

Tempsonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

R-Series
Analog

R-Series Models RP and RH Analog Outputs (Voltage/Current)

Document Part Number
550992 Revision F

Data Sheet



Model RP Profile-style position sensor

Model RH Rod-style position sensor

FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct Analog Outputs (Voltage or Current)
- Single or Dual Channel Outputs (Position + Speed)

BENEFITS

- Rugged Industrial Sensor
- Dual Magnet Position Measurement
- 100% Field Adjustable Null And Span Setpoints

APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions
- For Accurate, Dual-Magnet Position Measurement

TYPICAL INDUSTRIES

- Fluid Power
- Factory Automation
- Material Handling and Packaging
- Woodworking, Metalworking and Assembly Tools
- Plastic Injection and Blow Molding



R-Series Models RP and RH Sensors

Product Overview and Specifications

Product overview

R-Series model RH and RP sensors are extremely robust and are ideal for continuous operation under harsh industrial conditions. MTS offers two standard sensor housings, rod and profile extrusion. The rod housing is capable of withstanding high pressures such as those found in hydraulic cylinders. The profile extrusion housing provides convenient mounting options and captive sliding magnets which utilize slide bearings of special material that reduce friction, and help mitigate dirt build up. The sensor head contains the active signal conditioning and a complete integrated electronics interface. Double shielding is used to ensure EMI protection for unsurpassed reliability and operating safety.

Product specifications

Parameters	Specifications	Parameters	Specifications
OUTPUT		ENVIRONMENTAL	
Measured output variables:	Position + speed (magnitude) or velocity (with direction) for single or dual magnets	Operating conditions:	Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 30 ppm/°C
Resolution:	Position measurement: 16 bit; 0.0015% (minimum 1 µm) Speed measurement: 0.1 mm/s	EMC test:	Electromagnetic emission: IEC/EN 50081-1 Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified
Linearity deviation:	< ± 0.01% full stroke (minimum ± 50 µm)	Shock rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)	Vibration rating:	15 g (30 g with HVR option)/10 to 2000 Hz, IEC standard 68-2-6
Hysteresis:	< 4 µm	WIRING	
Analog Outputs:	Voltage: 0 to 10, 10 to 0, -10 to +10, +10 to -10 Vdc (minimum controller load >5k ohms) Current: 4(0) to 20 mA, 20 to 4(0) mA (minimum/max load 0/500 ohms)	Connection type:	6-pin male D60 (M16) connector or integral cable
Stroke lengths:	Range (Profile style): 25 to 5080 mm (1 to 200 in.) Range (Rod style): 25 to 7620 mm (2 to 300 in.) Update times: 0.5 ms up to 1200 mm, 1.0 ms up to 2400 mm, 2.0 ms up to 4800 mm, 5.0 ms up to 7620 mm stroke length	PROFILE STYLE SENSOR (MODEL RP)	
Speed measurement:	Range: 0.025 - 10 m/s (1.0 - 400.0 in./s) Deviation: <0.5% Resolution: 0.1 mm/s (0.004 in./s) Update times: Refer to update times in 'stroke lengths' above	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)
ELECTRONICS		Sealing:	IP 65 **
Operating voltage:	+24 Vdc nominal: -15% or +20% * Polarity protection: up to -30 Vdc Over voltage protection: up to 36 Vdc Current drain: 100 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Sensor extrusion:	Aluminum (Tempsonics profile style)
Setpoints:	Setpoint adjustment (Null/Span): 100% of electrical stroke length. 25 mm (0.98 in.) min. distance between setpoints. For dual-magnet outputs: 76 mm (3 in.) min. distance between magnets	Mounting:	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove
ROD STYLE SENSOR (MODEL RH)		Magnet types:	Captive-sliding magnet or open-ring magnet
		Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)
		Sealing:	IP 67 or IP 68 for integral cable models **
		Sensor rod:	304L stainless steel
		Operating pressure:	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)
		Mounting:	Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A
		Typical mounting torque:	45 N·m (33 ft. - lbs.)
		Magnet types:	Ring magnet, open-ring magnet, or magnet float

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Output options

R-Series analog sensors provide single or dual-magnet sensor options along with single or dual-channel outputs (see 'Figure 1').

The R-Series analog sensor can be ordered for single-position magnet applications which provide one position output, and/or one velocity output over the active stroke length.

The R-Series sensor can also be ordered for dual-position magnet applications which provide two position outputs, or two velocity outputs, or one of each.

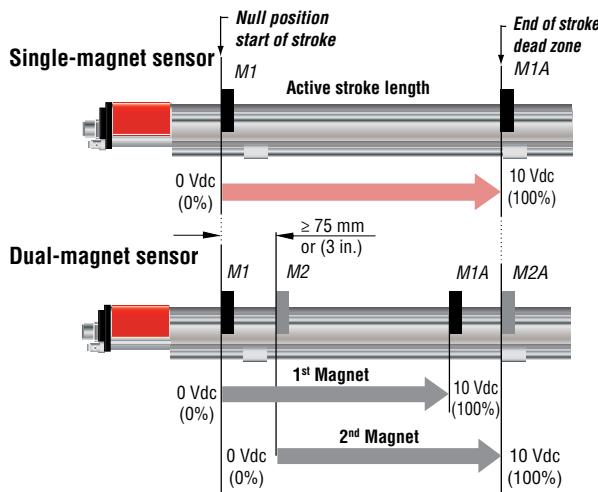


Figure 1. Single and dual-magnet output diagram

When using dual magnets, the minimum allowed distance between the magnets is 75 mm (3 in.) to maintain proper sensor output.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY

Diagnostic LEDs (green/red), located beside the connector or cable exit (see 'Figure 2'), provide basic visual monitoring for normal sensor operation and troubleshooting. Diagnostic display LEDs indicate four modes described in 'Table 1'.



Figure 2. R-Series sensor diagnostic LEDs

Green	Red	Operation status/mode
ON	OFF	Normal function (operation mode)
ON	Flashing	Magnet out of setup range
ON	ON	Magnet not detected or wrong quantity of magnets
Flashing	ON	Programming mode

Table 1. Diagnostic LED codes

Advanced communication and programmability

SENSOR FIELD PROGRAMMING

Temposonics R-Series Analog sensors are pre-configured at the factory by model number designation. For many applications, normal sensor installation and operation does not require additional adjustment. If however, sensor parameter changes are required in the field, the 'R-Series Analog PC Programming Kit, part no. 253309-1' (see 'Figure 3') can be used to easily program the sensor electronically without opening the sensor's housing.

Field programming to adjust the output values is available for any setting needed, within the selected output range. Each sensor's output range is selected from the available options when ordering a particular sensor model number. There are six different manufacturing build types available, three single channel and three dual channel outputs in various ranges as described below:

Single-channel output for either position or speed:

- Voltage output between 0 and +10 volts
- Voltage output between -10 and +10 volts
- Current output between 0 (or 4) and 20 mA

Dual-channel outputs for position and/or speed:

- Voltage outputs between 0 and +10 volts
- Voltage outputs between -10 and +10 volts
- Current outputs between 0 (or 4) and 20 mA

Field Programming Notes:

Field programming allows for numerous custom sensor configurations; however, please note that field programming can not be used to change the R-Series Analog sensor from one manufacturing build type to another.

Field programming (output voltages):

1. Sensor models ordered with *one output channel* can not be reprogrammed in the field to provide a second output channel.
2. Sensor models ordered with *positive only output voltages* can not be reprogrammed in the field to include negative output voltages.
3. Sensor models ordered with *both positive and negative output voltages* can be reprogrammed in the field for positive only voltages, or negative only voltages. However, resolution is then reduced.



Figure 3. R-Series Analog PC Programming Kit, Part no. 253309-1
(For single or dual magnet sensor applications)

R-Series Analog Sensor Field Programming

Advanced communication and programmability

SENSOR FIELD PROGRAMMING

R-Series Analog PC Programming Kit (Part no.: 253309-1)
includes the following components:

- Wall adapter style power supply (24 Vdc output)
- USB Serial converter box with USB cable to connect to PC
- Two connection cables:
 - Cable with connector if sensor is ordered with the D60 integral connector option.
 - Cable with quick connects if sensor is ordered with the integral cable option.
- R-Series Analog PC Setup software, available for download at www.mtssensors.com.

The R-Series Analog PC Setup software user-friendly interface (see 'Figure 4') enables the operator to take advantage of customizing the following settings:

- Magnet positions and sensor output values for Setpoint 1 (*Null*) and Setpoint 2 (*Span*) for single or dual magnets. For additional information about setpoints, refer to section '*R-Series analog handheld programmer for single-magnet sensors*'.
- Output range settings for speed, or for speed with direction.
- Assign position or velocity output functions for the single or dual magnets, and for the one or two output channels. Output function assignments are limited to the manufacturing build type of the sensor.
- Assign error output values when the magnet moves beyond the programmed setpoints.

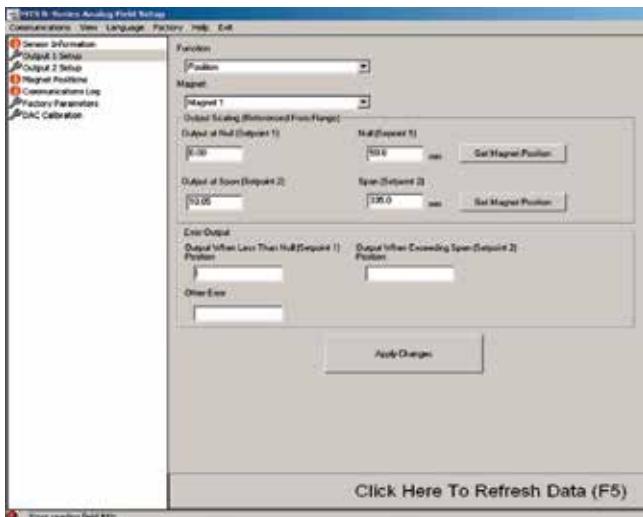


Figure 4. R-Series PC Setup software interface

R-SERIES ANALOG HANDHELD PROGRAMMER FOR SINGLE MAGNET SENSOR APPLICATIONS

The R-Series Analog Handheld Programmer (shown in Figure 5) can be used to program the magnet positions for the start of output, (0% = 0 Vdc, -10 Vdc, 4 mA, or 0 mA), and the end of output, (100% = 10 Vdc or 20 mA), for the single magnet version of the R-Series analog sensor.



Figure 5. R-Series Analog Handheld Programmer, Part no.: 253124

Standard factory settings place the setpoint 1 '*Null*' and setpoint 2 '*Span*' at the limits of the sensor's active stroke range. For example, a sensor ordered with 4 - 20 mA output will be factory set for 4 mA output at the bottom limit of the stroke range at the '*Null*' position. Likewise, the 20 mA output will be factory set at the top limit of the stroke range at the '*Span*' position.

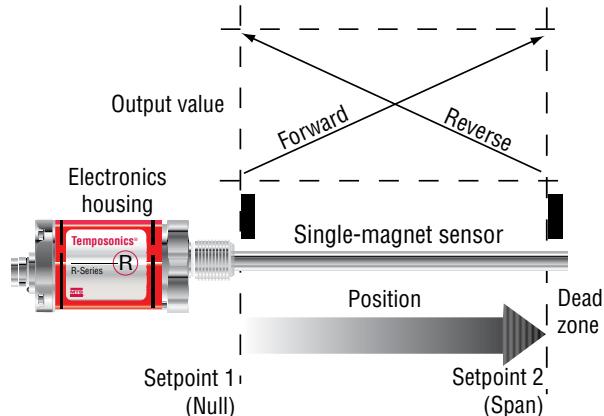


Figure 6. Standard factory settings

Setpoint 1 and setpoint 2 can be re-positioned for the actual measuring length needed anywhere within the active stroke range.

Note:

The minimum distance allowed between setpoint 1 and setpoint 2 is 25 mm (0.98 in.).

These adjustments are easily performed, even when the sensor is not directly accessible, by connecting the analog handheld programmer to the sensor's integral cable or extension cable.

When programming new setpoints, the R-Series Analog Handheld Programmer adjusts the sensor output values to either 0% or 100% at the two selected magnet positions. To program other setpoint output values, use the '*R-Series Analog PC Programming Kit*' (Part no.: 253309-1).

Note:

The R-Series Analog Handheld Programmer can also be used to change the output direction from forward-acting (e.g. 4 - 20 mA output) to reverse-acting (20 - 4 mA output), as well as, reverse-acting to forward-acting.

R-SERIES ANALOG CABINET PROGRAMMER FOR SINGLE MAGNET SENSORS

The R-Series Analog Cabinet Programmer (see 'Figure 7') provides the same programming functions as the R-Series Analog Handheld Programmer and is designed to mount in a control cabinet. The R-Series Analog Cabinet Programmer includes a rear snap-in mounting feature that allows the unit to mount on standard 35 mm DIN rail.

After installation, the programmer can remain wired up to both the sensor and PLC interface module if reprogramming or a different machine setup is later required, a built-in 'Program/Run' switch allows this programmability.



Figure 7. R-Series Analog Cabinet Programmer (two shown),
Part no.: 253408 (for single-magnet sensor applications)

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.

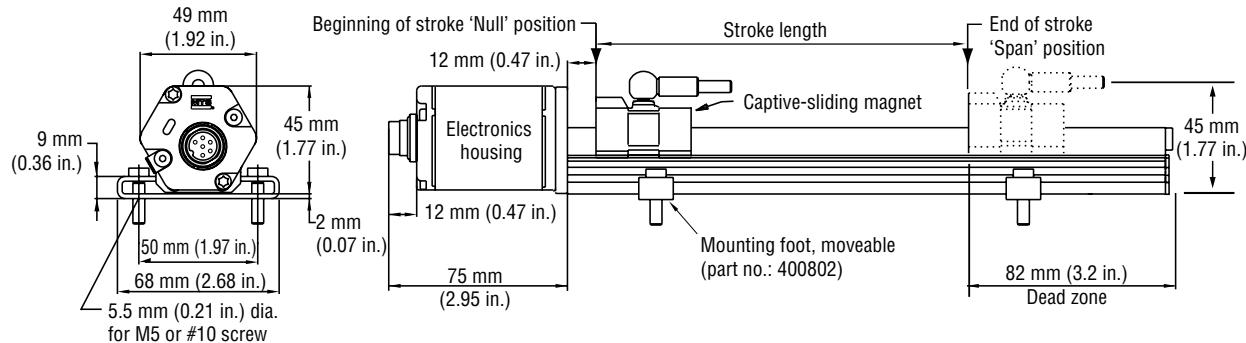


Figure 8. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D60** integral connection type option)

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

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

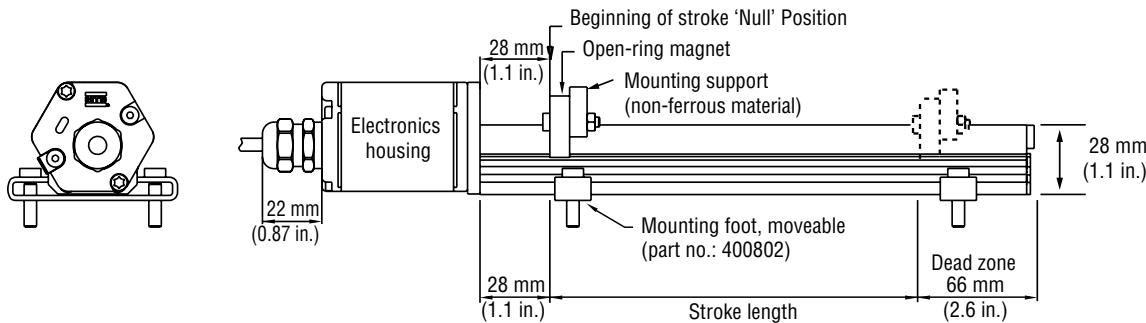


Figure 9. R-Series Model RP Profile-style sensor dimension reference (Shown with the **R05** integral cable connection type option)

Standard magnet selections, mounting and installation (Model RP)**SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)**

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.

R-Series Model RH Rod-Style Sensor**Dimension References****Model RH rod-style sensor dimension references**

The Tempsonics 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 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 (197.1 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.

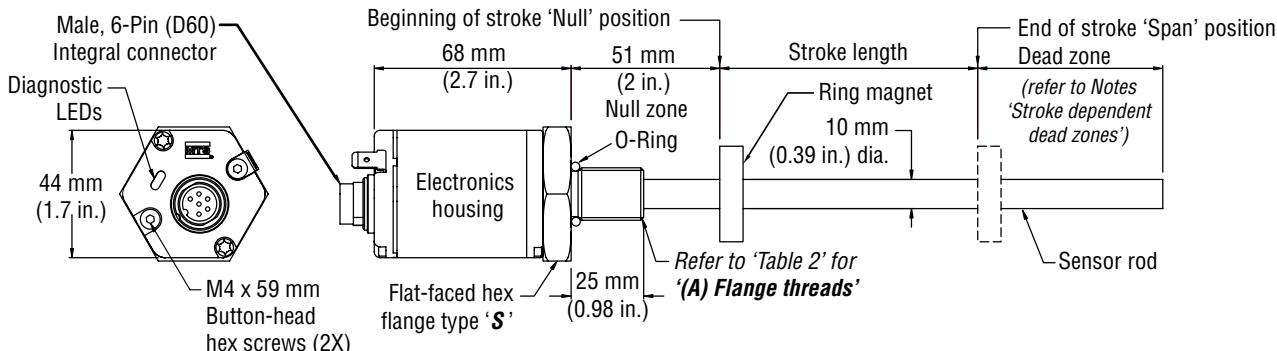


Figure 10. Model RH Rod-style sensor dimension reference (shown with the **D60** integral connection)

MODEL RH, ROD-STYLE SENSOR WITH 6-PIN DIN MATING CABLE CONNECTOR (MAGNET ORDERED SEPARATELY)

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

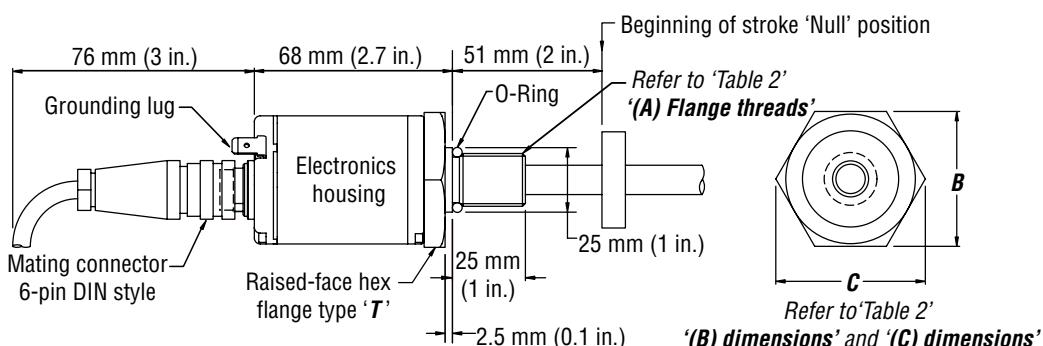


Figure 11. Model RH Rod-style sensor dimension reference (shown with mating cable connector)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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 magnet selections, mounting and installation (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.

