Tempsonics®
Magnetostrictive Linear Position Sensors

RD4 Powerlink V2
Data Sheet

– Detached sensor electronics
– Mounting in applications with limited space
– Diagnostics LEDs
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.

RD4 SENSOR

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 MTS Sensors. The position magnet is mounted on the moving machine part and travels contactlessly over the sensor rod with the built-in waveguide.

Temposonics® RD4 is a high-performance position sensor with detached electronics: the sensor rod with the built-in waveguide is connected via a cable to the electronics. This sensor design allows easy mounting in limited spaces while isolating the sensor electronics from high temperatures, high vibration and shock, or other environmental extremes. The sensor can be integrated into a hydraulic cylinder. Typical applications are steel mills, wood- and metalworking industries.

POWERLINK V2 INTERFACE

Temposonics® position sensors fulfil the requirements of the Ethernet Powerlink Standardization Group (EPSG). Ethernet Powerlink V2 is an open protocol based on the Ethernet-standard according to IEEE 802.3. It is an extension to the Ethernet protocol which allows real-time data communication. Within the Ethernet Powerlink protocol a CANopen based communication protocol for user data is specified. Powerlink is the only Ethernet protocol that meets the high real-time requirements with a software-only concept. No special Powerlink hardware is needed.

Delivered information:
- Absolute position
- Velocity
- Status
TECHNICAL DATA

Output

- Interface: Ethernet POWERLINK
- Data protocol: POWERLINK V2 according to IEEE 802.3
- Measured value: Position, velocity / option: multi-position measurement (2…4 positions)

Measurement parameters

- Resolution: 1 μm, 2 μm, 5 μm, 10 μm, 50 μm or 100 μm (selectable)
- Cycle time: Stroke length up to 2400 mm, up to 4800 mm, up to 5080 mm
  - Cycle time: 1.0 ms, 2.0 ms, 4.0 ms
- Linearity: < ±0.02 % F.S. (minimum ±50 μm)
- Repeatability: < ±0.001 % F.S. (minimum ±2.5 μm) typical
- Hysteresis: < 4 μm

Operating conditions

- Operating temperature electronics: −40…+75 °C (−40…+167 °F)
- Humidity: 90 % relative humidity, no condensation
- Ingress protection for sensor electronics: IP67 (housing and connectors correctly fitted)
- Ingress protection sensor rod with connecting cable for side cable entry: IP65 (connectors correctly fitted)
- Ingress protection sensor rod with single wires and flat connector with bottom cable entry: IP30
- Shock test: 100 g (single shock), IEC standard 60068-2-27
- Vibration test: 10 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
- Operating pressure: 350 bar (5076 psi), 700 bar (10,153 psi) peak (at 10 × 1 min)
- Magnet movement velocity: Any

Design / Material

- Sensor electronics housing: Aluminum
- Sensor flange: Stainless steel 1.4305 (AISI 303)
- Sensor rod: Stainless steel 1.4306 (AISI 304L)
- Stroke length: 25…5080 mm (1…200 in.)

Mechanical mounting

- Mounting position: Any
- Mounting instruction: Please consult the technical drawings and the operation manual (document number: 551657)

Electrical connection

- Connection type: 2 × M12 female connector (5 pin), 1 × M8 male connector (4 pin)
- Operating voltage: +24 VDC (−15 / +20 %)
- Ripple: ≤ 0.28 Vpp
- Current consumption: 110 mA typical
- Dielectric strength: 500 VDC (DC ground to machine ground)
- Polarity protection: Up to −30 VDC
- Overvoltage protection: Up to 36 VDC

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1/ The number of magnets depends on the stroke length
2/ With position magnet # 251 416-2
3/ For rod style «S» the linearity deviation can be higher in the first 30 mm (1.2 in.) of stroke length
4/ The IP rating is not part of the UL approval
5/ Measuring rod and connecting cable mounted inside metal housing
6/ Power supply must be able to provide current of 1 A for power up process
Temposonics® RD4 Powerlink V2
Data Sheet

TECHNICAL DRAWINGS

RD4 with bottom cable entry

![Diagram of RD4 with bottom cable entry]

RD4 with side cable entry

![Diagram of RD4 with side cable entry]

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

Recommendation:
Use M6×45 (ISO 4762) screws for sensor fastening. Fastening torque: 6 Nm.

