Temposonics
AN AMPHENOL COMPANY

Data Sheet

R-Series V RM5 PROFINET IO RT & IRT

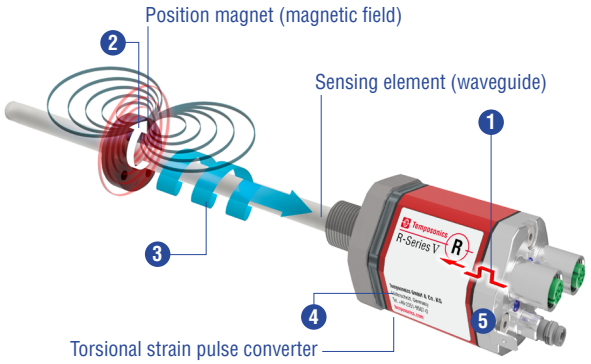
Magnetostrictive Linear Position Sensors

- Super shield housing with IP68/IP69 against ingress of dust and water
- Minimum position resolution 0.5 µm
- Position and velocity measurement for up to 30 magnets

THE NEW V 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 a 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.



Measurement cycle

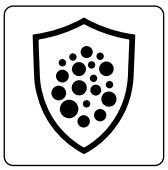
1	Current pulse generates magnetic field
2	Interaction with position magnet field generates torsional strain pulse
3	Torsional strain pulse propagates
4	Strain pulse detected by converter
5	Time-of-flight converted into position

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

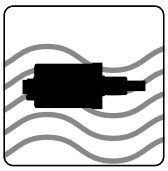
R-SERIES V RM5 PROFINET

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:

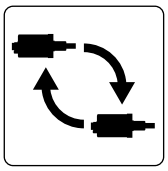
Protection against corrosion
The housing made of high-quality stainless steel offers very good corrosion resistance. Thus, you can use the R-Series V also in aggressive environments.



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.

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)

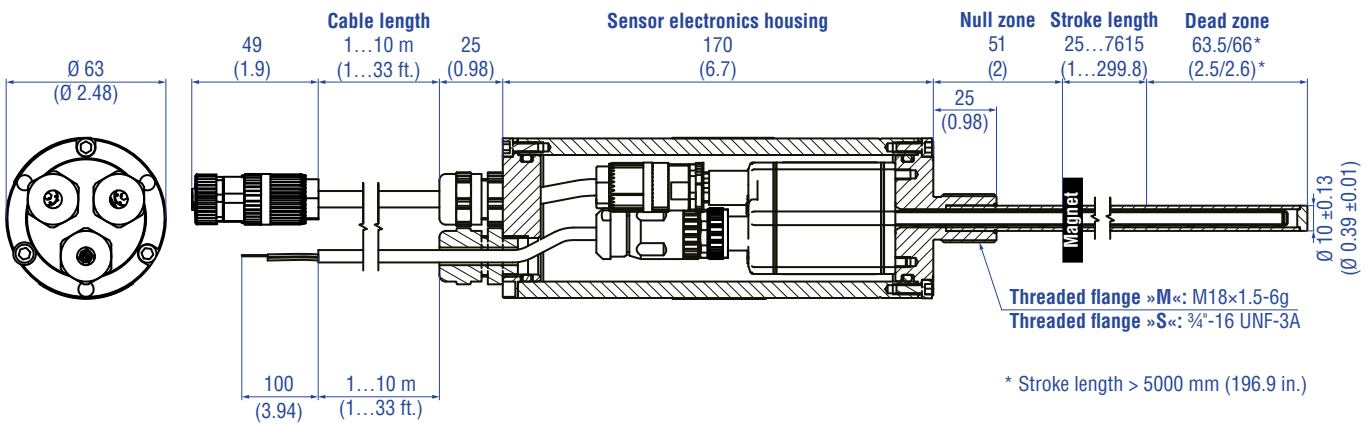
TECHNICAL DATA

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[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	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: 551973)
Electrical connection	
Connection type	2 × cable with M12 female connector (D-coded), 1 × cable
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

RM5-M/-S – RM5 with threaded flange M18×1.5 or ¾"-16 UNF-3A, example: Connection type MXX (cable outlet)



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

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)

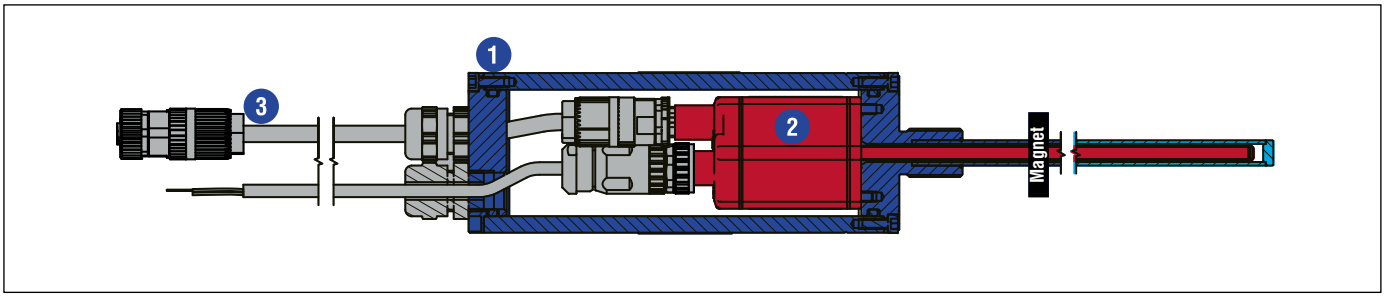


Fig. 3: Structure of RM5 PROFINET

CONNECTOR WIRING

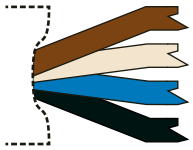
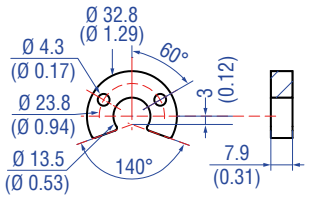
MXX		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
Cable	**Color**	**Function**
	BN	+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

