *(Drawing dimensions are for reference only)*

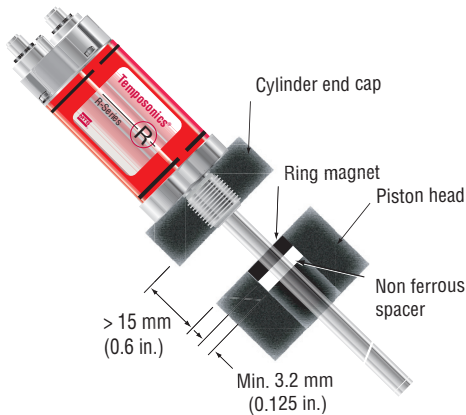
 <p>14 mm (0.55 in.) Min. I.D.</p> <p>51 mm (2 in.) Spherical O.D.</p> <p>53 mm (2.1 in.)</p> <p>3.4 mm (0.13 in.)</p>	<p><b>Magnet float</b> (Level sensing applications) Specific gravity: 0.70 maximum Pressure: 870 psi maximum</p> <p>(This float is used with Model RH rod-style sensors for hydraulic fluid or fresh water applications only). Collar (part no.: 560777) is recommended for end of stroke stops.</p>	251447
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### Model RH Rod-Style sensor mounting

The position magnet requires minimum distances away from ferrous metals to allow proper sensor output. The minimum distance from the front of the magnet to the cylinder end cap is 15 mm (0.6 in.).

The minimum distance from the back of the magnet to the piston head is 3.2 mm (0.125 in.). However, a minimum distance of at least 5 mm (0.197 in.) is preferred for added performance margin. The non-ferrous spacer (part no.: 400633) provides this minimum distance when used along with the standard ring magnet (part no.: 201542-2), as shown in 'Figure 7'.

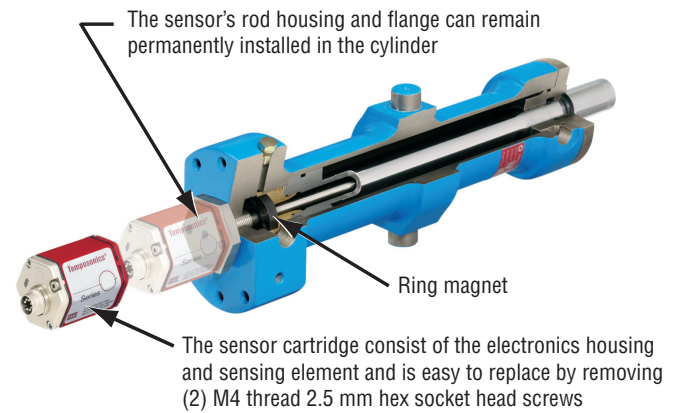


**Figure 7.** Model RH rod-style mounting

### Cylinder installation

When used for direct-stroke measurement in fluid cylinders, the sensor's high pressure, stainless steel rod installs into a bore in the piston head/rod assembly as shown in 'Figure 8'. This method guarantees a long-life and trouble-free operation.

The sensor cartridge can be removed from the flange and rod housing while still installed in the cylinder. This procedure allows quick and easy sensor cartridge replacement without the loss of hydraulic pressure.



**Figure 8.** Fluid cylinder installation

### Connections and wiring

#### (D58) BUS CONNECTOR OPTION

D58 connector option for 'daisy chain' topologies. A separate cable is used for the supply voltage. Unused connectors should be covered by a protective cap (part no.: 370537).

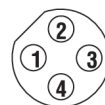
#### BUS CONNECTIONS PORTS 1 AND 2



**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



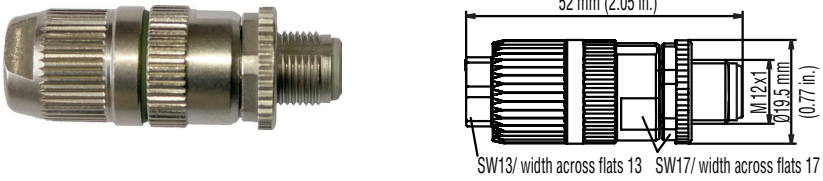
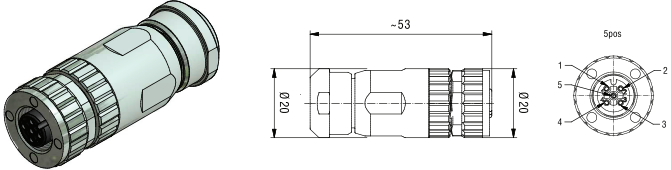

