

## Data Sheet

# R-Series – RP PROFIBUS

## Magnetostrictive Linear Position Sensors

- For mounting on machines
- Rugged industrial sensor
- Diagnostics LEDs



## MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the beginning of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

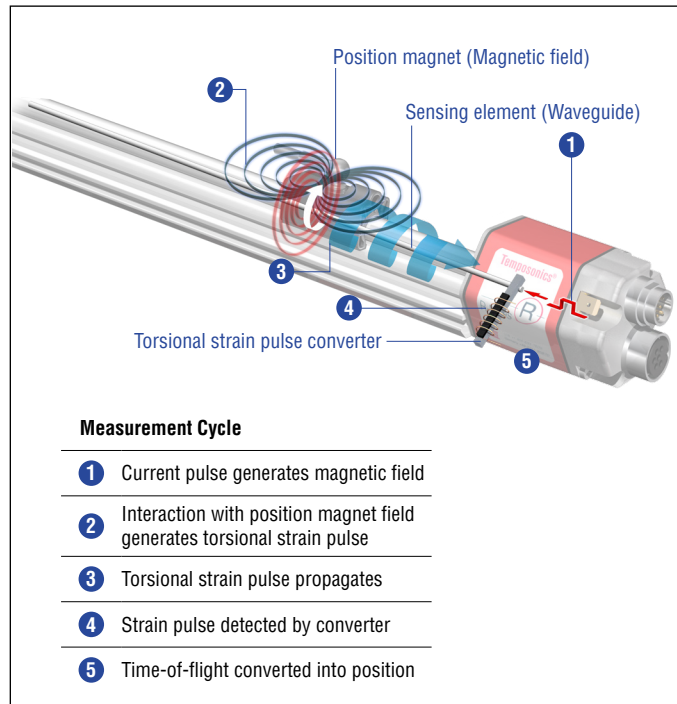


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

## RP SENSOR PROFIBUS

Robust, non-contact and wear free, the Temposonics linear position sensors provide best durability and accurate position measurement solutions in harsh industrial environments. The position measurement accuracy is tightly controlled by the quality of the waveguide which is manufactured by Temposonics. The position magnet is mounted on the moving machine part and travels contactlessly over the sensor sensing element with the built-in waveguide.

Temposonics® RP is a high-performance sensor for external mounting. The position magnet, mounted to the movable machine part, can either be an U-magnet or a captive-sliding magnet. The free magnets travel along the sensor profile with a defined distance. This kind of installation tolerates a lateral offset as well as a height offset. Therefore the robust sensor is very versatile. A superior performance for instance in plastic and rubber as well as in paper and wood processing industry is guaranteed.

Temposonics sensors fulfill all requirements of PROFIBUS-DP according to EN 50170. The sensor realizes the absolute position measuring with direct transmission of serial, bitsynchronous data in RS485 standard to control units in a baudrate of 12 Mbit/s maximum. In addition to data transmission, PROFIBUS provides powerful functions for diagnostics and configuration, loaded into the bus via the GSD (General Station Description).



