

## Data Sheet

# R-Series V RM5 PROFINET IO RT & IRT

## Magnetostrictive Linear Position Sensors

- Super shield housing with IP68/IP69 against ingress of dust and water
- Minimum position resolution 0.5  $\mu\text{m}$
- Position and velocity measurement for up to 30 magnets



**V**  
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 beginning 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.

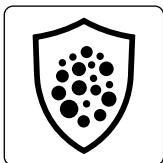
## R-SERIES V RM5 PROFINET

The Temposonics® R-Series V brings very powerful sensor performance to meet the many demands of your application. The RM5 sensor is the version of the RH5 rod sensor in a protective housing (super shield housing). The main advantages of the RM5 are:



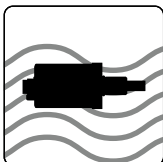
### Protection against corrosion

The housing made of high-quality stainless steel offers very good corrosion resistance. Thus, you can use the R-Series V also in aggressive environments.



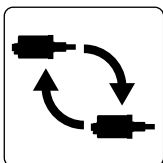
### Protection against ingress of dust

The housing protects the internal sensor against penetration of dust. This maintains the sensor's performance even in heavy dust.



### Protection against ingress of water

The housing protects the internal sensor when submerged. This allows you to use the R-Series V even under water.



### Easy and fast replacement

If necessary, the sensor inside the housing can be replaced easily and fast. This saves time and downtime costs.

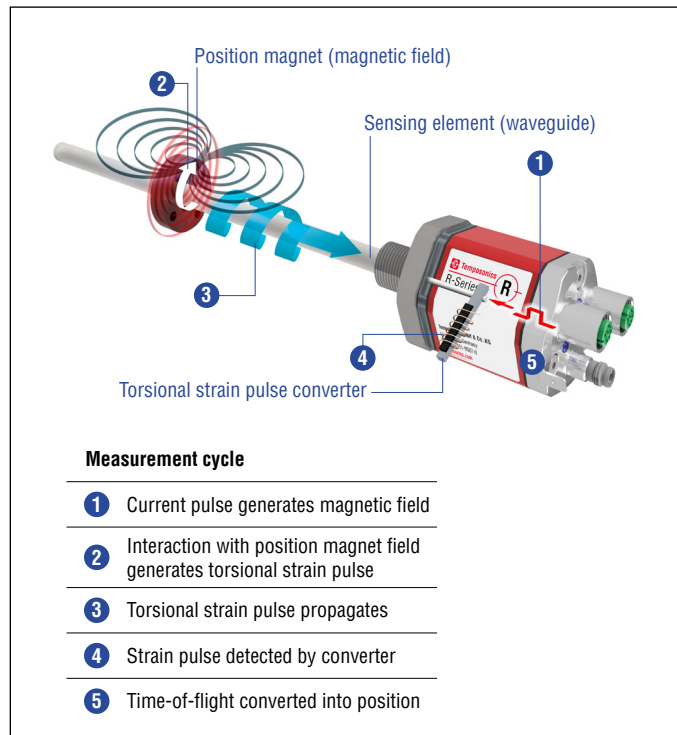


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

In addition the R-Series V PROFINET scores with the following features:



### 30 positions simultaneously

The R-Series V PROFINET can detect and report the position and velocity of up to 30 magnets simultaneously.



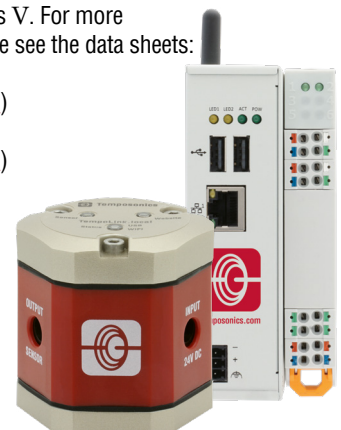
### R-Series V PROFINET

In addition to the measured position value via the PROFINET protocol further data about the current sensor status, such as the total distance travelled, the internal temperature and the total operating hours, can be displayed for diagnostic purposes.

