



Temposonics

AN AMPHENOL COMPANY

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® smart assistant



THE NEW **V** GENERATION

MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Tempsonics rely on the company's proprietary magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Tempsonics® 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.

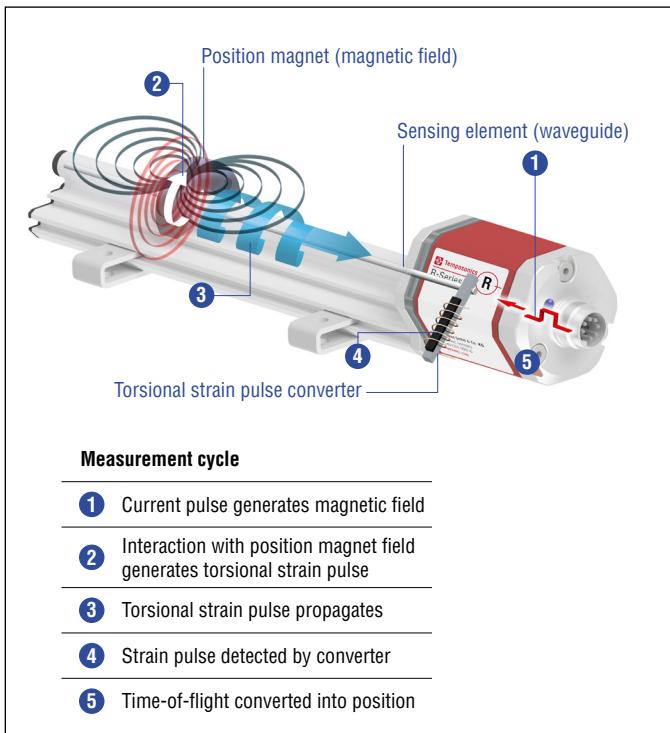
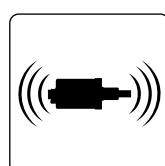


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

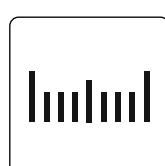
R-SERIES V RP5 Analog

The Tempsonics® 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:



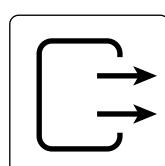
High shock and vibration resistance

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



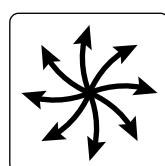
Internal resolution 0.1 µm

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.

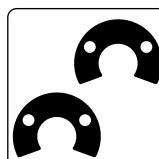


Multiple output options

The following values can be output via the second output:

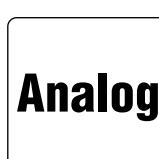
- Speed/velocity of the first magnet
- Reversed position of the first magnet
- Position of the second magnet
- Temperature in the sensor electronics housing

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® 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](#))