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

Models RP and RH connections and wiring

STANDARD MALE (D60) 6-PIN DIN INTEGRAL CONNECTOR (M16)

Note:

When using the single channel output, (pins 1 and 2), the unused pins for output 2 (pins 3 and 4) should be left floating (unconnected), unless sensor programming is being performed.



Male, 6-pin (D60) integral connector pin-out as viewed from the end of the sensor

Pin number	Wire color	Function / Analog outputs
1	Gray	Output 1/ Position 1: 0 to 10, 10 to 0, -10 to +10, +10 to -10 Vdc 4 to 20, 20 to 4, 0 to 20, 20 to 0 mA (Required for programming mode / 0% setting)
2	Pink	Return for pin 1
3	Yellow	Output 2/ Position 2 or Speed: 0 to 10, 10 to 0, -10 to +10, +10 to -10 Vdc 4 to 20, 20 to 4, 0 to 20, 20 to 0 mA (Required for programming mode / 100% setting)
4	Green	Return for pin 3
5	Red or Brown	+24 Vdc (-15/+20%) (Required for programming mode)
6	White	DC ground (for supply) (Required for programming mode)

Models RP and RH Sensors

Ordering Information

<input type="checkbox"/>																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

(3 to 7 digit code, defined by the output option selected)

SENSOR MODEL

RP = Profile style

RH = Hydraulic rod style

1-2

HOUSING STYLE

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

- S** = Captive-sliding magnet with ball joint **V** = Captive-sliding magnet with ball joint at top (part no. 252182) **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 and 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

3

STROKE LENGTH

4-8

M = Millimeters (Encode in 5 mm 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.)

CONNECTION TYPE

9-11

Integral connector:

- D60** = 6-pin DIN (M16), male, standard

Integral cables:

- R** = Integral cable, PVC jacket, pigtail termination, standard

- F** = Integral cable, black polyurethane jacket with pigtail termination

Cable length:
Encode in feet if using US customary stroke length
Encode in meters if using metric stroke length
> = 3 (03) to 98 (98) ft. or 1 (01) to 30 (30) meters.

Cable Length Note:

MTS recommends the maximum integral cable length to be 10 meters (33 ft.). Cables greater than 10 m (33 ft.) in length are available, however, proper care must be taken during handling and installation.

INPUT VOLTAGE

12

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

- A** = Same as option "1" except includes the High Vibration-Resistant (HVR) option for **Model RH only**, limited to stroke range = 50 mm (2 in.) - 2000 mm (78.7 in.). Refer to 'HVR Option Note'.

HVR Option Note:

The High Vibration-Resistant (HVR) option provides the model RH rod-style sensors with increased resistance to shock and vibration for use in heavy duty machinery. Refer to "G-Series and R-Series Sensors for High Shock and Vibration Applications", document part no.: 551073 for more information.

OUTPUT (13 - 19)

13-19

3 to 7 digit code defined by the output option selected from pages 12 and 13

1 Output channel with 1 magnet (3 digit code).

Output #1 = Magnet position

- | | | | |
|------------|------------------|------------|--------------|
| V01 | = 0 to +10 Vdc | A01 | = 4 to 20 mA |
| V11 | = +10 to 0 Vdc | A11 | = 20 to 4 mA |
| V21 | = -10 to +10 Vdc | A21 | = 0 to 20 mA |
| V31 | = +10 to -10 Vdc | A31 | = 20 to 0 mA |

CONTINUED ON NEXT PAGE

**Models RP and RH Sensors
Ordering Information**

R	<input type="checkbox"/>																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	

(3 to 7 digit code, defined by the output option selected)

2 Output channels with 2 magnets (3 digit code) _____ = **13 - 15**

Choose a value described below to encode 3 digits (sensor part number boxes 13-15) refer to 'Setpoint Note'

Output #1 = Magnet #1 position

V02	= 0 to +10 Vdc	Output #2 = Magnet #2 position
V12	= +10 to 0 Vdc	0 to +10 Vdc
V22	= -10 to +10 Vdc	+10 to 0 Vdc
V32	= +10 to -10 Vdc	-10 to +10 Vdc
A02	= 4 to 20 mA	+10 to -10 Vdc
A12	= 20 to 4 mA	4 to 20 mA
A22	= 0 to 20 mA	20 to 4 mA
A32	= 20 to 0 mA	0 to 20 mA
		20 to 0 mA

2 Output channels with 1 magnet (7 digit code) _____ = **13 - 19**

(Choose a maximum speed value described below in Table 3 to encode all 7 digits (sensor part number boxes 13 - 19))

Output #1 = Magnet position

V01 _____	= 0 to +10 Vdc
V11 _____	= +10 to 0 Vdc
A01 _____	= 4 to 20 mA
A11 _____	= 20 to 4 mA

Output #1 = magnet position

V41 _____	= 0 to +10 Vdc
V51 _____	= +10 to 0 Vdc
V61 _____	= 0 to +10 Vdc
V71 _____	= +10 to 0 Vdc
V81 _____	= -10 to +10 Vdc
V91 _____	= +10 to -10 Vdc
A41 _____	= 4 to 20 mA
A51 _____	= 20 to 4 mA

Output #1 = Magnet position (forward-acting)

V03	= 0 to +10 Vdc (3 digit code)	Output #2 = Speed magnitude
		+10 (towards head) 0 (at rest) +10 (towards tip) Vdc
		+10 (towards head) 0 (at rest) +10 (towards tip) Vdc
		20 (towards head) 4 (at rest) 20 (towards tip) mA
		20 (towards head) 4 (at rest) 20 (towards tip) mA

Output #2 = Velocity (speed with direction)

0 (towards head)	5 (at rest)	+10 (towards tip) Vdc
+10 (towards head)	5 (at rest)	0 (towards tip) Vdc
-10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
+10 (towards head)	0 (at rest)	-10 (towards tip) Vdc
-10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
+10 (towards head)	0 (at rest)	-10 (towards tip) Vdc
4 (towards head)	12 (at rest)	20 (towards tip) mA
20 (towards head)	12 (at rest)	4 (towards tip) mA

Output #2 = Magnet position (reverse-acting)

+10 to 0 Vdc

TABLE 3. FOR SENSOR MODELS WITH SPEED OUTPUT

(Choose a maximum speed value described below to encode the last 4 digits (sensor part number boxes 16-19))

For US customary stroke lengths, encode speed for in./s.

- = Speed output maximum
- Available range for US customary stroke lengths is 1.0 to 400.0 in./s, (0010 ... 4000)

Example:

Maximum speed of 12.0 in./s, and output produced for velocity = [-10(towards head) ... 0(at rest) ... +10(towards tip) Volts]

Encode: **V 6 1 0 1 2 0** or **V 8 1 0 1 2 0**

For metric stroke lengths, encode speed for m/s (range #1) or mm/s (range #2) using the information provided below:

Speed range #1, (0)

- = Speed output maximum
- Speed range #1 for metric stroke lengths is 0.1 to 10.0 m/s, (0001 ... 0100)

Example:

Maximum speed of 5.5 m/s, and output produced for speed = [+10(towards head) ... 0(at rest) ... +10(towards tip) Volts],

Encode: **V 0 1 0 0 5 5** or **V 1 1 0 0 5 5**

Speed range #2, (1)

- = Speed output maximum.
- Speed range #2 for metric stroke lengths is 25 to 90 mm/s, (1025 ... 1090)

Example:

Maximum speed of 50 mm/s, and output produced for velocity = [4(towards head) ... 12(at rest) ... 20(towards tip) mA]

Encode: **A 4 1 1 0 5 0**

Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

R-Series Models RP and RH
Synchronous Serial Interface (SSI) Output

Document Part Number
550989 Revision F

Data Sheet



Model RP Profile-style position sensor

Model RH Rod-style position sensor

**R-Series
SSI**

FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct 24/25/26 Bit SSI Output, Gray/Binary Formats
- Synchronous Measurement for Accurate Velocity/Acceleration Calculations

BENEFITS

- Superior Accuracy; Resolution Down to 0.5 Micron
- Rugged Industrial Sensor
- High-Speed Update Options
- Linearity Correction Options
- Velocity Output Option
- Optional Differential Measurement Between Two Magnets

APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions
- For Fast, Precision Motion Control

TYPICAL INDUSTRIES

- Factory Automation
- Fluid Power
- Plastic Injection and Blow Molding
- Material Handling and Packaging
- Woodworking, Metalworking and Machine Tools



R-Series Models RP and RH Sensors (SSI)

Product Overview and Specifications

Product overview

R-Series model RP and RH sensors are extremely robust and are ideal for continuous operation under harsh industrial conditions. MTS offers two standard sensor housings, rod and profile extrusion. The rod housing is capable of withstanding high pressures such as those found in hydraulic cylinders. The profile extrusion housing provides convenient mounting options and captive-sliding magnets which utilize slide bearings of special material that reduce friction, and help mitigate dirt build up. The sensor head contains the active signal conditioning and a complete integrated electronics interface. Double shielding is used to ensure EMI protection for unsurpassed reliability and operating safety.

Product specifications

Parameters	Specifications	Parameters	Specifications
OUTPUT		ENVIRONMENTAL	
Measured output variables:	Position, or position difference between 2 magnets, or velocity, internal temperature	Operating conditions:	Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 15 ppm/ °C
Resolution:	0.5 µm, 1 µm, 2 µm, 5 µm, 10 µm, 20 µm, 50 µm, 100 µm	EMC test:	Electromagnetic emission: IEC/EN 50081-1 Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified
Update Rate Measuring length:	300 750 1000 2000 5000 mm	Shock rating:	100 g (single hit)/ IEC standard 68-2-27 (survivability)
Measurements/Sec:	3.7 3.0 2.3 1.2 0.5 kHz (Up to 10 kHz for high-speed update option)	Vibration rating:	15 g (30 g with HVR option)/ 10 to 2000 Hz, IEC standard 68-2-6
Linearity deviation:	< ± 0.01% full stroke, (minimum ± 40 µm) (Linearity Correction Option (LCO) available)	WIRING	
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)	Connection type:	7-pin male D70 (M16) connector, 10-pin male MS connector or integral cable
Hysteresis:	< 4 µm (2 µm is typical)	PROFILE STYLE SENSOR (MODEL RP)	
Outputs:	Interface: Synchronous Serial Interface (SSI) (RS-422 type differential signal pairs) Data format: Binary or gray, optional parity and error bit, optional internal temperature. Data length: 8 to 32 bit Data speed (Baud rate): 70 kBd* to 1 MBd, depending on cable length (see below):	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)
Length:	<3 <50 <100 <200 <400 m	Sealing:	IP 65**
Baud rate:	1.0 MBd <400 kBd <300 kBd <200 kBd <100 kBd	Sensor extrusion:	Aluminum (Tempsonics profile style)
Stroke length:	Range (Profile style): 25 to 5080 mm (1 to 200 in.) Range (Rod style): 25 to 7620 mm (1 to 300 in.)	Mounting	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove
Distance between magnets:	75 mm (3 in.) Minimum for 2 magnet differential output * With standard monoflop of 16 µs	Magnet types:	Captive-sliding magnet or open-ring magnet
ELECTRONICS		ROD STYLE SENSOR (MODEL RH)	
Operating voltage:	+24 Vdc nominal: -15% or +20% * Polarity protection: up to -30 Vdc Oversupply protection: up to 36 Vdc Current drain: 100 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)
		Sealing:	IP 67 or IP 68 for integral cable models**
		Sensor rod:	304L stainless steel
		Operating pressure:	350 bar static, 690 bar peak (5000 psi, 10,000 psi peak)
		Mounting:	Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A
		Typical mounting torque:	45 N·m (33 ft. - lbs.)
		Magnet types:	Ring magnet, open-ring magnet, or magnet float

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Synchronous Serial Interface (SSI)

Tempsonics R-Series sensors with SSI fulfill all requirements of the SSI standard for an absolute encoder. The position value is encoded in a 24/25/26 code format and is transmitted at high speed in SSI standard format to the control device. The main feature of SSI is the synchronized data transfer. Data transfer synchronization simplifies the closed-loop control system.

A clock pulse train from a controller is used to gate out sensor data. One bit of position data is transmitted to the controller for each clock pulse received by the sensor (see 'Figures 1 and 2'). The absolute position data is continually updated by the sensor and converted by the shift register into serial information. (see 'Figure 3').

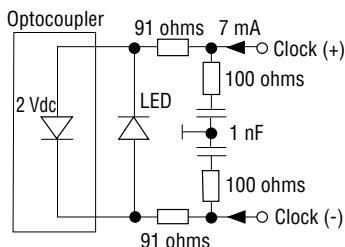


Figure 1. Sensor input

Measuring modes

THE SENSOR MEASUREMENT CYCLE

For all Tempsonics position sensors, the measurement cycle begins with a very short electrical current pulse being applied to the sensor's waveguide. This is called the 'interrogation pulse'. It creates a magnetic field that interacts with another magnetic field emanating from the position magnet. This interaction produces the magnetostrictive effect and results in a localized mechanical strain in the sensor's waveguide. When the interrogation pulse ends, the strain is suddenly released, sending a rotational sonic strain pulse down the waveguide. The measurement cycle ends when the sonic strain pulse arrives at the end of the waveguide and is detected by the sensor's electronics. By accurately measuring the travel time of the sonic strain pulse the magnet's precise position is determined.

ASYNCHRONOUS MEASURING MODE

For the SSI sensor, the position data is always communicated to the controller or PLC using the Synchronous Serial Interface format. When the SSI sensor is operated as fast as possible, i.e. in Asynchronous Measuring Mode, the position data is updated and stored inside the sensor as quickly as the sensor's measurement cycle will allow. The minimum time for the measurement cycle is determined by the sensor's overall stroke length.

The controller's loop time will determine when the sensor's stored data is collected. For this mode the controller loop time is not synchronized with the sensor's measurement cycle time. However, if it is always slower than the sensor's cycle time then there will always be new position data available in the sensor's shift register, waiting to be clocked out over the SSI interface.

As shown in 'Figure 4', although the sensor is updating the position data as fast as possible, the actual data values collected by the controller can have varying delay times. This is shown as the delays from when the magnet's position was captured, (at the instant the interrogation pulse had started the relevant measurement cycle), to when the data is delivered at the end of the controller loop cycle.

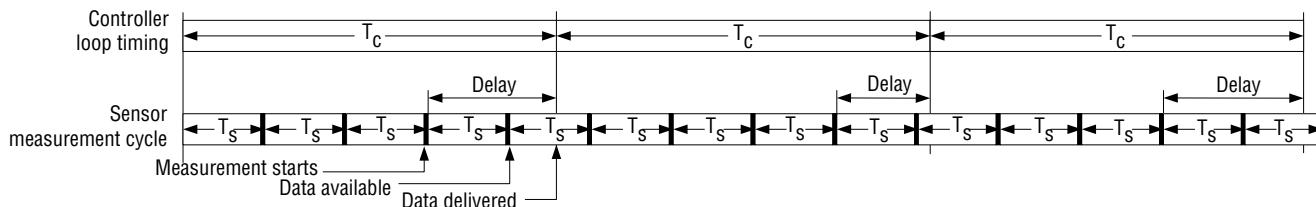


Figure 4. Asynchronous measuring mode, controller loop timing

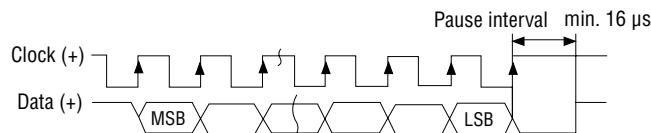


Figure 2. Timing Diagram

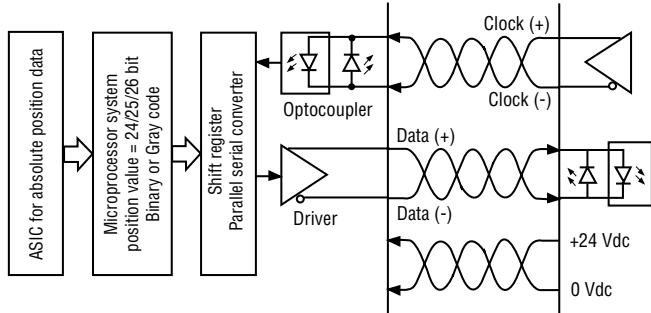


Figure 3. Logic Diagram

R-Series Models RP and RH Sensors (SSI)

Measuring Modes and Advanced Output Options

SYNCHRONOUS MEASURING MODE ('SYNC 1' OPTION)

Using the Synchronous Measuring Mode, the Temposonics SSI sensor has timing capabilities to optimize the communication link to the controller. Many motion control applications require velocity and/or acceleration be calculated, and therefore, must rely on position data having minimal delay, and minimal timing variability. With the Synchronous Measuring Mode, MTS Sensors has developed a proprietary algorithm to not only guarantee true measurement synchronization but at the same time minimize any propagation delay relative to the controller loop rate.

First, the sensor quickly determines the controller's loop timing – typically after one stable cycle period. Once this is known, and determined to be repeatable to specified limits, the sensor knows exactly when data will be required. The sensor then determines when to start the next measurement cycle, delaying the interrogation pulse, so that the measurement cycle will complete just in time to deliver the freshest data possible when the controller makes the next request, (*see 'Figure 5'*).

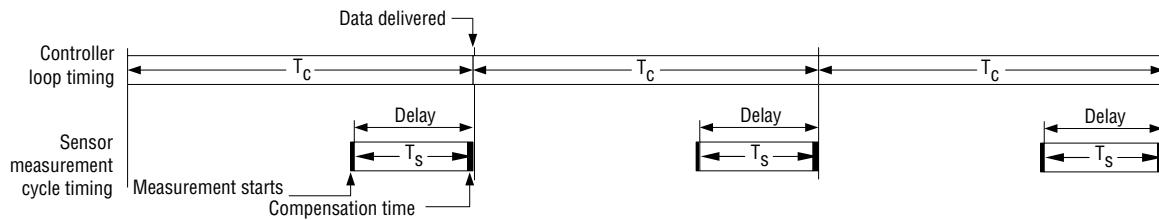


Figure 5. Synchronous measuring mode, Sync 1 option

This form of synchronization to the controller provides the high quality position data needed for complex motion control algorithms and for multiple axes machines requiring tight coordination. When developing applications that will use the Synchronous Measuring Mode, the designer must choose a controller or PLC input module that supports this mode.

Advanced output options

The Temposonics SSI sensor has advanced output options that are helpful for maximizing system performance in demanding applications requiring very high accuracy and speed.

ENHANCEMENTS FOR THE SYNCHRONOUS MEASURING MODE ('SYNC 2' & 'SYNC 3' OPTIONS)

The 'Sync 2' option provides a high speed update feature. When motion control applications require new position data faster than the sensor's measurement cycle time, the high speed update feature provides extrapolated data values, calculated on the fly. A prediction algorithm generates usable position data for delivery to the controller whenever the sensor has not yet completed the next measurement cycle. These extrapolated values are used by the controller as normally updated position data, allowing very fast controller loop times that are necessary for tight control of high speed applications.

