NOVOHALL
Rotary Sensor
Touchless
RFC-4800
CANopen
Mobile Applications

Special Features
• Touchless hall technology
• Electrical range 360°
• 2 part design, mechanically decoupled
• High protection class IP67, IP68, IP69
• Resolution 14 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, exceeds E1 requirements
• Other configurations see separate data sheets

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

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. The sensor is perfectly suitable for use in harsh environmental conditions through the completely encapsulated electronics.

Description

<table>
<thead>
<tr>
<th>Material</th>
<th>Housing: high grade, temperature resistant plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>With 2 pan head screws M4x20 (included in delivery)</td>
</tr>
<tr>
<td>Fastening torque of mounting</td>
<td>350 Ncm</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>Cable 2x 2x 0.34 mm² (AWG 22), TPE, shielded / Cable 4x 0.5 mm² (AWG 23), TPE, shielded / Cable 4x 2x 0.25 mm² (AWG 24), TPE, shielded / Connector M12x1, A-coded with cable L = 0.15 m</td>
</tr>
</tbody>
</table>

Mechanical Data

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>See dimension drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical travel</td>
<td>continuous</td>
</tr>
<tr>
<td>Weight (w/o connection)</td>
<td>approx. 50 g</td>
</tr>
</tbody>
</table>
Ordering Specifications

Preferred types printed in bold
• Delivery times up to 25 pcs. within 10 working days ExW
• Best low-volume pricing

Accessories included in delivery
• 2x Pan head screws M4x20

Interface
6: CANopen

Interface parameters
Single-channel version
1: 1x position, 1x speed
5: 1x position, 1x speed with bus termination 120 Ohm

Dual-channel version
2: 2x position, 2x speed
6: 2x position, 2x speed with bus termination 120 Ohm

Baud rate
1: 1000 kBaud
2: 800 kBaud
3: 500 kBaud
4: 250 kBaud
5: 125 kBaud
7: 50 kBaud

Electrical connection
202: Cable, 0.6 mm², 4-pole, shielded, L = 1 m
236: Cable, 0.34 mm², 4-pole, shielded, L = 3 m
240: Cable, 0.34 mm², 4-pole, shielded, L = 5 m
432: Cable, 0.25 mm², 8-pole, shielded, L = 1 m (CANv2.0b"
511: Connector M12x1, 5-pin, with cable, shielded, L = 0.15 m

Cable versions (e.g. unshielded) and assembled connectors on request
*) Only models without bus termination 120 Ohm

Series
Resolution
14: 14 bits

Interface
2: Digital Interface

Mechanical version
4851: Elongated hole mounting
4852: Round hole mounting
When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
**Technical Data**

**Type**

- CANopen

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**Measured variables**

- Position and speed

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**Measuring range speed**

- 0 ... 1600 rpm

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**Number of channels**

- 1 / 2

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**Protocol**

- CANopen protocol to CiA DS-301 V4.2.0, Device profile DS-406 V3.3 Encoder Class C2, LSS services to CiA DS-305 V1.1.2

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**Programmable parameters**

- Position, speed, cams, working areas, rotating direction, scale, offset, node ID, baud rate

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**Diagnosis**

- Activated (in case of error, output signal is outside of the plausible signal range)

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**Node ID**

- 1 ... 127 (default 127)

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**Baud rate**

- 50 ... 1000 kBaud

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**Update rate (output)**

- 1 kHz

---

**Resolution position (across 360°)**

- 14 bits

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**Resolution speed**

- \( 360° \div 2^{14} \approx 0.022°/\text{ms} \)

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**Independent linearity**

- \( \pm0.5 \%\text{FS} \)

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**Repeatability**

- \( \pm0.1° \)

---

**Hysteresis**

- \( \pm0.1° \)

---

**Temperature error**

- \( \pm0.2 \%\text{FS} \)

---

**Supply voltage \( Ub \)**

- 12/24 VDC (11 ... 34 VDC)

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**Current consumption at Power-on**

- \( \leq 50 \text{ mA} \)

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**Overvoltage protection**

- 45 VDC (permanent)

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**Polarity protection**

- Yes (supply lines)

---

**Short circuit protection**

- Yes (all outputs vs. GND and supply voltage up to 40 VDC)

---

**Insulation resistance (500 VDC)**

- \( \geq 10 \text{ M\Omega} \)

---

**Bus termination internal**

- 120 \( \Omega \) (optionally)

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**Environmental Data**

**Max. operational speed**

- Mechanically unlimited

---

**Vibration**

- IEC 60068-2-6
  - 20 g, 5 ... 2000 Hz, Amax = 0.75 mm

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**Shock**

- IEC 60068-2-27
  - 50 g, 6 ms

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**Protection class DIN EN 60529**

