

# Tempsonics®

Magnetostrictive Linear Position Sensors

## R-Series V RH Profinet RT & IRT Data Sheet

- Profinet with IRT (Isochronous Real Time)
- Position + velocity measurements for up to 30 magnets
- Field adjustments and diagnostics using the new TempoLink smart assistant



I AM THE NEW GENERATION

## MEASURING TECHNOLOGY

The absolute, linear position sensors provided by MTS Sensors rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics® position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

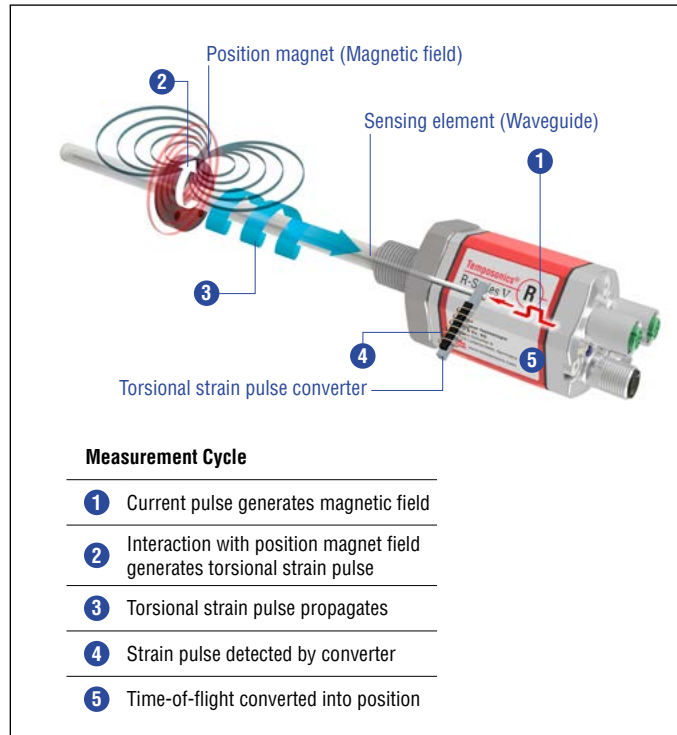


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

## R-SERIES V PROFINET RT & IRT

Temposonics® R-Series V brings very powerful sensor performance to meet the many demands of your application. The R-Series V is the long term solution for harsh environments having high levels of shock and vibration. The sensors are available with Profinet RT (Real Time) and IRT (Isochronous Real Time). Profinet IRT offers a synchronized communication with a minimum cycle time as fast as 250  $\mu$ s. For time-critical applications R-Series V with linear extrapolation enables synchronized controller communication for any stroke length of the sensor. In addition, the sensors are available with internal linearization which offers improved linearity for overall higher accuracy of the position measurement values.

With many outstanding features the R-Series V model sensors are fit for a very broad range of applications.

## TempoLink YOUR SMART ASSISTANT

The TempoLink smart assistant is an accessory for the R-Series V family of sensors that supports setup and diagnostics. Depending on the sensor protocol it enables the adjustment of parameters like measurement direction, resolution and filter settings. For diagnostics and analysis of operational data the R-Series V sensors continuously track values such as total distance traveled by the position magnet, internal temperature of the sensor and the quality of the position signal. This additional information can be read out via TempoLink smart assistant even while the sensor remains operational in the application.

TempoLink smart assistant is connected to the sensor via the power connection, which now adds bidirectional communication for setup and diagnostics. The TempoLink smart assistant is operated using a graphical user-interface that will be displayed on your smartphone, tablet, laptop or PC. Just connect your Wi-Fi-enabled device to TempoLink Wi-Fi access point and go to the website URL for the user-interface.