Fig. 3: Temposonics’ RD4 sensor electronics housings
Threaded flange »C« & »D« (for bottom- or side entry)

| PUR cable: | Ø 6 (Ø 0.24) |
| Bending radius: | > 24 (> 0.94) |
| Cable length (bottom cable entry): | 65 / 170 / 230 / 350 (2.6 / 6.7 / 9.1 / 13.8) |
| Cable length (side cable entry): | 250 / 400 / 600 (9.8 / 15.7 / 23.6) |

Null zone: 51
Stroke length: 25…5080
Dead zone: 63.5 / 66*

Magnet
Cable for bottom cable entry
Cable for side cable entry

Threaded flange »G« (for bottom- or side entry)

| PUR cable: | Ø 6 (Ø 0.24) |
| Bending radius: | > 24 (> 0.94) |
| Cable length (bottom cable entry): | 65 / 170 / 230 / 350 (2.6 / 6.7 / 9.1 / 13.8) |
| Cable length (side cable entry): | 250 / 400 / 600 (9.8 / 15.7 / 23.6) |

Null zone: 31
Stroke length: 25…5080
Dead zone: 63.5 / 66*

Magnet
Cable for bottom cable entry
Cable for side cable entry

Threaded flange »M« & »T« (for bottom- or side entry)

| PUR cable: | Ø 6 (Ø 0.24) |
| Bending radius: | > 24 (> 0.94) |
| Cable length (bottom cable entry): | 65 / 170 / 230 / 350 (2.6 / 6.7 / 9.1 / 13.8) |
| Cable length (side cable entry): | 250 / 400 / 600 (9.8 / 15.7 / 23.6) |

Null zone: 51
Stroke length: 25…5080
Dead zone: 63.5 / 66*

Magnet
Cable for bottom cable entry
Cable for side cable entry

Pressure fit flange »S« (for bottom- or side entry)

| PUR cable: | Ø 6 (Ø 0.24) |
| Bending radius: | > 24 (> 0.94) |
| Cable length (bottom cable entry): | 65 / 170 / 230 / 350 (2.6 / 6.7 / 9.1 / 13.8) |
| Cable length (side cable entry): | 250 / 400 / 600 (9.8 / 15.7 / 23.6) |

Null zone: 21.4
Stroke length: 25…2540
Dead zone: 63.5

Magnet
Cable for bottom cable entry
Cable for side cable entry

Controlling design dimensions are in millimeters and measurements in ( ) are in inches
## CONNECTOR WIRINGS

### D56

<table>
<thead>
<tr>
<th>Signal</th>
<th>M12 female connector (D-coded)</th>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Diagram" /></td>
<td>1</td>
<td>Tx (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Rx (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Tx (−)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Rx (−)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

### M12 female connector (D-coded)

<table>
<thead>
<tr>
<th>Power supply</th>
<th>M8 male connector</th>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram" /></td>
<td>1</td>
<td>+24 VDC (−15 / +20 %)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Not connected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>DC Ground (0 V)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Not connected</td>
<td></td>
</tr>
</tbody>
</table>

*Fig. 5: Connector wirings D56*
## FREQUENTLY ORDERED ACCESSORIES

– Additional options available in our Accessories Guide

### Position magnets

<table>
<thead>
<tr>
<th>Ring magnet OD33</th>
<th>Ring magnet OD25.4</th>
<th>Ring magnet Part no. 402 316</th>
<th>U-magnet OD33 Part no. 251416-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight: Approx. 14 g</td>
<td>Weight: Approx. 10 g</td>
<td>Weight: Approx. 13 g</td>
<td>Weight: Approx. 11 g</td>
</tr>
<tr>
<td>Surface pressure: Max. 40 N/mm²</td>
<td>Surface pressure: Max. 40 N/mm²</td>
<td>Surface pressure: Max. 20 N/mm²</td>
<td>Surface pressure: Max. 40 N/mm²</td>
</tr>
<tr>
<td>Fastening torque for M4 screws: 1 Nm</td>
<td>Fastening torque for M4 screws: 1 Nm</td>
<td>Fastening torque for M4 screws: 1 Nm</td>
<td>Fastening torque for M4 screws: 1 Nm</td>
</tr>
<tr>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
<td>Operating temperature: −40…+100 °C (−40…+212 °F)</td>
<td>Operating temperature: −40…+100 °C (−40…+212 °F)</td>
<td>Operating temperature: −40…+105 °C (−40…+221 °F)</td>
</tr>
</tbody>
</table>

