Data Sheet

R-Series Ⅴ RM5 Analog
Magnetostrictive Linear Position Sensors

▮ Super shield housing with IP68/IP69 against ingress of dust and water

▮ Direct analog output, position + speed

▮ Dual magnet position measurement

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 Analog

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.
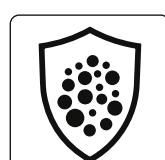
Protection against ingress of dust
The housing protects the internal sensor against penetration of dust. This maintains the sensor's performance even in heavy dust.
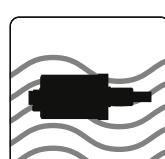
Protection against ingress of water
The housing protects the internal sensor when submerged. This allows you to use the R-Series Ⅴ even under water.
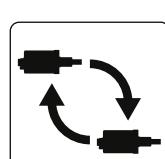
Easy and fast replacement
If necessary, the sensor inside the housing can be replaced easily and fast. This saves time and downtime costs.

In addition the R-Series Ⅴ Analog scores with the following features:
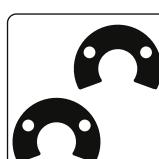
2 positions simultaneously
The R-Series Ⅴ Analog can detect and report the position of up to 2 magnets simultaneously.
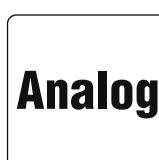
R-Series Ⅴ Analog
With the R-Series Ⅴ Analog you can configure the analog output (current/voltage) that it fits best for your application and also adjust it on site with the sensor assistant.

All settings under control with the sensor assistant for the R-Series Ⅴ
The TempoLink® smart assistant supports you in setup and diagnostics of the R-Series Ⅴ. For more information of the assistant please see the data sheet:
• TempoLink® smart assistant
  (Document part number: 552070)

TECHNICAL DATA

Output	
Analog	Voltage: 0…10 /10…0/–10…+10/+10…–10 VDC (min. controller load > 5 kΩ) Current: 4(0)…20/20…4(0) mA (min./max. load 0/500 Ω)
Measured output variables	Position for one or two position magnets Position + speed (without direction) or velocity (with direction) for one position magnet Position for one position magnet + temperature inside the sensor electronics housing

Measurement parameters						
Position measurement						
Null/Span adjustment	100 % of electrical stroke					
Resolution	16 bit (internal resolution 0.1 µm)					
Update time	Stroke length	≤ 200 mm	≤ 350 mm	≤ 1200 mm	≤ 2400 mm	≤ 4800 mm	≤ 7615 mm
	Update time	0.25 ms	0.333 ms	0.5 ms	1.0 ms	2.0 ms	5.0 ms
Linearity deviation [1]	< ±0.01 % F.S. (minimum ±50 µm)					
Repeatability	< ±0.001 % F.S. (minimum ±1 µm)					
Hysteresis	< 4 µm typical					
Temperature coefficient	< 30 ppm/K typical					
Velocity measurement						
Range	0.01…10 m/s or 1…400 in./s					
Deviation	≤ 0.05 %					
Resolution	16 bit (minimum 0.01 mm/s)					

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: 552063)

Electrical connection	
Connection type	Cable outlet
Operating voltage	+12…30 VDC ±20 % (9.6…36 VDC)
Power consumption	< 3.25 W
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 HXX/RXX/TXX (cable outlet)

