Data Sheet

R-Series V RH5 PROFINET IO RT & IRT
Magnetostrictive Linear Position Sensors

▌ Minimum position resolution 0.5 µm
▌ Position and velocity measurements for up to 30 magnets
▌ Field adjustments and diagnostics using the new TempoLink® smart assistant

THE NEW GENERATION

MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary 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.
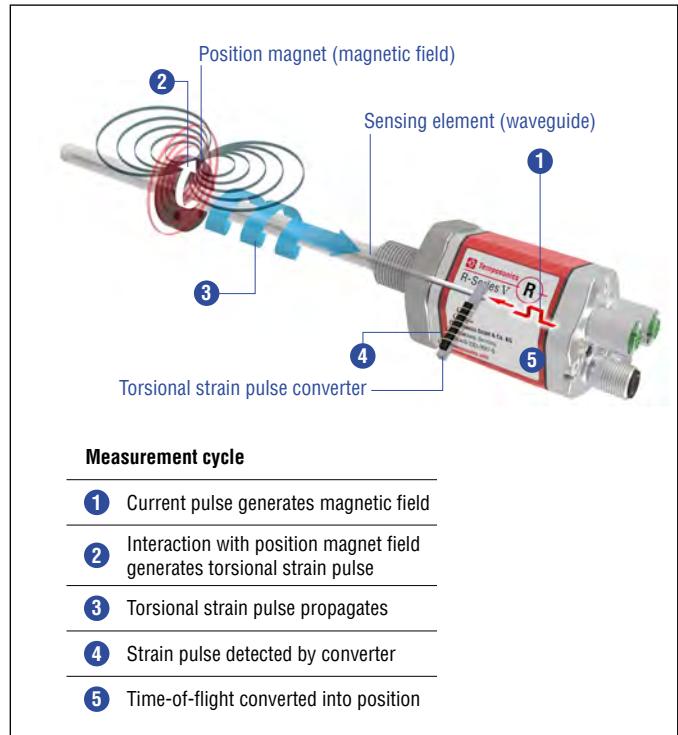

Measurement cycle

➊	Current pulse generates magnetic field
➋	Interaction with position magnet field generates torsional strain pulse
➌	Torsional strain pulse propagates
➍	Strain pulse detected by converter
➎	Time-of-flight converted into position

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

R-SERIES Ⅴ PROFINET

Temposonics® R-Series Ⅴ brings very powerful sensor performance to meet the many demands of your application. This series is the long term solution for harsh environments that have 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 of 250 µs. 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. In addition to the measured position value via the PROFINET protocol further data about the current sensor status, such like the total distance travelled, the internal temperature and the total operating hours, can be displayed for diagnostic purposes.

With many outstanding features the R-Series Ⅴ 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 positon 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 V4.2				
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	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 [1]	Stroke length	≤ 500 mm	> 500 mm			
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.			
	Optional internal linearization: Linearity tolerance (Applies for the first magnet for multi-position measurement)					
	Stroke length	25…300 mm	300…600 mm	600…1200 mm		
	typical	±15 µm	±20 µm	±25 µm		
	maximum	±25 µm	±30 µm	±50 µm		
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical				
Hysteresis	< 4 µm typical				
Temperature coefficient	< 15 ppm/K typical				
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)/ RH5-J: 15 g / 10…2000 Hz, IEC standard 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 CE				
Operating pressure	350 bar (5076 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod/RH5-J: 800 bar (11,603 psi)				
Magnet movement velocity	Any				
Design/Material					
Sensor electronics housing	Aluminum (painted), zinc die cast				
Sensor flange	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.)/RH5-J: 25…5900 mm (1…232 in.)				
Mechanical mounting					
Mounting position	Any				
Mounting instruction	Please consult the technical drawings on page 4 and the operation manual (document number: 551973)				
Electrical connection					
Connection type	2 × M12 female connectors (D-coded), 1 × M12 male connector (A-coded) 2 × M12 female connectors (D-coded), 1 × M8 male connector				
Operating voltage	+12…30 VDC ±20 % (9.6…36 VDC)				
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/ With position magnet # 251 416-2