- IP67 / IP68 / IP69, IP67 (connector M12)

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**Operating temperature**

- \(-40° \ldots +105°C, -25° \ldots +85°C (connector M12)\)

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**Life**

- Mechanically unlimited

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**Functional safety**

- If you need assistance in using our products in safety-related systems, please contact us

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**MTTF (IEC 60050)**

- 843 years (one-channel) or 819 years (two-channel, per channel)

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**Traceability**

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

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**Conformity/Approval**

- WEEE see https://www.novotechnik.de/en/downloads/certificates/eu-directive-weee/

**EMC Compatibility**

- ISO 10055 ESD (Handling/Component)
  - \( 8 \text{ kV} \)

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- ISO 11452-2 Radiated HF-fields
  - \( 100 \text{ V/m} \)

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- ISO 11452-5 Radiated HF-Fields, stripline
  - \( 200 \text{ V/m} \)

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- CISPR 25 Radiated emission
  - Level 3

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- ISO 7637-2 Transient Emissions
  - Level 3

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- ISO 7637-2 Pulses on supply lines
  - \( [1, 2a, 2b, 3a, 3b, 4, 5] \) Level 4

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- ISO 7637-3 Pulses on output lines
  - Level 4

---

- Emission/Immunity
  - Exceeds EN requirements

\( FS = \) Full scale: Signal span according to electrical measuring range
<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 2_ _</th>
<th>Cable code 4_ _</th>
<th>Connector code 5_ _</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage U_b</td>
<td>WH</td>
<td>WH, RD</td>
<td>Pin 2</td>
</tr>
<tr>
<td>GND</td>
<td>BN</td>
<td>BN, BU</td>
<td>Pin 3</td>
</tr>
<tr>
<td>CAN_H</td>
<td>YE</td>
<td>YE, PK</td>
<td>Pin 4</td>
</tr>
<tr>
<td>CAN_L</td>
<td>GN</td>
<td>GN, GY</td>
<td>Pin 5</td>
</tr>
<tr>
<td>CAN_SHLD</td>
<td>Shield</td>
<td>Shield</td>
<td>Pin 1</td>
</tr>
</tbody>
</table>

Connect cable shielding to GND

![Diagram of pin assignment M12 6-plate, A-coded](image)
Position Markers

Z-RFC-P02
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with screw lock) or with locking pin (both included in delivery).
Material: PF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400005661 | 1
400056080 | 25

Z-RFC-P08
Position marker for fixation with threaded pin M5 (included in delivery).
Material: PF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056070 | 1
400056084 | 25

Z-RFC-P41
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with screw lock) or with locking pin (both included in delivery).
Material: PF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400105037 | 1
400105038 | 25

Z-RFC-P47
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with screw lock) or with threaded pin M5 (both included in delivery).
Material: PF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400105039 | 1
400105040 | 25
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
Operating temp. -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056074 | 1
400056085 | 25

**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
Operating temp. -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
300105041 | 1
300105042 | 25

**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
Operating temp. -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056086 | 1
400056087 | 25

**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
Operating temp. -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056088 | 1
400056089 | 25
Position Markers

Z-RFC-P22
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with screw lock, 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
P/N | Pack. unit [pcs]
--- | ---
400106735 | 1
400106736 | 25

Z-RFC-P18
Screw position marker M10 x 25 mm, similar DIN 933, magnet potted
Material: Aluminium, anodized
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
--- | ---
400104756 | 1
400104757 | 25

Z-RFC-P28
Screw position marker M10x1 x 20 mm, similar DIN 933, magnet potted
Material: Aluminium, anodized
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
--- | ---
400108462 | 1
400108463 | 25

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
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
--- | ---
400104754 | 1
400104755 | 25
Position Markers

Z-RFC-P20
Screw position marker M10 x 25 mm, similar DIN 933
Material: Aluminium, anodized
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400104758</td>
<td>1</td>
</tr>
<tr>
<td>400104759</td>
<td>25</td>
</tr>
</tbody>
</table>

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
Operating temp.: -40 ... +125°C

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400005658</td>
<td>1</td>
</tr>
<tr>
<td>400005659</td>
<td>50</td>
</tr>
</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
Operating temp.: -40 ... +125°C

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400005659</td>
<td>1</td>
</tr>
<tr>
<td>400005662</td>
<td>50</td>
</tr>
</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</th>
<th>ØB / A [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400056206</td>
<td>Z-RFC-S01</td>
<td>6 / 4.5</td>
</tr>
<tr>
<td>400056207</td>
<td>Z-RFC-S02</td>
<td>8 / 5.5</td>
</tr>
<tr>
<td>400056208</td>
<td>Z-RFC-S03</td>
<td>10 / 5.5</td>
</tr>
</tbody>
</table>
### Position Markers