Controlling design dimensions are in millimeters and measurements in ( ) are in inches
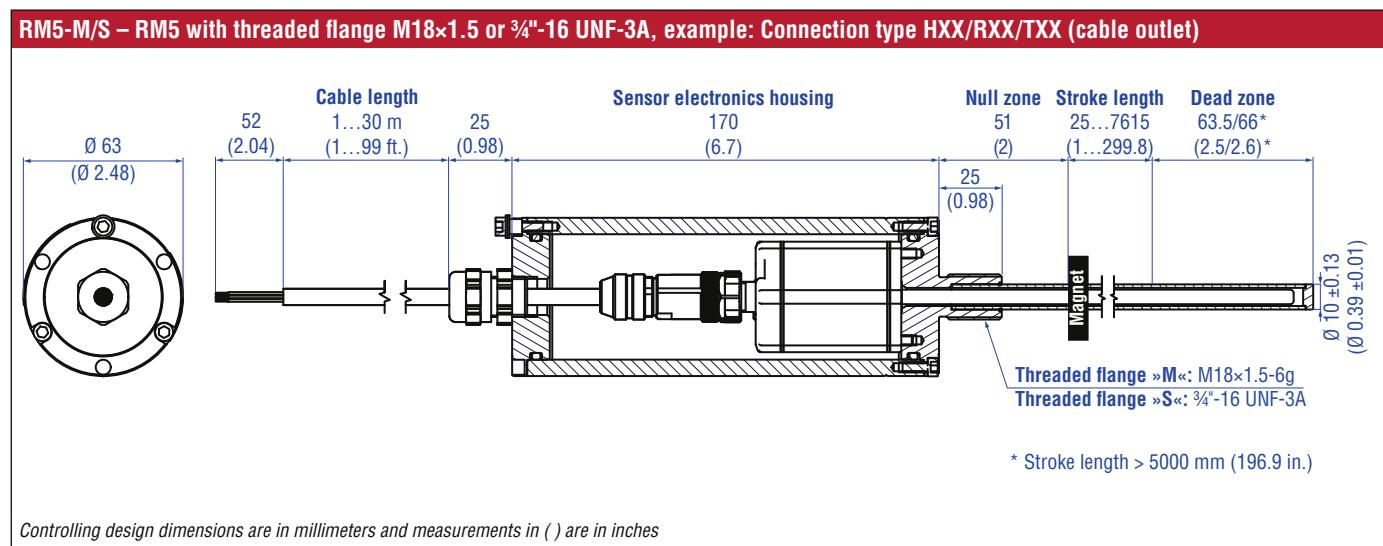
Fig. 2: Temposonics® RM5 with ring magnet

STRUCTURE

The RM5 Analog consists of (Fig. 3)

1 Super shield housing
2 R-Series Ⅴ sensor with connector outlet (connection type D34)
**3** Cable for direct connection to the controller (connection type HXX/RXX/TXX)
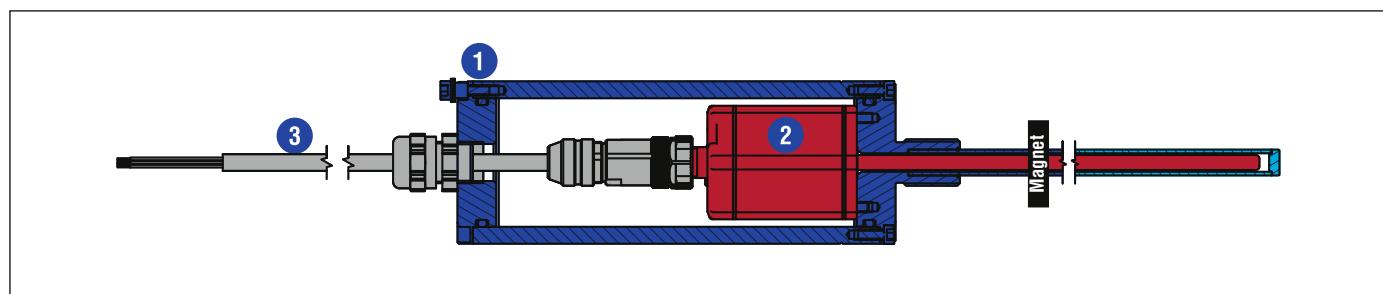