TECHNICAL DRAWING

RH5-M/S-A/-V – RH5 with threaded flange M18×1.5-6g or ¾"-16 UNF-3A, example: Connection type D58 (connector output)

Threaded flange	a	b
»M«	A/F 46	53 (2.09)
»S«	A/F 44.5 (1.75)	51.3 (2.02)

Sensor electronics housing · 17 (0.67) · 68 (2.68) · Null zone 51 (2.01) · Stroke length 25…7620 (1…300) · Dead zone 63.5/66* (2.5/2.6*) · 25 (0.98) · Ø 10 ±0.13 (Ø 0.39 ±0.01)

Threaded flange »M«: M18×1.5-6g
Threaded flange »S«: ¾"-16 UNF-3A

* Stroke length > 5000 mm (196.9 in.)

RH5-T-A/-V – RH5 with threaded flange ¾"-16 UNF-3A with raised-face, example: Connection type D58 (connector output)

A/F 44.5 · 51.3 (2.02)

Sensor electronics housing · 17 (0.67) · 65.5 (2.58) · Null zone 51 (2.01) · 2.5 (0.1) · Stroke length 25…7620 (1…300) · Dead zone 63.5/66* (2.5/2.6*) · 25 (0.98) · Ø 25.4 (Ø 1) · Ø 10 ±0.13 (Ø 0.39 ±0.01)

Threaded flange »T«: ¾"-16 UNF-3A

* Stroke length > 5000 mm (196.9 in.)

Mechanical option »B«: Bushing on rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A

Dead zone 63.5/66* (2.5/2.6*) · 8 (0.31) · Ø 12.8 ±0.1 (Ø 0.5 ±0.004) · Ø 10 (Ø 0.39) · 3 (0.12) · 22 (0.87) · 15 (0.59)

* Stroke length > 5000 mm (196.9 in.)

Mechanical option »M«: Thread M4 at rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A

Dead zone 70/72.5* (2.76/2.85*) · Thread M4 · Ø 10 ±0.13 (Ø 0.39 ±0.01) · 3.5 (0.14) · 6 (0.24)

* Stroke length > 5000 mm (196.9 in.)

RH5-J-A/-V – RH5 with threaded flange M22×1.5 and Ø 12.7 mm rod, example: Connection type D58 (connector output)

A/F 46 · 53 (2.09)

Sensor electronics housing · 17 (0.67) · 68 (2.68) · Null zone 51 (2.01) · Stroke length 25…5900 (1…232) · Dead zone 73.6 (2.9) · 25 (0.98) · Ø 12.7 ±0.13 (Ø 0.5 ±0.01)