The 'Sync 3' option provides an additional enhancement to the high speed update feature of Sync 2. For this mode the prediction algorithm is used for all of the sensor's position data to compensate for the inherent lag time due to the sensor's measurement cycle.

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 +/- 20 microns (0.0008 in.). For stroke lengths over 5000 mm (197 in.), the linearity accuracy is improved up to a 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.

ERROR DELAY (SKIP FILTER)

For applications having very high shock and vibration levels that exceed the sensor specification ratings the Error Delay (Skip Filter) can be used to prevent errors being produced on some types of controllers. During these very high shock events the sensor may fail to capture the magnet return signal, and if so, will normally output a zero position value. The Error Delay will instead repeat the last good output value. For long duration shock events the Error Delay will continue to repeat the good output value up to the number of times selected.

NOISE REDUCTION FILTER

Complex systems can have various noise sources sometime significant enough to require filtering. If needed, a Simple Moving Average (SMA) filter function is available to reduce noise effects. The filter algorithm can be adjusted to include the last 2, 4, or 8 output values in the calculated average.

PEAK REDUCTION FILTER

A variation of the filter function is the Weighted Infinite Average (WIA) filter. If needed, this filter can provide a greater smoothing effect and has an adjustable weight parameter.

TEMPERATURE MONITORING

A temperature monitoring device is included inside the sensor electronics housing. Its output can be used to track the general operating conditions for the sensor and to monitor for over temperature. It cannot be used for calculating temperature compensation.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY

Diagnostic LEDs (green/red), located beside the connector or cable exit (*see 'Figure 6'*), provide basic visual monitoring for normal sensor operation and troubleshooting. Diagnostic display LEDs indicate four modes described in '*Table 1*'.



Figure 6. R-Series sensor Integrated diagnostic LEDs

Green	Red	Operation status/mode
ON	OFF	Normal function (operation mode)
ON	ON	Magnet not detected or wrong quantity of magnets
ON	Flashing	Sensor not synchronous (<i>For synchronous measurement mode only</i>)
Flashing	ON	Programming mode

Table 1. Diagnostic display indicator modes

Advanced communication and programmability

SENSOR FIELD PROGRAMMING

Temposonics R-Series sensors with SSI are pre configured at the factory by model number designation. In the event that sensor parameter changes are required in the field, the '*R-Series SSI PC Programming Kit, part no. 253310-1*' (*see 'Figure 7'*) can be used to easily program the sensor electronically without opening the sensor's housing.



Figure 7. R-Series SSI PC Programming Kit, Part no. 253310-1

R-SERIES SSI PC PROGRAMMING KIT (PART NO.: 253310-1) INCLUDES THE FOLLOWING COMPONENTS:

- Wall adapter style power supply (24 Vdc output).
- USB Serial converter box with USB cable to connect to PC
- Two connection cables:
 - Cable with connector if sensor is ordered with the D70 integral connector option.
 - Cable with quick connects if sensor is ordered with the integral cable option.
- R-Series SSI PC Setup software, available for download at www.mtssensors.com

The Utility software included in the R-Series SSI PC Setup software provides a user-friendly interface (*see 'Figure 8'*).

The setup software allows the following set of parameters to be field programmed.

FIELD PROGRAMMABLE PARAMETERS:

- Data length
- Data format
- Resolution
- Measuring direction
- Synchronous / asynchronous measurement
- Measurement filter

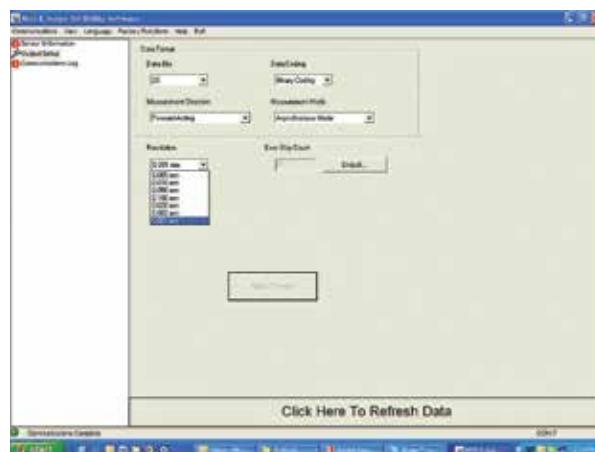


Figure 8. R-Series SSI PC Setup software interface

R-Series Model RP Profile-Style Sensor Dimension References

Model RP - Magnet Selection and Mounting Reference

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.

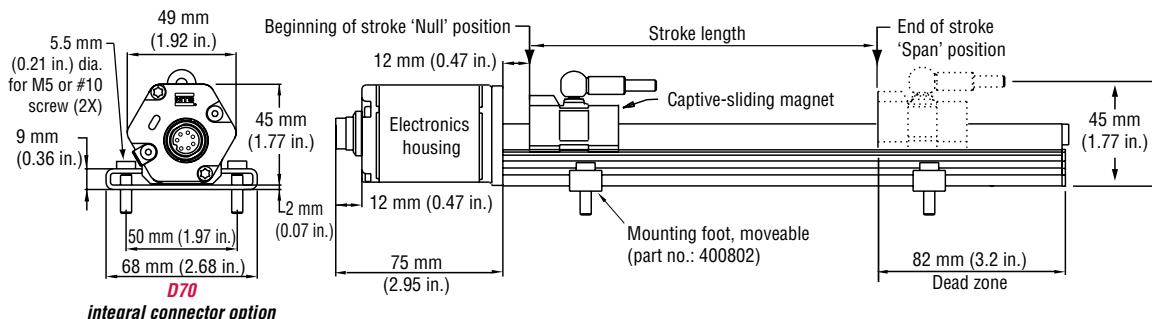


Figure 9. R-Series Model RP Profile-style sensor dimension reference (Shown with **D70** Integral connector option)

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

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

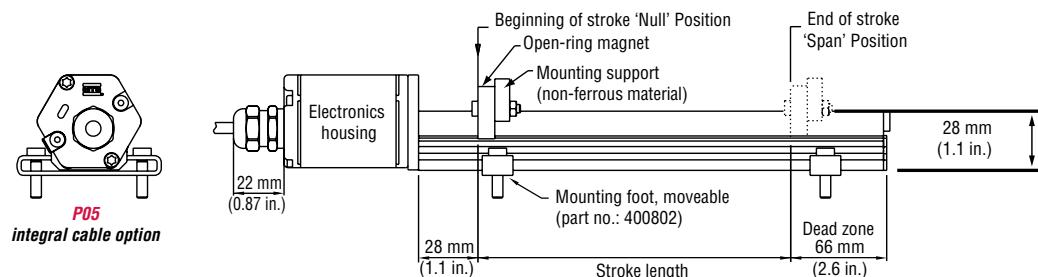


Figure 10. R-Series Model RP Profile-style sensor dimension reference (Shown with **P05** Integral cable option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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 references

The Tempsonics 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 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 (197.1 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.

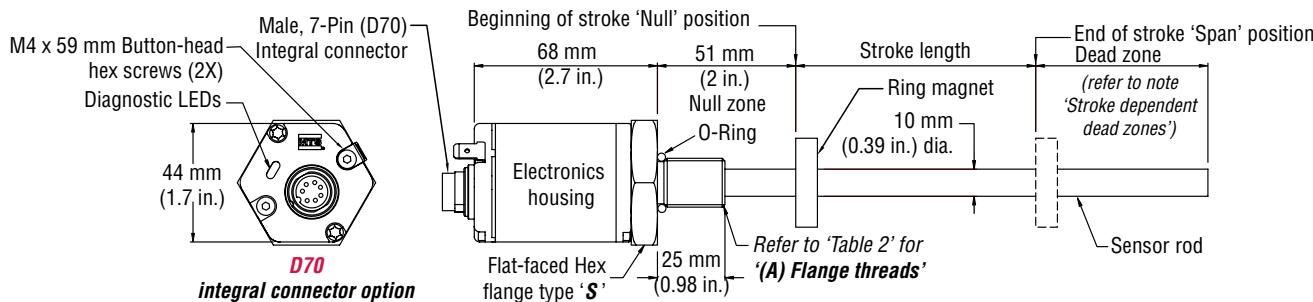


Figure 11. Model RP Profile-style sensor dimension reference (Shown with **D70** Integral connector option)

MODEL RH, ROD-STYLE SENSOR WITH 7-PIN MATING CONNECTOR (MAGNET ORDERED SEPARATELY)

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

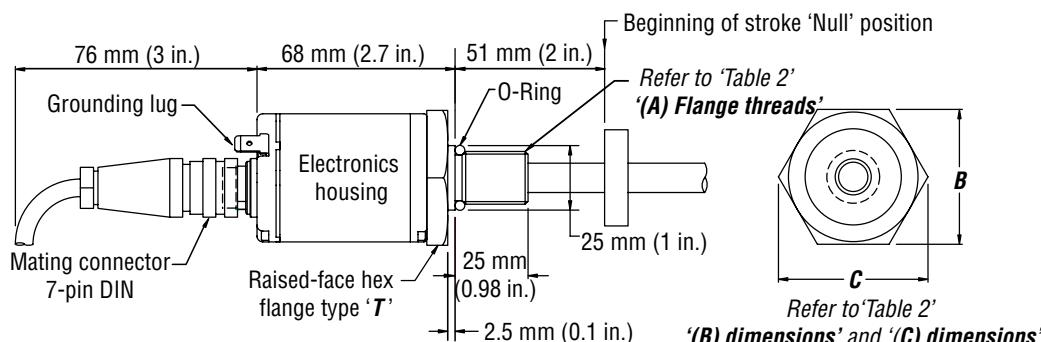


Figure 12. Model RH Rod-style sensor dimension reference (Shown with mating cable connector)

Housing style flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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

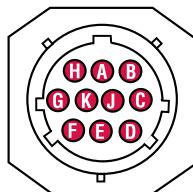
Standard magnet selections, mounting and installation (Model RH)

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

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

R-Series Models RP and RH Sensors**Connections and Wiring****Connections and wiring****STANDARD MALE 7-PIN DIN (D70) INTEGRAL CONNECTOR WIRING**Male, 7-pin (D70) integral connector
(pin-out as viewed from the end of the sensor)

Pin no.	Ext. cable	Function / SSI outputs
1	Gray	Data (-)
2	Pink	Data (+)
3	Yellow	Clock (+)
4	Green	Clock (-)
5	Brown	+24 Vdc (-15/+20%)
6	White	DC ground (for supply)
7	N.C.	N/A

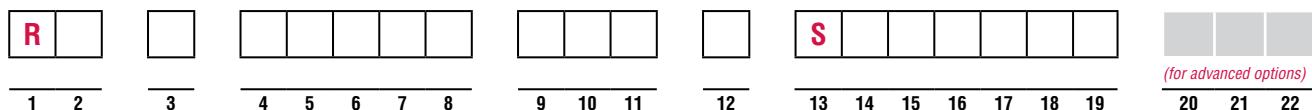
Male, 10-pin (MS) integral connector
(pin-out as viewed from the end of the sensor)

Pin no.	Ext. cable	Function / SSI outputs
A	White	DC Ground
B	-	No connection
C	Gray	Data (-)
D	Pink	Data (+)
E	Red	+24 Vdc (-15 / +20%)
F	-	No connection
G	Yellow	Clock (+)
H	Green	Clock (-)
I	-	No connection
J	-	No connection
K	-	No connection

Notes:

1. Sensor diagnostics LED's are not available with the MS connector option.
2. MS style cable connector, part no.: 370013, (field installed) mates with the integral MS connector.

**R-Series Models RP and RH Sensors
Ordering Information**



SENSOR MODEL

RP = Profile style

RH = Hydraulic rod style

= **R** **1-2**

HOUSING STYLE

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 and 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

= **3**

STROKE LENGTH

= **4-8**

M = Millimeters
(Encode in 5 mm 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.)

CONNECTION TYPE

= **9-11**

Integral connector:

D70 = 7-pin DIN (M16), male, standard
MS0 = 10-Pin MS style, male

Cable Length Note:

MTS recommends the maximum integral cable length to be 10 meters (33 ft.). Cables greater than 10 m (33 ft.) in length are available, however, proper care must be taken during handling and installation.

Integral cables:

P = Integral high-performance cable, orange jacket with pigtail termination
R = Integral cable, PVC jacket, pigtail termination, standard
F = Integral cable, black polyurethane jacket with pigtail termination

Cable length:

Encode in feet if using US customary stroke length

Encode in meters if using metric stroke length

→ = 3 (03) to 98 (98) ft. or 1 (01) to 30 (30) meters.

INPUT VOLTAGE

= **12**

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

HVR Option Note:

The High Vibration-Resistant (HVR) option provides the model RH rod-style sensors with increased resistance to shock and vibration for use in heavy duty machinery. Refer to "G-Series and R-Series Sensors for High Shock and Vibration Applications", document part no.: 551073 for more information.

A = Same as option "1" except includes the High Vibration-Resistant (HVR) option for **Model RH only**, limited to stroke range = 25 mm (1 in.) - 2000 mm (78.7 in.). Refer to 'HVR Option Note'.

OUTPUT (13 - 19)

S + the 6 digit Output code defined (Continue to the next page)

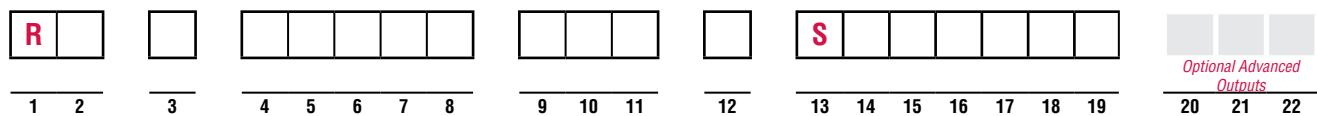
OPTIONAL ADVANCED OUTPUTS (18 - 22)

99 + the 3 digit Output code defined (Continue to the next page)

**R-Series
SSI**

R-Series Models RP and RH Sensors

Ordering Information



OUTPUT (13 - 19)
S + the 6 digit Output code

= **S** **13-19**

[14] Data length

- 1** = 25 bits
- 2** = 24 bits
- 3** = 26 bits

[15] Output Format

- B** = Binary
- G** = Gray code

[16] Resolution

- 1** = 0.005 mm
- 2** = 0.01 mm
- 3** = 0.05 mm
- 4** = 0.1 mm
- 5** = 0.02 mm
- 6** = 0.002 mm
- 8** = 0.001 mm
- 9** = 0.0005 mm

[17] Filtering Performance

- 1** = Standard, no filter
- A** = No filter + error delay (4 cycles)
- C** = No filter + error delay (8 cycles)
- D** = No filter + error delay (10 cycles)
- G** = Noise reduction filter (8 values) + error delay (10 cycles)
- K** = Peak reduction filter (8 values)
- N** = Peak reduction filter (8 values) + error delay (10 cycles)

[18] [19] Signal Options (scale orientation)

- 00** = Measuring direction forward, async
- 01** = Measuring direction reverse, async
- 02** = Measuring direction forward, sync1
- 05** = Measuring direction forward, bit-25 = Alarm, bit-26 = Parity even, (select data length 26 bits), async
- 16** = Measuring direction forward, LCO
- 99** = **Advanced output options (Enter 99 and an additional 3 character suffix as shown below for boxes 18-22).**
Advanced outputs are optional and are not required to complete a valid model number.

OPTIONAL ADVANCED OUTPUTS (18-22)
99 + 3 digit Output code

= **9** **9**
18 19

18-22
20 21 22

[20] Measurement Contents

- 1** = Position
- 2** = Position difference between 2 magnets
- 3** = Velocity
- 4** = Position + temperature
- 5** = Position difference between 2 magnets + temperature
- 6** = Velocity + temperature

[21] Direction and Sync Mode

- 1** = Forward async
- 2** = Forward sync1
- 3** = Forward sync2
- 4** = Forward sync3
- 5** = Reverse async
- 6** = Reverse sync1
- 7** = Reverse sync2
- 8** = Reverse sync3

[22] Linearity Correction Option (LCO) and Communication Diagnostics

- 0** = No further option
- 1** = LCO
- 2** = Additional alarm bit + even parity bit (data length 26 bits)
- 4** = Additional alarm bit + even parity bit + LCO (data length 26 bits)

Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

R-Series Models RP and RH CANbus Outputs (CANopen/CANbasic)

Document Part Number
550991 Revision E

Data Sheet



Model RP Profile-style position sensor

Model RH Rod-style position sensor

R-Series
CANbus

FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Superior Accuracy, Resolution down to 2 µm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct CAN Output (Position + Velocity)

BENEFITS

- Rugged Industrial Sensor
- Selectable Bus Termination (CANopen)
- CANopen with Heartbeat Function

APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions
- For Accurate, Multi-Magnet Position Measurement
(up to 20 positions per sensor)

TYPICAL INDUSTRIES

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



R-Series Models RP and RH Sensors CANbus

Product Overview and Specifications

Product overview

R-Series model RH and RP sensors are extremely robust and are ideal for continuous operation under harsh industrial conditions.

MTS offers two standard sensor housings, rod and profile extrusion. The rod housing is capable of withstanding high pressures such as those found in hydraulic cylinders.

The profile extrusion housing provides convenient mounting options and captive sliding magnets which utilize slide bearings of special material that reduce friction, and help mitigate dirt build up.

The sensor head contains the active signal conditioning and a complete integrated electronics interface. Double shielding is used to ensure EMI protection for unsurpassed reliability and operating safety.