### All settings under control with the smart assistants for the R-Series V

The TempoLink® and the TempoGate® smart assistants support you in setup and diagnostics of the R-Series V. For more information of these assistants please see the data sheets:

- TempoLink® smart assistant (Document part number: [552070](#))
- TempoGate® smart assistant (Document part number: [552110](#))



## TECHNICAL DATA

Output						
Interface	PROFINET RT PROFINET IRT version 2.3					
Data protocol	Linear-Profil und Encoder-Profil 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	≤ 7615 mm
	Cycle time	250 µs	500 µs	1000 µs	2000 µs	4000 µs
Linearity deviation <sup>1</sup>	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	100 % relative humidity, no condensation					
Ingress protection	IP68 (3 m/180 d)/IP69					
Shock test	100 g/6 ms, IEC standard 60068-2-27					
Vibration test	10 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 RM5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011					
Operating pressure	350 bar (5076 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod					
Magnet movement velocity	Any					
Design/Material						
Sensor electronics housing	Stainless steel 1.4404 (AISI 316L)					
Sensor flange	Stainless steel 1.4404 (AISI 316L)					
Sensor rod	Stainless steel 1.4404 (AISI 316L)					
RoHS compliance	The used materials are compliant with the requirements of EU Directive 2011/65/EU and EU Regulation 2015/863 as well as UKSI 2022 No. 622					
Stroke length	25...7615 mm (1...299.8 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings and the operation manual (document number: <a href="#">551973</a> )					
Electrical connection						
Connection type	2 × cable with M12 female connector (D-coded), 1 × cable					
Operating voltage	+12...30 VDC ±20 % (9.6...36 VDC); The RM5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval					
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

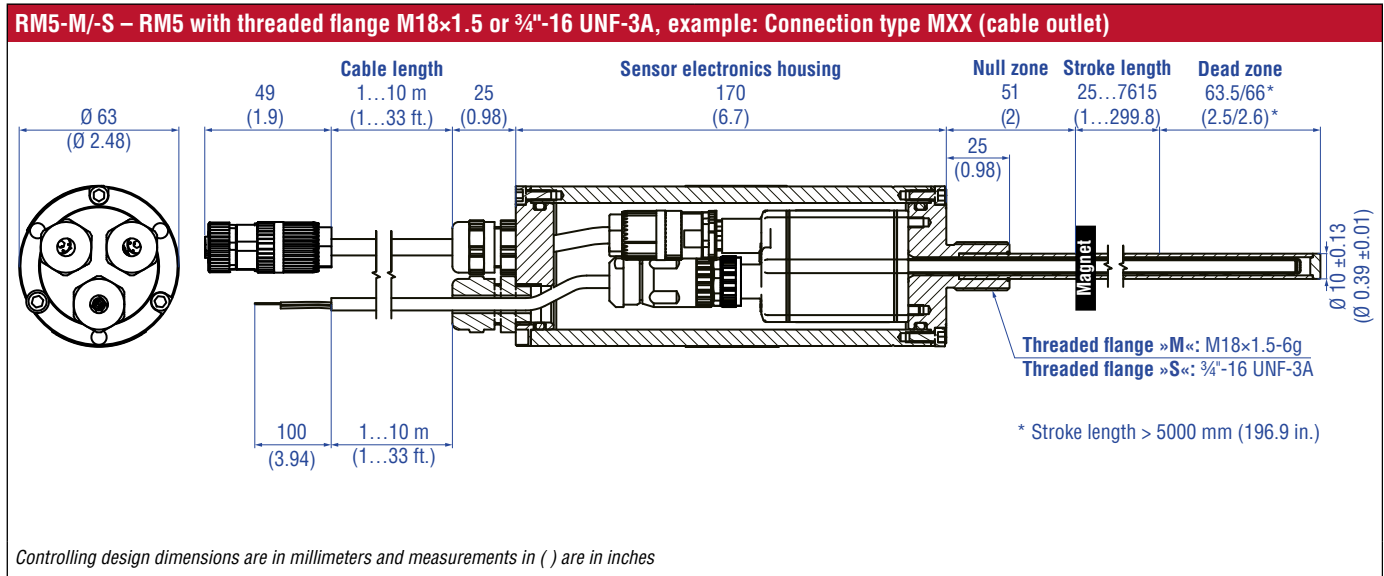


Fig. 2: Temposonics® RM5 with ring magnet

## STRUCTURE

The RM5 PROFINET consists of (Fig. 3)