Fig. 2: Typical application: Plastics processing

## TECHNICAL DATA

Output																	
Interface	IEC 61158 CPF3 PROFIBUS																
Data format/Data transmission rate	PROFIBUS-DP slave/Maximum 12 Mbit/s																
Measured value	Position/option: Simultaneous multi-position measurement with up to 20 magnets																
Accuracy																	
Resolution Position	1...1000 µm (selectable)																
Cycle time	<table border="1"> <tr> <td>Stroke length</td> <td>≤ 500 mm</td> <td>≤ 2000 mm</td> <td>≤ 4500 mm</td> <td>≤ 5080 mm</td> </tr> <tr> <td>Cycle time</td> <td>0.5 ms</td> <td>1.0 ms</td> <td>2.0 ms</td> <td>3.1 ms</td> </tr> </table> (each additional magnet + 0.05 ms)	Stroke length	≤ 500 mm	≤ 2000 mm	≤ 4500 mm	≤ 5080 mm	Cycle time	0.5 ms	1.0 ms	2.0 ms	3.1 ms						
Stroke length	≤ 500 mm	≤ 2000 mm	≤ 4500 mm	≤ 5080 mm													
Cycle time	0.5 ms	1.0 ms	2.0 ms	3.1 ms													
Linearity deviation <sup>1</sup>	< ±0.01 % F.S. (minimum ±50 µm) Optional internal linearization: Linearity tolerance (Applies for the first magnet for multi-position measurement) <table border="1"> <tr> <td>Stroke length</td> <td>&lt; 300 mm</td> <td>&gt; 300...600 mm</td> <td>&gt; 600...1200 mm</td> </tr> <tr> <td>Tolerance</td> <td>typ. ±15 µm/max. ±25 µm</td> <td>typ. ±20 µm/max. ±30 µm</td> <td>typ. ±30 µm/max. ±50 µm</td> </tr> <tr> <td>Stroke length</td> <td>1200...3000 mm</td> <td>3000...5080 mm</td> <td></td> </tr> <tr> <td>Tolerance</td> <td>typ. ±45 µm/max. ±90 µm</td> <td>typ. ±85 µm/max. ±150 µm</td> <td></td> </tr> </table>	Stroke length	< 300 mm	> 300...600 mm	> 600...1200 mm	Tolerance	typ. ±15 µm/max. ±25 µm	typ. ±20 µm/max. ±30 µm	typ. ±30 µm/max. ±50 µm	Stroke length	1200...3000 mm	3000...5080 mm		Tolerance	typ. ±45 µm/max. ±90 µm	typ. ±85 µm/max. ±150 µm	
Stroke length	< 300 mm	> 300...600 mm	> 600...1200 mm														
Tolerance	typ. ±15 µm/max. ±25 µm	typ. ±20 µm/max. ±30 µm	typ. ±30 µm/max. ±50 µm														
Stroke length	1200...3000 mm	3000...5080 mm															
Tolerance	typ. ±45 µm/max. ±90 µm	typ. ±85 µm/max. ±150 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...+75 °C (-40...+167 °F)																
Humidity	90 % relative humidity, no condensation																
Ingress protection <sup>2</sup>	IP65 (if mating connectors are correctly fitted)																
Shock test	100 g (single shock), IEC standard 68-2-27																
Vibration test	15 g/10...2000 Hz, IEC standard 68-2-6 (resonance frequencies excluded)																
EMC test	Electromagnetic emission EN 61000-6-3 Electromagnetic immunity EN 61000-6-2 The sensor meets the requirements of the EU directives and is marked with <b>CE</b> .																
Magnet movement velocity	Any (with sliding magnet: Maximum 10 m/s)																
Design/Material																	
Sensor electronics housing	Aluminum																
Sensor profile	Aluminum																
Stroke length	25...5080 mm (1...200 in.)																
Installation																	
Mounting position	Any																
Mounting instruction	Please consult the technical drawings on <a href="#">page 4</a>																
Electrical connection																	
Connection types (selectable)	1 × M16 male connector (6 pin), 1 × M16 female connector (6 pin) or 1 × M12 male connector (5 pin), 1 × M12 female connector (5 pin), 1 × M8 male connector (4 pin) or 2 × cable outlet, 1 × M8 male connector (4 pin)																
Operating voltage	24 VDC (-15/+20 %); UL recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA)/Canadian Electrical Code																
Current consumption	110 mA typical																
Dielectric strength	500 VDC (DC ground to machine ground)																
Polarity protection	Up to -30 VDC																
Over voltage protection	Up to 36 VDC																