Product specifications

Parameters	Specifications	Parameters	Specifications	
OUTPUT			ENVIRONMENTAL	
Measured output variables:			Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F)	
Resolution:	Position, velocity, optional multi-magnet position measurements (up to 20 magnet positions simultaneously)	Relative humidity: 90% no condensation	Temperature coefficient: < 15 ppm/ °C	
CANopen:		EMC test:	Electromagnetic emission: IEC/EN 50081-1	
Position:	Velocity: 5 µm 0.5 mm/s 2 µm 0.2 mm/s	Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified	Shock rating: 100 g (single hit)/IEC standard 68-2-27 (survivability)	
CANbasic:	Position: 5 µm 1.0 mm/s 2 µm 0.1 mm/s	Vibration rating: 15 g / 10 to 2000 Hz / IEC standard 68-2-6	WIRING	
Update times:	1.0 ms up to 2400 mm, 2.0 ms up to 4800 mm, 4.0 ms up to 7600 mm stroke length Add 0.5 ms for CANbasic up to 1200 mm	Connection type: Single or dual 6-pin male D60 (M16) connector or two 5-pin Male/Female D54 (M12) connectors with 4-pin male (MS) connector or integral cable	PROFILE STYLE SENSOR (MODEL RP)	
Linearity deviation:	< ± 0.01% full stroke (minimum ± 40 µm) (Linearity Correction Option (LCO) available)	Electronic head: Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)	Sealing: IP 65**	
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)	Sensor extrusion: Aluminum (Tempsonics, profile style)	Sensor extrusion: Aluminum (Tempsonics, profile style)	
Hysteresis:	< 4 µm	Mounting: Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove	Mounting: Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove	
Outputs:	Interface: CAN-Fieldbus system ISO DIS 11898 Data protocol CANopen: CIA standard DS-301 V4.02 encoder profile DS-406 V3.1 CANbasic: CAN 2.0 A	Magnet types: Captive-sliding magnet or open-ring magnet	Magnet types: Captive-sliding magnet or open-ring magnet	
Baud rate, kBit/s:	1000 800 500 250 125 50 20	ROD STYLE SENSOR (MODEL RH)		
Cable length, m:	<25 <50 <100 <250 <500 <1000 <2500 <i>Sensors will be supplied with ordered Baud rate which can be changed by the customer.</i>	Electronic head: Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)	Sealing: IP 67 or IP 68 for integral cable models**	Sealing: IP 67 or IP 68 for integral cable models**
Stroke length:	Range (Profile style): 25 mm to 5080 mm (1 in. to 200 in.) Range (Rod style): 25 mm to 7620 mm (1 in. to 300 in.)	Sensor rod: 304L stainless steel	Operating pressure: 350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)	Sensor rod: 304L stainless steel
ELECTRONICS		Mounting: Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A	Mounting: Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A	Mounting: Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A
Operating voltage:	+24 Vdc nominal: -15% or +20%* Polarity protection: up to -30 Vdc Over voltage protection: up to 36 Vdc Current drain: 100 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Typical mounting torque: 45 N·m (33 ft. - lbs.)	Magnet types: Ring magnet, open-ring magnet, or magnet float	Magnet types: Ring magnet, open-ring magnet, or magnet float

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY

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



Figure 1. R-Series sensor Integrated diagnostic LEDs

Green	Red	Operation status/mode
ON	OFF	Normal function (operation mode)
ON	ON	Magnet not detected or wrong quantity of magnets
OFF	ON	Initialization error
Flashing	Flashing	Power out of range (high or low)

Table 1. Diagnostic display indicator modes

CANbus protocol

Temposonics R-Series models RP and RH linear-position sensors, as slave devices, fulfill all requirements of the CANbus (ISO 11898) protocol. The sensor's electronics convert the position measurements into bus oriented outputs and transfer this data directly to the controller.

The bus interface is appropriate for serial data transfer up to 1 Mbps maximum. Sensor integrated software supports bus profiles CANopen, CANbasic and DeviceNet for a comprehensive customized configuration of the sensor-bus system.

DeviceNet documentation is available from the MTS website at <http://www.mtssensors.com/products/linear-position-sensors/index.html>.

OPERATION MODES

R-Series sensors with CANbus protocol provide the following single or multi-magnet measurements:

Standard measurements:

- CANbasic; Position + velocity (using one magnet)
- CANopen; Position + velocity (using one to four magnets) + sensor internal electronics temperature

Multi-magnet measurement:

CANbasic; Positions for each of two to twenty magnets simultaneously.

When using multiple magnets, the minimum allowed distance between magnets is 75 mm (3 in.) to maintain proper sensor output (see 'Figure 2').

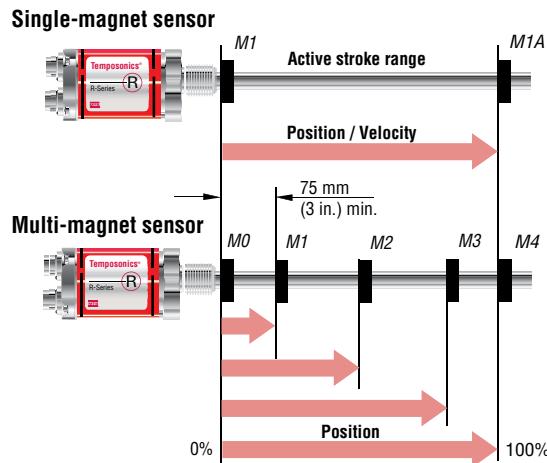


Figure 2. Single and multi-magnet output diagram

CANopen communication and functionality

CANopen corresponds to encoder profile 'DS-406 V3.1 (CIA standard DS-301 V4.02)'. The CANopen functionality is described below in the following communication objects.

Note:

Conformance Test Certificate No. CiA199902-301V30/I-004 is provided by the CANbus user organization CiA (CAN in Automation) for MTS CANopen sensors.

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 +/- 20 microns (0.0008 in.). For stroke lengths over 5000 mm (197 in.), the linearity accuracy is improved up to a 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.

SERVICE DATA OBJECT (SDO)

The SDO is mainly used for sensor configuration. Selectable parameters are as follows:

- Resolution for position + velocity
- 4 set points
- Preset of the operation range and the null position for four magnets

PROCESS DATA OBJECT (PDO)

The PDO provides real-time data transfer of sensor measurements in up to 8-byte data blocks. The sensor uses PDO's to relay information about magnet position, velocity, limit status, cam control and operation range for up to four magnets.

Data formats:

- 32-bits for position
- 16-bits for velocity
- 8-bits for value limit.

R-Series Models RP and RH Sensors - CANbus Outputs Enhanced Monitoring Diagnostics, Functionality and Programmability

CANbus outputs

PDO TRANSMISSION TYPE

Asynchronous (cycle time of 1 to 65.535 ms) or synchronous

- Synchronization Object (SYNC)
- Emergency Object
- Nodeguard Object
- Heartbeat function
- Selectable bus termination
- Monitoring for the sensor internal electronics temperature

CANopen communication and functionality

CANOPEN CONFIGURATION

A software file is used as an Electronic Data Sheet (EDS) for sensor configuration. The EDS file is available on the R-Series Setup software mini diskette, part number: 551052 that comes with the sensor. To download the latest software go to MTS website at: <http://www.mtssensors.com>.

Note: Factory default node address = 127 (7F hex).

CANbasic (MTS)

CANbasic (MTS) allows a simple, flexible adaptation to customized profiles with a short bus access. The CANbasic protocol complies with CAN the 2.0A standard and includes applications data for single-magnet measurement (position, velocity, sensor status and five setpoints).

Note: Factory default node address = 00.

CANbasic (Multi-magnet measurement)

CANbasic (Multi-magnet measurement) provides position measurement on a single sensor using a maximum of twenty magnets. Setup and operation are accomplished through the on-site control system.

Note: Factory default node address = 00.

CANopen handheld address programmer

The *CANopen Handheld Address Programmer* (see 'Figure 3') is offered as an accessory used to setup the Node-Address for sensors with the CANopen interface. This setup is usually completed by the bus' LMT/LSS-Service. If the master system or customer controller does not support this service, connecting the CANopen Handheld Address Programmer to the sensor will bypass the service and allow direct setup.



Figure 3. R-Series CANopen Handheld Address Programmer
(part no. 252382-D62) Installation Instructions
(part no.: 551192)

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.

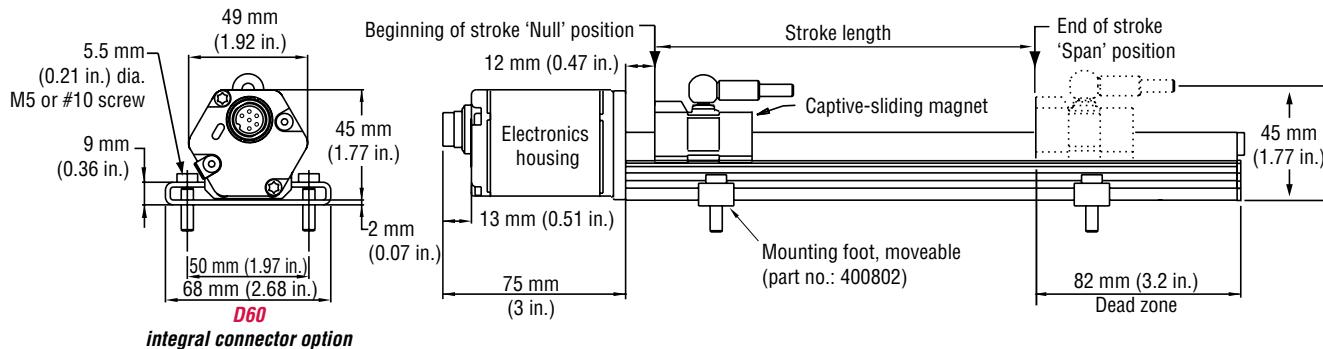


Figure 4. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D60** integral connector option)

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

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

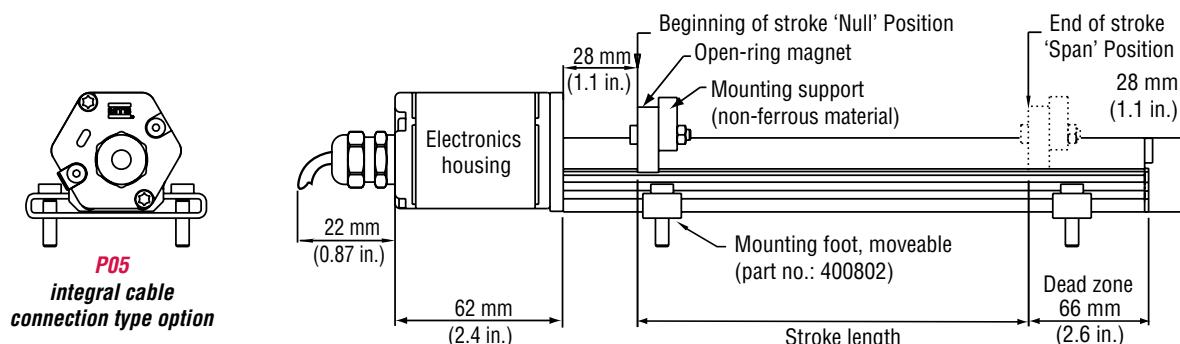


Figure 5. R-Series Model RP Profile-style sensor dimension reference (Shown with the **P05** integral cable option)

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

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

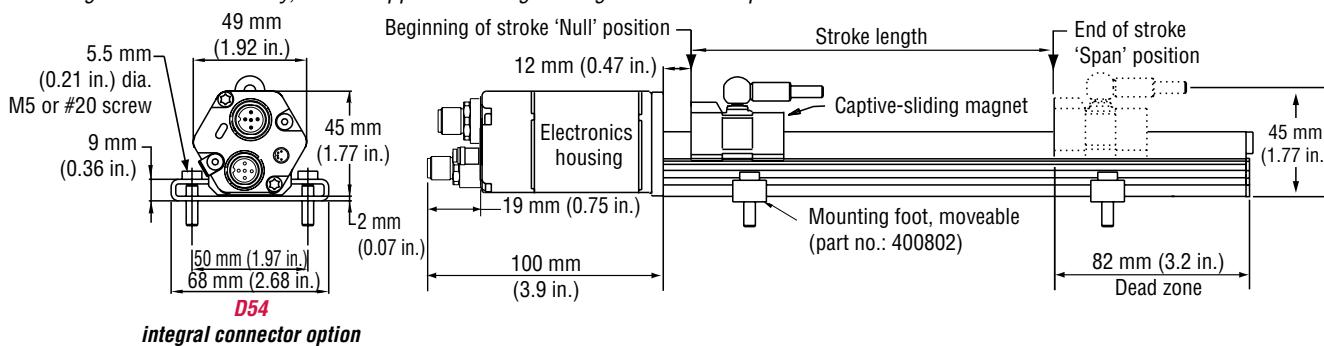


Figure 6. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D54** integral connector option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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.

R-Series Model RH Rod-Style Sensor

Dimension References

Model RH rod-style sensor dimension reference

The Tempsonics 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 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.

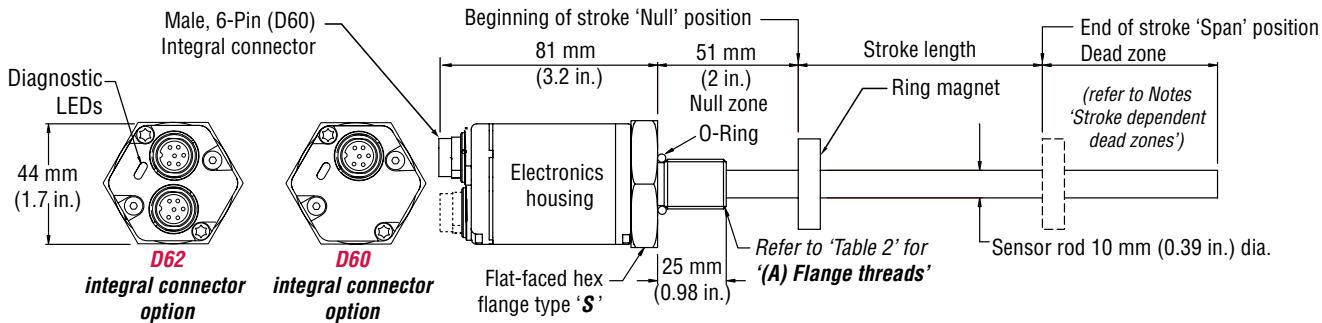


Figure 7. Model RH Rod-style sensor dimension reference (shown with **D60 / D62** integral connector options)

MODEL RH, ROD-STYLE SENSOR

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

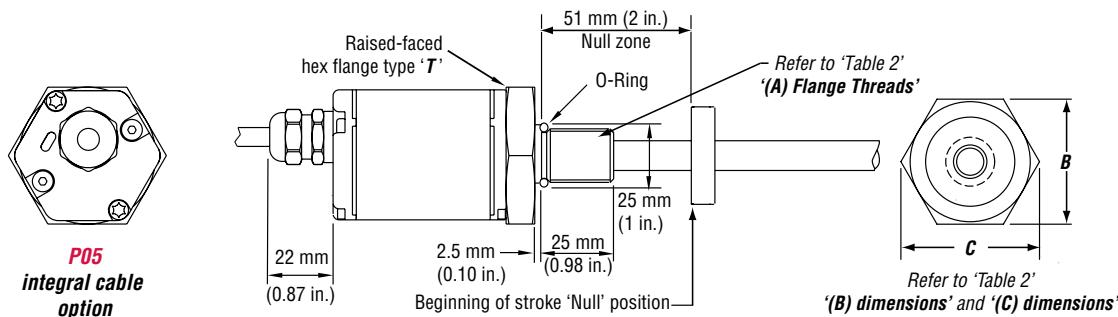


Figure 8. Model RH Rod-style sensor dimension reference (shown with **P05** integral cable option)

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

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

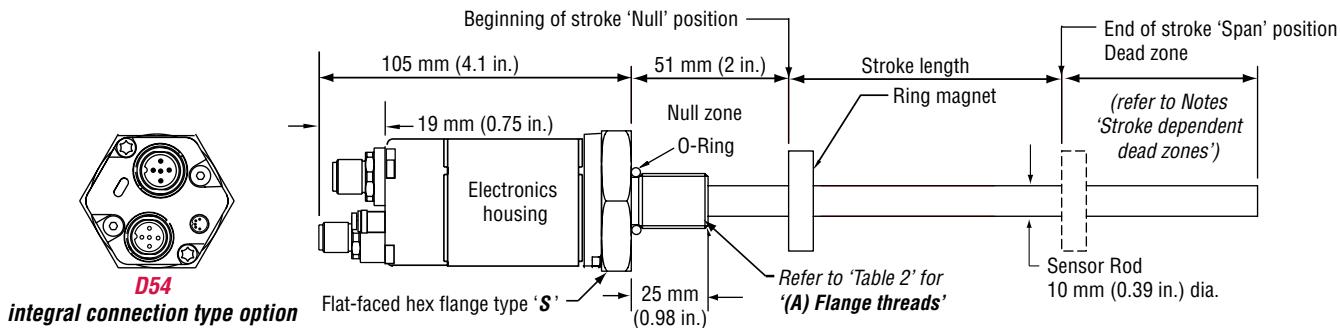


Figure 9. Model RH Rod-style sensor dimension reference (Shown with the **D54** Integral cable connection type option)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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, cable connector selections, mounting and installation (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.

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

Connections and wiring

STANDARD MALE (M16) INTEGRAL CONNECTOR FOR SINGLE (D60) AND DUAL (D62) TYPE CONNECTIONS



Male, 6-pin (D60) integral connector pin-out as viewed from the end of the sensor

Pin number	Cable Wire color	Function / CANbus outputs
1	Gray	CAN (-)
2	Pink	CAN (+)
3	Yellow	N.C.
4	Green	N.C.
5	Red or Brown	+24 Vdc (-15/+20%)
6	White	DC ground (for supply)

MALE/FEMALE (M12) INTEGRAL CONNECTORS FOR (D54) TYPE CONNECTIONS



Male, 5-pin (D54) integral connector pin-out as viewed from the end of the sensor



Female, 5-pin (D54) integral connector pin-out as viewed from the end of the sensor

Pin number	Function / CANbus outputs
1	Shield
2	N.C.
3	N.C.
4	CAN (+)
5	(CAN (-))



Input voltage, male, 4-pin (D54) integral connector pin-out as viewed from the end of the sensor

Pin number	Cable wire color	Function
1	Brown	+24 Vdc (-15/+20%)
2	White	N.C.
3	Blue	DC ground (for supply)
4	Black	N.C.

R-Series
CANbus

Model RP and RH Sensors

Ordering Information

R	C																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

SENSOR MODEL _____ = **R** **C** **1-2**

RP = Profile style

RH = Hydraulic rod style

HOUSING STYLE _____ = **C** **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 and 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

STROKE LENGTH _____ = **4-8**

M = Millimeters
(Encode in 5 mm increments)

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.)

CONNECTION TYPE _____ = **9-11**

Integral connector:

D60 = 6-pin DIN (M16), male, standard

D62 = 6-pin DIN (M16), male, dual

D54 = 5-pin DIN (M12), male/female and 4-pin (M8) male

Integral cable:

P _____ = Integral cable, Orange polyurethane jacket with pigtail termination

Cable Length Note:

MTS recommends the maximum integral cable length to be 10 meters (33 ft.). Cables greater than 10 m (33 ft.) in length are available, however, proper care must be taken during handling and installation.

Cable length:

Encode in feet if using US customary stroke length
Encode in meters if using metric stroke length

> _____ = 3 (03) to 98 (98) ft. or 1 (01) to 30 (30) meters.

INPUT VOLTAGE _____ = **1** **12**

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

OUTPUT (13 - 19) _____ = **C** **13-19**

C _____ = CANbus output - Enter the 6 digit output code (1-6) defined by the following selections
[1] [2] [3] [4] [5] [6]

[1] [2] [3] Protocol

101 = CANbasic (MTS)

207 = Multi-position measurement

304 = CANopen

504 = CANopen with Linearity Correction Option (LCO)

[4] Baud rate

1 = 1000 kBit/s

2 = 500 kBit/s

3 = 250 kBit/s

4 = 125 kBit/s

[5] Resolution

1 = 0.005 mm (0.0002 in.)

2 = 0.002 mm (0.00008 in.)

