NOVOHALL
Rotary Sensor
touchless technology

Series RFC-4800

Special features
• Touchless hall technology
• Electrical range up to 360°
• 2-part, mechanically decoupled
• High protection class, IP67, IP69
• Resolution up to 14 bit
• Wear-free
• Temperature range -40 °C to +105 °C
• Single and multi-channel versions
• Optimized for use in industrial and mobile applications
  with highest EMC requirements such as ISO pulses and high
  interferences to ISO 11452 and ECE-Standard
• Suitable for safety-relevant applications according to
  DIN EN ISO 13849
• Interfaces:
  Voltage, current, SSI, incremental, CANopen, SPI, IO-Link
• Customized versions

Applications
• Manufacturing Engineering
  Textile machinery
  Packaging machinery
  Sheet metal and wire machinery
• Automation technology
• Medical engineering
• Mobile working machines
  Industrial trucks
  Construction machinery
  Agricultural and forestry machinery
• Marine applications

The two-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.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawings</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical Data</td>
<td>4</td>
</tr>
<tr>
<td>Output Characteristics</td>
<td>5</td>
</tr>
<tr>
<td>Analog Versions for Industrial Applications</td>
<td>6</td>
</tr>
<tr>
<td>Technical Data</td>
<td>6</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>7</td>
</tr>
<tr>
<td>Analog Versions for Mobile Applications</td>
<td>8</td>
</tr>
<tr>
<td>Technical Data</td>
<td>8</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>9</td>
</tr>
<tr>
<td>Digital Versions</td>
<td>10</td>
</tr>
<tr>
<td>SSI</td>
<td>10</td>
</tr>
<tr>
<td>Incremental for Industrial and Mobile Applications</td>
<td>11</td>
</tr>
<tr>
<td>SPI</td>
<td>14</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>15</td>
</tr>
<tr>
<td>Fieldbus Versions, IO-Link</td>
<td>16</td>
</tr>
<tr>
<td>CANopen</td>
<td>16</td>
</tr>
<tr>
<td>IO-Link</td>
<td>17</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>18</td>
</tr>
<tr>
<td>Accessories</td>
<td>19</td>
</tr>
<tr>
<td>Position Markers</td>
<td>19</td>
</tr>
<tr>
<td>M12 Connector System</td>
<td>23</td>
</tr>
<tr>
<td>Signal processing</td>
<td>26</td>
</tr>
<tr>
<td>Customized Versions</td>
<td>27</td>
</tr>
<tr>
<td>Connecting Options</td>
<td>27</td>
</tr>
</tbody>
</table>
CAD data see www.novotechnik.de/en/download/cad-data/
Mechanical Data

Description

Housing
- High grade, temperature resistant plastic

Electrical connection
- Cable 4 x 0.5 mm², AWG 20, TPE, shielded (analog voltage / current CE, CANopen)
- Cable 4 x 0.5 mm², AWG 20, TPE, unshielded (analog voltage / current mobil)
- Cable 5 x 0.14 mm², AWG 26, PUR, shielded (SPI)
- Cable 8 x 0.25 mm², AWG 24, TPE, shielded (SSI, Incremental, CANopen IN/OUT)
- Wire 0.5 mm², AWG 20, PVC (analog voltage / current mobile, Incremental Open Collector)
- Connector M12x1, 4-pin / 5-pin / 8-pin with cable L=0.15 m
- Connector AMP-Superseal, 4-pin with cable L = 0.15 m

Mechanical Data

Dimensions
- See dimension drawing

Mounting
- With 2 lens flange head screws M4 (enclosed in delivery)

Fastening torque of mounting screws
- 250 Ncm

Mechanical travel
- 360° continuous

Maximum operational speed
- Mechanically unlimited

Weight (without connection)
- Approx. 50 g

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

Shock IEC 60068-2-27
- 50 (6 ms) g

Life
- Mechanically unlimited

Protection class DIN EN 60529
- IP67 / IP68 / IP69 (with M12 connector: IP67)

Temperature diagram

Current output: max. operating temperature as a function of the supply voltage
- 105°C @ 12 V / 250 Ω
- 101°C @ 24 V / 50 Ω
- 92°C @ 24 V / 250 Ω