1/ With position magnet # 251416-2

2/ The IP rating is not part of the UL recognition

TECHNICAL DRAWING

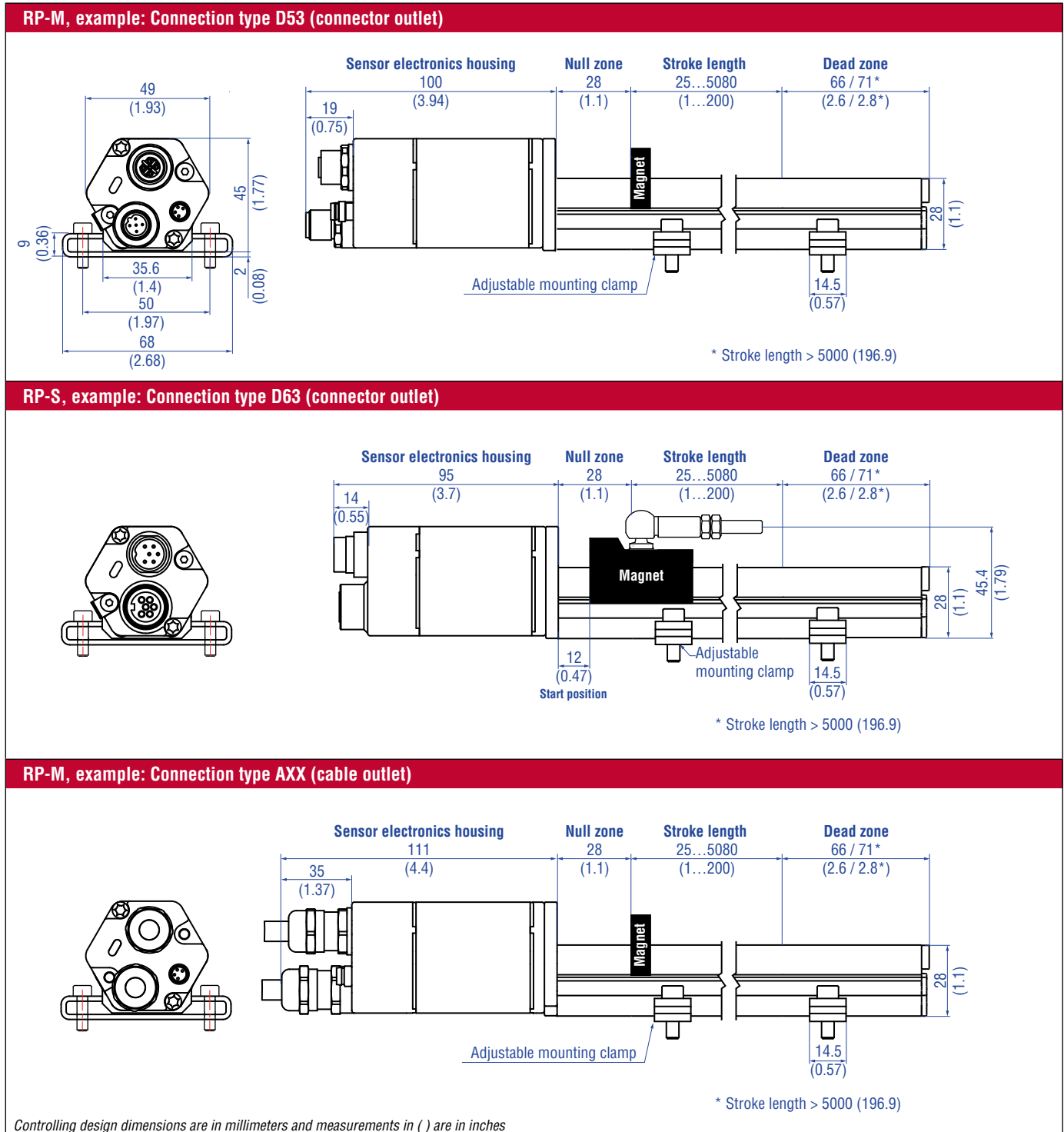


Fig. 3: Temposonics® RP with U-magnet (connection type example D53 and AXX) and magnet slider (connection type example D63)

## CONNECTOR WIRING




D53		
<b>In – Signal</b>		
<b>M12 male connector (B-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	Not connected
	2	RxD/TxD-N (bus)
	3	Not connected
	4	RxD/TxD-P (bus)
	5	Shield
<b>Out – Signal</b>		
<b>M12 female connector (B-coded)</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	VP +5 VDC (for bus termination)
	2	RxD/TxD-N (bus)
	3	Data GND (for bus termination)
	4	RxD/TxD-P (bus)
	5	Shield
<b>Power supply</b>		
<b>M8 male connector</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	+24 VDC (-15/+20 %)
	2	Not connected
	3	DC Ground (0 V)
	4	Not connected

Fig. 4: Connector wiring D53



D63		
<b>In – Signal + power supply</b>		
<b>M16 male connector</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	RxD/TxD-N (bus)
	2	RxD/TxD-P (bus)
	3	Not connected
	4	Not connected
	5	+24 VDC (-15/+20 %)
	6	DC Ground (0 V)
<b>Out – Signal + power supply</b>		
<b>M16 female connector</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	RxD/TxD-N (bus)
	2	RxD/TxD-P (bus)
	3	Data GND (for bus termination)
	4	VP +5 VDC (for bus termination)
	5	+24 VDC (-15/+20 %)
	6	DC Ground (0 V)