- 1 Super shield housing
- 2 R-Series V sensor with connector outlet (connection type D58)
- 3 Cable for direct connection to the controller (connection type MXX)

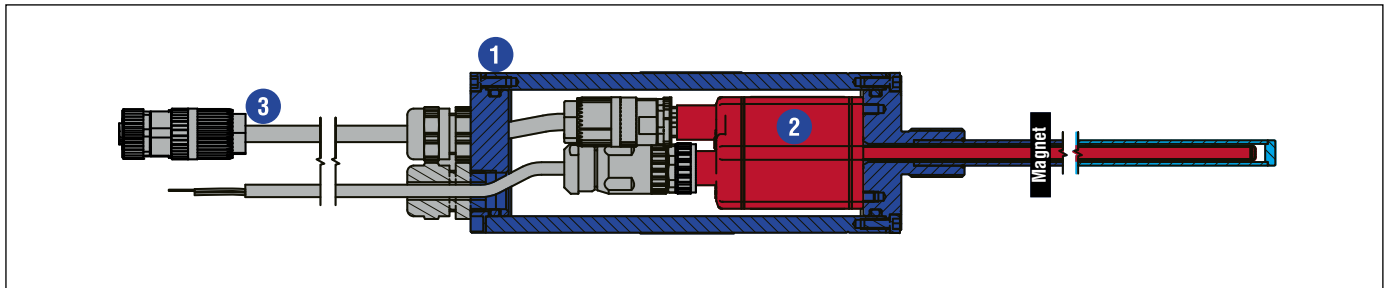


Fig. 3: Structure of RM5 PROFINET

## CONNECTOR WIRING



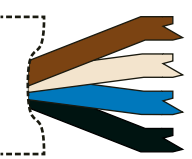
MXX		
<b>Port 1 – Signal</b>		
<b>M12 female connector (D-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
<b>Port 2 – Signal</b>		
<b>M12 female connector (D-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
<b>Power supply</b>		
<b>Cable</b>	<b>Color</b>	<b>Function</b>
	BN	+12...30 VDC (±20 %)
	WH	Not connected
	BU	DC Ground (0 V)
	BK	Not connected

Fig. 4: Connector wiring MXX

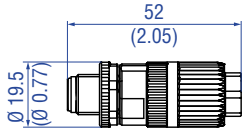
**FREQUENTLY ORDERED ACCESSORIES** – Additional options available in our [Accessories Catalog](#) 551444

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>Marked version for sensors with internal linearization: Part no. 254 226</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>Marked version for sensors with internal linearization: Part no. 253 620</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>Marked version for sensors with internal linearization: Part no. 253 621</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: Plastic carrier with neodymium magnet 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> M18x1.5-6g 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>

Mounting accessories		
<p><b>Hex jam nut M18x1.5-6g</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: Steel, zinc plated</p>	<p><b>Fixing clip</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>

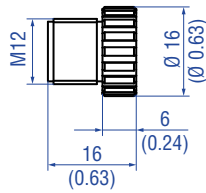
**Cable connectors\* – Signal**



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

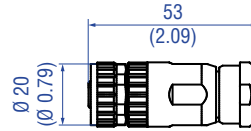
Material: Zinc nickel-plated  
Termination: Insulation-displacement  
Cable Ø: 6...7.2 mm (0.2...0.28 in.)  
Wire: 24 AWG – 22 AWG  
Operating temperature:  
–25...+85 °C (–13...+185 °F)  
Ingress protection: IP65 / IP67 (correctly fitted)  
Fastening torque: 0.6 Nm

**Cable connectors\* – Power**



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

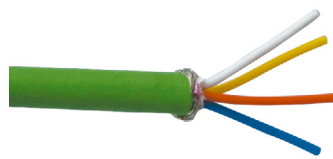
Female connectors M12 should be covered by this protective cap  
Material: Brass nickel-plated  
Ingress protection: IP67 (correctly fitted)  
Fastening torque: 0.39...0.49 Nm



**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: max. 1.5 mm<sup>2</sup> (16 AWG)  
Operating temperature:  
–30...+85 °C (–22...+185 °F)  
Ingress protection: IP67 (correctly fitted)  
Fastening torque: 0.6 Nm

**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 mm<sup>2</sup> (22 AWG)  
Bending radius: 6 × D (fixed installation)  
Operating temperature:  
–20...+60 °C (–4...+140 °F)



**PVC power cable**  
Part no. 530 108

Material: PVC jacket; gray  
Features: Shielded, flexible, mostly flame resistant  
Cable Ø: 4.9 mm (0.19 in.)  
Cross section: 3 × 0.34 mm<sup>2</sup>  
Bending radius: 5 × D (fixed installation)  
Operating temperature:  
–30...+80 °C (–22...+176 °F)

**Cable sets**



**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  
Feature: 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  
Feature: 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  
Color of connectors and cable jacket may change. Color codes for the individual wires and technical properties remain unchanged.

