

# **Data Sheet**

# **R-Series V RP5 Analog**

Magnetostrictive Linear Position Sensors

- Output of position and speed/velocity
- Dual magnet position measurement
- Field adjustments and diagnostics using the TempoLink<sup>®</sup> smart assistant



# 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<sup>®</sup> 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.



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

# **R-SERIES V RP5 Analog**

The Temposonics® R-Series V brings very powerful sensor performance to meet the many demands of your application. The main advantages of the profile version RP5 with Analog output (current/ voltage) are:



#### High shock and vibration resistance

The R-Series V is the long term solution for harsh environments that have high levels of shock and vibration.



#### Internal resolution 0.1 µm

The sensor works with an internal resolution of 0.1 µm to detect and report smallest position changes.



#### Dual output channel

The sensor is available with single output channel or with dual output channels.



#### Multiple output options

The following values can be output via the second output:

- · Speed/velocity of the first magnet
- · Reversed position of the first magnet
- Position of the second magnet
- · Temperature in the sensor electronics housing

#### 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) for your application and also adjust it on site with the smart assistant.

All settings under control with the smart assistant for the R-Series V The TempoLink<sup>®</sup> 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<sup>®</sup> smart assistant
- (Document part number: 552070)



# **TECHNICAL DATA**

Output							
Analog	Voltage: $010 / 100 / -10+10 / +1010$ VDC (min. controller load > 5 k $\Omega$ ) Current: 4(0)20/204(0) mA (min./max. load 0/500 $\Omega$ )						
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 st	roke					
Resolution	16 bit (internal resolu	ution 0.1 µm)					
Update time	Stroke length         ≤ 200 mm         ≤ 350 mm         ≤ 1200 mm         ≤ 2400 mm         ≤ 4800 mm         ≤ 6350 mm           Update time         0.25 ms         0.333 ms         0.5 ms         1.0 ms         2.0 ms         5.0 ms						
Linearity deviation <sup>1</sup>	< ±0.01 % F.S. (minir	mum ±50 µm)					
Repeatability	< ±0.001 % F.S. (min	imum ±1 μm)					
Hysteresis	< 4 µm typical						
Temperature coefficient	< 30 ppm/K typical						
Speed/velocity measurement	t						
Range	0.0110 m/s or 1	400 in./s					
Deviation	≤ 0.05 %						
Resolution	16 bit (minimum 0.07	1 mm/s)					
Operating conditions							
Operating temperature	-40+85 °C (-40	+185 °F)					
Humidity	90 % relative humidit	ty, no condens	sation				
Ingress protection	IP67 (connectors cor	rectly fitted)/I	P68 (3 m/3 d) f	or cable outlet			
Shock test	150 g/11 ms, IEC sta	ndard 60068-	2-27				
Vibration test	30 g/102000 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 RP5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TB CU 020/2011						
Magnet movement velocity	Magnet slider: Max. 10 m/s; U-magnet: Any; block magnet: Any						
Design/Material							
Sensor electronics housing	Aluminum (painted),	zinc die cast					
Sensor profile	Aluminum						
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	256350 mm (12	250 in.)					
Mechanical mounting							
Mounting position	Any						
Mounting instruction	Please consult the technical drawings on page 4 and the operation manual (document part number: 552063)						
Electrical connection							
Connection type	1 × M16 male connectors (6 pin), 1 × M12 male connector (5 pin) or cable outlet						
Operating voltage	1230 VDC ±20 % (9.636 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**



Fig. 2: Temposonics® RP5 with U-magnet/magnet slider

## **CONNECTOR WIRING**

D34			
Signal + power suppl	y		
M12 male connector	Output	Pin	Function
		1	+1230 VDC (±20 %)
	1	2	Position (magnet 1)
0		3	DC Ground (0 V)
View on sensor	2*	4	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing
		5	Signal Ground
			* order dependent

Fig. 3: Connector wiring D34

D60					
Signal + power supply					
M16 male connector	Output	Pin	Function		
	4	1	Position (magnet 1)		
	'	2	Signal Ground		
	2*	3	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing		
View on sensor		4	Signal Ground		
		5	+1230 VDC (±20 %)		
		6	DC Ground (0 V)		
			* order dependent		

Fig. 4: Connector wiring D60

#### HXX or LXX / RXX or EXX / TXX or GXX / UXX Signal + power supply Cable **Output Color Function** GY Position (magnet 1) 1 PK Signal Ground YE Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or 2\* 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. 5: Connector wiring for cable outlet

#### NOTICE

For sensors with current output (order code section **h** Output **A** Current), the output 1 (position (magnet 1)) must be connected in any case.