Fig. 5: Connector wiring D63




AXX		
<b>Signal</b>		
<b>Cable</b>	<b>Color</b>	<b>Function</b>
	GN	RxD/TxD-N (bus)
	RD	RxD/TxD-P (bus)
<b>Cable</b>	<b>Color</b>	<b>Function</b>
	GN	RxD/TxD-N (bus)
	RD	RxD/TxD-P (bus)
<b>Power supply</b>		
<b>M8 male connector</b>	<b>Pin</b>	<b>Function</b>
 <p>View on sensor</p>	1	+24 VDC (-15/+20 %)
	2	Not connected
	3	DC Ground (0 V)
	4	Not connected

Fig. 6: Connector wiring AXX

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

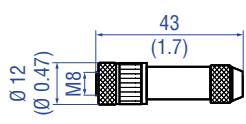
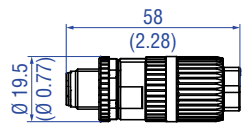
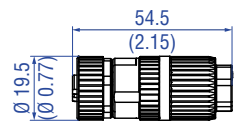
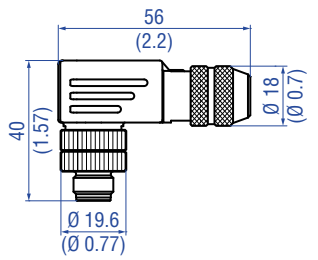
**Position magnets**

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

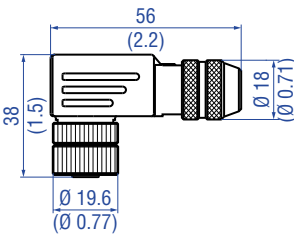
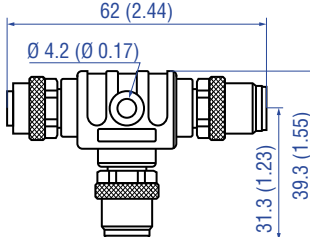
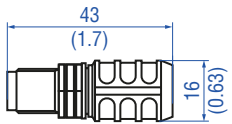
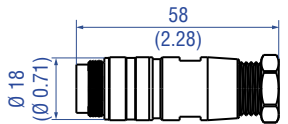
**Position magnets** | **Mounting accessories**

<p><b>U-magnet OD33</b> <b>Part no. 251 416-2</b></p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p> <p>Marked version for sensors with internal linearization: Part no. 254 226</p>	<p><b>Block magnet L</b> <b>Part no. 403 448</b></p> <p>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)</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	<p><b>Mounting clamp</b> <b>Part no. 400 802</b></p> <p>Material: Stainless steel (AISI 304)</p>	<p><b>T-nut</b> <b>Part no. 401 602</b></p> <p>Fastening torque for M5 screw: 4.5 Nm</p>

**Cable connectors\***

			
<p><b>M8 female connector (4 pin), straight</b> Part no. 370 504</p>	<p><b>M12 B-coded male connector (5 pin), straight</b> Part no. 560 884</p>	<p><b>M12 B-coded female connector (5 pin), straight</b> Part no. 560 885</p>	<p><b>M12 B-coded male connector (5 pin), angled</b> Part no. 370 515</p>
<p>Material: CuZn nickel plated Termination: Solder Cable Ø: 3.5...5 mm (0.14...0.28 in.) Wire: 0.25 mm<sup>2</sup> Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.5 Nm</p>	<p>Material: Zinc nickel plated Termination: Insulation-displacement Contact insert: Silver plated Cable Ø: 7...8.8 mm (0.28...0.35 in.) Wire: 0.34 mm<sup>2</sup> (22 AWG) Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP65/IP67 (correctly fitted) Number of contacts: 3 pin Fastening torque: 0.6 Nm</p>	<p>Material: Zinc nickel plated Termination: Insulation-displacement Contact insert: Silver plated Cable Ø: 7...8.8 mm (0.28...0.35 in.) Wire: 0.34 mm<sup>2</sup> (22 AWG) Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP65/IP67 (correctly fitted) Number of contacts: 3 pin Fastening torque: 0.6 Nm</p>	<p>Material: Zinc nickel plated Termination: Screw Contact insert: Silver plated Cable Ø: 6...8 mm (0.24...0.31 in.) Wire: 0.75 mm<sup>2</sup> (18 AWG) Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.4 Nm</p>