[6] Type

1 = Standard

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

Z + Enter a 2 digit code

Z _____ = Enter range (02 - 20) 20 magnets maximum

Tempsonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors



R-Series Models RP and RH DeviceNet Output

Document Part Number
550651 Revision F

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 2 µm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct DeviceNet Output

BENEFITS

- Rugged Industrial Sensor
- Cost-effective Communications Network linking Industrial Measurement and Control Devices
- Interface Up to 64 Devices using one cable

APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions

TYPICAL INDUSTRIES

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

R-Series
DeviceNet



R-Series Model RH Rod-Style Sensor

Product Overview and Specifications

Product overview

R-Series model RH and RP sensors are extremely robust and are ideal for continuous operation under harsh industrial conditions.

MTS offers two standard sensor housings, rod and profile extrusion. The rod housing is capable of withstanding high pressures such as those found in hydraulic cylinders.

The profile extrusion housing provides convenient mounting options and captive sliding magnets which utilize slide bearings of special material that reduce friction, and help mitigate dirt build up. The sensor head contains the active signal conditioning and a complete integrated electronics interface. Double shielding is used to ensure EMI protection for unsurpassed reliability and operating safety.

Controller Area Network (CAN) is a standard for device level communications and the foundation of fieldbus systems like DeviceNet, CANopen and CANbus. These fieldbus systems can provide high speed transmission appropriate for position indication and for motion control in industrial applications.

DeviceNet allows users to interface up to 64 devices using a single cable, thus eliminating the need for conventional methods of multiple wire runs. DeviceNet provides a way to define how, and in which priority, data will be transmitted over the network. The result is a lower complexity, cost-effective communications network linking industrial measurement and control devices. Together, the open DeviceNet protocol and the MTS "smart" R-Series sensors offer an effective, high-precision data transfer system that is well suited for industrial automation.

Product specifications

Parameters	Specifications	Parameters	Specifications	
OUTPUT			ENVIRONMENTAL	
Measured output variable:	Position	Operating conditions:	Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F)	
Resolution:	2 µm or 5 µm		Relative humidity: 90% no condensation	
Update times:	0.5 ms up to 1200 mm, 1.0 ms up to 2400 mm, 2.0 ms up to 4800 mm, 4.0 ms up to 7600 mm stroke length		Temperature coefficient: 15 ppm/°C	
Linearity deviation:	< ± 0.01% full stroke (minimum ± 40 µm)	EMC test:	Electromagnetic emission: IEC/EN 50081-1	
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)		Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified	
Hysteresis:	< 4 µm	Shock rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)	
Output:	Interface: CAN-Fieldbus system ISO DIS 11898 Data protocol DeviceNet release 2.0	Vibration rating:	15 g / 10 to 2000 Hz / IEC standard 68-2-6	
Baud rate, kBit/s:	500 250 125	WIRING	Connection type: 5-pin male D51 DeviceNet connector	
Cable length, m:	<100 <250 <500	PROFILE STYLE SENSOR (MODEL RP)		
	<i>Sensors will be supplied with ordered Baud rate which can be changed by the customer.</i>	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)	
Stroke length:	Range (Profile style): 25 mm to 5080 mm (1 in. to 200 in.) Range (Rod style): 25 mm to 7620 mm (1 in. to 300 in.)	Sealing:	IP 65**	
		Sensor extrusion:	Aluminum (Temposonics profile style)	
		Mounting:	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove	
		Magnet types:	Captive-sliding magnet or open-ring magnet	
ELECTRONICS			ROD STYLE SENSOR (MODEL RH)	
Operating voltage:	+24 Vdc nominal: -15% or +20%*	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connector/cable exit)	
	Polarity protection: up to -30 Vdc	Sealing:	IP 67 or IP 68 for integral cable models**	
	Oversupply protection: up to 36 Vdc	Sensor rod:	304L stainless steel	
	Current drain: 90 mA typical	Operating pressure:	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)	
	Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Mounting:	Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A	
		Typical mounting torque:	45 N-m (33 ft. - lbs.)	
		Magnet types:	Ring magnet, open-ring magnet, or magnet float	

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY

Integrated diagnostic LEDs (green/red), located beside sensor connector (see 'Figure 1'), provide basic visual monitoring for normal sensor operation and DeviceNet communications. Diagnostic display LEDs indicate two modes, Network and Module status as described in 'Table 1'.



Figure 1. R-Series sensor Integrated diagnostic LEDs

DeviceNet protocol

R-Series models RP and RH linear-position sensors as slave devices fulfill all requirements of the CANbus (ISO 11898) standard. The sensors electronics and integrated software implement the DeviceNet protocol to convert the displacement measurements into bus oriented outputs and transfer this data directly to the controller. The DeviceNet protocol is appropriate for serial data transfer up to 500 kBit/sec.

When using the DeviceNet protocol with R-series sensors, functionality always includes but is not limited to the following:

- Position
- Error Detection
- Polling & bit-strobe communications modes

PLUG AND PLAY

R-Series sensors with DeviceNet output can be directly connected to a DeviceNet network. The plug and play design makes installation quick and easy. The sensor acts as a "slave" device that transmits

Network Status LED	Operation status/mode
Green	Normal function (operation mode)
Green Flashing	Waiting for instructions from DeviceNet master
Red	Initialization error
Red Flashing	No answer from DeviceNet master

Module Status LED	Operation status/mode
Green	Normal function (operation mode)
Red	Magnet not detected

Table 1. Diagnostic display indicator modes

its position and status data upon request to the "master" device such as a PLC or IPC. After initial system configuration, the user is not required to have extensive knowledge concerning network timing and sensor technology to execute operations within DeviceNet environment. Sensor-specific parameters are installed into the network using the Electronic Data Sheet (EDS). To obtain the EDS, go to www.mtssensors.com.

There are only two programmable parameters, which are, the node identifier and the baud rate. If desired, a PC programming tool, such as DeviceNet Manager offered by Allen Bradley, can be used to change their values. **The node identifier is factory set at node 63.**

The selected baud rate is shown in the sensor's model number. Note that the sensor will only be recognized on a network running at the same baud rate.

**R-Series
DeviceNet**

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.

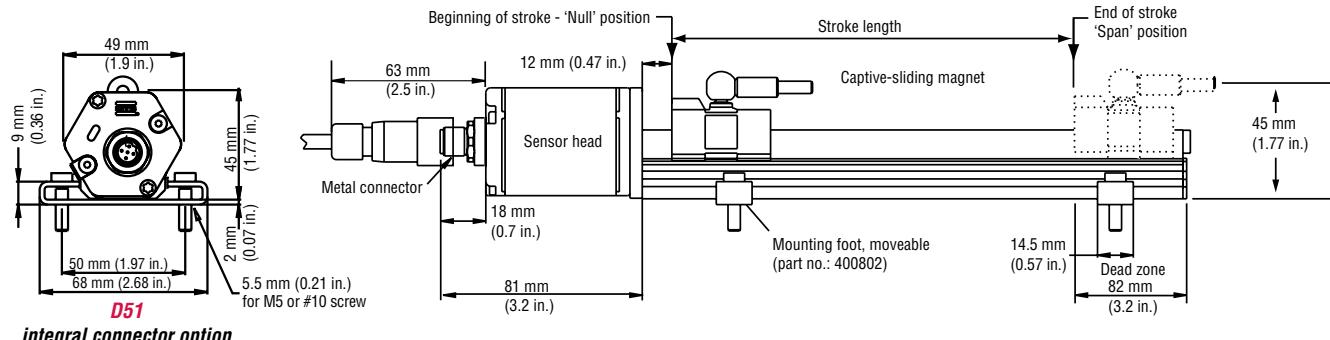


Figure 2. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D51** integral connector option)

Model RP Profile-Style Sensor Dimensions

Model RP Sensors - Standard Magnet and Installation References

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

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

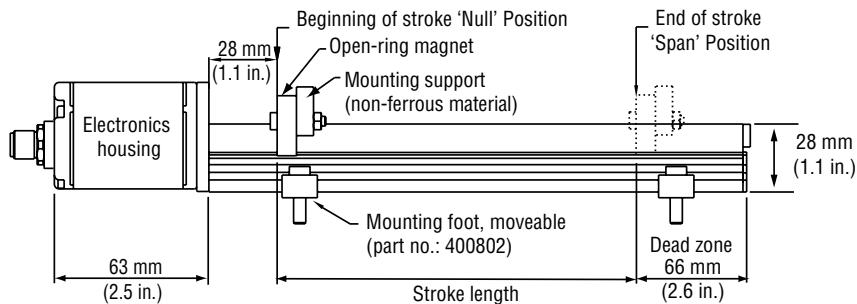


Figure 3. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D51** integral connector option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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 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.

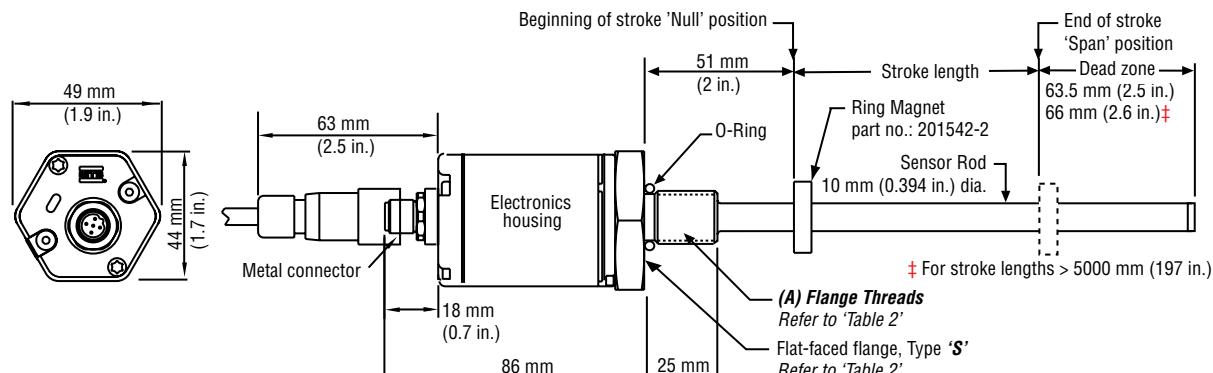


Figure 4. Model RH Rod-style sensor dimension reference (shown with **D51** integral connector options)

Model RH Rod-Style Sensor Dimensions
 Model RH Sensors - Standard Magnet and Installation References
 Connection and Wiring

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

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

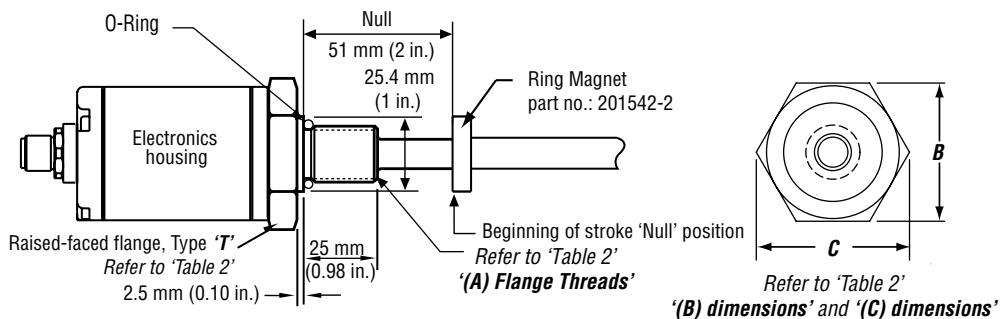


Figure 5. Model RH Rod-style sensor dimension reference (shown with **D51** integral connector option)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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 magnet selections, mounting and installation (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.

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

Connections and wiring

CABLE CONNECTOR (FIELD INSTALLED FEMALE MICRO DEVICENET)



Male, 5-pin (DeviceNet micro connector) pin-out as viewed from the end of the sensor

Pin number	Function / DeviceNet outputs
1	Shield
2	+24 Vdc (+20% / -15%)
3	DC ground (for supply)
4	CAN (+)
5	CAN (-)

R-Series
DeviceNet

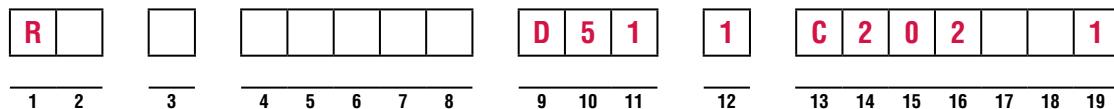
Models RP and RH Sensors

Cable Connector Options and Ordering Information

CABLE CONNECTOR OPTIONS (FIELD INSTALLABLE) 5-PIN DIN (D51) FEMALE (Drawing dimensions are for reference only)

Appropriate grounding of cable shield is required at the controller end. Molded extension cables are available from third-party vendors.

Connector and connector dimensions	Description	Part number
	Female Cable Connector, Straight Exit (D51) (Field installable) 5-Pin micro DeviceNet connector mates with male (D51) connection type	370375
	Female Cable Connector, 90° exit, (D51) (Field installable) 5-Pin micro DeviceNet connector mates with male (D51) connection type	370376



SENSOR MODEL

RP = Profile style

RH = Hydraulic rod style

1-2

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)

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 and 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

STROKE LENGTH

4-8

M = Millimeters
(Encode in 5 mm increments)

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.)

CONNECTION TYPE

D **5** **1**

Integral connector:

D51 = 5-pin Micro DeviceNet, male, standard

INPUT VOLTAGE

12

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

OUTPUT (13 - 19)

C

13-19

C = CANbus output - Enter the 6 digit output code (1-6) defined by the following selections
[1] [2] [3] [4] [5] [6]

[1] [2] [3] Protocol

202 = DeviceNet

[4] Baud rate

2 = 500 kBit/s

3 = 250 kBit/s

4 = 125 kBit/s

[5] Resolution

1 = 5 µm (0.0002 in.)

2 = 2 µm (0.00008 in.)

[6] Type

1 = Standard

Tempsonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

R-Series Models RP and RH Profibus-DP Output Data Sheet

Document Part Number
550990 Revision D



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 µm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct Profibus-DP Output (Position +Velocity)
- Standard and Multi-magnet position measurements
(up to 20 positions per sensor)

BENEFITS

- Rugged Industrial Sensor
- Fulfills All Requirements of Profibus-DP
(EN 50170) Protocol
- Profibus-DP Provides Powerful Functions for
Diagnostics and Configuration
- Linearity Correction Options

APPLICATIONS

- Continuous Operation In Harsh Industrial Conditions
- High Pressure Conditions
- For Accurate, Multi-Magnet Position Measurement
(up to 20 positions per sensor)

TYPICAL INDUSTRIES

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

R-Series
Profibus



R-Series Models RP/RH Sensors with Profibus-DP Output

Product Overview and Specifications

Product overview

R-Series model RH and RP sensors are extremely robust and are ideal for continuous operation under harsh industrial conditions. MTS offers two standard sensor housings, rod and profile extrusion. The rod housing is capable of withstanding high pressures such as those found in hydraulic cylinders. The profile extrusion housing provides convenient mounting options and captive sliding magnets which utilize slide bearings of special material that reduce friction, and help mitigate dirt build up. The sensor head contains the active signal conditioning and a complete integrated electronics interface. Double shielding is used to ensure EMI protection for unsurpassed reliability and operating safety.

Product specifications

Parameters	Specifications
OUTPUT	
Measured output variables:	Position, up to 20 magnet positions simultaneously Position + Velocity, up to 5 magnets simultaneously
Resolution:	1 µm, other values are selectable when using the .gsd file
Update times:	0.5 ms at 500 mm, 1 ms at 2000 mm, 2 ms at 4500 mm, 3.1 ms at 7600 mm stroke length. For each additional magnet add 0.05 ms.. Add 0.03 ms for approximate values for velocity measurements.
Linearity deviation:	< ± 0.01% full stroke (minimum ± 50 µm) (Linearity Correction Option (LCO) available)
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)
Hysteresis:	< 4 µm
Outputs:	Interface: Profibus-DP system ISO 74498 Data format: Profibus-DP (EN 50 170)
Data transmission rates:	12 MBd 1.5 MBd 500 kBd 187.5 kBd ≤93.75 kBd
Cable length, m:	<100 <200 <400 <1000 <1200
Stroke length:	Range (Profile style): 25 mm to 5080 mm (1 in. to 200 in.) Range (Rod style): 25 mm to 7620 mm (1 in. to 300 in.)

ELECTRONICS

Operating voltage:	+24 Vdc nominal: -15% or +20%*
	Polarity protection: up to -30 Vdc
	Over voltage protection: up to 36 Vdc
	Current drain: 90 mA typical
	Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Temposonics R-Series models RP and RH linear-position sensors fulfill all requirements of Profibus-DP (EN 50170) protocol. They also provide absolute position data to Profibus control units by using a serial, bit synchronous, RS-485 format at a baud rate up to 12 Mbps maximum.

In addition to data transmission, Profibus-DP provides powerful functionality for diagnostics and configuration, which is loaded into the bus using the GSD electronic device data sheet file. The downloadable .gsd file for Temposonics Profibus model sensors is available at <http://www.mtssensors.com>.

Parameters	Specifications
ENVIRONMENTAL	
Operating conditions:	Operating temperature: -40 °C (-40 °F) to 75 °C (167 °F)
	Relative humidity: 90% no condensation
	Temperature coefficient: < 15 ppm/ °C
EMC test:	Electromagnetic emission: IEC/EN 50081-1
	Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified
Shock rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)
Vibration rating:	15 g / 10 to 2000 Hz / IEC standard 68-2-6
WIRING	
Connection type:	D63 option: Two 6-pin (M16) connectors one male and one female D53 option: Two 5-pin (M12) connectors one male and one female, plus one 4-pin connector (M8) male
PROFILE STYLE SENSOR (MODEL RP)	
Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
Sealing:	IP 65**
Sensor extrusion:	Aluminum (Temposonics profile style)
Mounting:	Any orientation. Adjustable mounting feet or T-Slot nut (M5 threads) in bottom groove
Magnet types:	Captive-sliding magnet or open-ring magnet
ROD STYLE SENSOR (MODEL RH)	
Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
Sealing:	IP 67**
Sensor rod:	304L stainless steel
Operating pressure:	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)
Mounting:	Any orientation. Threaded flange M18x1.5 or 3/4-16 UNF-3A
Typical mounting torque:	45 N·m (33 ft. - lbs.)
Magnet types:	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'.



Figure 1. R-Series sensor Integrated diagnostic LEDs

Profibus-DP output parameters

R-Series sensors with Profibus-DP output are compliant with Profibus DP slave class 2 and have the following features:

Selectable outputs:

- Absolute position measurement
- Velocity measurement
- Sensor Status
- Error detection (e.g. magnet status)

Selectable parameters:

- Offset / preset for each magnet
- Measuring direction; forward and reverse acting
- Intel® and Motorola® data format transfers

OPERATION MODES

R-Series sensors with Profibus-DP protocol provide the following single or multi-magnet measurements:

Standard measurement (P102 output code):

- Position (using one magnet)

Multi-magnet measurement (P101 output code):

- Position (using up to 20 magnets simultaneously)

Multi-magnet measurement (P103 output code):

- Position + velocity (using up to 5 magnets simultaneously)

Profibus-DP communication and functionality

DATA EXCHANGE

For multi-magnet measurement, 1 status byte and 3 bytes of position data for each position are transmitted. The status byte contains an error bit and the position number for the following measurement value. Dependent on sensor parameters, sensor data can be transferred in different data formats, (e.g. Intel® or Motorola®)

Note: Factory default node address = 125 (7D hex)

Green	Red	Operation status/mode
ON	OFF	Normal function (operation mode)
ON	ON	Magnet not detected or wrong quantity of magnets
Flashing	OFF	Waiting for master parameters
Flashing	ON	Programming mode

Table 1. Diagnostic display indicator modes

When using multiple magnets, the minimum allowed distance between magnets is 75 mm (3. in.) to maintain proper sensor output (see 'Figure 2').