Fig. 2: R-Series V sensor with TempoLink Smart Assistant

## TECHNICAL DATA

Output						
Interface	Profinet RT Profinet IRT version 2.3					
Data protocol	MTS Profile and Encoder Profile 4.1					
Data transmission rate	100 MBit/s (maximum)					
Measured value	Position, velocity / option: Simultaneous multi-position and multi-velocity measurements up to 30 magnets					
Measurement parameters						
Resolution: Position	0.5...100 µm (selectable)					
Cycle time <sup>1</sup>	Stroke length	≤ 50 mm	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 7620 mm
	Cycle time	250 µs	500 µs	1000 µs	2000 µs	4000 µs
Linearity deviation <sup>2</sup>	Stroke length	up to 500 mm	greater 500 mm			
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.			
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical					
Hysteresis	< 4 µm, typical 2 µm					
Operating conditions						
Operating temperature	-40...+85 °C (-40...+185 °F)					
Humidity	90 % relative humidity, no condensation					
Ingress protection	IP67 (connectors correctly fitted)					
Shock test	150 g / 11 ms, IEC standard 60068-2-27					
Vibration test	30 g / 10...2000 Hz, IEC 60068-2-6 (excluding resonant frequencies)					
EMC test	Electromagnetic emission according to EN 61000-6-3					
	Electromagnetic immunity according to EN 61000-6-2					
	The sensor meets the requirements of the EC directives and is marked with <b>CE</b>					
Operating pressure	350 bar (5076 psi) / 700 bar (10153 psi) peak (at 10 × 1 min) for sensor rod					
Magnet movement velocity	Any					
Design / Material						
Sensor electronics housing	Aluminum (painted), zinc die cast					
Sensor flange	Stainless steel 1.4305 (AISI 303) / RH5-J: Stainless steel 1.4305 (AISI 303)					
Sensor rod	Stainless steel 1.4306 (AISI 304L) / RH5-J: Stainless steel 1.4301 (AISI 304)					
Stroke length	25...7620 mm (1...300 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on <a href="#">page 4</a> and the operation manual (document number: <a href="#">551973</a> )					
Electrical connection						
Connection type	2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)					
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC) <sup>3</sup>					
Power consumption	Less than 4 W typical					
Dielectric strength	500 VDC (DC ground to machine ground)					
Polarity protection	Up to -36 VDC					
Overvoltage protection	Up to 36 VDC					

1/ Sensor with standard settings. Further information can be found in the [operating manual R-Series V Profinet \(document number: 551973\)](#)