**Cable connectors\***

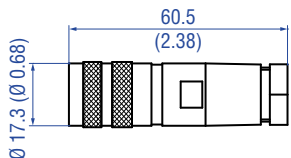
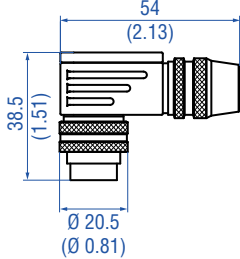
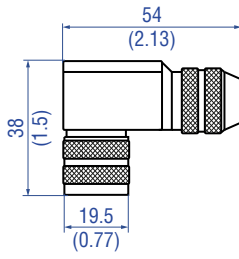
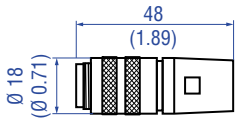
			
<p><b>M12 B-coded female connector (5 pin), angled</b> Part no. 370 514</p>	<p><b>M12 B-coded T connector (5 pin)</b> Part no. 560 887</p>	<p><b>Active M12 B-coded male bus terminator (5 pin)</b> Part no. 560 888</p>	<p><b>M16 male connector (6 pin), straight</b> Part no. 370 427</p>
<p>Material: Zinc nickel plated Termination: Screw Contact insert: Silver plated Cable Ø: 6...8 mm (0.24...0.31 in.) Wire: 0.75 mm<sup>2</sup> (18 AWG) Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.4 Nm</p>	<p>Material: Zinc nickel plated Termination: Solder Contact insert: Silver plated Installation: Field installable Operating temperature: -30...+90 °C (-22...+130 °F) Ingress protection: IP67 (correctly fitted)</p>	<p>Housing: PUR Termination: Screw Contact insert: Silver plated Operating temperature: -40...+75 °C (-40...+167 °F) Ingress protection: IP67 (correctly fitted)</p>	<p>Material: Zinc nickel plated Termination: Solder Contact insert: Silver plated Cable clamp: PG9 Cable Ø: 6...8 mm (0.24...0.31 in.) Operating temperature: -40...+100 °C (-40...+212 °F) Ingress protection: IP65/IP67 (correctly fitted)</p>

\*/ Follow the manufacturer's mounting instructions

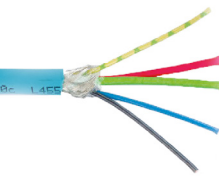


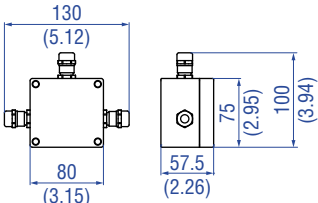
Controlling design dimensions are in millimeters and measurements in ( ) are in inches



**Cable connectors\***

			
<p><b>M16 female connector (6 pin), straight</b> Part no. 370 423</p>	<p><b>M16 male connector (6 pin), angled</b> Part no. 370 621</p>	<p><b>M16 female connector (6 pin), angled</b> Part no. 370 460</p>	<p><b>Active M16 male bus terminator (6 pin)</b> Part no. 370 620</p>
<p>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</p>	<p>Material: Brass nickel plated Termination: Solder Contact insert: Silver plated Cable Ø: 6...8 mm (0.24...0.31 in.) Operating temperature: -30...+95 °C (-22...+203 °F) Ingress protection: IP67 (correctly fitted)</p>	<p>Material: Zinc nickel plated Termination: Solder Cable Ø: 6...8 mm (0.24...0.31 in.) Wire: 0.75 mm<sup>2</sup> (20 AWG) Operating temperature: -40...+95 °C (-40...+203 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm</p>	<p>Material: Zinc nickel plated Contact insert: Silver plated Operating temperature: -40...+75 °C (-40...+167 °F) Ingress protection: IP67 (correctly fitted)</p>