Single-magnet sensor



Multi-magnet sensor

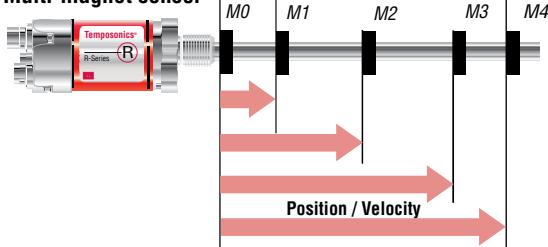


Figure 2. Single and multi-magnet output diagram

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 microns (0.0008 in.). For stroke lengths over 5000 mm (197 in.) the linearity accuracy is improved up to a 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.

Profibus-DP Programming Accessories

Model RP Profile-Style Sensor Dimension References

Profibus-DP handheld address programmer

The Profibus-DP Handheld Address Programmer (see 'Figure 3') is offered as an accessory used to setup the Slave Address via the Profibus-DP interface. Addressing is usually performed by the Profibus-DP SetSlaveAddress command. If the master system or controller does not support this service, connecting the Profibus-DP Handheld Address Programmer to the sensor will bypass the service and allow direct setup. Default Node ID is 125 (7D Hex).

When ordering the *Profibus-DP Node and Field Address Programmer* accessory, for D53 and D63 style connections, order part no.: 280640. The Profibus-DP Node and Address Programmer Installation instructions (document part no.: 551193) is available in PDF format at <http://www.mtssensors.com>.



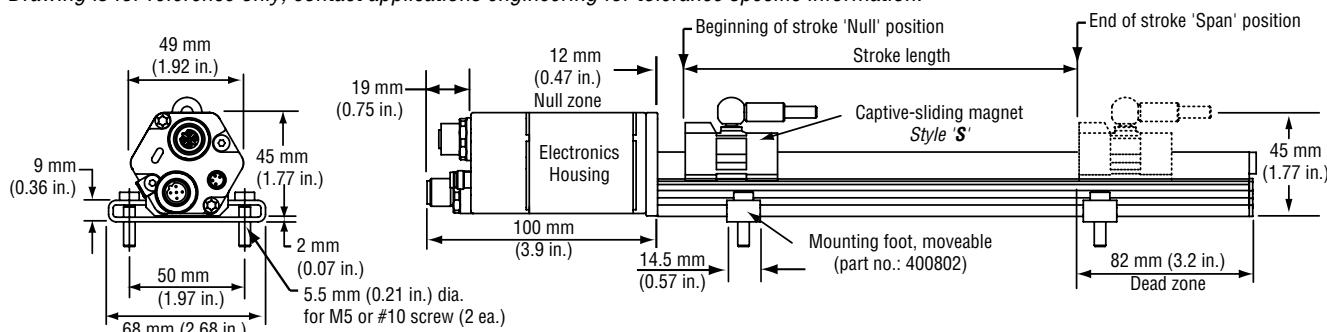
Figure 3. R-Series Profibus-DP Handheld Address Programmer, part no.: 280640

Programming accessory	Function	Part number
Profibus handheld address programmer	For sensors with the D63 connection type	280640
Profibus handheld address programmer	For sensors with the D53 connection type	280640
Profibus master simulator	Check sensor operation using Bihl + Wiedemann, Model 1131	401727
Master simulator cable	For sensors with the D63 connection type	401726
Master simulator cable	For sensors with the D53 connection type	252383
Profibus noise filter box	Junction box with noise filter for connecting 24 Vdc input power on to the bus when using the hybrid Profibus cable, (D63 connection type).	252916

Model RP profile-style sensor dimension references

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

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

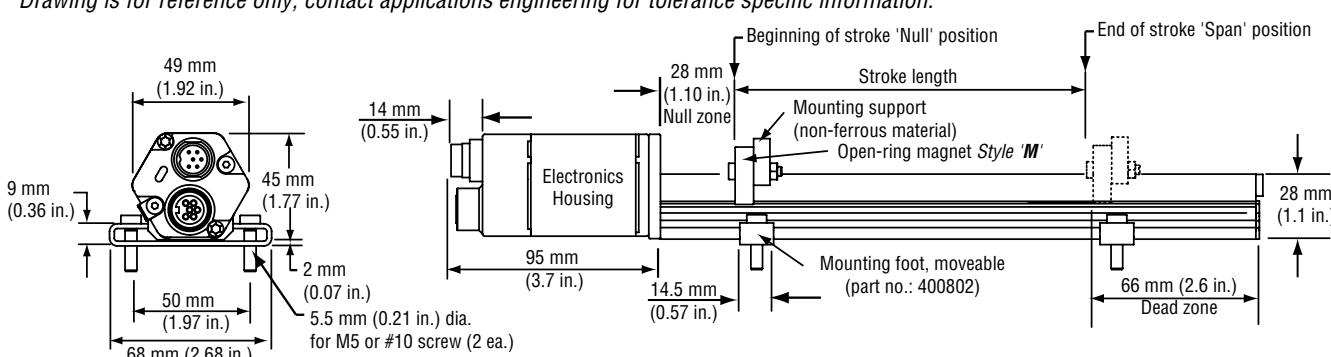


D53 Connector option

Figure 4. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D53** connector option)

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

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

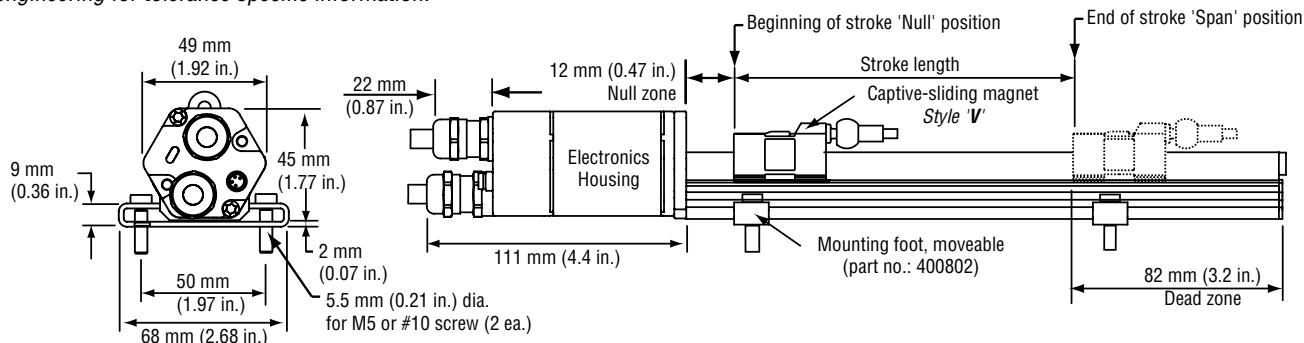


D63 Connector option

Figure 5. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D63** connector option)

Models RP Profile-Style and RH Rod-Style Sensor Dimensions Standard Magnet, Mounting and Installation References

MODEL RP, PROFILE-STYLE SENSOR WITH STYLE V CAPTIVE-SLIDING MAGNET Drawing is for reference only, contact applications engineering for tolerance specific information.



A05 Integral cable option

Figure 6. R-Series Model RP Profile-style sensor dimension reference (Shown with the A05 integral cable option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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 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 DIMENSION REFERENCE

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

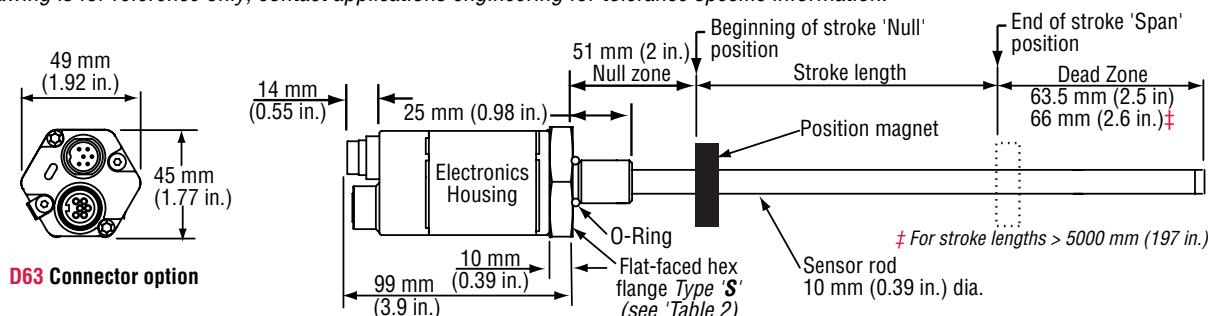


Figure 7. Model RH Rod-style sensor dimension reference (shown with D63 connector option)

R-Series
Profibus

Model RH Rod-Style Sensor Dimensions
Standard Magnet, Mounting and Installation References

Model RH rod-style sensor dimension reference (Cont.)

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

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

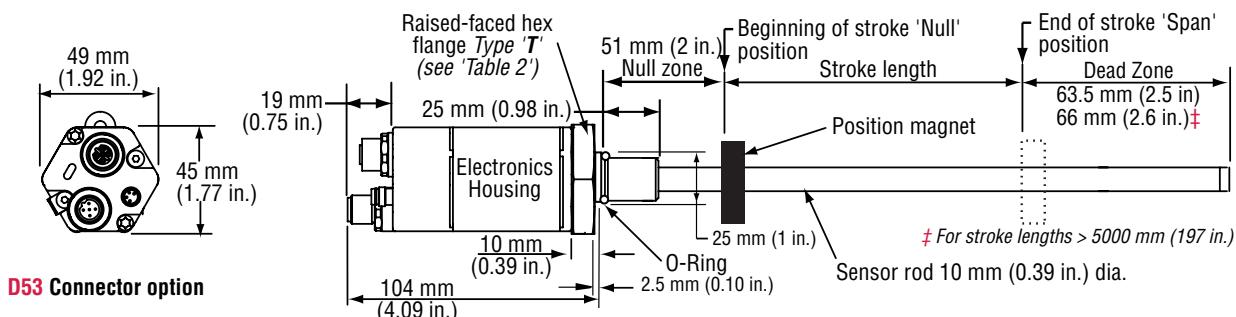


Figure 8. Model RH Rod-style sensor dimension reference (shown with **D53** connector option)

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

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

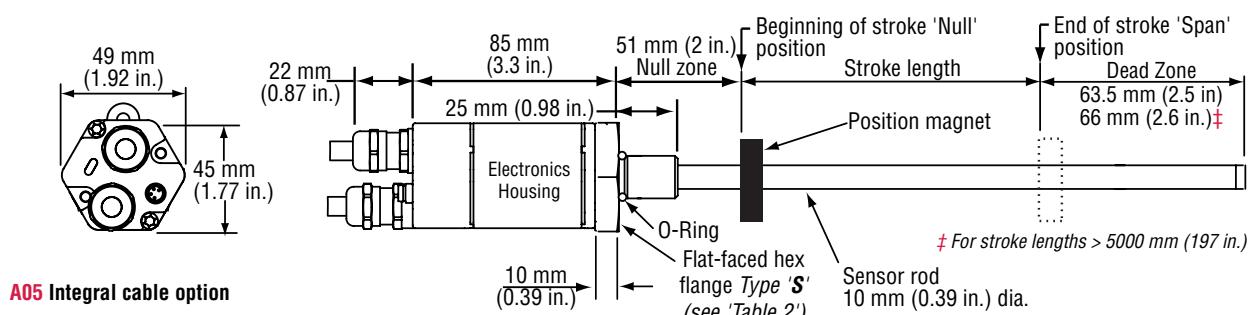


Figure 9. Model RH Rod-style sensor dimension reference (Shown with the **A05** Integral cable connection type option)

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

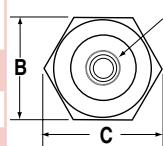


Table 2. Model RH Rod-style sensor housing style and flange type references

Standard magnet selections, mounting and installation (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.

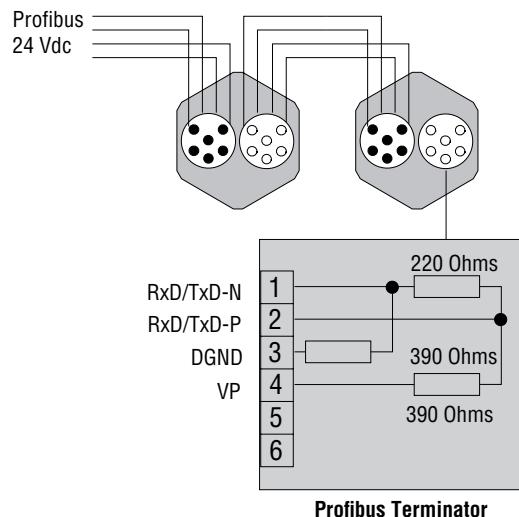
Refer to the Accessories section of this catalog for magnet selections and detailed mounting and installation information.

Connection and wiring options

BUS / INPUT VOLTAGE CONNECTION OPTIONS (DAISY-CHAIN TOPOLOGIES)

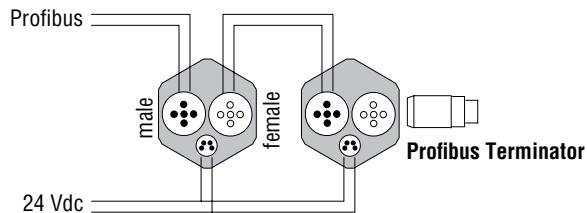
(D63) CONNECTOR OPTION

The shielded hybrid cable (5 wires; two bus, two power supply and 1 machine ground, part no.: 530040) is used for both bus and supply voltage (D63) connections. This provides convenient daisy-chain connections for applications with multiple Profibus-DP sensors.



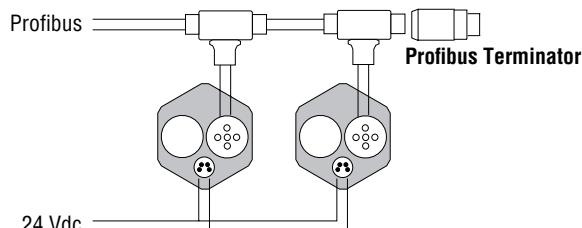
(D53) CONNECTOR OPTION

For (D53) connection types, a separate 4-pin connector and cable is used for the supply voltage.



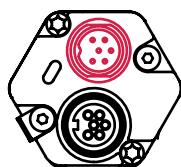
(D53) CONNECTOR OPTION WITH THE 'T' CONNECTOR

A 'T' connector is used with the separate bus cable to enable the bus to remain active when a sensor is disconnected.



Bus connector option (D63)

(D63) BUS CONNECTOR OPTION PINOUTS/FUNCTIONS

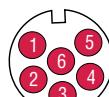


**D63 Male
6-pin outlet**

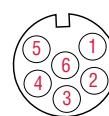


**D63 Female
6-pin outlet**

MALE/FEMALE, 6-PIN (D63) INTEGRAL CONNECTOR OPTION FOR SHIELDED HYBRID CABLE FOR BUS AND INPUT VOLTAGE



Male, 6-pin (M16) integral connector pin-out
as viewed from the end of the sensor



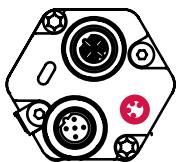
Female, 6-pin (M16) integral connector pin-out
as viewed from the end of the sensor

Pin number	Cable wire color	Function
1	Green	RxD/TxD-N (Bus)
2	Red	RxD/TxD-P (Bus)
3	N/A	DGnd (Bus termination) <i>female connector only</i>
4	N/A	VP (Bus termination) <i>female connector only</i>
5	Black	+24 Vdc (-15/+20%)
6	Blue	DC ground (for supply)
N/A	Yellow/ Green	Shielding, machine ground

R-Series Models RP and RH Sensors - Profibus-DP Connection and Wiring

Connections and wiring (D53)

(D53) BUS CONNECTOR OPTION PINOUTS/FUNCTIONS



D53
Male, 4-pin
Input voltage



D53
Male
5-pin outlet



D53
Female
5-pin outlet

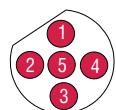
MALE/FEMALE, 5-PIN (D53) INTEGRAL CONNECTOR OPTION

(D53) INPUT VOLTAGE INTEGRAL CONNECTOR OPTION

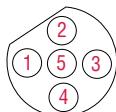


Input voltage, male, 4-pin (M8) integral connector pin-out as viewed from the end of the sensor

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



Male, 5-pin (M12) integral connector pin-out as viewed from the end of the sensor



Female, 5-pin (M12) integral connector pin-out as viewed from the end of the sensor

Pin number	Cable wire color	Function
1	N/A	VP+5 (Bus termination) <i>female connector only</i>
2	Green	RxD/TxD-N (Bus)
3	N/A.	DGnd (Bus termination) <i>female connector only</i>
4	Red	RxD / TxD-P (Bus)
5	Shield	Shield

**Models RP and RH Sensors
Ordering Information**

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

SENSOR MODEL _____ = **R** **1-2**

RP = Profile style **RH** = Hydraulic rod style

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 and 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

STROKE LENGTH _____ = **4-8**

M = Millimeters
(Encode in 5 mm increments)

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

Stroke Length Notes:

- Profile-style sensor (model RP) stroke range = 25 mm (1 in.) - 5080 mm. (200 in.)
- Rod-style sensor (model RH) stroke range = 25 mm (1 in.) - 7620 mm (300 in.)

CONNECTION TYPES _____ = **9-11**

Integral connector:

D63 = Two 6-pin DIN (M16), male/female, standard

D53 = Two 5-pin DIN (M12), male/female plus one 4-pin (M8) male

Integral cable:

A _____ = Integral cable, Hybrid Profibus with pigtail termination

Cable length:
Encode in feet if using US customary stroke length
Encode in meters if using metric stroke length

INPUT VOLTAGE _____ = **12**

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

OUTPUT (13 - 16) _____ = **P** **13-16**

P _____ = *Profibus-DP protocol - Enter the 3 digit output code (1-3) defined by the following selections*

[1] [2] [3] *= Profibus-DP protocol - Enter the 3 digit output code (1-3) defined by the following selections*

[1] [2] [3] Protocol

101 = Multi-magnet (multi-position measurement) max. 20 positions

102 = Single magnet measurement (standard)

103 = Position, velocity (max. 5 positions and 5 velocities)

105 = Multi-magnet, up to 20 magnets with Linearity Correction Option (LCO)
(Code P105 replaces codes P201L and P202L)

NUMBER OF MAGNETS (17- 19) FOR MULTI-POSITION MEASUREMENT ONLY _____ = **Z** **17-19**

Z + Enter a 2 digit code

Z _____ = If output **P101** or **P202L** is entered, enter a number between (02 - 20).
[1] [2] If output **P103** is entered, enter a number between (02 - 05)
(For multi-position measurements, additional magnets are ordered separately.)