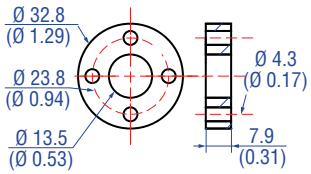
Position magnets



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)

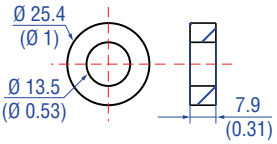
Marked version for sensors with internal linearization: Part no. 254 226



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)

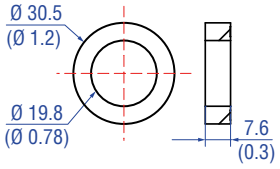
Marked version for sensors with internal linearization: Part no. 253 620



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)

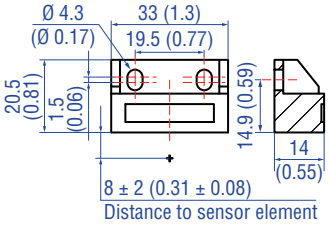
Marked version for sensors with internal linearization: Part no. 253 621



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

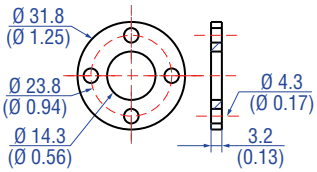


Block magnet L
Part no. 403 448

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.

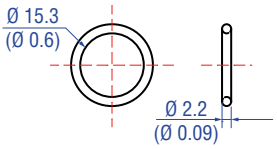
Magnet spacer



Magnet spacer
Part no. 400 633

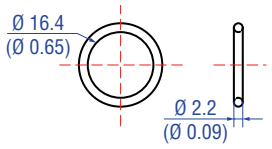
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



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

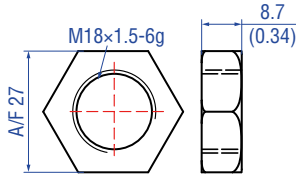
Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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

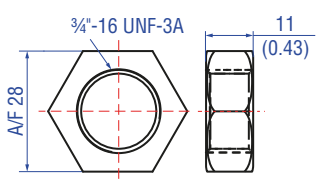
Material: Fluoroelastomer
Durometer: 75 ± 5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Mounting accessories



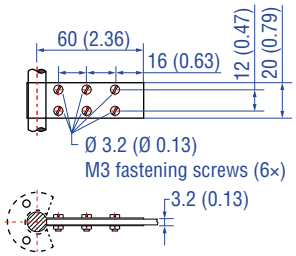
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



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

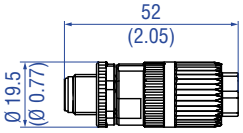
Material: Steel, zinc plated



Fixing clip
Part no. 561 481

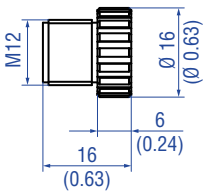
Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.)) when using an U-magnet or block magnet
Material: Brass, non-magnetic

Cable connectors* – Signal



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

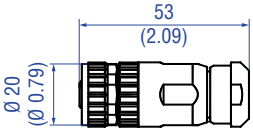
Material: Zinc nickel-plated
Termination: Insulation-displacement
Cable Ø: 5.5…7.2 mm (0.2…0.28 in.)
Wire: 24 AWG – 22 AWG
Operating temperature:
–25…+85 °C (–13…+185 °F)
Ingress protection: IP65 / IP67 (correctly fitted)
Fastening torque: 0.6 Nm



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

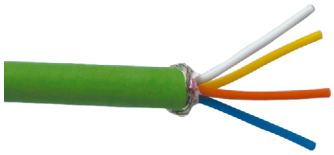
Cable connectors* – Power



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

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)
Bending radius: 5 × 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 mm²
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
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
Color of connectors and cable jacket may change. Color codes for the individual wires and technical properties remain unchanged.

Cable sets

Power cable with M12 A-coded female connector (5 pin), straight – pigtail
Part no. 370 673

Material: PUR jacket; black
Features: Shielded
Cable length: 5 m (16.4 ft)
Ingress protection: IP67 (correctly fitted)
Operating temperature:
–25…+80 °C (–13…+176 °F)

Programming tools

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

TempoGate® smart assistant for Temposonics® R-Series V
Part no. TG-C-0-D*xx*
(*xx* indicates the number of R-Series V sensors that can be connected (even numbers only))

- OPC UA server for diagnostics of the R-Series V
- For installation in the control cabinet
- Connection via LAN and Wi-Fi
- See data sheet “TempoGate® smart assistant” document part no.: 552110) for further information

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			

a Sensor model

R M 5	Super shield housing

b Design

M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)

c Mechanical options

A	Standard

d Stroke length

X X X X M	0025…7615 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…7615 mm	250 mm

X X X X U	001.0…299.8 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…299.8 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

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

g System

1	Standard

h Output

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.

Manuals, Software & 3D Models available at:
www.temposonics.com

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.

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 transfered 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 (**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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