Fig. 3: Structure of RM5 Analog

CONNECTOR WIRING
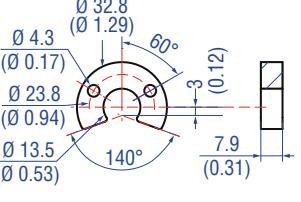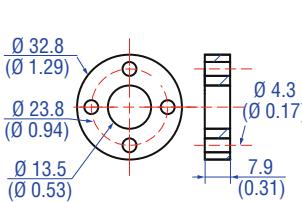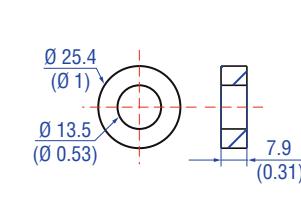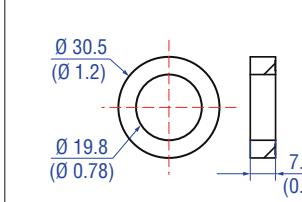
HXX / RXX / TXX			
Signal + power supply			
Cable	**Output**	**Color**	**Function**
	1	GY	Position (magnet 1)
		PK	Signal Ground
	2*	YE	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing
		GN	Signal Ground
		BN	+12…30 VDC (±20 %)
		WH	DC Ground (0 V)
			* order dependent
For cable type TXX, the extra red & blue wires are not used.			
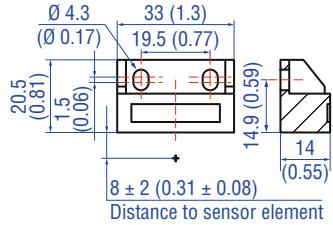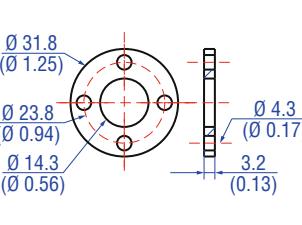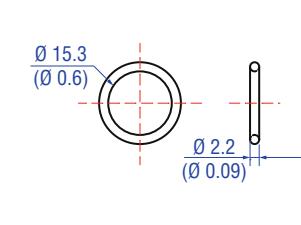
Fig. 4: Connector wiring HXX/RXX/TXX
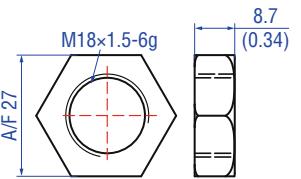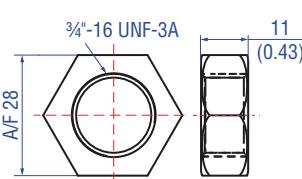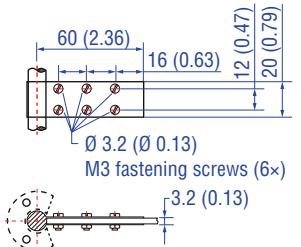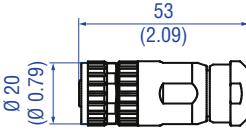
FREQUENTLY ORDERED ACCESSORIES – Additional options available in our Accessories Catalog 🗋 551444

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 | 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)

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

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

Cable connector*	Cables		

M12 A-coded female connector (4 pin/5 pin), straight Part no. 370 677	**PVC cable Part no. 530 032**	**PUR cable Part no. 530 052**	**FEP cable Part no. 530 112**
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	Material: PVC jacket; gray Features: Twisted pair, shielded, flexible Cable Ø: 6 mm (0.23 in.) Cross section: $3 \times 2 \times 0.14$ mm² Bending radius: $10 \times D$ (fixed installation) Operating temperature: –40…+105 °C (–40…+221 °F)	Material: PUR jacket; orange Features: Twisted pair, shielded, highly flexible, halogen free, suitable for drag chains, mostly oil & flame resistant Cable Ø: 6.4 mm (0.25 in.) Cross section: $3 \times 2 \times 0.25$ mm² Bending radius: $5 \times D$ (fixed installation) Operating temperature: –30…+80 °C (–22…+176 °F)	Material: FEP jacket; black Features: Twisted pair, shielded, flexible, high thermal resistance, mostly oil & acid resistant Cable Ø: 7.6 mm (0.3 in.) Cross section: $4 \times 2 \times 0.25$ mm² Bending radius: $8 – 10 \times D$ (fixed installation) Operating temperature: –100…+180 °C (–148…+356 °F)

Cable sets	Programming tools		

Cable with M12 A-coded female connector (5 pin), straight – pigtail Part no. 370 673	**Hand programmer for analog output Part no. 253 124**	**Cabinet programmer for analog output Part no. 253 408**	**TempoLink® kit for Temposonics® R-Series Ⅴ Part no. TL-1-0-AD60 (for D60) Part no. TL-1-0-AS00 (for cable outlet) Part no. TL-1-0-AD34 (for D34)**
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)	Easy teach-in-setups of stroke length and direction on desired zero / span positions. For sensors with 1 magnet.	Features snap-in mounting on standard DIN rail (35 mm). This programmer can be permanently mounted in a control cabinet and includes a program/run switch. For sensors with 1 magnet.	• 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

*/ Follow the manufacturer's mounting instructions
Color of connectors and cable jacket may change. Colors of the cores and technical properties remain unchanged.
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Extension cables

PVC cable with M12 female connector (6 pin), straight – pigtail

PVC cable (part no. 530 032) with M12 female connector, straight (part no. 370 677)