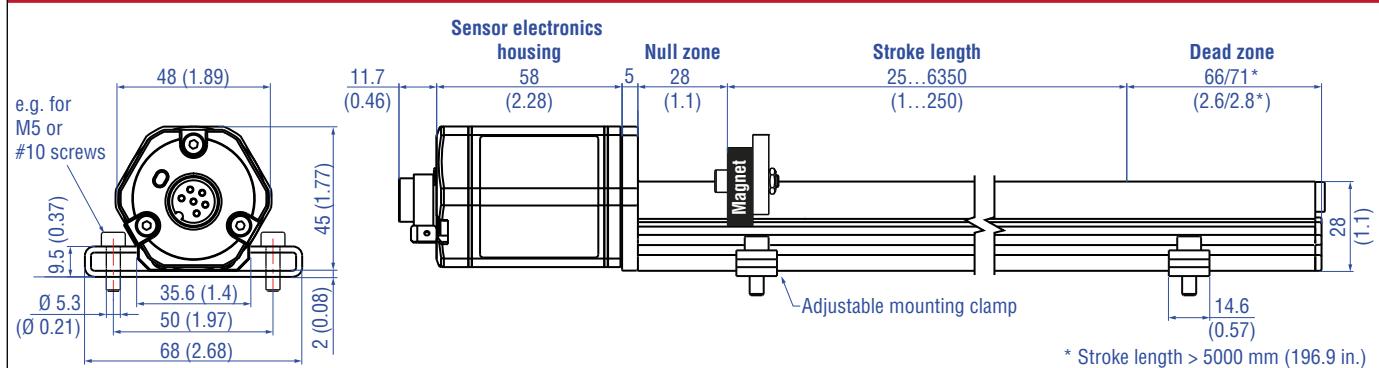
TECHNICAL DATA

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						
	Update time	0.25 ms	0.333 ms	0.5 ms	1.0 ms	2.0 ms						
						≤ 6350 mm						
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											
Speed/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	90 % relative humidity, no condensation											
Ingress protection	IP67 (connectors correctly fitted)/IP68 (3 m/3 d) for cable outlet											
Shock test	150 g/11 ms, IEC standard 60068-2-27											
Vibration test	30 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 RP5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR 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	25...6350 mm (1...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	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											

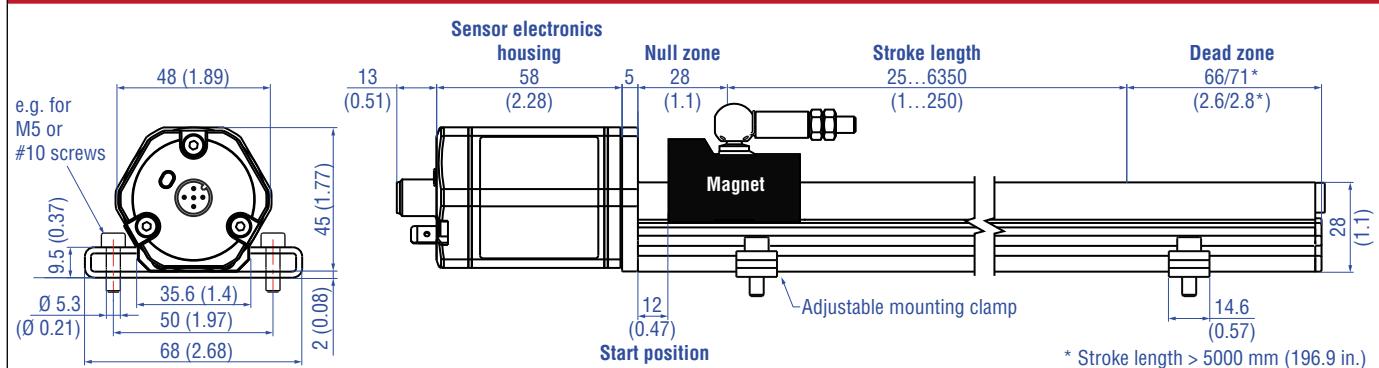
1/ With position magnet # 251 416-2

TECHNICAL DRAWING

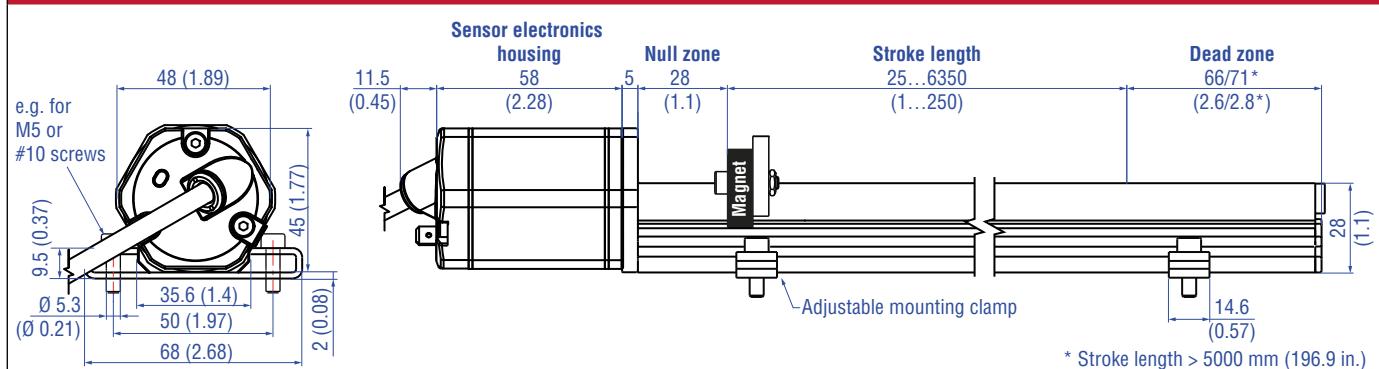
RP5-M, example: Connection type D60 (connector outlet)



