**NOVOHALL**  
Rotary Sensor  
Touchless

**RFC-4800**  
Ratiometric

**Mobile Applications**

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**Special Features**

- Touchless hall technology
- Electrical range up to 360°
- 2 part design, mechanically decoupled
- High protection class IP67, IP68, IP69
- Resolution up to 12 bit
- Wear-free
- Temperature range -40 °C to +105 °C
- One and multi-channel versions
- Optimized for use in mobile applications with highest EMC requirements such as ISO pulses and high interferences to ISO 11452 and ECE-Standard
- Suitable for safety-related applications according to DIN EN ISO 13849
- Other configurations see separate data sheets

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**Applications**

- Mobile working machines (industrial trucks, construction machinery, agricultural and forestry machinery)
- Marine applications

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The 2 part design consisting of sensor and magnetic position marker offers great flexibility when mounting. The absence of shaft and bearing makes the assembly much less sensitive to axial and radial application tolerances - separate couplings are obsolete. Measurements can be made transmissively through any non-ferromagnetic material. With its completely encapsulated electronics the sensor is perfectly suited for use in harsh environments. Single and dual-channel versions are available and suitable for use in safety-related applications.

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**Description**

- **Material**
  - Housing: high grade, temperature resistant plastic
- **Mounting**
  - With 2 pan head screws M4x20 (included in delivery)
- **Fastening torque of mounting**
  - 350 Ncm
- **Electrical connection**
  - Cable 4x 0.5 mm² (AWG 20), TPE, unshielded / Connector M12x1 or AMP Superseal with cable L = 0.15 m / Lead wires 0.5 mm² (AWG 20), PVC

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**Mechanical Data**

- **Dimensions**
  - See dimension drawing
- **Mechanical travel**
  - 360° continuous
- **Weight (w/o connection)**
  - approx. 50 g
**Ordering Specifications**

Preferred types printed in bould

- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

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### Accessories included in delivery

- 2x Pan head screws M4x20

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| R | F | C | - | 4 | 8 | 5 | 1 | - | 6 | 3 | 6 | - | 2 | 1 | 1 | - | 4 | 0 | 1 |

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**Supply voltage Ub**

2: U_b = 5 VDC

### Output signal

1: 5 ... 95% ratiometric to supply voltage U_b (0.25 ... 4.75 VDC)

2: 10 ... 95% ratiometric to supply voltage U_b (0.5 ... 4.5 VDC)

### Output characteristics:

1: Rising characteristic cw

2: Rising characteristic ccw

3: Crossed outputs, channel 1 rising cw (partly redundant)

4: Crossed outputs, channel 1 rising ccw (fully redundant)

Other output characteristics on request

**Electrical connection**

- Single-channel / partly redundant version
  - 251: Cable, 4-pole, unshielded, L = 0.5 m
  - 252: Cable, 4-pole, unshielded, L = 1 m
  - 256: Cable, 4-pole, unshielded, L = 3 m
  - 260: Cable, 4-pole, unshielded, L = 5 m
  - 270: Cable, 4-pole, shielded, L = 10 m
  - 401: Lead wires, 3x L = 0.5 m (single)
  - 411: Lead wires, 4x L = 0.5 m (partly redundant)
  - 551: Connector M12x1, 4-pin, with cable L = 0.15 m, unshielded
  - 552: Connector AMP Supersnap, 4-pin, with cable L = 0.15 m, unshielded

**Fully redundant version**

- 421: Lead wires, 6x L = 0.5 m

Cable versions and assembled connectors on request

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### Measuring range

- (X): Angle 0° ... 30° min.
- 06, 12, 18, 24, 36
- 36: Angle 0° ... 360° max.

Other angles on request

### Number of channels

- 6: Single-channel version (1x supply voltage U_b, 1x output)
- 7: Partly redundant version (1x supply voltage U_b, 2x output)
- 8: Fully redundant version (2x supply voltage U_b, 2x output)

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**Series**

- 4851: Elongated hole mounting for easy adjustment
- 4852: Round hole mounting
- 4853: Elongated hole mounting, without diagnostic function
- 4854: Round hole mounting, without diagnostic function

Other configurations e.g., with internal shielding against magnetic fields on request
When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
## Technical Data