2/ With position magnet # 251 416-2

3/ Power supply must be able to provide current of 1 A for power up process

## TECHNICAL DRAWING

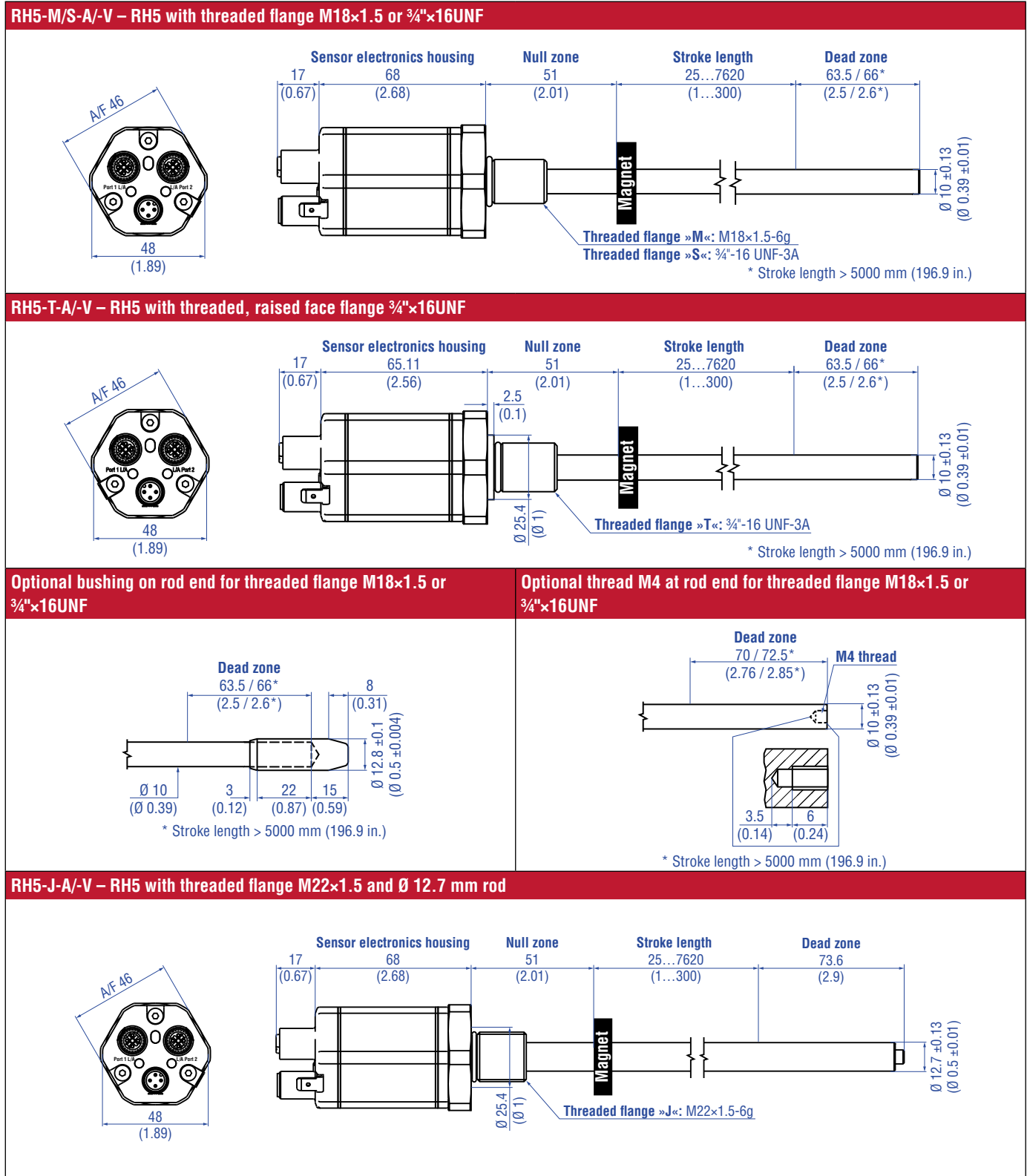


Fig. 3: Temposonics® RH5 with ring magnet

Controlling design dimensions are in millimeters and measurements in ( ) are in inches

## CONNECTOR WIRING


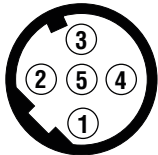
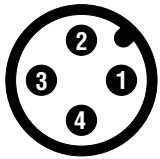
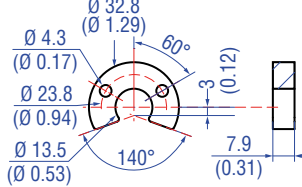
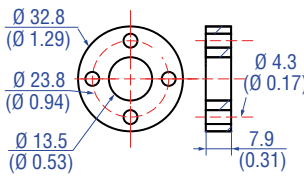
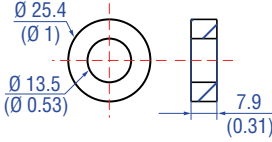
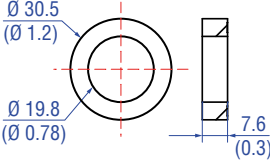
D58		
Signal		
<b>Port 1 – M12 female connector (D-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not connected
<b>Port 2 – M12 female connector (D-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not connected
Power supply		
<b>M12 male connector (A-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	12...30 VDC ( $\pm 20\%$ )
	2	Not connected
	3	DC Ground (0 V)
	4	Not connected

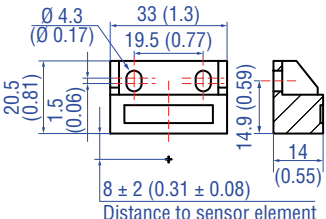
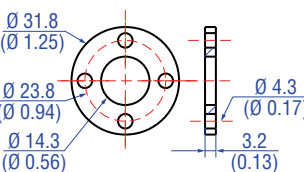
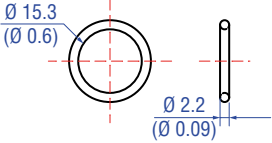
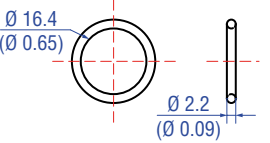
Fig. 4: Connector wiring D58