### Magnet spacer

<table>
<thead>
<tr>
<th>U-magnet OD63.5</th>
<th>O-ring for threaded flange M18×1.5-6g Part no. 401 133</th>
<th>O-ring for threaded flange ¾&quot;-16 UNF-3A Part no. 560 315</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material: PA 66-GF30, magnets compound-filled</td>
<td>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A</td>
<td>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A</td>
</tr>
<tr>
<td>Weight: Approx. 26 g</td>
<td>Operating temperature: −40…+204 °C (−40…+400 °F)</td>
<td>Operating temperature: −40…+204 °C (−40…+400 °F)</td>
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<tr>
<td>Surface pressure: 20 N/mm²</td>
<td>Fastening torque for M4 screws: 1 Nm</td>
<td>Material: Fluoeroelastomer</td>
</tr>
<tr>
<td>Fastening torque for M4 screws: 1 Nm</td>
<td>Operating temperature: −40…+167 °F</td>
<td>Durometer: 75 ± 5 Shore A</td>
</tr>
<tr>
<td>Operating temperature: −40…+75 °C (−40…+167 °F)</td>
<td></td>
<td>Operating temperature: −40…+167 °F</td>
</tr>
</tbody>
</table>

### O-rings

<table>
<thead>
<tr>
<th>O-ring for pressure fit flange Ø 26.9 mm Part no. 560 705</th>
<th>Back-up ring for pressure fit flange Ø 26.9 mm Part no. 560 629</th>
<th>Hex jam nut M18×1.5-6g Part no. 500 018</th>
<th>Hex jam nut ¾&quot;-16 UNF-3A Part no. 500 015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature: −53…+107 °C (−65…+225 °F)</td>
<td>Operating temperature: −40…+400 °F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mounting accessory

<table>
<thead>
<tr>
<th>Part no. 561 481</th>
</tr>
</thead>
</table>

**Fixing clip for rod with Ø 10 mm**

**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

**Termination:** Insulation-displacement

**Cable Ø:** 5.5…7.2 mm (0.2…0.28 in.)

**Wire:** 24 AWG – 22 AWG

**Operating temperature:** −25…+85 °C (−13…+185 °F)

**Ingress protection:** IP65 / IP67 (correctly fitted)

**Fastening torque:** 0.6 Nm

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Cable connectors *

| **M12 D-coded male connector** (4 pin), straight |
| **Part no. 370 523** |

**Material:** Zinc nickel-plated

**Termination:** Solder

**Cable Ø:** 3.5…5 mm (0.14…0.28 in.)

**Wire:** 0.25 mm²

**Operating temperature:** −40…+85 °C (−40…+185 °F)

**Ingress protection:** IP67 (correctly fitted)

**Fastening torque:** 0.39…0.49 Nm

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| **M8 female connector (4 pin), straight** |
| **Part no. 370 504** |

**Material:** CuZn nickel plated

**Termination:** Solder

**Cable Ø:** 3.5…5 mm (0.14…0.28 in.)

**Operating temperature:** −40…+85 °C (−40…+185 °F)

**Ingress protection:** IP67 (correctly fitted)

**Fastening torque:** 0.5 Nm

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| **M12 connector end cap** |
| **Part no. 370 537** |

**Female connectors M12 should be covered by this protective cap**

**Material:** Brass nickel-plated

**Termination:** Insulation-displacement

**Cable Ø:** 5.5…7.2 mm (0.2…0.28 in.)

**Wire:** 24 AWG – 22 AWG

**Operating temperature:** −25…+85 °C (−13…+185 °F)

**Ingress protection:** IP65 / IP67 (correctly fitted)

**Fastening torque:** 0.6 Nm

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Cables

**PUR cable**

**Part no. 530 125**

**Material:** PUR jacket; green

**Features:** Cat 5, highly flexible

**Cable Ø:** 6.5 mm (0.26 in.)

**Cross section:** 2 × 2 × 0.35 mm² (22/7 AWG)

**Operating temperature:** −20…+60 °C (−4…+140 °F)

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**PVC cable**

**Part no. 530 108**

**Material:** PVC jacket; gray

**Features:** Shielded, flexible

**Cable Ø:** 4.9 mm (0.19 in.)

**Cross section:** 3 × 0.34 mm²

**Operating temperature:** −30…+70 °C (−22…+158 °F)

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**Cable with M12 D-coded male connector (4 pin), straight – M12 D-coded, male connector (4 pin), straight**