### Type

<table>
<thead>
<tr>
<th>RFC-48_ <em>-</em> _ <em>-2</em> <em>-</em> _ _</th>
<th>Ratiometric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>ratiometric to supply voltage $Ub$</td>
</tr>
<tr>
<td>5 ... 95% (0.25 ... 4.75 V)</td>
<td>10 ... 90% (0.5 ... 4.5 V)</td>
</tr>
<tr>
<td>Load</td>
<td>$\geq 5 \text{ kΩ}$</td>
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<tr>
<td>Number of channels</td>
<td>1 / 2</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>activated (in case of error, output signal is outside of the plausible signal range)</td>
</tr>
<tr>
<td>Update rate</td>
<td>typ. 3.4 kHz</td>
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<tr>
<td>Measuring range</td>
<td>0 ... 30° up to 0 ... 360° in 10°-steps</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>$\leq \pm0.5 %$FS</td>
</tr>
<tr>
<td>Resolution</td>
<td>12 bits</td>
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<tr>
<td>Repeatability</td>
<td>typ. $\leq \pm0.1°$</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>typ. $&lt; \pm0.1°$</td>
</tr>
</tbody>
</table>

#### Only measuring range $360°$: typ. $< 0.25°$ (lower hysteresis on request)

### Supply voltage $Ub$

- Measuring range: 0 ... 175°, typ. ±0.7 %FS, Measuring range: 180°, typ. ±0.35 %FS
- 5 VDC (4.5 ... 5.5 VDC)

### Current consumption w/o load

- typ. 12 mA per channel

### Polarity protection

- yes (supply lines and outputs)

### Short circuit protection

- yes (vs. GND and supply voltage)

### Insulation resistance (500 VDC)

- $\geq 10 \text{ MΩ}$

### Environmental Data

#### Max. operational speed

- Mechanically unlimited

#### Shock IEC 60068-2-27

- 50 g, 6 ms

#### Protection class IEC 60529

- IP67, IP68, IP69 (connector M12)

#### Operating temperature

- -40 ... +105°C, -40 ... +85°C (connector M12)

#### Life

- Mechanically unlimited

#### Functional safety

- Suitable for safety-related applications according to ISO 13849 after customer validation.

#### MTTF (IEC 60068-1)

- 1652 years (one channel), 624 years (partly redundant, per channel) or 626 years (fully redundant, per channel)

#### MTTFd (IEC 60068-1 parts count method, w/o load)

- 3304 years (one channel), 1648 years (partly redundant, per channel) or 1653 years (fully redundant, per channel)

#### MTTFd-certificate


#### Traceability

- Serial number on type labeling; production batch of the sensor assembly and relevant sensor components

### EMC Compatibility

- ISO 10605 ESD (Handling/Component) 8 kV / 15 kV
- ISO 11452-2 Radiated HF-fields 100 V/m
- ISO 11452-5 Radiated HF-Fields, stripline 200 V/m
- CISPR 25 Radiated emission Level 5
- EN 13309 Construction machinery

#### Emission/Immunity E1

- acc. to ECE: R12

#### ISO 13768-1/-2 Construction machinery

- On request
## Connection Assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Supply voltage Ub</th>
<th>Signal output</th>
<th>Signal output 2</th>
<th>Supply voltage Ub 2</th>
<th>GND 2</th>
<th>Not assigned</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>GN</td>
<td>WH</td>
<td>YE</td>
<td>-</td>
<td>-</td>
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<td>Pin 2</td>
<td>Pin 4</td>
<td>Pin 3</td>
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<td>RD</td>
<td>BU</td>
<td>YE/BU/WH</td>
<td>BU/WH</td>
<td>BK/WH</td>
<td>BK/WH</td>
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<td>YE</td>
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<td>Pin 2</td>
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<td>Pin 3</td>
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<td>RD</td>
<td>BU</td>
<td>YE/BU/WH</td>
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<td>Pin 1</td>
<td>Pin 2</td>
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</tr>
</tbody>
</table>

### Notes
- Single-channel
- Partly redundant
- Fully redundant

![Pin assignment M12 4 poles A-coded](image)
Technical Data
Output Characteristics

Output characteristic
One-channel, rising cw

Output characteristic
Crossed output characteristics, ch. 1 rising cw

Output characteristic
On request: signal 2 = 0.5 x signal 1

Output characteristic
On request: output characteristics with offset

Output characteristic
On request: different gradients

Output characteristic
On request: trapezoid output characteristic

Output characteristic
On request: parabolic output characteristic
### Position Markers