**R-Series
Profibus**

Tempsonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

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

Document Part Number
551074 Revision C

Data Sheet



Model RP Profile-style position sensor



Model RH Rod-style position sensor

EtherCAT®
Technology Group

FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Superior Accuracy, Resolution down to 1 μm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct EtherCAT® Interface, Position + Velocity
- 100 μs 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 licenced by Beckhoff Automation GmbH, Germany



Tempsonics® Linear-Position Sensors - Industrial Product Catalog
Document Part No.: 551075 Revision F (EN) 09/2014

R-Series Models RP and RH Sensors

Product Overview and Specifications

Product overview

Tempsonics 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	Parameters	Specifications
OUTPUT		ENVIRONMENTAL	
Measured output variables:			Operating temperature: 0 °C (32 °F) to +75 °C (+167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 15 ppm/ °C
Resolution: 1 to 1000 µm selectable			Electromagnetic emission: IEC/EN 50081-1
Update time: 100 µs min. (high speed update feature is active when the controller's loop time is less than the sensor's measurement cycle time)			Electromagnetic susceptibility: IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified
Linearity deviation: < ± 0.01% full stroke (minimum ± 50 µm) (Linearity Correction Option (LCO) available)			Shock rating: 100 g (single hit)/IEC standard 68-2-27 (survivability)
Repeatability: < ± 0.001% full stroke (minimum ± 2.5 µm)			Vibration rating: 15 g / 10 to 2000 Hz / IEC standard 68-2-6
Hysteresis: < 4 µm			WIRING
Outputs:			Connection type: D56 option: Two female 4-pin (M12-D) plus one 4-pin male (M8) connector
PROFILE STYLE SENSOR (MODEL RP)			
Electronic head: Aluminum housing with diagnostic LED display (LEDs located beside connectors)			
Sealing: IP 65**			
Sensor extrusion: Aluminum (Tempsonics profile style)			
Mounting: Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove			
Magnet types: Captive-sliding magnet or open-ring magnet			
ROD STYLE SENSOR (MODEL RH)			
Electronic head: Aluminum housing with diagnostic LED display (LEDs located beside connectors)			
Sealing: IP 67**			
Sensor rod: 304L stainless steel			
Operating pressure: 350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)			
Mounting: Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A			
Typical mounting torque: 45 N·m (33 ft. - lbs.)			
Magnet types: Ring magnet, open-ring magnet, or magnet float			

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

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

Status LED (Green)	Off: On: Flashing:	Initializing Normal function Various flashing codes show different operational status
Error LED (Red)	Off: On: Flashing:	Normal function missing magnet Supply voltage beyond limits (high or low)
IN Port LED (Green)	Off: On: Flashing:	No link Link detected Traffic
OUT Port LED (Green)	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, fulfills 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 µs 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 75 mm (3 in.) to maintain proper sensor output (see 'Figure 2').

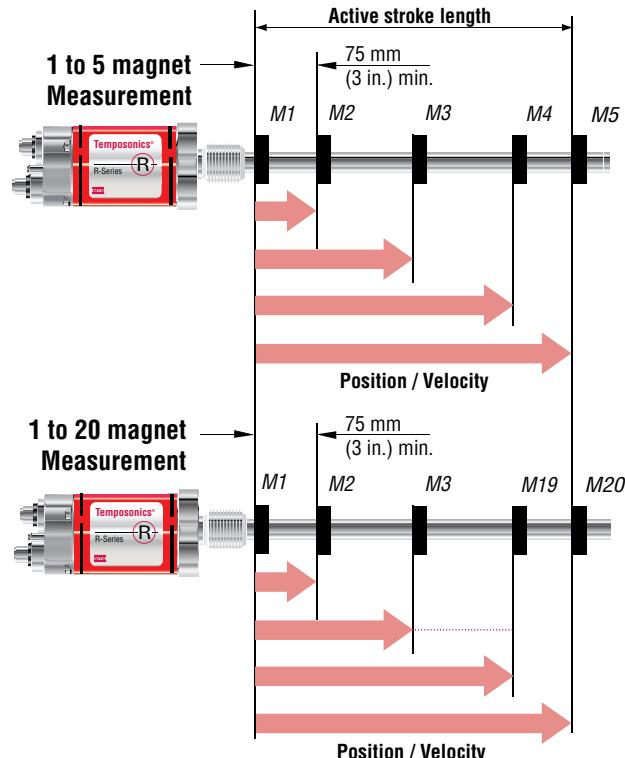


Figure 2. Single to multi-magnet output diagram

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 $\pm 20 \mu\text{m}$ (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®**

R-Series Model RP Profile-Style Sensor Dimension References

Model RP - Standard Magnet and Mounting 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.

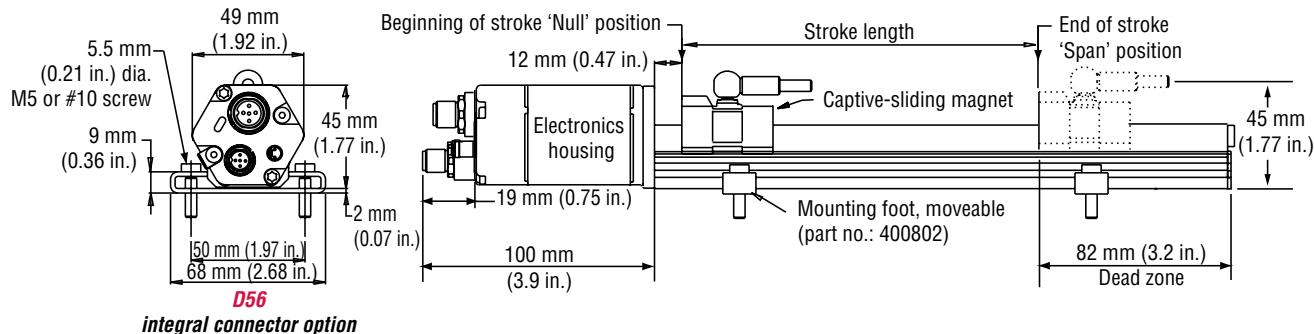


Figure 3. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

MODEL RP, PROFILE-STYLE SENSOR WITH OPEN-RING MAGNET Drawing is for reference only, contact applications engineering for tolerance specific information.

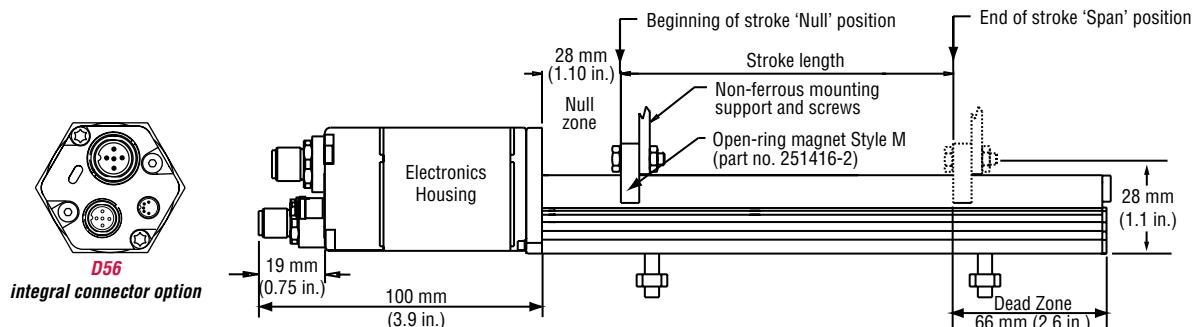


Figure 4. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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.

R-Series Model RH Rod-Style Sensor Dimension References Model RH - Standard Magnet and Mounting References

Model RH rod-style sensor dimension reference

The Tempsonics 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 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.

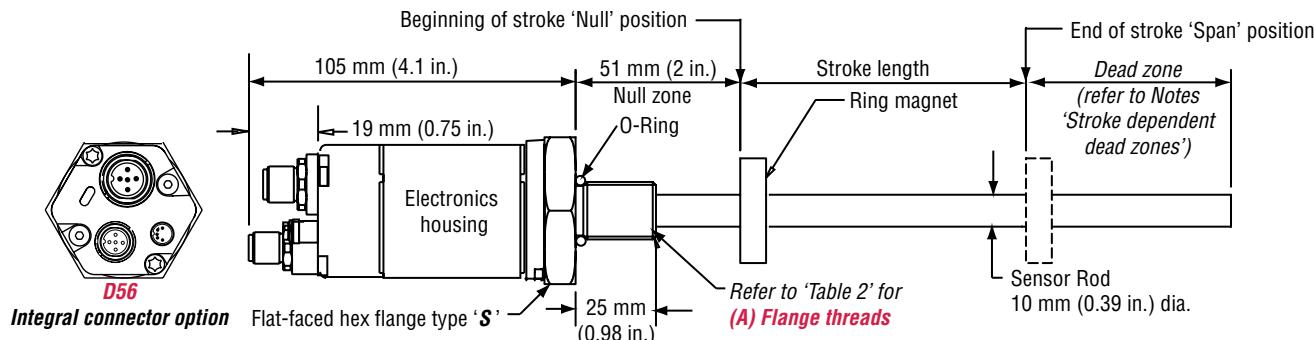


Figure 5. Model RH Rod-style sensor dimension reference (shown with D56 integral connector options)

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

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

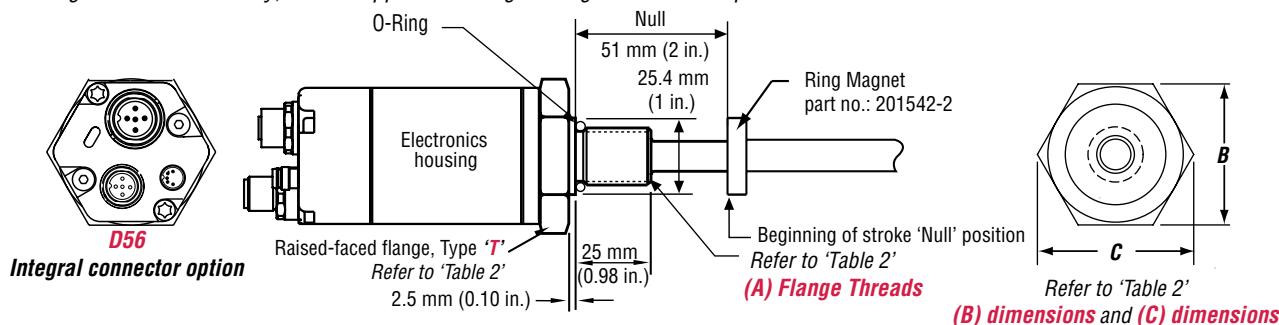


Figure 6. Model RH Rod-style sensor dimension reference (Shown with the D56 Integral cable connection type option)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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. The standard ring magnet (part number 201542-2) is suitable for most applications.

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

R-Series Models RP and RH Sensors Connections and Wiring

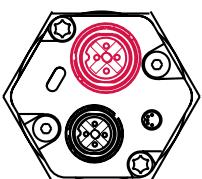
Connections and wiring

(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 (part no.: 370537).



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-

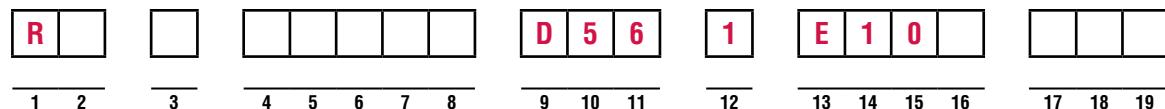
INPUT VOLTAGE



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

**R-Series Models RP and RH Sensors
Ordering Information**



SENSOR MODEL

RP = Profile style

RH = Hydraulic rod style

= **R** **1-2**

HOUSING STYLE

= **3**

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

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

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

STROKE LENGTH

=

4-8

— **M** = Millimeters
(Encode in 5 mm 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.)

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®**

Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors



R-Series Models RP and RH EtherNet/IP™ Industrial Ethernet Interface

Document Part Number
551253 Revision C

Data Sheet

R-Series
EtherNet/IP



EtherNet/IP™
conformance tested

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 µm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Direct EtherNet/IP Interface, Position + Velocity

BENEFITS

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



EtherNet/IP™ is a trademark used under license by ODVA.
EtherNet/IP CONFORMANCE TESTED™ is a certification mark of ODVA.



R-Series RP and RH Sensors - EtherNet/IP™**Product Overview and Specifications****Product overview**

Temposonics R-Series EtherNet/IP™ sensors represent MTS Sensors' development and product offering in networked position feedback. EtherNet/IP™ systems require only a single point of connection for both configuration and control, because EtherNet/IP supports both I/O (or implicit) messages—those that typically contain time-critical control data—and explicit messages—those in which the data field carries both protocol information and instructions for service performance. And, as a producer-consumer network that supports multiple communication hierarchies and message prioritization, EtherNet/IP™ provides more efficient use of bandwidth than a device network based on a source-destination model. EtherNet/IP systems can be configured to operate either in a master/slave or distributed control architecture using peer-to-peer communication.

Product specifications

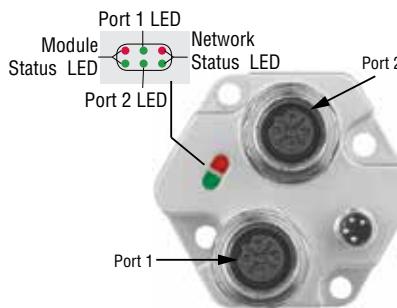
Parameters	Specifications	Parameters	Specifications
OUTPUT		ENVIRONMENTAL	
Measured output variables:	Simultaneous multi-position and velocity measurements up to 20 magnets.	Operating conditions:	Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 15 ppm/ °C
Resolution:	1 to 1000 µm selectable	EMC test:	Electromagnetic emission: EN 61000-6-4 Electromagnetic susceptibility: EN 61000-6-2, EN 61000-4-2/3/4/6 CE qualified
Update time:	1.0 ms up to 2000 mm 2.0 ms up to 4800 mm, 4.0 ms up to 7600 mm stroke length	Shock rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)
Linearity deviation:	< ± 0.01% full stroke (minimum ± 50 µm)	Vibration rating:	15 g / 10 to 2000 Hz / IEC standard 68-2-6
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)	WIRING	
Hysteresis:	< 4 µm	Connection type:	D56 option: Two female 4-pin (M12-D) plus one 4-pin male (M8) connector
Outputs:	Interface: EtherNet/IP™ Data transmission rate: 100 Mbit/s max.	PROFILE STYLE SENSOR (MODEL RP)	
Stroke length:	Range (Profile style): 25 mm to 5080 mm (1 in. to 200 in.) Range (Rod style): 25 mm to 7620 mm (1 in. to 300 in.)	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
ELECTRONICS		Sealing:	IP 65**
Operating voltage:	+24 Vdc nominal: -15% or +20%* Polarity protection: up to -30 Vdc Over voltage protection: up to 36 Vdc Current drain: 110 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Sensor extrusion:	Aluminum (Temposonics profile style)
		Mounting:	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove
		Magnet types:	Captive-sliding magnet or open-ring magnet
		ROD STYLE SENSOR (MODEL RH)	
		Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connectors)
		Sealing:	IP 67**
		Sensor rod:	304L stainless steel
		Operating pressure:	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)
		Mounting:	Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A
		Typical mounting torque:	45 N·m (33 ft. - lbs.)
		Magnet types:	Ring magnet, open-ring magnet, or magnet float

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY



Integrated green and red diagnostic LEDs are located beside the sensor's connectors as shown in 'Figure 1', the LEDs provide basic visual monitoring for normal sensor operation and troubleshooting. These diagnostic display LEDs indicate four modes as described in 'Table 1. Diagnostic display indicator modes'

Figure 1. R-Series sensor Integrated diagnostic LEDs

ETHER-NET PORT 1 (INLET)		
Green	On:	Ethernet connection established
Green	Flickering:	Data activity
Red	On:	Magnet not detected or wrong quantity of magnets
ETHER-NET PORT 2 (OUTLET)		
Green	On:	Ethernet connection established
Green	Flickering:	Data activity
NETWORK STATUS		
Green	On:	At least one connection established
Green	Flashing:	No connection established
Red	On:	Unrecoverable fault detected
Red	Flashing:	Recoverable fault detected
MODULE STATUS		
Green	On:	IP address configured
Green	Flashing:	IP address not configured
Red	Flashing:	Duplicate IP address detected

Table 1. Diagnostic display indicator modes

EtherNet/IP™ interface

EtherNet/IP™ is an Industrial Ethernet implementation of the Common Industrial Protocol (CIP), managed by the Open DeviceNet Vendors Association (ODVA), which defines communication services for automation. EtherNet/IP uses standard IEEE 802.3 technology at both the Physical Layer and Data Layers for compatibility with other applications and protocols. The protocol is also compliant with IEC 61158-2 for the physical layer and IEC 61784-1, -2 for measurement and control profiles.

Note:

Go to www.mtssensors.com to download latest EDS file.

This Ethernet/IP device also offers Device-Level-Ring (DLR) capability to directly connect devices to a ring topology without the use of external switches. DLR provides device-level network re-routing and failure point identification to improve reliability and network recovery time.

Operation modes and output

N101 Single and Multi-magnet position and velocity:

Up to 20 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').

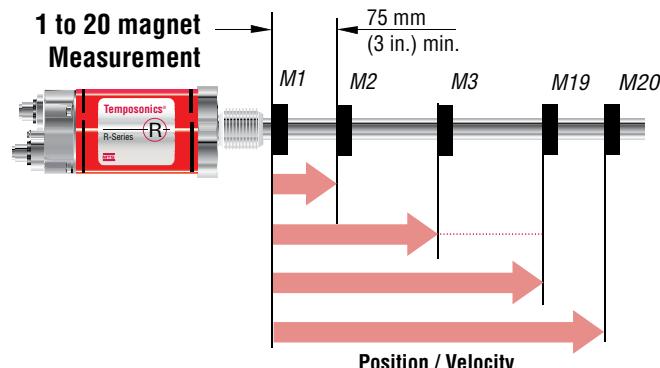


Figure 2. Single to multi-magnet output diagram

R-Series Model RP Profile-Style Sensor Dimension References Model RP - Standard Magnet and Mounting 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.