**Input voltage, male, 4-pin (M12-A) integral connector pin-out as viewed from the end of the sensor**

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

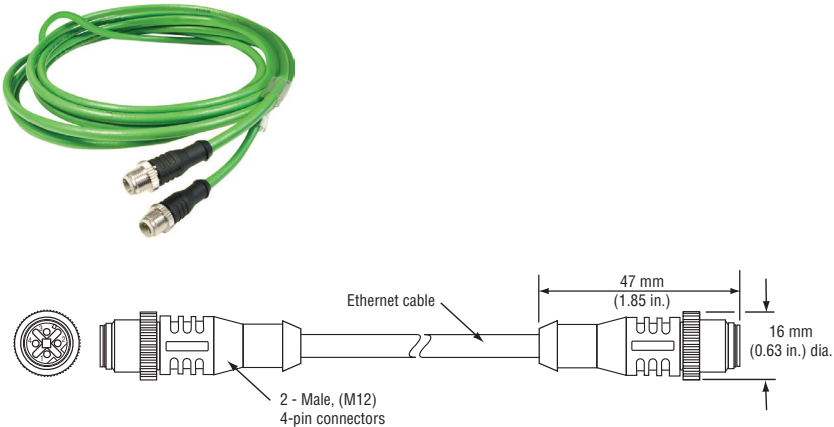
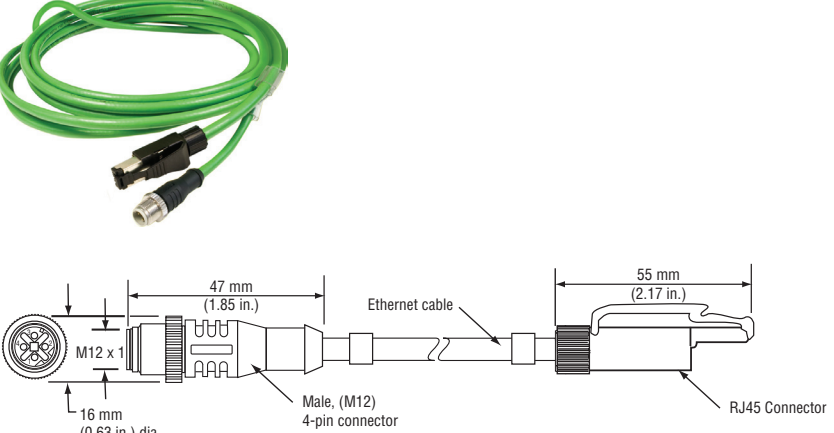
## Model RP and RH Sensors

### Ordering Information; Connector and Cable Assembly Options

**(D58) CABLE CONNECTOR OPTIONS** (Drawing dimensions are for reference only)

Connector and connector dimensions	Description	Part number
	<p><b>Bus Cable Connector, Male 4-pin (M12), D-coded with insulation displacement technology</b></p>	370523
	<p><b>Female cable connector, straight exit (Field installable)</b></p> <p>5-Pin (M12-A) connector for power supply  <b>Termination:</b> Screw terminals  <b>Cable gland:</b> for 4 to 8 mm dia cable</p>	370677
	<p><b>Connector end cap</b></p> <p>(Unused connectors should be covered by this protective cap)</p>	370537

### BUS CABLE WITH CONNECTORS (Drawing dimensions are for reference only)

Bus cable and connector assemblies	Description	Part number
	<p><b>Industrial Ethernet Bus Cable, 5 m length (Cat 5e ES)</b></p> <p>Assembly Includes two 4-pin (M12) connectors (D-coded) and PUR cable jacket (green)</p>	530064
	<p><b>Industrial Ethernet Bus Cable, 5 m length (Cat 5e ES)</b></p> <p>Assembly Includes one RJ45 connector and one 4-pin (M12) connector (D-coded) with PUR cable jacket (green) Cables using the RJ45 connector provide convenient sensor connection to a PC for setup and programming but are not recommended for factory floor installations.</p>	530065





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