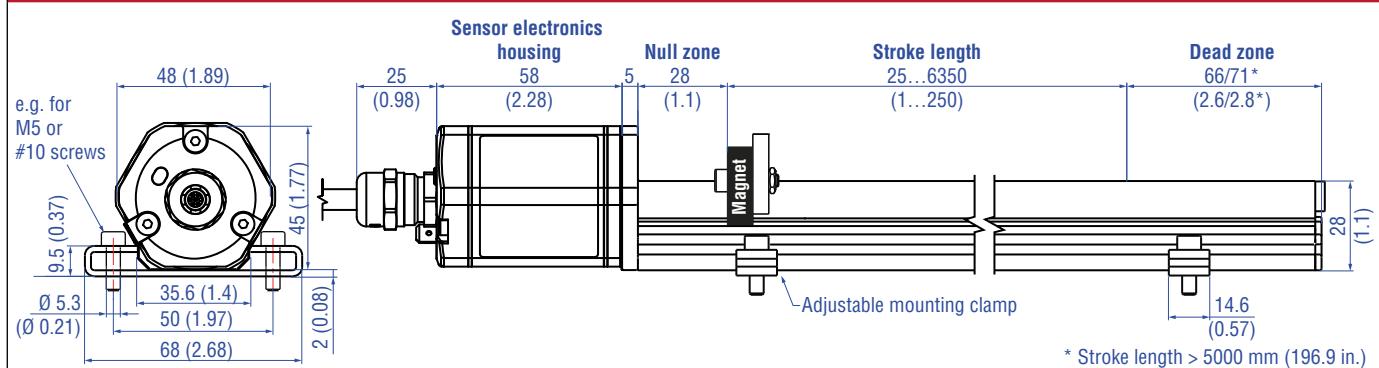
RP5-G/S, example: Connection type D34 (connector outlet)



RP5-M, example: Connection type EXX/GXX/LXX/UXX (angled cable outlet)



RP5-M, example: Connection type HXX/RXX/TXX (straight cable outlet)



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

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

CONNECTOR WIRING

D34				
Signal + power supply				
M12 male connector	Output	Pin	Function	
		1	1	+12...30 VDC ($\pm 20\%$)
		2	2	Position (magnet 1)
		3	3	DC Ground (0 V)
		2*	4	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing
		5	5	Signal Ground
* order dependent				

Fig. 3: Connector wiring D34

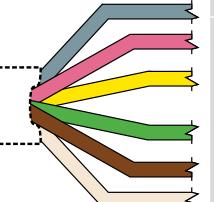
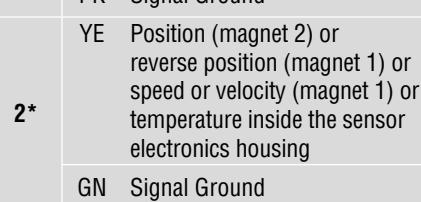
HXX or LXX / RXX or EXX / TXX or GXX / UXX					
Signal + power supply					
Cable	Output	Color	Function		
		1	GY	Position (magnet 1)	
		PK	Signal Ground		
		YE	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing		
		GN	Signal Ground		
		BN	+12...30 VDC ($\pm 20\%$)		
* order dependent					
For cable type TXX, the extra red & blue wires are not used.					

Fig. 5: Connector wiring for cable outlet

D60				
Signal + power supply				
M16 male connector	Output	Pin	Function	
		1	1	Position (magnet 1)
		2	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
		4	4	Signal Ground
		5	5	+12...30 VDC ($\pm 20\%$)
		6	6	DC Ground (0 V)
* order dependent				

Fig. 4: Connector wiring D60

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.