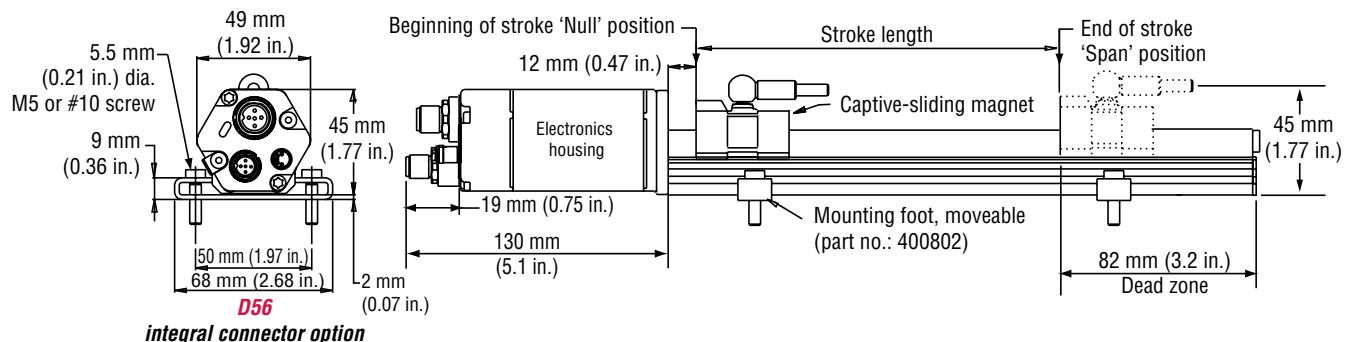


Figure 3. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

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

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

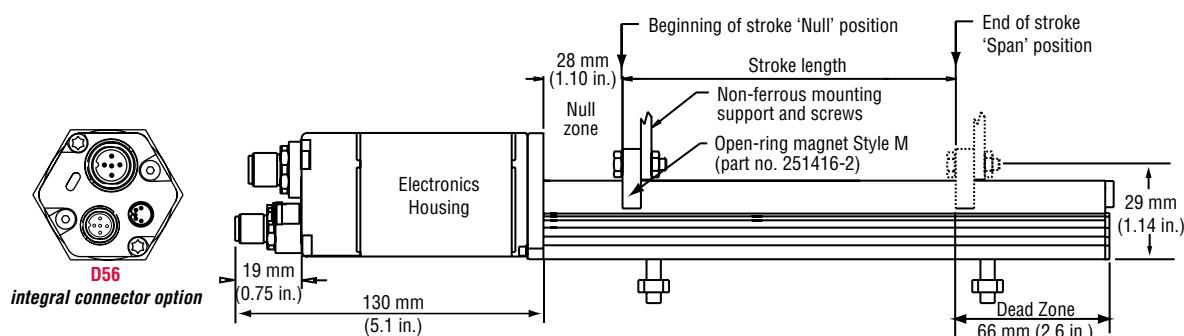


Figure 4. R-Series Model RP Profile-style sensor dimension reference (Shown with the **D56** connector option)

Standard magnet selections, mounting and installation (Model RP)

SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)

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 Tempsonics 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 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.

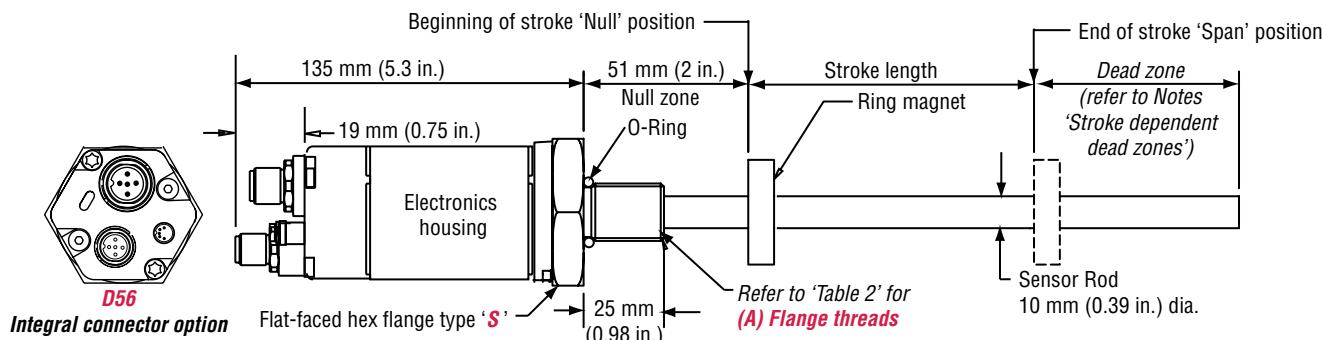


Figure 5. Model RH Rod-style sensor dimension reference (shown with **D56** integral connector options)

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

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

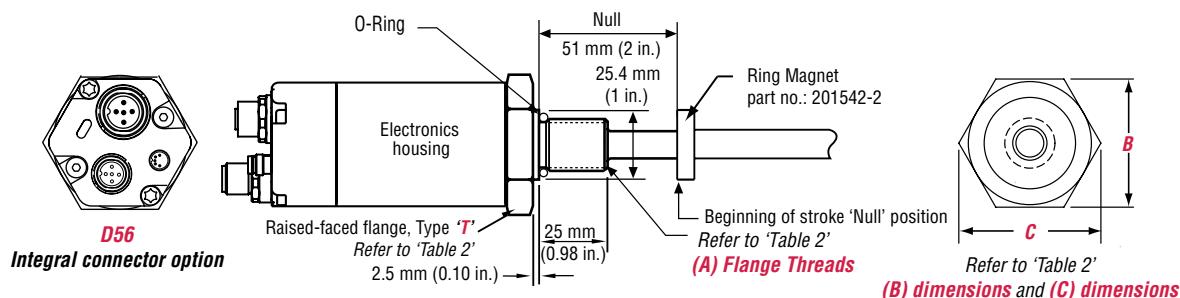


Figure 6. Model RH Rod-style sensor dimension reference (Shown with the **D56** Integral cable connection type option)

Housing style Flange type	Description	(A) Flange threads	(B) Dimensions	(C) Dimensions
T	US customary threads with raised-face flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
S	US customary threads with flat-faced flange	3/4" - 16 UNF-3A	1.75 in.	2 in.
M	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. The standard ring magnet (part number 201542-2) is suitable for most applications.

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

Models RP and RH Sensors Connections and Wiring

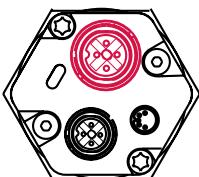
Connections and wiring

(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 (part no.: 370537).



D56
Female
4-pin Bus
Port 1



D56
Female
4-pin Bus
Port 2



D56
Male, 4-pin
Input voltage

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-

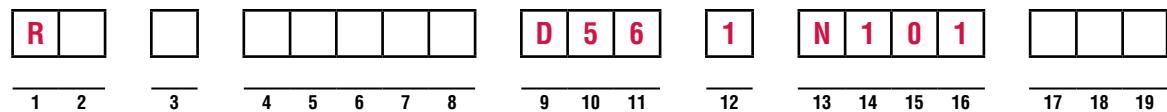
INPUT VOLTAGE



Input voltage, male, 4-pin (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

**Model RP and RH Sensors
Ordering Information**



SENSOR MODEL _____ = **R** _____ **1-2**

RP = Profile style

RH = Hydraulic rod style

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	

STROKE LENGTH _____ = _____ **4-8**

M = Millimeters
(Encode in 5 mm 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.)

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 _____ = **N** **1** **0** **1** **13-16**

N101 = EtherNet/IP, position and velocity, maximum 20 magnets

NUMBER OF MAGNETS _____ = **Z** _____ **17-19**

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

Z _____ = Number of magnets for output **N101** (range 02 to 20)

**R-Series
EtherNet/IP**

Temposonics®

Magnetostrictive, Absolute, Non-contact
Linear-Position Sensors

MTS
SENSORS

R-Series Models RP and RH Profinet Interface

Document Part Number
551451 Revision B

Data Sheet



Model RP Profile-style position sensor

Model RH Rod-style position sensor

**R-Series
Profinet**

FEATURES

- Linear, Absolute Measurement
- LEDs For Sensor Diagnostics
- Superior Accuracy, Resolution down to 1 μm
- Non-Contact Sensing Technology
- Linearity Deviation Less Than 0.01%
- Repeatability Within 0.001%
- Integrated 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



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	Parameters	Specifications	
OUTPUT			ENVIRONMENTAL	
Measured output variables:	Simultaneous multi-position or velocity measurements up to 19 magnets.	Operating conditions:	Operating temperature: -40 °C (-40 °F) to +75 °C (+167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 15 ppm/ °C	
Resolution:	1 to 100 µm selectable	EMC test:	Electromagnetic emission: EN 61000-6-4 (for industrial environments) Electromagnetic immunity: EN 61000-6-2 (The sensor meets the requirements of the EC directives and is marked with CE)	
Update time:	Dependent on stroke length	Shock rating:	100 g (single hit)/IEC standard 60068-2-27 (survivability)	
Motion control cycle time:	Minimum 1 ms	Vibration rating:	15 g / 10 to 2000 Hz / IEC standard 60068-2-6 (resonance frequencies excluded)	
Linearity deviation:	< ± 0.01% full stroke (minimum ± 50 µm)	WIRING		
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm)	Connection type:	D58 option: Two female 4-pin (M12-D) plus one 4-pin male (M12-A) connector	
Hysteresis:	< 4 µm	PROFILE STYLE SENSOR (MODEL RP)		
Outputs:	Interface: Profinet IO RT Data transmission rate: 100 Mbit/s max.	Electronic head:	Aluminum housing with diagnostic LED display (LEDs located beside connectors)	
Stroke length:	Range (Profile style): 25 mm to 5080 mm (1 in. to 200 in.) Range (Rod style): 25 mm to 7620 mm (1 in. to 300 in.)	Sealing:	IP 65**	
ELECTRONICS			Sensor extrusion: Aluminum (Tempsonics profile style)	
Operating voltage:	+24 Vdc nominal: -15% or +20%* Polarity protection: up to -30 Vdc Over voltage protection: up to 36 Vdc Current drain: 110 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)	Mounting:	Any orientation. Adjustable mounting feet or T-slot nut (M5 threads) in bottom groove	
ROD STYLE SENSOR (MODEL RH)			Magnet types: Captive-sliding magnet or open-ring magnet	
			Electronic head: Aluminum housing with diagnostic LED display (LEDs located beside connectors)	
			Sealing: IP 67**	
			Sensor rod: 304L stainless steel	
			Operating pressure: 350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)	
			Mounting: Any orientation. Threaded flange M18 x 1.5 or 3/4 - 16 UNF-3A	
			Typical mounting torque: 45 N·m (33 ft. - lbs.)	
			Magnet types: Ring magnet, open-ring magnet, or magnet float	

* UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.

** The IP rating is not part of the UL Recognition.

Enhanced monitoring and diagnostics

SENSOR STATUS AND DIAGNOSTIC DISPLAY



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 Tempsonics® Profibus sensors

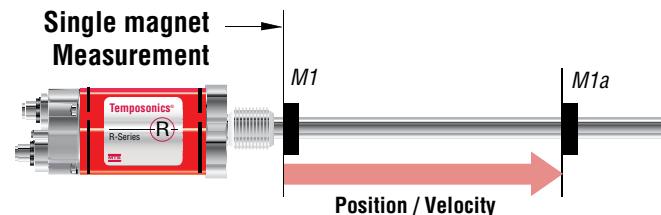
Operation modes and output

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').

**R-Series
Profinet**

U401



U402

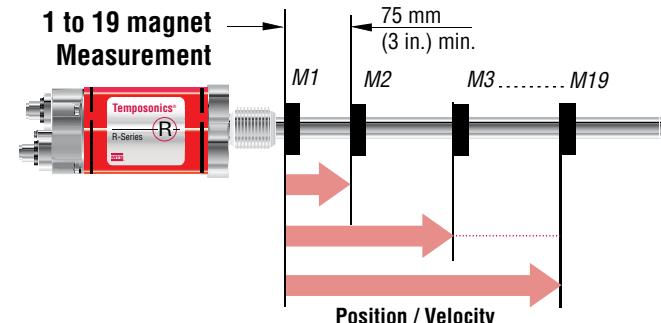
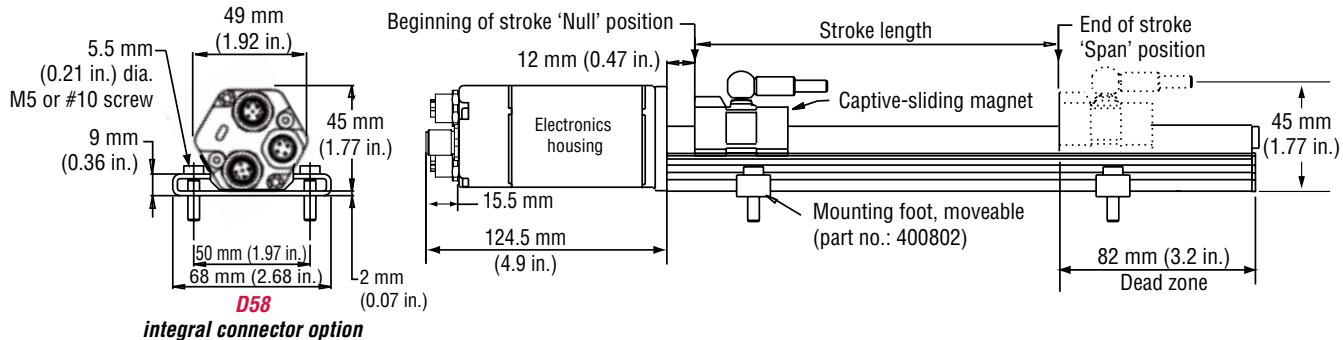
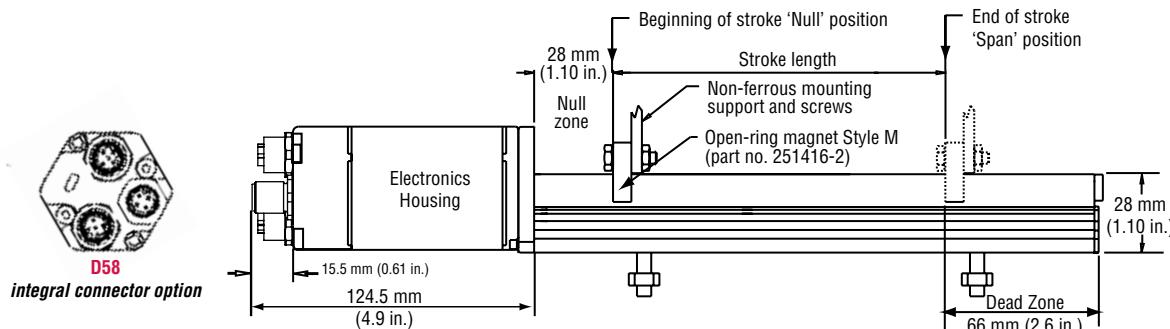


Figure 3. Single and multi-magnet output diagram

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 4.** 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 5.** R-Series Model RP Profile-style sensor dimension reference (Shown with the **D58** connector option)**Standard magnet selections, mounting and installation (Model RP)****SELECTION OF POSITION MAGNETS (ONE MAGNET INCLUDED WITH MODEL RP SENSOR)**

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 Tempsonics 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.

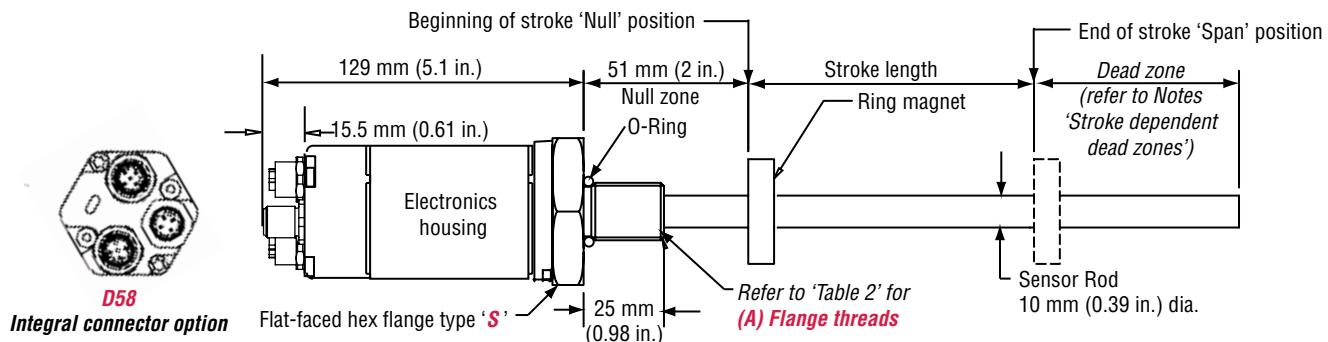


Figure 6. Model RH Rod-style sensor dimension reference (shown with **D58** integral connector options)

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

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

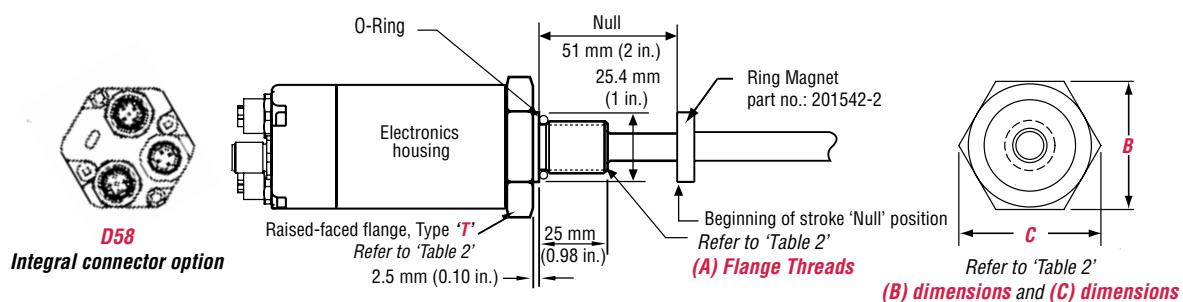


Figure 7. Model RH Rod-style sensor dimension reference (Shown with the **D58** Integral cable connection type option)

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

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. The standard ring magnet (part number 201542-2) is suitable for most applications.

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

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).

Model RH Rod-Style Sensor Mounting Cylinder Installation and Connections

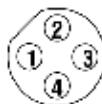
BUS CONNECTIONS PORTS 1 AND 2



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-

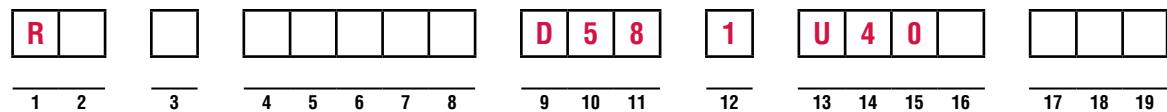
INPUT VOLTAGE



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**



SENSOR MODEL

RP = Profile style

RH = Hydraulic rod style

HOUSING STYLE

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	

STROKE LENGTH

M = Millimeters
(Encode in 5 mm 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.)

CONNECTION TYPE

Integral connector:

D58 = Two 4-pin female (M12-D), plus one 4-pin male (M12-A)

INPUT VOLTAGE

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

OUTPUT

U401 = Profinet RT, Encoder profile, 1 magnet

U402 = Profinet RT, MTS profile, 1 to 19 magnets

NUMBER OF MAGNETS

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

Z = Number of magnets for output **U402** (range 02 to 19)

**R-Series
Profinet**

