Temposonics®
Magnetostrictive Linear Position Sensors

R-Series V RP5 Analog
Data Sheet

– Direct analog output, position + speed
– Dual magnet position measurement
– Field adjustments and diagnostics using the new TempoLink smart assistant
MEASURING TECHNOLOGY

The absolute, linear position sensors provided by MTS Sensors rely on the company’s proprietary Temposonics® 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 end 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 Analog

Temposonics® R-Series V brings very powerful sensor performance to meet the many demands of your application. The R-Series V is the long term solution for harsh environments that have high levels of shock and vibration. Sensor models with analog outputs (voltage/current) have options for one or two position magnets, and for single or dual output channels.

When the R-Series V Analog sensor is ordered with a single output channel for one position magnet, the output will be the measured position value presented in either voltage or current.

When the sensor is ordered with dual output channels the second output can be configured to report the position of the second magnet or the reverse position or velocity of one magnet or the temperature inside of the electronics housing. Other configurations can be adjusted using the TempoLink smart assistant.

With many outstanding features the R-Series V sensors are fit for a very broad range of applications.

TempoLink YOUR SMART ASSISTANT

The TempoLink smart assistant is an accessory for the R-Series V family of sensors that supports setup and diagnostics. For the R-Series V Analog model, it enables the adjustment of parameters like the output values for the zero and span setpoints and their locations on the sensor. For diagnostics and analysis of operational data the R-Series V sensors continuously track values such as total distance traveled by the position magnet, internal temperature of the sensor and the quality of the position signal. This additional information can be read out via TempoLink smart assistant even while the sensor remains operational in the application.

TempoLink smart assistant is connected to the sensor via the power connection, which now adds bidirectional communication for setup and diagnostics. The TempoLink smart assistant is operated using a graphical user-interface that will be displayed on your smartphone, tablet, laptop or PC. Just connect your Wi-Fi-enabled device to TempoLink Wi-Fi access point and go to the website URL for the user-interface.

Fig. 2: R-Series V sensor with TempoLink smart assistant
TECHNICAL DATA

Output
Analog
Voltage: 0…10/10…0/−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 (magnitude) or velocity (with direction) for one position magnet.
Sensor 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)
Linearity deviation \(< \pm 0.01 \%\) F.S. (minimum \(\pm 50 \mu m\))
Repeatability \(< \pm 0.001 \%\) F.S. (minimum \(\pm 1 \mu m\))
Hysteresis \(< 4 \mu m\)
Update time
Stroke length ≤ 1200 mm ≤ 2400 mm ≤ 4800 mm ≤ 6350 mm
Update time 0.5 ms 1.0 ms 2.0 ms 5.0 ms

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
Temperature coefficient < 30 ppm/K
Ingress protection IP67 (connectors correctly fitted)
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 sensor meets the requirements of the EC directives and is marked with CE

Magnet movement velocity Any

Design / Material
Sensor electronics housing Aluminum (painted), zinc die cast
Sensor profile Aluminum
Stroke length 25…6350 mm (1…250 in.)

Mechanical mounting
Mounting position Any
Mounting instruction Please consult the technical drawings on page 4

Electrical connection
Connection type 1 × M16 male connectors (6 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-A/-V, example: Connector outlet D60**

<table>
<thead>
<tr>
<th>Sensor electronics housing</th>
<th>Null zone</th>
<th>Stroke length</th>
<th>Dead zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>28</td>
<td>25...6350</td>
<td>66/71*</td>
</tr>
</tbody>
</table>

* Stroke length > 5000 mm (196.9 in.)

**RP5-M-A/-V, example: Cable outlet HXX/RXX/TXX**

<table>
<thead>
<tr>
<th>Sensor electronics housing</th>
<th>Null zone</th>
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</tr>
</tbody>
</table>

* Stroke length > 5000 mm (196.9 in.)