Threaded flange »J«: M22×1.5-6g

Controlling design dimensions are in millimeters and measurements in ( ) are in inches
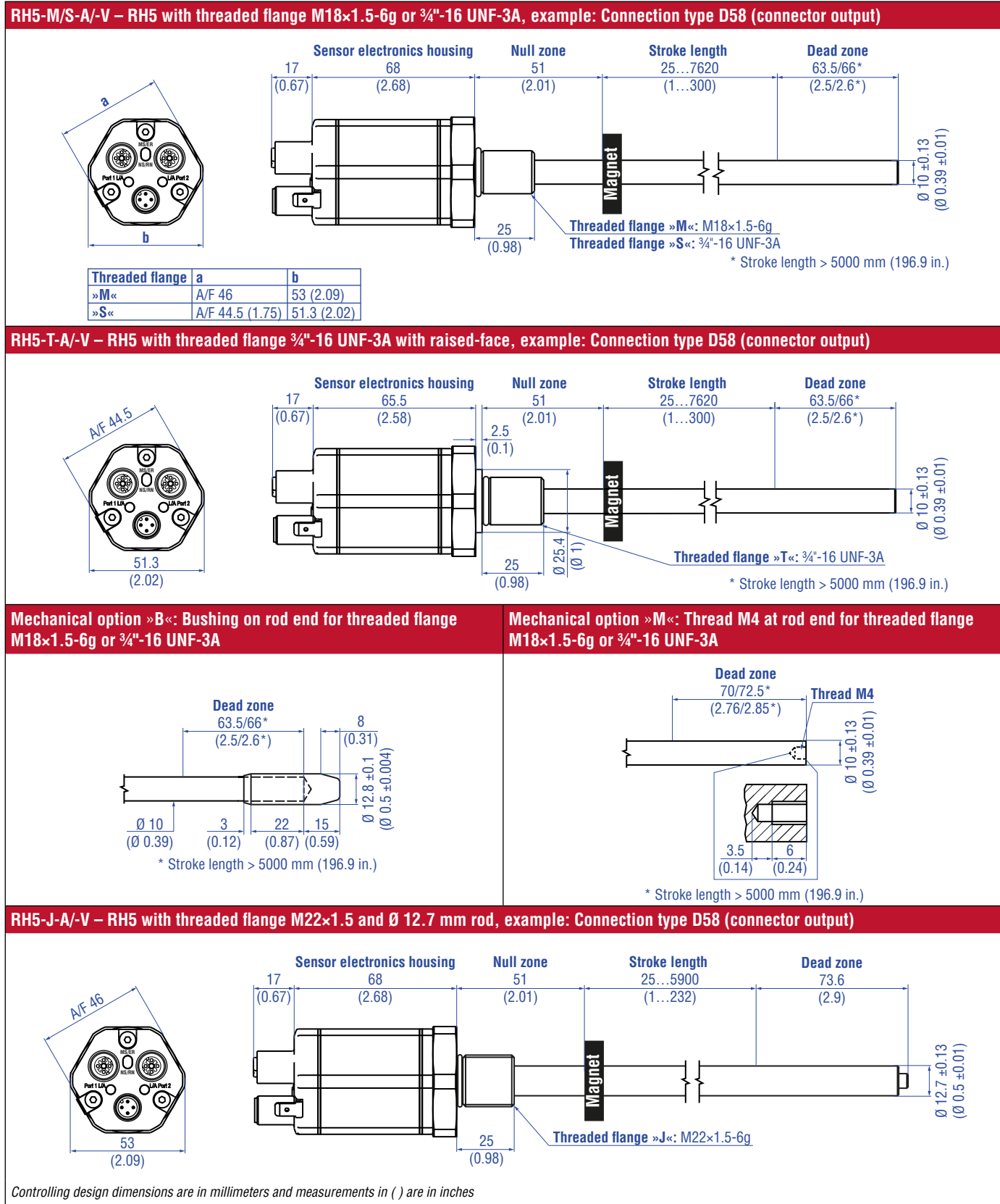
Fig. 3: Temposonics® RH5 with ring magnet

CONNECTOR WIRING

D58		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
	1	Tx (+)
	2	Rx (+)
	3	Tx (−)
View on sensor	4	Rx (−)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
	1	Tx (+)
	2	Rx (+)
	3	Tx (−)
View on sensor	4	Rx (−)
Power supply		
M12 male connector (A-coded)	**Pin**	**Function**
	1	+12…30 VDC (±20 %)
	2	Not connected
	3	DC Ground (0 V)
View on sensor	4	Not connected

Fig. 4: Connector wiring D58
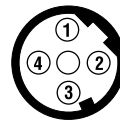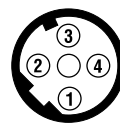
D56		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
	1	Tx (+)
	2	Rx (+)
	3	Tx (−)
View on sensor	4	Rx (−)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
	1	Tx (+)
	2	Rx (+)
	3	Tx (−)
View on sensor	4	Rx (−)
Power supply		
M8 male connector	**Pin**	**Function**
	1	+12…30 VDC (±20 %)
	2	Not connected
	3	DC Ground (0 V)
View on sensor	4	Not connected