<table>
<thead>
<tr>
<th>Position Marker</th>
<th>Description</th>
<th>Material</th>
<th>Max. Permitted Radial Offset</th>
<th>P/N</th>
<th>Pack. Unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-RFC-P02</td>
<td>Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both included in delivery).</td>
<td>PF</td>
<td>± 3 mm</td>
<td>400005661</td>
<td>1</td>
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<td>400005600</td>
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<tr>
<td>Z-RFC-P08</td>
<td>Position marker for fixation with threaded pin M5 (included in delivery).</td>
<td>PF</td>
<td>± 3 mm</td>
<td>400056070</td>
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<td>400056084</td>
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<tr>
<td>Z-RFC-P41</td>
<td>Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both included in delivery).</td>
<td>PF</td>
<td>± 3 mm</td>
<td>400105037</td>
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<td>400105038</td>
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<td>Z-RFC-P47</td>
<td>Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with threaded pin M5 (both included in delivery).</td>
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<td>400105039</td>
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<td>400105040</td>
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</table>
Position Markers

Z-RFC-P23
Position marker for fixation with threaded pin M4 (included in delivery)
Caution: For orientation of the output characteristic please follow the user manual of the position marker!
Material: PA6-GF
Max. permitted radial offset: ± 3 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tr>
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<tr>
<td>400056085</td>
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</tbody>
</table>

Z-RFC-P43
Position marker for fixation with threaded pin M4 (included in delivery)
Caution: For orientation of the output characteristic please follow the user manual of the position marker!
Material: PA6-GF
Max. permitted radial offset: ± 3 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tr>
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<tr>
<td>400105042</td>
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</table>

Z-RFC-P30
Position marker for frontal fixation with 2 cylinder screws M3x8 (included in delivery).
Material: PBT-GF
Max. permitted radial offset: ± 1.5 mm

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<th>P/N</th>
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<td>400056087</td>
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</table>

Z-RFC-P31
Position marker for frontal fixation with 2 cylinder screws M3x8 (included in delivery).
Material: PBT-GF
Max. permitted radial offset: ± 3 mm

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<th>Pack. unit [pcs]</th>
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<td>400056089</td>
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</table>
## Position Markers

**Z-RFC-P22**
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation, included in delivery).

- **Attention:** Closed side of position marker faces the active side of sensor.
- **Material:** Aluminium, anodized
- **Max. permitted radial offset:** ± 4 mm
- **Operating temp.:** -40 ... +125°C

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<td>400106735</td>
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<tr>
<td>400106736</td>
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</tbody>
</table>

**Z-RFC-P18**
Screw position marker M10 x 25 mm, similar DIN 933, magnet potted

- **Material:** Aluminium, anodized
- **Max. permitted radial offset:** ± 3 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tbody>
<tr>
<td>400104756</td>
<td>1</td>
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<tr>
<td>400104757</td>
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</tbody>
</table>

**Z-RFC-P19**
Screw position marker M8 x 25 mm, similar DIN 933/ISO 4017, magnet potted

- **Material:** Aluminium, anodized
- **Max. permitted radial offset:** ± 1.5 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tr>
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<td>400104755</td>
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</tbody>
</table>

**Z-RFC-P20**
Screw position marker M10 x 25 mm, similar DIN 933

- **Material:** Aluminium, anodized
- **Max. permitted radial offset:** ± 3 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400104758</td>
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<tr>
<td>400104759</td>
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</tbody>
</table>
Position Markers

Z-RFC-P03
Magnet for direct application onto customer's shaft (see user manual).
We recommend mounting on non-magnetizable materials; otherwise the specified working distances will vary (e.g. reduction of approx. 20% with axial mounting on a magnetizable shaft).
Max. permitted radial offset ± 1.5 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>400056081</td>
<td>50</td>
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</tbody>
</table>

Z-RFC-P04
Magnet for direct application onto customer's shaft (see user manual).
We recommend mounting on non-magnetizable materials; otherwise the specified working distances will vary (e.g. reduction of approx. 20% with axial mounting on a magnetizable shaft).
Max. permitted radial offset ± 3 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tbody>
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<tr>
<td>400056082</td>
<td>50</td>
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</tbody>
</table>

Z-RFC-S01/S02/S03
Shaft adapter for fixation at position marker Z-RFC-P02/P41 with locking pin
Material SS 1.4305 / AISI 303

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type ØB / A [mm]</th>
</tr>
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<tbody>
<tr>
<td>400056206</td>
<td>Z-RFC-S01 6 / 4.5</td>
</tr>
<tr>
<td>400056207</td>
<td>Z-RFC-S02 8 / 6.5</td>
</tr>
<tr>
<td>400056208</td>
<td>Z-RFC-S03 10 / 8.5</td>
</tr>
</tbody>
</table>
### Working Distances Position Markers [mm] - Single-channel Versions