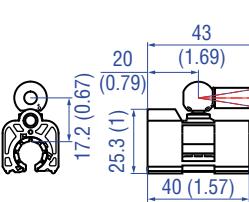
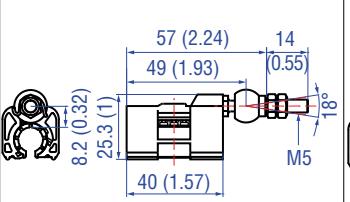
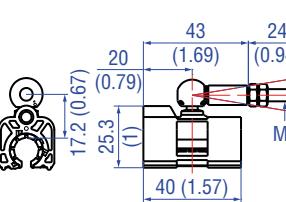
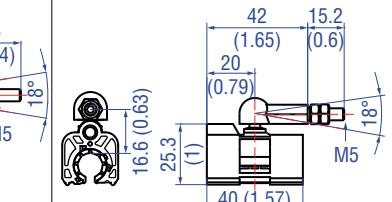
Straight cable outlet			Cable type	Angled cable outlet
H	X	X	Part no. 530 052	PUR → L X X Part no. 530 052
R	X	X	Part no. 530 032	PVC → E X X Part no. 530 032
T	X	X	Part no. 530 112	FEP → G X X Part no. 530 157

Fig. 6: Cable types assignment

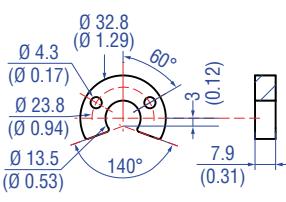
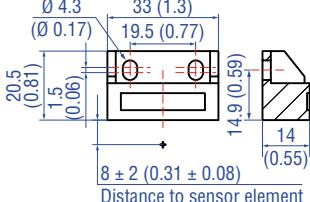
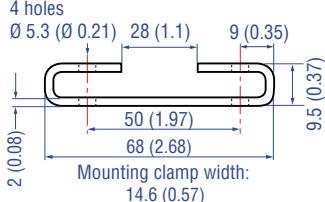
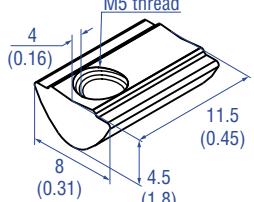
FREQUENTLY ORDERED ACCESSORIES

– Additional options available in our [Accessories Catalog](#)  551444

Position magnets

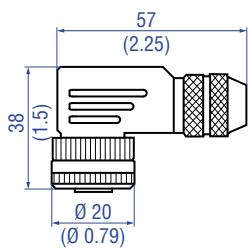
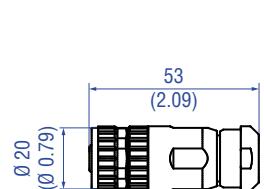
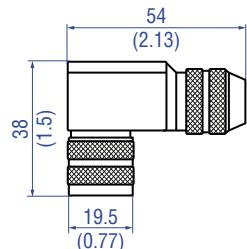
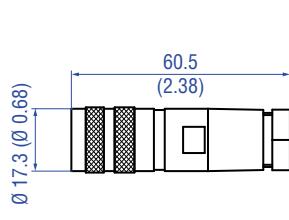
			
Magnet slider S, joint at top Part no. 252 182	Magnet slider V, joint at front Part no. 252 184	Magnet slider N longer ball-joint arm Part no. 252 183	Magnet slider G, backlash free Part no. 253 421
Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)	Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)	Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)	Material: GRP, magnet hard ferrite Weight: Approx. 25 g Operating temperature: -40...+85 °C (-40...+185 °F)

Position magnets

			
U-magnet OD33 Part no. 251 416-2	Block magnet L Part no. 403 448	Mounting clamp Part no. 400 802	T-nut Part no. 401 602
Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)	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)	Material: Stainless steel (AISI 304)	Fastening torque for M5 screw: 4.5 Nm
This magnet may influence the sensor performance specifications for some applications.			