Straight cable outlet		Cable	e type	Ang	gled	cab	le outlet		
Η	X	X	Part no. 530 052	PUR	→	L	X	X	Part no. 530 052
R	X	X	Part no. 530 032	PVC	→	Ε	X	X	Part no. 530 032
Т	X	X	Part no. 530 112	FEP	→	G	X	X	Part no. 530 157

Fig. 6: Cable types assignment

# FREQUENTLY ORDERED ACCESSORIES – Additional options available in our Accessories Catalog 🗍 551444

#### Position magnets



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

#### **Cable connectors\*** 54 57 (2.13) (2.25)60.5 53 (2.38)7.3 (Ø 0.68) (2.09) 38 (1.5) 8 Ø 20 0 Ø 20 19.5 (Ø 0.79) (0.77) M16 female connector (6 pin), M16 female connector (6 pin), M12 A-coded female connector M12 A-coded female connector straight angled (4 pin/5 pin), straight (5 pin), angled Part no. 370 678 Part no. 370 423 Part no. 370 460 Part no. 370 677 Material: Zinc nickel plated Material: Zinc nickel plated Material: GD-Zn, Ni Material: GD-Zn, Ni Termination: Solder Termination: Screw: max. 0.75 mm<sup>2</sup> Termination: Solder Termination: Screw Cable Ø: 6...8 mm (0.24...0.31 in.) Cable Ø: 6...8 mm (0.24...0.31 in.) Contact insert: CuZn Contact insert: CuZn Operating temperature: Wire: 0.75 mm<sup>2</sup> (20 AWG) Cable Ø: 4...8 mm (0.16...0.31 in.) Cable Ø: 5...8 mm (0.2...0.31 in.) -40...+100 °C (-40...+212 °F) Wire: 0.75 mm<sup>2</sup> (18 AWG) Operating temperature: Wire: 1.5 mm<sup>2</sup> Ingress protection: IP65/IP67 -40...+95 °C (-40...+203 °F) Operating temperature: Operating temperature: -30...+85 °C (-22...+185 °F) Ingress protection: IP67 (correctly fitted) (correctly fitted) Ingress protection: IP67 (correctly fitted) -25...+85 °C (-13...+185 °F) Fastening torque: 0.6 Nm Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm Fastening torque: 0.6 Nm Fastening torque: 0.4 Nm Cables **PVC** cable PUR cable FEP cable FEP cable Part no. 530 032 Part no. 530 052 Part no. 530 112 Part no. 530 157 Material: PVC jacket; gray Material: PUR jacket; orange Material: FEP jacket; black Material: FEP jacket; black Features: Twisted pair, shielded, flexible Features: Twisted pair, shielded, flexible, Features: Twisted pair, shielded, Features: Twisted pair, shielded Cable Ø: 6.7 mm (0.26 in.) Cable Ø: 6 mm (0.23 in.) highly flexible, halogen free, suitable high thermal resistance, mostly oil & Cross section: $3 \times 2 \times 0.14 \text{ mm}^2$ for drag chains, mostly oil & flame acid resistant Cross section: $3 \times 2 \times 0.14 \text{ mm}^2$ Bending radius: 10 × D resistant Cable Ø: 7.6 mm (0.3 in.) Operating temperature: -40...+180 °C Cross section: $4 \times 2 \times 0.25 \text{ mm}^2$ Bending radius: $8 - 10 \times D$ (-40...+356 °F) Cable Ø: 6.4 mm (0.25 in.) (fixed installation) Operating temperature: Cross section: 3 × 2 × 0.25 mm<sup>2</sup>

\*/ Follow the manufacturer's mounting instructions

-40...+105 °C (-40...+221 °F)

Color of connectors and cable jacket may change. Color codes for the individual wires and technical properties remain unchanged. Controlling design dimensions are in millimeters and measurements in () are in inches

Bending radius: 5 × D

Operating temperature: -30...+80 °C (-22...+176 °F)

(fixed installation)

(fixed installation)

Operating temperature: -100...+180 °C (-148...+356 °F)

Cable	Cable sets	
		0
Silicone cable Part no. 530 176	Cable with M12 A-coded female connector (5 pin), straight – pigtail Part no. 370 673	Cable with M12 A-coded female connector (5 pin), angled – pigtail Part no. 370 675
Material: Silicone jacket; black Features: Twisted pair, shielded Cable Ø: 6.3 mm (0.25 in.) Cross section: $3 \times 2 \times 0.14$ mm <sup>2</sup> Bending radius: $7 \times D$ (fixed installation) Operating temperature: $-50+150$ °C ( $-58+302$ °F)	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)	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		

Hand programmer for analog output Part no. 253 124	Cabinet programmer for analog output Part no. 253 408	TempoLink <sup>®</sup> kit for Temposonics <sup>®</sup> 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)
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.	<ul> <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<sup>®</sup> smart assistant" (document part no.: 552070) for further information</li> </ul>

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.