<table>
<thead>
<tr>
<th>RFC-4851</th>
<th>RFC-4852</th>
<th>RFC-4853</th>
<th>RFC-4854</th>
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</thead>
<tbody>
<tr>
<td>Z-RFC-P02 / P04 / P08</td>
<td>Z-RFC-P02 / P04 / P08</td>
<td>Z-RFC-P30</td>
<td>Z-RFC-P30</td>
</tr>
<tr>
<td>Z-RFC-P02 / P23 / P31</td>
<td>Z-RFC-P02 / P23 / P31</td>
<td>Z-RFC-P18</td>
<td>Z-RFC-P18</td>
</tr>
<tr>
<td>Z-RFC-P03 / P30</td>
<td>Z-RFC-P03 / P30</td>
<td>Z-RFC-P19</td>
<td>Z-RFC-P19</td>
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<tr>
<td>Z-RFC-P18</td>
<td>Z-RFC-P18</td>
<td>Z-RFC-P22</td>
<td>Z-RFC-P22</td>
</tr>
</tbody>
</table>

### Working Distances Position Markers [mm] - Redundant Versions

<table>
<thead>
<tr>
<th>RFC-4851</th>
<th>RFC-4852</th>
<th>RFC-4853</th>
<th>RFC-4854</th>
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<tbody>
<tr>
<td>Z-RFC-P02 / P04 / P08</td>
<td>Z-RFC-P20 / P23 / P31</td>
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<td>Z-RFC-P30</td>
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<td>Z-RFC-P18</td>
<td>Z-RFC-P22</td>
<td>Z-RFC-P22</td>
</tr>
</tbody>
</table>

### Lateral Magnet Offset

Lateral magnet offset will cause additional linearity error. The angle error, which is caused by radial displacement of sensor and position marker depends on the used position marker or magnet.

### Additional Linearity Error at Radial Displacement - Single-channel Versions

<table>
<thead>
<tr>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P02 / P04 / P08</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mm: ±0.4°</td>
<td>0.5 mm: ±0.4°</td>
<td>0.5 mm: ±0.4°</td>
<td>0.5 mm: ±0.4°</td>
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<tr>
<td>0.5 mm: ±1.1°</td>
<td>0.5 mm: ±1.1°</td>
<td>0.5 mm: ±1.1°</td>
<td>0.5 mm: ±1.1°</td>
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<tr>
<td>0.5 mm: ±3.5°</td>
<td>0.5 mm: ±3.5°</td>
<td>0.5 mm: ±3.5°</td>
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</table>

### Additional Linearity Error at Radial Displacement - Redundant Versions

<table>
<thead>
<tr>
<th>Z-RFC-P02 / P04 / P08</th>
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<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P02 / P04 / P08</th>
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</thead>
<tbody>
<tr>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±0.7°</td>
</tr>
<tr>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±1.8°</td>
</tr>
<tr>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±5.2°</td>
</tr>
</tbody>
</table>
Connector System
M12

M12x1 Mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended
Plug housing: PA
Cable sheath: PUR, Ø = max. 6 mm, -40 ... +85°C (flexible)
Lead wires: PP, 0.34 mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
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<tbody>
<tr>
<td>400056135</td>
<td>EEM-33-35</td>
<td>2 m</td>
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<tr>
<td>400056136</td>
<td>EEM-33-36</td>
<td>5 m</td>
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<tr>
<td>400056137</td>
<td>EEM-33-37</td>
<td>10 m</td>
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IP67: Protection class IP67 DIN EN 60529
IP68: Protection class IP68 DIN EN 60529
Very good Electromagnetic Compatibility (EMC) and shield systems
Very good resistance to oils, coolants and lubricants
Suitable for applications in drag chains
UL - approved
CAN-Bus
Connecting Options on request

**M12 connector**
- Customized lengths
- 3-, 4-, 6- and 6-pole versions
- Protection class IP68
- Ordering codes of standard versions see ordering specifications

**Tyco AMP Super Seal**
- Pin- and bushing housing
- Customized lengths
- 3-, 4- and 6-pole versions
- Protection class IP67
- On request

**Deutsch DTM 04**
- Pin- and bushing housing
- Customized lengths
- 3-, 4- and 6-pole versions
- Protection class IP67
- On request

**ITT Cannon Sure Seal connector**
- Customized lengths
- 3-, 4- and 6-pole versions
- Protection class IP67
- On request

**Molex Mini Fit jr.**
- Customized length and lead wires
- 3-, 4- and 6-pole versions
- On request
The specifications contained in our datasheets are intended solely for informational purposes. The documented specification values are based on ideal operational and environmental conditions and can vary significantly depending on the actual customer application. Using our products at or close to one or more of the specified performance ranges can lead to limitations regarding other performance parameters. It is therefore necessary that the end user verifies relevant performance parameters in the intended application. We reserve the right to change product specifications without notice.