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

Cable connectors*



**M16 female connector (6 pin), straight
Part no. 370 423**

Material: Zinc nickel plated
Termination: Solder
Cable Ø: 6...8 mm (0.24...0.31 in.)
Operating temperature:
-40...+100 °C (-40...+212 °F)
Ingress protection: IP65/IP67
(correctly fitted)
Fastening torque: 0.6 Nm

**M16 female connector (6 pin), angled
Part no. 370 460**

Material: Zinc nickel plated
Termination: Solder
Cable Ø: 6...8 mm (0.24...0.31 in.)
Wire: 0.75 mm² (20 AWG)
Operating temperature:
-40...+95 °C (-40...+203 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm

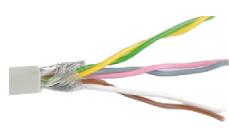
**M12 A-coded female connector (4 pin/5 pin), straight
Part no. 370 677**

Material: GD-Zn, Ni
Termination: Screw
Contact insert: CuZn
Cable Ø: 4...8 mm (0.16...0.31 in.)
Wire: 1.5 mm²
Operating temperature:
-30...+85 °C (-22...+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm

**M12 A-coded female connector (5 pin), angled
Part no. 370 678**

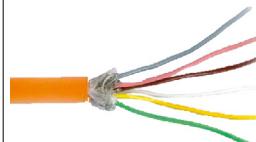
Material: GD-Zn, Ni
Termination: Screw; max. 0.75 mm²
Contact insert: CuZn
Cable Ø: 5...8 mm (0.2...0.31 in.)
Wire: 0.75 mm² (18 AWG)
Operating temperature:
-25...+85 °C (-13...+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.4 Nm

Cables



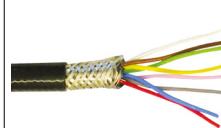
**PVC cable
Part no. 530 032**

Material: PVC jacket; gray
Features: Twisted pair, shielded, flexible
Cable Ø: 6 mm (0.23 in.)
Cross section: 3 × 2 × 0.14 mm²
Bending radius: 10 × D
(fixed installation)
Operating temperature:
-40...+105 °C (-40...+221 °F)



**PUR cable
Part no. 530 052**

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 × 2 × 0.25 mm²
Bending radius: 5 × D
(fixed installation)
Operating temperature:
-30...+80 °C (-22...+176 °F)



**FEP cable
Part no. 530 112**

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 × 2 × 0.25 mm²
Bending radius: 8 – 10 × D
(fixed installation)
Operating temperature:
-100...+180 °C (-148...+356 °F)



**FEP cable
Part no. 530 157**

Material: FEP jacket; black
Features: Twisted pair, shielded
Cable Ø: 6.7 mm (0.26 in.)
Cross section: 3 × 2 × 0.14 mm²
Operating temperature: -40...+180 °C
(-40...+356 °F)

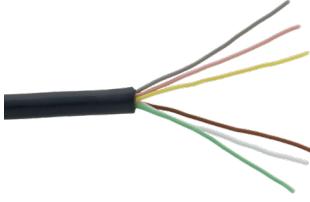
*/ Follow the manufacturer's mounting instructions

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

Tempsonics® R-Series V RP5 Analog

Data Sheet

Cable	Cable sets	
		
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
<p>Material: Silicone jacket; black Features: Twisted pair, shielded Cable Ø: 6.3 mm (0.25 in.) Cross section: $3 \times 2 \times 0.14 \text{ mm}^2$ Bending radius: $7 \times D$ (fixed installation) Operating temperature: $-50 \dots +150 \text{ }^{\circ}\text{C}$ $(-58 \dots +302 \text{ }^{\circ}\text{F})$</p>		
Hand programmer for analog output Part no. 253 124	Cabinet programmer for analog output Part no. 253 408	TempoLink® kit for Tempsonics® 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 style="list-style-type: none"> • 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

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")



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")

Extension cables M16



PVC cable with M16 female connector (6 pin), straight – pigtail

PVC cable (part no. 530 032) with M16 female connector, straight (part no. 370 423)

Order code:
K2-A-370423-xxxxyy-530032-0

(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")