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

Fig. 3: Temposonics’ RPS with U-magnet

**CONNECTOR WIRING**

### D60

<table>
<thead>
<tr>
<th>Signal + power supply</th>
<th>M16 male connector</th>
<th>Output</th>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>Position (magnet 1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>Signal Ground</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2*</td>
<td>Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>Signal Ground</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
<td>+12...30 VDC (±20 %)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>6</td>
<td>DC Ground (0 V)</td>
<td></td>
</tr>
</tbody>
</table>

* order dependent

Fig. 4: Connector wiring D60

### HXX / RXX / TXX

<table>
<thead>
<tr>
<th>Signal + power supply</th>
<th>Cable</th>
<th>Output</th>
<th>Color</th>
<th>Function</th>
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<td>1</td>
<td>GY</td>
<td>Position (magnet 1)</td>
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<td></td>
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<td>PK</td>
<td>Signal Ground</td>
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</tr>
<tr>
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<td>2*</td>
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<td>Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing</td>
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<td>GN</td>
<td>Signal Ground</td>
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</tr>
<tr>
<td></td>
<td>4</td>
<td>BN</td>
<td>+12...30 VDC (±20 %)</td>
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<td>WH</td>
<td>DC Ground (0 V)</td>
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</tr>
</tbody>
</table>

* order dependent

Fig. 5: Connector wiring for cable outlet
FREQUENTLY ORDERED ACCESSORIES – Additional options available in our Accessories Guide [551444]

### Position magnets

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Description</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>252 182</td>
<td>Magnet slider S, joint at top</td>
<td>Ø 4.3 (Ø 0.17) x 140° (5.5)</td>
</tr>
<tr>
<td>252 183</td>
<td>Magnet slider N, longer ball-joint arm</td>
<td>Ø 4.3 (Ø 0.17) x 140° (5.5)</td>
</tr>
<tr>
<td>252 184</td>
<td>Magnet slider V, joint at front</td>
<td>Ø 4.3 (Ø 0.17) x 140° (5.5)</td>
</tr>
</tbody>
</table>

### Mounting accessories

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Description</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 802</td>
<td>Mounting clamp</td>
<td>50 (1.97) x 68 (2.68)</td>
</tr>
<tr>
<td>401 602</td>
<td>T-nut</td>
<td>4 (0.16) x 8 (0.31)</td>
</tr>
</tbody>
</table>

Controlling design dimensions are in millimeters and measurements in () are in inches.
Temposonics® R-Series V RP5 Analog
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<table>
<thead>
<tr>
<th>Cable connectors*</th>
<th>Programming tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>M16 female connector (6 pin), straight Part no. 370 423</td>
<td>TempoLink kit for Temposonics® R-Series V Part no. TL-1-0-AS60 (for D60) Part no. TL-1-0-AS00 (for cable outlet)</td>
</tr>
<tr>
<td>M16 female connector (6 pin), angled Part no. 370 460</td>
<td>Hand programmer for analog output Part no. 253 124</td>
</tr>
</tbody>
</table>

- **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

- **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

- **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 product brief “TempoLink smart assistant” (document part no.: 551976) for further information**

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**Programming tool**

**Cables**

- **Cabinet programmer for analog output Part no. 253 408**
  - 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)

- **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, energy chain capable, 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)

- **Teflon® cable Part no. 530 112**
  - Material: Teflon® 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)

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* Follow the manufacturer’s mounting instructions

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

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</table>

**a. Sensor model**
- RP5 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**
- 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

- 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**
- D 6 0 M16 male connector (6 pin)
- H X X XX m PUR cable (part no. 530 052) See “Frequently ordered accessories” for cable specifications
- R X X XX m PVC cable (part no. 530 032) See “Frequently ordered accessories” for cable specifications
- T X X XX m Teflon® cable (part no. 530 112) 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)
- 3 Position and velocity (1 magnet and 2 outputs)
- 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

**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
Max speed or velocity value

(optional: use when “Function” is 2 or 3)

For metric stroke lengths encode speed in m/s for the values 0.01 to 9.99 m/s (001…999)
For US customary stroke lengths encode speed in inches/s for the values 1 to 400 in./s (001…400)

Use the codes (00E) for 0.025 m/s, and (A00) for 10.0 m/s to provide backwards compatibility for these old R-Series selections.

NOTICE

• For the RP5, the magnet selected in “Design” is included in the scope of delivery. 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 multi-position measurement, e.g. 2 × U-magnet (part no. 251 416-2).

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.mtssensors.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.

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 sensor’s model number.

Measuring direction
When moving the position, the position and velocity values increase in the 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.

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.

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