**FREQUENTLY ORDERED ACCESSORIES** – Additional options available in our [Accessories Guide](#)  [551444](#)

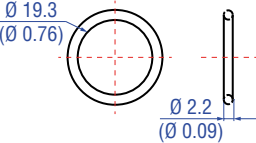
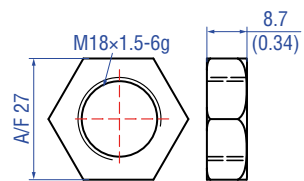
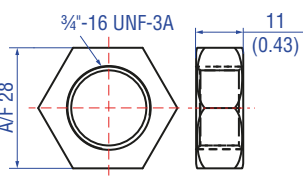
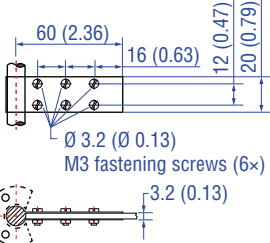
**Position magnets**

			
<p><b>U-magnet OD33</b> Part no. 251 416-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD33</b> Part no. 201 542-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD25.4</b> Part no. 400 533</p> <p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm<sup>2</sup> Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet</b> Part no. 402 316</p> <p>Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm<sup>2</sup> Operating temperature: -40...+100 °C (-40...+212 °F)</p>

**Position magnet      Magnet spacer      O-rings**

			
<p><b>Block magnet L</b> Part no. 403 448</p> <p>Material: Hard ferrite Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	<p><b>Magnet spacer</b> Part no. 400 633</p> <p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm</p>	<p><b>O-ring for threaded flange</b> M18×1.5-6g Part no. 401 133</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p><b>O-ring for threaded flange</b> ¾"-16 UNF-3A Part no. 560 315</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>

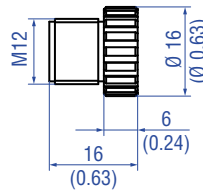
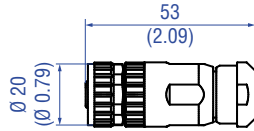
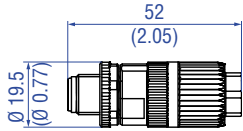
**O-rings      Mounting accessories**

			
<p><b>O-ring for threaded flange</b> M22×1.5-6g Part no. 561 337</p> <p>Material: FPM Durometer: 75 Shore A Operating temperature: -20...+200 °C (-6...+392 °F)</p>	<p><b>Hex jam nut M18×1.5-6g</b> Part no. 500 018</p> <p>Material: Steel, zinc, plated</p>	<p><b>Hex jam nut ¾"-16 UNF-3A</b> Part no. 500 015</p> <p>Material: Zinc plated with nylon insert</p>	<p><b>Fixing clip for rod with Ø 10 mm</b> Part no. 561 481</p> <p>Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.)) when using an U-magnet or block magnet Material: Brass, non-magnetic</p>

Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Cable connectors<sup>4</sup>

Programming kit



**M12 D-coded male connector (4 pin), straight**  
Part no. 370 523

Material: Zinc nickel-plated  
Termination: Insulation-displacement  
Cable Ø: 5.5...7.2 mm (0.2...0.28 in.)  
Wire: 24 AWG – 22 AWG  
Operating temperature:  
–25...+85 °C (–13...+185 °F)  
Ingress protection: IP65 / IP67 (correctly fitted)  
Fastening torque: 0.6 Nm

**M12 A-coded female connector (5 pin), straight**  
Part no. 370 677

Material: GD-Zn, Ni  
Termination: Screw  
Contact insert: CuZn  
Cable Ø: 4...8 mm (0.16...0.31 in.)  
Wire: 1.5 mm<sup>2</sup>  
Operating temperature:  
–30...+85 °C (–22...+185 °F)  
Ingress protection: IP67 (correctly fitted)  
Fastening torque: 0.6 Nm

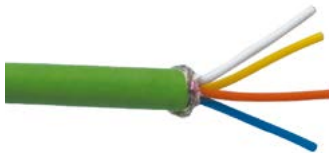
**M12 connector end cap**  
Part no. 370 537

Female connectors M12 should be covered by this protective cap  
Material: Brass nickel-plated  
Ingress protection: IP67 (correctly fitted)  
Fastening torque: 0.39...0.49 Nm

**TempoLink kit for Tempsonics® R-Series V**  
Part no. TL-1-0-EM12 (for D58)

- Connect wirelessly via Wi-Fi enabled device or via USB with the diagnostic tool
- Simple connectivity to the sensor via 24 VDC power line
- User friendly interface for mobile devices and desktop computers
- Rugged ABS plastic construction for the industrial environment
- See product brief “TempoLink smart assistant” (document part no.: 551976) for further information