Order code:
K2-A-370677-xxxxyy-530032-0
(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")

PUR cable with M12 female connector (6 pin), straight – pigtail

PUR cable (part no. 530 052) with M12 female connector, straight (part no. 370 677)

Order code:
K2-A-370677-xxxxyy-530052-0
(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")

FEP cable with M12 female connector (6 pin), straight – pigtail

FEP cable (part no. 530 112) with M12 female connector, straight (part no. 370 677)

Order code:
K2-A-370677-xxxxyy-530112-0
(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")

Color of connectors and cable jacket may change. Colors of the cores 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	21	22	23
R	M	5		A											1					////	////	////
a		b	c		d					e		f			g	h	i	j	k	l		

optional

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
0 X	01…02 Position(s) (1…2 magnet(s))

f	Connection type
H X X	XX m PUR cable (part no. 530 052) H01…H30 (1…30 m/3…99 ft.) (Note the temperature range of the cable!) See "Frequently ordered accessories" for cable specifications
R X X	XX m PVC cable (part no. 530 032) R01…R30 (1…30 m/3…99 ft.) See "Frequently ordered accessories" for cable specifications
T X X	XX m FEP cable (part no. 530 112) T01…T30 (1…30 m/3…99 ft.) See "Frequently ordered accessories" for cable specifications

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

g	System
1	Standard

h	Output
A	Current
V	Voltage

i	Function
1	Position (1 or 2 magnets/outputs)
2	Position and speed (1 magnet and 2 outputs) Specify the maximum speed value in section **l**
3	Position and velocity (1 magnet and 2 outputs) Specify the maximum velocity value in section **l**
4	Position and reverse position (1 magnet and 2 outputs)
5	Position and temperature inside the sensor electronics housing (1 magnet and 2 outputs)
6	Differential (2 magnets and 1 output)

j	Options
0	Standard
3	Over range output mode

k	Output range
0	0…10 VDC or 4…20 mA
1	10…0 VDC or 20…4 mA
2	−10…+10 VDC or 0…20 mA
3	+10…−10 VDC or 20…0 mA
V	0…10 VDC for position, −10…+10 VDC for velocity

l	Max. speed or velocity value
(optional: use when i "Function" is 2 or 3)	
	For metric stroke lengths encode speed or velocity in m/s for the values 0.01 to 9.99 m/s (001…999) For US customary stroke lengths encode speed or velocity in inches/s for the values 1 to 400 in./s (001…400)

To get a speed or velocity output of 0.025 m/s or 10 m/s for the R-Series V Analog, enter code (00E) for 0.025 m/s or (A00) for 10.0 m/s in the order code.

NOTICE

- Specify the 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 differential/multi-position measurement.

DELIVERY

- Sensor
- O-ring

Accessories have to be ordered separately.

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

GLOSSARY

A

Analog output
For a sensor with analog output, the measured value is output as an analog voltage signal or current signal.

D

Differential
For differential measurement, the distance between the two position magnets is output as a value.
(→ multi-position measurement)

M

Max. speed or velocity value
For speed or velocity, the output value generated is scaled based on the maximum speed or velocity value indicated in the order code.

Measuring direction
• Forward: Values increasing from sensor electronics housing to rod end/profile end
• Reverse: Values decreasing from sensor electronics housing to rod end/profile end

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

O

Over range output mode
When enabled this mode allows the position output values to continue to increase or decrease when the magnet travels beyond the active stroke range.

R

Resolution
The sensor precisely measures time to provide the position measurement. For the analog output the measured time value is converted into an analog voltage signal or current signal using a high-performance **D**igital to **A**nalog **C**onverter (DAC) having 16 bits of resolution.

S

Speed
The output value for speed indicates how fast the position magnet is being moved, independent of the measuring direction. (→ Velocity)

T

Temperature inside the sensor electronics housing
The temperature inside the sensor electronics housing is reported as an analog voltage signal or current signal. For each output range, the 0 % output value has the factory default setpoint at –40 °C, and the 100 % output value has the default setpoint at +100 °C.
Note: A dedicated temperature chip is used for the output signal and its values may vary from those reported on the TempoLink® application screen.

V

Velocity
The output value for velocity indicates how fast the position magnet is being moved, and in which direction. (→ Speed)

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