**Cable** **Filter box**

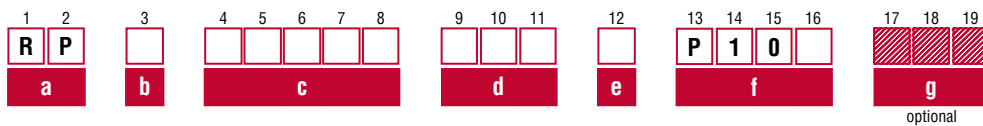
			
<p><b>PVC signal cable</b> Part no. 530 040</p>	<p><b>PVC power cable</b> Part no. 530 108</p>	<p><b>PUR signal cable</b> Part no. 530 109</p>	<p><b>PROFIBUS filter box, M16 (6 pin)</b> Part no. 252 916</p>
<p>Material: PVC jacket; petrol Features: Hybrid cable (PROFIBUS and power supply feed in), flexible Cable Ø: 8 mm (0.31 in.) Cross section: 1 × 2 × 0.65 mm<sup>2</sup> 3 × 1 × 0.75 mm<sup>2</sup> Bending radius: 5 × D (fixed installation) Operating temperature: -30...+80 °C (-22...+176 °F)</p>	<p>Material: PVC jacket; gray Features: Shielded, flexible, mostly flame resistant Cable Ø: 4.9 mm (0.19 in.) Cross section: 3 × 0.34 mm<sup>2</sup> Bending radius: 10 × D Operating temperature: -30...+80 °C (-22...+176 °F)</p>	<p>Material: PUR jacket; violet Features: Highly flexible, halogen free, suitable for drag chains, mostly oil &amp; flame resistant Cable Ø: 8 mm (0.31 in.) Cross section: 1 × 2 × 0.25 mm<sup>2</sup> Bending radius: 65 mm Operating temperature: -30...+70 °C (-22...+158 °F)</p>	<p>EMC conformal feeding of +24 VDC operating voltage into the Profibus-DP hybrid cable.</p>

\*/ Follow the manufacturer's mounting instructions

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



## ORDER CODE



<b>a</b>	<b>Bauform</b>	
<b>R</b>	<b>P</b>	Profile

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

<b>d</b>	<b>Stroke length</b>				
<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>M</b>	0025...5080 mm
<b>Standard stroke length (mm)</b>		<b>Ordering steps</b>			
25... 500 mm		25 mm			
500...2500 mm		50 mm			
2500...5080 mm		100 mm			
<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>U</b>	001.0...200.0 in.
<b>Standard stroke length (in.)</b>		<b>Ordering steps</b>			
1... 20 in.		1.0 in.			
20...100 in.		2.0 in.			
100...200 in.		4.0 in.			
Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.					

<b>d</b>	<b>Connection type</b>		
<b>D</b>	<b>5</b>	<b>3</b>	1 × M12 male connector (5 pin), 1 × M12 female connector (5 pin) 1 × M8 male connector (4 pin)
<b>D</b>	<b>6</b>	<b>3</b>	1 × M16 male connector (6 pin) 1 × M16 female connector (6 pin)
<b>A</b>	<b>X</b>	<b>X</b>	XX m PUR cable (Part no. 530 109) A01...A10 (1...10 m) (see chapter “frequently ordered accessories” for cable specifications and note the temperature range of the cable), 1 × M8 male connector (4 pin)
*/ Encode in meters if using metric stroke length. Encode in feet if using US customary stroke length.			

<b>e</b>	<b>Operating voltage</b>
<b>1</b>	+24 VDC (-15/+20 %)
<b>A</b>	+24 VDC (-15/+20 %), vibration resistant (stroke length 25...2000 mm/1...79 in.)

<b>f</b>	<b>Output</b>			
<b>P</b>	<b>1</b>	<b>0</b>	<b>1</b>	Profibus-DP (1...20 position(s))
<b>P</b>	<b>1</b>	<b>0</b>	<b>2</b>	Profibus-DP (1 position)
<b>P</b>	<b>1</b>	<b>0</b>	<b>5</b>	Profibus-DP, intern linearization (1...15 position(s))

### Optional

<b>g</b>	<b>Number of magnets for multi-position measurement</b>		
<b>Z</b>	<b>X</b>	<b>X</b>	Z02...Z20 (2...20 magnets)

### NOTICE

- Select the P101 or P105 in **f** “Output” for multi-position measurement (number of magnets ≥ 2).
- Specify magnet numbers for your sensing application and order 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, e.g. 2 × U-magnets (part no. 251 416-2).
- If the option for internal linearization (P105) in **f** “Output” is chosen, select a suitable magnet.

## DELIVERY



- Sensor
- Position magnet
- 2 mounting clamps up to 1250 mm (49 in.) + 1 clamp for each 500 mm (20 in.)

Accessories have to be ordered separately

Manuals, Software & 3D Models available at:  
[www.temposonics.com](http://www.temposonics.com)

**UNITED STATES**  
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