Cable



**PUR cable**  
Part no. 530 125

Material: PUR jacket; green  
Features: Cat 5, highly flexible  
Cable Ø: 6.5 mm (0.26 in.)  
Cross section: 2 × 2 × 0.35 mm<sup>2</sup> (22/7 AWG)  
Operating temperature:  
–20...+60 °C (–4...+140 °F)

**PVC cable**  
Part no. 530 108

Material: PVC jacket; gray  
Features: Shielded, flexible  
Cable Ø: 4.9 mm (0.19 in.)  
Cross section: 3 × 0.34 mm<sup>2</sup>  
Operating temperature:  
–30...+80 °C (–22...+176 °F)

**Cable with M12 D-coded male connector (4 pin), straight – M12 D-coded, male connector (4 pin), straight**  
Part no. 530 064

Material: PUR jacket; green  
Features: Cat 5e  
Cable length: 5 m (16.4 ft)  
Cable Ø: 6.5 mm (0.26 in.)  
Ingress protection: IP65, IP67, IP68 (correctly fitted)  
Operating temperature:  
–30...+70 °C (–22...+158 °F)

**Cable with M12 D-coded male connector (4 pin), straight – RJ45 male connector, straight**  
Part no. 530 065

Material: PUR jacket; green  
Features: Cat 5e  
Cable length: 5 m (16.4 ft)  
Cable Ø: 6.5 mm (0.26 in.)  
Ingress protection M12 connector: IP67 (correctly fitted)  
Ingress protection RJ45 connector: IP20 (correctly fitted)  
Operating temperature:  
–30...+70 °C (–22...+158 °F)

4/ Follow the manufacturer's mounting instructions

Controlling design dimensions are in millimeters and measurements in ( ) are in inches

## ORDER CODE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
R	H	5										D	5	8	1	U	4		
a			b	c	d						e	f			g	h			

<b>a</b>	<b>Sensor model</b>
R H 5	Rod

<b>b</b>	<b>Design</b>
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm, 800 bar)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"×16UNF - 3A (standard)
T	Threaded flange ¾"×16UNF - 3A (with raised-face)

<b>c</b>	<b>Mechanical options</b>
A	Standard
B	Bushing on rod end (only for flange option »M«, »S« & »T«)
M	Female thread M4 at rod end (only for flange option »M«, »S« & »T«)
V	Fluorelastomer seals for the electronics housing

<b>d</b>	<b>Stroke length</b>
X X X X M	0025...7620 mm
	<b>Standard stroke length (mm)*      Ordering steps</b>
	25 ... 500 mm                              5 mm
	500 ... 750 mm                            10 mm
	750 ...1000 mm                          25 mm
	1000 ...2500 mm                        50 mm
	2500 ...5000 mm                        100 mm
	5000 ...7620 mm                        250 mm
X X X X U	001.0...300.0 in.
	<b>Standard stroke length (in.)*      Ordering steps</b>
	1... 20 in.                                    0.2 in.
	20... 30 in.                                  0.4 in.
	30... 40 in.                                  1.0 in.
	40...100 in.                                2.0 in.
	100...200 in.                              4.0 in.
	200...300 in.                              10.0 in.

<b>e</b>	<b>Number of magnets</b>
X X	01...30 Position(s) (1...30 magnet(s))

<b>f</b>	<b>Connection type</b>
D 5 8	2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)

<b>g</b>	<b>System</b>
1	Standard

<b>h</b>	<b>Output</b>
U 4 0 1	Profinet RT & IRT with encoder profile (single position)
U 4 0 2	Profinet RT & IRT with MTS profile (single- & multi-position)
U 4 1 1	Profinet RT & IRT with encoder profile (single position) and internal linearization
U 4 1 2	Profinet RT & IRT with MTS profile (single- & multi-position) and internal linearization

### NOTICE

- For multi-position measurement the MTS profile for protocol options is required.
- Please specify magnet numbers for your sensing application and order separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement, e.g. 2 × U-magnets (part no. 251 416-2).

### DELIVERY



#### RH5-B:

- Base unit (without flange/rod assembly)

Accessories have to be ordered separately.

#### RH5-J / -M / -S / -T:

- Sensor
- O-ring

\* / Non standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments

Manuals, Software & 3D Models available at:  
[www.mtssensors.com](http://www.mtssensors.com)



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