**Working Distances Position Markers [mm] - Single-channel Versions**

<table>
<thead>
<tr>
<th>Markers</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P20 / P23 / P31</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18 / P28</th>
<th>Z-RFC-P19</th>
<th>Z-RFC-P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3 ... 5</td>
<td>0 ... 2.7</td>
<td>0.7 ... 2.2</td>
<td>0 ... 4.5</td>
<td>0 ... 2.2</td>
<td>4.4 ... 9.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Markers</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P20 / P23 / P31</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18 / P28</th>
<th>Z-RFC-P19</th>
<th>Z-RFC-P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9 ... 4.5</td>
<td>0 ... 2.3</td>
<td>0.3 ... 1.8</td>
<td>0 ... 4.5</td>
<td>0 ... 1.7</td>
<td>4 ... 8.8</td>
<td></td>
<td></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.

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

<table>
<thead>
<tr>
<th>Markers</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P20 / P23 / P31</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18 / P28</th>
<th>Z-RFC-P19</th>
<th>Z-RFC-P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mm: ±0.4°</td>
<td>0.5 mm: ±0.4°</td>
<td>0.5 mm: ±1.4°</td>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±1.3°</td>
<td>1.0 mm: ±0.8°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 mm: ±1.1°</td>
<td>1.0 mm: ±1.1°</td>
<td>1.0 mm: ±3.7°</td>
<td>1.0 mm: ±1.3°</td>
<td>1.0 mm: ±2.6°</td>
<td>2.0 mm: ±1.8°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 mm: ±3.5°</td>
<td>2.0 mm: ±3.5°</td>
<td>2.0 mm: ±6.0°</td>
<td>2.0 mm: ±3.3°</td>
<td>2.0 mm: ±17°</td>
<td>4.0 mm: ±5.4°</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Markers</th>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P20 / P23 / P31</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18 / P28</th>
<th>Z-RFC-P19</th>
<th>Z-RFC-P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mm: ±0.3°</td>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±2.5°</td>
<td>0.5 mm: ±1.1°</td>
<td>0.5 mm: ±2.2°</td>
<td>1.0 mm: ±1.1°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±6.4°</td>
<td>1.0 mm: ±2°</td>
<td>1.0 mm: ±4.5°</td>
<td>2.0 mm: ±2.4°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±10°</td>
<td>2.0 mm: ±4.6°</td>
<td>2.0 mm: ±17°</td>
<td>4.0 mm: ±6.7°</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Connector System
### M12

**EEM-33-52**
- M12x1 Mating female/male connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded (shield on knurl), CAN-Bus
- Plug housing: PUR
- Cable sheath: PUR, Ø = 6.7 mm
- Lead wires: PE, 2x0.25 mm² + 2x0.34 mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>400103937</td>
<td>EEM-33-52</td>
<td>5 m</td>
</tr>
</tbody>
</table>

**EEM-33-41/43**
- M12x1 Mating female connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded, open ended, CAN-Bus
- Plug housing: PUR
- Cable sheath: PUR, Ø = 7.2 mm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>400056141</td>
<td>EEM-33-41</td>
<td>2 m</td>
</tr>
<tr>
<td>400056143</td>
<td>EEM-33-43</td>
<td>10 m</td>
</tr>
</tbody>
</table>

**EEM-33-73**
- M12x1 Mating female connector, 5-pin, straight, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus
- Plug housing: Metal
- For wire gauge: 6 ... 8 mm, max. 0.75 mm²

**EEM-33-45**
- M12x1 splitter / T-connector, 5-pin, A-coded, IP68, 1:1 connection, female - male - female, CAN-Bus
- Plug housing: PUR

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>400056145</td>
<td>EEM-33-73</td>
<td></td>
</tr>
<tr>
<td>400056146</td>
<td>EEM-33-45</td>
<td></td>
</tr>
</tbody>
</table>
Connector System
M12

M12x1 terminating resistor, 5-pin, A-coded, IP67, 120Ω resistance, CAN-Bus

Plug housing PUR, -25 ... +85°C

P/N 400056147 Type EEM-33-47

Protection class IP67 DIN EN 60529
Very good Electromagnetic Compatibility (EMC) and shield systems

Protection class IP68 DIN EN 60529
Very good resistance to oils, coolants and lubricants

Canbus

SUITED FOR APPLICATIONS IN DRAGCHAINS

UL - approved
Connecting Options on request

- **M12 connector**
  - Customized lengths
  - 3-, 4-, 6- and 6-pole versions
  - Protection class IP67
  - 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.