### **Extension cables M12**



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")

Extension cables M16



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")

#### Notice for extension cables M12/M16

Code

0150

0200

0460

0500

0760

1000

1 1			Standard	cable lengths
			Meters	Feet
			1.5	5
			2	6.6
			4.6	15
			5	16.4
			7.6	25
			10	32.8
			15.2	50
PVC cable with M16 female connector (6 pin), straight – pigtail	PUR cable with M16 female connector (6 pin), straight – pigtail	FEP cable with M16 female connector (6 pin), straight – pigtail	For addition	nal extension
PVC cable (part no. 530 032) with M16 female connector, straight (part no. 370 423)	PUR cable (part no. 530 052) with M16 female connector, straight (part no. 370 423)	FEP cable (part no. 530 112) with M16 female connector, straight (part no. 370 423)	for industr part no.: 5	ial sensors (d <u>51444</u> ).
Order code: <b>K2-A-370423-xxxxyy-530032-0</b> (where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")	Order code: <b>K2-A-370423-xxxxyy-530052-0</b> (where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")	Order code: <b>K2-A-370423-xxxxyy-530112-0</b> (where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")		

.2 50 1520 r additional extension cables ference the accessory catalog industrial sensors (document rt no.: <u>551444</u>).

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

# **ORDER CODE**



a	Sensor model					
R	P 5 Profile					
b	Design					
G	Magnet slider backlash free (	part no. 253 421)				
L	Block magnet L (part no. 403	3 448)				
М	U-magnet OD33 (part no. 25	1 416-2)				
Ν	Magnet slider longer ball-joir	ited arm (part no. 252 183)				
0	No position magnet					
S	Magnet slider joint at top (pa	rt no. 252 182)				
V	Magnet slider joint at front (p	oart no. 252 184)				
C	Mechanical options					
A	Standard					
V	Fluorelastomer seals for the	sensor electronics housing				
d	Stroke length					
u Y	<b>X X X M</b> 0025 635	Ոՠՠ				
Sta	andard stroke length (mm)	Ordering steps				
010	25 500 mm	25 mm				
	500 2500 mm	50 mm				
	2500 5000 mm	100 mm				
	5000 6350 mm	250 mm				
v						
^ ©‡/	Chandevid strate length (in )					
312	otanuaru struke length (In.) Urdering steps					
	1 20 m. I.U m.					
	20100 in. 2.0 in.					
	100200 in. 4.0 in.					
	200250 in.	10.0 in.				
No	n-standard stroke lengths are st be encoded in 5 mm/0 1 in	available; increments.				
mu						

### e Number of magnets

**0 X** 01...02 Position(s) (1...2 magnet(s))

f	t Connection type					
Co	nnec	tor				
D	3	4	M12 male connector (5 pin)			
D	6	0	M16 male connector (6 pin)			
Ang	yled	cab	le outlet			
Ε	Χ	Х	XX m/ft. PVC cable (part no. 530 032)			
			E01E30 (130 m/399 ft.)			
			See "Frequently ordered accessories" for cable			
C	v	v	XX m/ft FEP cable (part no 530 157)			
u	<b>^</b>	<b>^</b>	G01G30 (130 m/399 ft.)			
			See "Frequently ordered accessories" for cable			
			specifications			
L	Χ	Х	XX m/ft. PUR cable (part no. 530 052)			
			L01L30 (130 m/399 ft.)			
			(Note the temperature range of the cable!)			
			specifications			
U	X	Х	XX m/ft. Silicone cable (part no. 530 176)			
			U01U30 (130 m/399 ft.)			
			See "Frequently ordered accessories" for cable			
		_	specifications			
Str	aigh	t ca	ble outlet			
Η	X	Х	XX m/ft. PUR cable (part no. 530 052)			
			H01H30 (130 m/399 ft.)			
			See "Frequently ordered accessories" for cable			
			specifications			
R	X	X	XX m/ft. PVC cable (part no. 530 032)			
			R01R30 (130 m/399 ft.)			
	See "Frequently ordered accessories" for cable					
			specifications			
Τ	X	X	XX $m/\pi$ . FEP cable (part no. 530 112)			
	101130 (130 M/399 II.) See "Frequently ordered accessories" for cable					
	specifications					
End	code	in n	neters if using metric stroke length.			
End	code	in f	eet if using US customary stroke length.			

# gSystem1Standard

h	Output
A	Current
V	Voltage

Accessories have to be ordered

separately.

#### 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
- 3 Position and velocity (1 magnet and 2 outputs) Specify the maximum velocity value in section
- 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 ....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

#### I Max. speed or velocity value

#### (optional: use when 🚺 "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

- For RP5, the magnet selected in b "Design" is included in the scope of delivery. Specify the number of magnets for your application. For multi-position measurements with more than 1 magnet order the other 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
   Position magnet (not valid for RP5 with design »O«)
   2 mounting clamps
  - up to 1250 mm (50 in.) stroke length + 1 mounting clamp for each
  - 500 mm (20 in.) additional
  - stroke length

stroke length

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)

#### Μ

#### 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.

#### 0

#### 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. ( $\rightarrow$  Velocity)

**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<sup>®</sup> application screen.

#### V Velocity

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



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