Fig. 5: Connector wiring D56

FREQUENTLY ORDERED ACCESSORIES – Additional options available in our Accessories Guide ▯ 551444
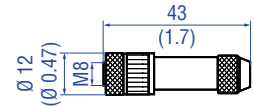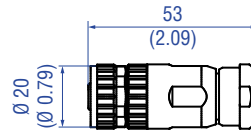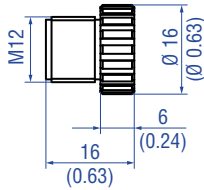
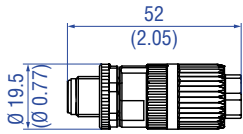## Position magnets

U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)

Marked version for sensors with internal linearization: Part no. 254 226

Ring magnet OD33
Part no. 201 542-2

Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)

Marked version for sensors with internal linearization: Part no. 253 620

Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+105 °C (–40…+221 °F)

Marked version for sensors with internal linearization: Part no. 253 621

Ring magnet
Part no. 402 316

Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)

Position magnet | Magnet spacer | O-rings

Block magnet L
Part no. 403 448

Material: Plastic carrier with hard ferrite magnet
Weight: Approx. 20 g
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+75 °C (–40…+167 °F)

This magnet may influence the sensor performance specifications for some applications.

Magnet spacer
Part no. 400 633

Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

O-ring | Mounting accessories

O-ring for threaded flange
M22×1.5-6g
Part no. 561 337

Material: FPM
Durometer: 75 Shore A
Operating temperature:
–20…+200 °C (–6…+392 °F)

Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated

Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

Fixing clip
Part no. 561 481

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

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

Cable connectors* – Signal

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 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

Cable connectors* – Power

M12 A-coded female connector (4 pin/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 mm²
Operating temperature:
−30…+85 °C (−22…+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm

M8 female connector (4 pin), straight
Part no. 370 504

Material: CuZn nickel plated
Termination: Solder
Cable Ø: 3.5…5 mm (0.14…0.28 in.)
Wire: 0.25 mm²
Operating temperature:
−40…+85 °C (−40…+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.5 Nm

Programming kit

TempoLink® kit for Temposonics® R-Series V
Part no. TL-1-0-EM08 (D56)
Part no. TL-1-0-EM12 (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 (permissible cable length: 30 m)
• User friendly interface for mobile devices and desktop computers
• See data sheet "TempoLink smart assistant" (document part no.: 552070) for further information

Cables

PUR signal cable
Part no. 530 125

Material: PUR jacket; green
Features: Cat 5, highly flexible, halogen free, suitable for drag chains, mostly oil & flame resistant
Cable Ø: 6.5 mm (0.26 in.)
Cross section: 2 × 2 × 0.35 mm² (22 AWG)
Operating temperature:
−20…+60 °C (−4…+140 °F)

Signal 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)

Signal 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)

*/ Follow the manufacturer's mounting instructions

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

Cables

PVC power cable **Part no. 530 108**	**Power cable with M8 female connector (4 pin), straight – pigtail** **Part no. 530 066 (5 m (16.4 ft.))** **Part no. 530 096 (10 m (32.8 ft.))** **Part no. 530 093 (15 m (49.2 ft.))**
Material: PVC jacket; gray Features: Shielded, flexible, mostly flame resistant Cable Ø: 4.9 mm (0.19 in.) Cross section: 3 × 0.34 mm² Bending radius: 10 × D Operating temperature: –30…+80 °C (–22…+176 °F)	Material: PUR jacket; gray Features: Shielded Cable Ø: 8 mm (0.3 in.) Operating temperature: –40…+90 °C (–40…+194 °F)

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		1	U	4		
a			b	c	d					e		f			g	h			

a	Sensor model
R H 5	Rod

b	Design
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm), stroke length: 25…5900 mm (1…232 in.)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)
T	Threaded flange ¾"-16 UNF-3A (with raised-face)

c	Mechanical options
A	Standard
B	Bushing on rod end (only for design »M«, »S« & »T«)
M	Thread M4 at rod end (only for design »M«, »S« & »T«)
V	Fluorelastomer seals for the sensor electronics housing

d	Stroke length	
X X X X M	0025…7620 mm	
Standard stroke length (mm)		Ordering steps
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.	
Standard stroke length (in.)		Ordering steps
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.