Cable sets	Programming tools	
		
<p><b>Power cable with M12 A-coded female connector (5 pin), straight – pigtail</b> <b>Part no. 370 673</b></p>	<p><b>TempoLink® kit for Temposonics® R-Series V</b> <b>Part no. TL-1-0-EM08 (D56)</b> <b>Part no. TL-1-0-EM12 (D58)</b></p>	<p><b>TempoGate® smart assistant for Temposonics® R-Series V</b> <b>Part no. TG-C-0-Dxx</b> (xx indicates the number of R-Series V sensors that can be connected (even numbers only))</p>
<p>Material: PUR jacket; black Feature: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: -25...+80 °C (-13...+176 °F)</p>	<ul style="list-style-type: none"> <li>• Connect wirelessly via Wi-Fi enabled device or via USB with the diagnostic tool</li> <li>• Simple connectivity to the sensor via 24 VDC power line (permissible cable length: 30 m)</li> <li>• User friendly interface for mobile devices and desktop computers</li> <li>• See data sheet “TempoLink® smart assistant” (document part no.: <a href="#">552070</a>) for further information</li> </ul>	<ul style="list-style-type: none"> <li>• OPC UA server for diagnostics of the R-Series V</li> <li>• For installation in the control cabinet</li> <li>• Connection via LAN and Wi-Fi</li> <li>• See data sheet “TempoGate® smart assistant” document part no.: <a href="#">552110</a> for further information</li> </ul>

Color of connectors and cable jacket may change. Color codes for the individual wires and technical properties remain unchanged.



## ORDER CODE

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

<b>a</b>	<b>Sensor model</b>
R M 5	Super shield housing

<b>b</b>	<b>Design</b>
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)

<b>c</b>	<b>Mechanical options</b>
A	Standard

<b>d</b>	<b>Stroke length</b>
X X X X M	0025...7615 mm
<b>Standard stroke length (mm)</b>	
	<b>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...7615 mm	250 mm

X X X X U	001.0...299.8 in.
<b>Standard stroke length (in.)</b>	
	<b>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...299.8 in.	10.0 in.

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

<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>
M X X	2 × XX m/ft. PUR cable (part no. 530 125) for data lines with M12 female connector (part no. 370 830) and 1 × XX m/ft. PVC cable (part no. 530108) for power supply M01...M10 (1...10 m/1...33 ft.) See "Frequently ordered accessories" for cable & connector specifications
Encode in meters if using metric stroke length Encode in feet if using US customary stroke length	

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

<b>h</b>	<b>Output</b>
U 4 0 2	PROFINET RT & IRT, position and velocity, linear profile (1...30 magnet(s))
U 4 0 1	PROFINET RT & IRT, position and velocity, encoder profile (1 magnet)
U 4 1 2	PROFINET RT & IRT, position and velocity, linear profile, internal linearization (1...30 magnet(s))
U 4 1 1	PROFINET RT & IRT, position and velocity, encoder profile, internal linearization (1 magnet)

### NOTICE

- Select the linear 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.
- If the option for internal linearization (U411, U412) in **h** "Output" is chosen, select a suitable magnet.

## DELIVERY



- 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. (→ Linear 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 field device are described in a GSDML file (**G**eneral **S**tation **D**escription). The XML-based GSDML file 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](http://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)

### L

#### Linear Profile

The linear 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 transferred simultaneously. (→ Encoder Profile)

### M

#### 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 (**P**rocess **F**ield **N**etwork) is an Industrial Ethernet interface and is managed by the **PROFIBUS Nutzerorganisation e.V. (PNO)**. The R-Series V PROFINET and its corresponding GSDML file are certified 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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