PUR cable with M16 female connector (6 pin), straight – pigtail

PUR cable (part no. 530 052) with M16 female connector, straight (part no. 370 423)

Order code:
K2-A-370423-xxxxyy-530052-0

(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")



FEP cable with M16 female connector (6 pin), straight – pigtail

FEP cable (part no. 530 112) with M16 female connector, straight (part no. 370 423)

Order code:
K2-A-370423-xxxxyy-530112-0

(where xxxx = cable length and yy = unit in centimeters "CM" or feet "FT")

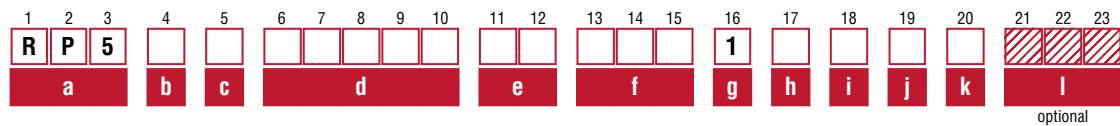
Notice for extension cables
M12/M16

Standard cable lengths		
Meters	Feet	Code
1.5	5	0150
2	6.6	0200
4.6	15	0460
5	16.4	0500
7.6	25	0760
10	32.8	1000
15.2	50	1520

For additional extension cables reference the accessory catalog for industrial sensors (document part no.: [551444](#)).

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

ORDER CODE



optional

a	Sensor model
R	P 5 Profile

b	Design
G	Magnet slider backlash free (part no. 253 421)
L	Block magnet L (part no. 403 448)
M	U-magnet OD33 (part no. 251 416-2)
N	Magnet slider longer ball-jointed arm (part no. 252 183)
O	No position magnet
S	Magnet slider joint at top (part no. 252 182)
V	Magnet slider joint at front (part no. 252 184)

c	Mechanical options
A	Standard
V	Fluorelastomer seals for the sensor electronics housing

d	Stroke length
X X X X M	0025...6350 mm

Standard stroke length (mm)	Ordering steps
25... 500 mm	25 mm
500...2500 mm	50 mm
2500...5000 mm	100 mm
5000...6350 mm	250 mm

X X X X U	001.0...250.0 in.
-----------	-------------------

Standard stroke length (in.)	Ordering steps
1... 20 in.	1.0 in.
20...100 in.	2.0 in.
100...200 in.	4.0 in.
200...250 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
Connector	

D 3 4	XX m/ft. PVC cable (part no. 530 032) E01...E30 (1...30 m/3...99 ft.)
D 6 0	M16 male connector (6 pin)

Angled cable outlet	
E X X	XX m/ft. FEP cable (part no. 530 157) G01...G30 (1...30 m/3...99 ft.)

E X X	XX m/ft. FEP cable (part no. 530 157) G01...G30 (1...30 m/3...99 ft.)
G X X	See "Frequently ordered accessories" for cable specifications

L X X	XX m/ft. PUR cable (part no. 530 052) L01...L30 (1...30 m/3...99 ft.)
L X X	(Note the temperature range of the cable!)

L X X	See "Frequently ordered accessories" for cable specifications
U X X	XX m/ft. Silicone cable (part no. 530 176) U01...U30 (1...30 m/3...99 ft.)
U X X	See "Frequently ordered accessories" for cable specifications

Straight cable outlet	
H X X	XX m/ft. PUR cable (part no. 530 052) H01...H30 (1...30 m/3...99 ft.)

H X X	(Note the temperature range of the cable!)
H X X	See "Frequently ordered accessories" for cable specifications

R X X	XX m/ft. PVC cable (part no. 530 032) R01...R30 (1...30 m/3...99 ft.)
R X X	See "Frequently ordered accessories" for cable specifications

T X X	XX m/ft. FEP cable (part no. 530 112) T01...T30 (1...30 m/3...99 ft.)
T X X	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 i
3	Position and velocity (1 magnet and 2 outputs) Specify the maximum velocity value in section i
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)	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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.).

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

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 **Digital to Analog Converter (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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