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

e	Number of magnets
X X	01…30 position(s) (1…30 magnet(s))

f	Connection type
D 5 8	2×M12 female connectors (D-coded), 1×M12 male connector (A-coded)
D 5 6	2×M12 female connectors (D-coded), 1×M8 male connector

g	System
1	Standard

h	Output
U 4 0 2	PROFINET RT & IRT, position and velocity, MTS profile (1…30 position(s))
U 4 0 1	PROFINET RT & IRT, position and velocity, encoder profile (1 position)
U 4 1 2	PROFINET RT & IRT, position and velocity, MTS profile, internal linearization (1…30 position(s))
U 4 1 1	PROFINET RT & IRT, position and velocity, encoder profile, internal linearization (1 position)

NOTICE

- Select the MTS profile (U402 or U412) in **h** "Output" for multi-position measurement.
- Specify number of magnets for your application and order the magnets 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-magnet (part no. 251 416-2).
- If the option for internal linearization (U411, U412) in **h** "Output" is chosen, select a suitable magnet.

DELIVERY

RH5-B:
- Base unit (without flange/rod assembly)
- 3 socket screws M4

RH5-J/-M/-S/-T:
- Sensor
- O-ring

Accessories have to be ordered separately.

GLOSSARY

E

Encoder Profile

The encoder profile corresponds to the specification of the encoder profile V4.2 (PNO no. 3.162). With this profile, the position and the velocity of one magnet can be measured and transferred simultaneously. (→ MTS Profile)

Extrapolation

The native measurement cycle time of a sensor increases with the stroke length. With extrapolation, the sensor is able to report data faster than the native cycle time, independent of the stroke length of the sensor. Without extrapolation, if data is requested faster than the native cycle time, the last measured value is repeated.

G

GSDML

The properties and functions of a PROFINET IO fi eld device are described in a GSDML file (**G**eneral **S**tation **D**escription). The XML-based GSDML fi le contains all relevant data that are important for the implementation of the device in the controller as well as for data exchange during operation. The GSDML file of the R-Series V PROFINET is available on the homepage www.temposonics.com.

I

Internal Linearization

The internal linearization offers an improved linearity for an overall higher accuracy of the position measurement. The internal linearization is set for the sensor during production.

IRT Filter

With PROFINET IRT (**I**sochronous **R**eal **T**ime) a clock-synchronous data transmission takes place. The application, the data transmission as well as the device cycle are synchronous. IRT enables a clock-synchronous data exchange with a minimum cycle time of 250 µs in the network. The R-Series V PROFINET supports PROFINET RT and IRT. (→ RT)

M

MTS Profile

The MTS profile was developed by Temposonics and is tailored to the characteristics of magnetostrictive position sensors. With this profile, the positions and velocities of up to 30 magnets can be reported and transfered simultaneously. (→ Encoder Profile)

Multi-position measurement

During the measurement cycle, the positions of every magnet on the sensor are simultaneously reported. The velocity is continuously calculated based on these changing position values as the magnets are moved.

P

PROFINET

PROFINET (**Pro**cess **Fi**eld **Net**work) is an Industrial Ethernet interface and is managed by the **P**ROFIBUS **N**utzer**o**rganiation e.V. (PNO). The R-Series V PROFINET and its corresponding GSDML file are certitified by the PNO.

R

RT

With PROFINET RT (**R**eal **T**ime) the data exchange is without clock synchronization. In this case, the application, the data transmission and the field devices operate according to their own processing cycle. The R-Series V PROFINET supports PROFINET RT and IRT. (→ IRT)

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