**Part no. 530 064**

**Material:** PUR jacket; green

**Features:** Cat 5e

**Cable length:** 5 m (16.4 ft)

**Cable Ø:** 6.5 mm (0.26 in.)

**Operating temperature:** −30…+70 °C (−22…+158 °F)

**Ingress protection M12 connector:** IP67 (correctly fitted)

**Ingress protection RJ45 connector:** IP20 (correctly fitted)

**Operating temperature:** −30…+70 °C (−22…+158 °F)

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**Cable with M12 D-coded male connector (4 pin), straight – RJ45 male connector, straight**

**Part no. 530 065**

**Material:** PUR jacket; green

**Features:** Cat 5e

**Cable length:** 5 m (16.4 ft)

**Cable Ø:** 6.5 mm (0.26 in.)

**Operating temperature:** −30…+70 °C (−22…+158 °F)

**Ingress protection RJ45 connector:** IP20 (correctly fitted)

**Operating temperature:** −30…+70 °C (−22…+158 °F)

**NOTICE**

* Follow the manufacturer’s mounting instructions

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| R | D | 4 | a | b | c | d | e | f | g |

**a** Sensor model
- **R D 4** Detached sensor electronics

**b** Design
- **C** Threaded flange M18×1.5-6g, A/F 46
- **D** Threaded flange ¾"-16 UNF-3A, A/F 46
- **G** Threaded flange M18×1.5-6g, A/F 24
- **M** Threaded flange M18×1.5-6g, A/F 23
- **S** Pressure fit flange Ø 26.9 mm f6
- **T** Threaded flange ¾"-16 UNF-3A, A/F 23

**c** Integral cable of sensor rod
- For side cable entry on sensor electronics housing
  - **D 1 S** PUR cable with M16 connector, length 250 mm (9.8 in.)
  - **D 2 S** PUR cable with M16 connector, length 400 mm (15.7 in.)
  - **D 3 S** PUR cable with M16 connector, length 600 mm (23.6 in.)
- For bottom cable entry on sensor electronics housing
  - **R 2 B** PUR cable / wires with flat connector, length 65 mm (2.6 in.)
  - **R 4 B** PUR cable / wires with flat connector, length 170 mm (6.7 in.)
  - **R 5 B** PUR cable / wires with flat connector length 230 mm (9.1 in.)
  - **R 6 B** PUR cable / wires with flat connector, length 350 mm (13.8 in.)

**d** Stroke length
- Flange »C«, »D«, »G«, »M«, »T«: 0025…5080 mm
- Flange »S«: 0025…2540 mm

<table>
<thead>
<tr>
<th>Standard stroke length (mm)*</th>
<th>Ordering steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>25... 500 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>500... 750 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>750...1000 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>1000...2500 mm</td>
<td>50 mm</td>
</tr>
<tr>
<td>2500...5080 mm</td>
<td>100 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard stroke length (in.)*</th>
<th>Ordering steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1... 20 in.</td>
<td>0.2 in.</td>
</tr>
<tr>
<td>20... 30 in.</td>
<td>0.4 in.</td>
</tr>
<tr>
<td>30... 40 in.</td>
<td>1.0 in.</td>
</tr>
<tr>
<td>40...100 in.</td>
<td>2.0 in.</td>
</tr>
<tr>
<td>100...200 in.</td>
<td>4.0 in.</td>
</tr>
</tbody>
</table>

**e** Connection type
- **D 5 6** 2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin)

**f** Output
- **U 3 0 1** Powerlink V2

Optional:
- **Z 0 2** 2 magnets
- **Z 0 3** 3 magnets
- **Z 0 4** 4 magnets

**NOTICE**
Use magnets of the same type e.g. 2 × ring magnet (part no. 201542-2) for multi-position measurement.

* Note: Specifying required magnet numbers for your sensing application.

**DELIVERY**
- **RD4-C/-D/-G/-M/-T**: Accessories have to be ordered separately
- **RD4-S**: Sensor, O-ring, back-up ring

Manuals, Software & 3D models available at: www.mtssensors.com

* Non standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments
7/ Note: Specify magnet numbers for your sensing application and order separately