Voltage output: max. operating temperature as a function of the supply voltage
- 105°C @ 12 V / 10 kΩ
- 105°C @ 24 V / 10 kΩ
Output Characteristics

- One-channel, cw
- One-channel, ccw
- Two channels, crossed output characteristics, channels 1 cw
- On request: Two channels, signal 2 = 0.5 x signal 1
- On request: Different gradients
- On request: 2 offset output characteristics
- On request: Trapezoid output characteristic
- On request: Parabolic output characteristic
**Technical Data - Versions for Industrial Applications**

Design optimized for use in machine and plant engineering. High reliability, simple interface to PLC, high variety.

### Type Designations

<table>
<thead>
<tr>
<th>Designation</th>
<th>RFC-48...-1 1 -... 4</th>
<th>RFC-48...-1 2 -... 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Designation</td>
<td>ratiometric</td>
<td>voltage</td>
</tr>
</tbody>
</table>

### Electrical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0.25 ... 4.75 V (5 ... 95 %)</th>
<th>0.5 ... 4.5 V (10 ... 90 %)</th>
<th>0.1 ... 10 V (load ≥ 10 kΩ)</th>
<th>4 ... 20 mA (burden ≤ 500 Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>1 / 2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td>activated (in case of error output signal is outside of the plausible signal range)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update rate</td>
<td>typical 3.4 kHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring range</td>
<td>0 ... 30 up to 0 ... 360, in 10°-steps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent linearity</td>
<td>≤ 0.5 % FS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>typical ≤ 0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis at measuring range &lt; 360°</td>
<td>typical ≤ 0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis at measuring range &gt; 360°</td>
<td>typical ≤ 0.25 (lower hysteresis on request)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature error at measuring range 30 up to 170°</td>
<td>typical ≤ ±0.7</td>
<td>typical ±1.0</td>
<td>typical ±1.2</td>
<td>% FS</td>
</tr>
<tr>
<td>Temperature error at measuring range 180 up to 360°</td>
<td>typical ±0.35</td>
<td>typical ±0.5</td>
<td>typical ±0.6</td>
<td>% FS</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>5 (4.5 ... 5.5) VDC</td>
<td>24 (18 ... 30) VDC</td>
<td>24 (13 ... 33) VDC</td>
<td>VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>typical 12 per channel mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, on supply lines and outputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0.5 (AWG 20)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Environmental Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>-40 ... +105 °C</th>
<th>-25 ... +85 °C with M12 connector</th>
<th>-25 ... +85 °C with M12 connecto</th>
<th>-25 ... +85 °C with M12 connecto</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTTF (DIN EN ISO 13849-1)</td>
<td>96 (per channel) years</td>
<td>46 years</td>
<td>40 years</td>
<td></td>
</tr>
</tbody>
</table>

### Connection Assignment

**One-channel versions**

- **Supply voltage Ub**: GNpin 1
- **Signal output**: WHpin 2
- **GND**: BNpin 3
- **Not assigned**: YEpin 4

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

**Redundant versions**

- **Supply voltage Ub**: GNpin 1
- **Signal output 1**: WHpin 2
- **GND**: BNpin 3
- **Signal output 2**: YEpin 4

Cable shielding connect to GND.
### Ordering Specifications

**Preferred types printed in bold:**
- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

#### Supply voltage \( U_b \)

<table>
<thead>
<tr>
<th>1</th>
<th>24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5 V</td>
</tr>
</tbody>
</table>

#### Output signal supply voltage \( U_b = 24 \) V

| 1 | 0.1...10 V (only one-channel) |
| 2 | 4 ... 20 mA (only one-channel) |

#### Output signal supply voltage \( U_b = 5 \) V

| 1 | 0.25 ... 4.75 V ratiometric to supply voltage \( U_b \) (5 ... 95 %) |
| 2 | 0.5 ... 4.5 V ratiometric to supply voltage \( U_b \) (10 ... 90 %) |

#### Output characteristics

1: Rising cw  
2: Rising ccw  
3: Crossed output channel 1 rising cw (partly redundant)

Other output characteristics on request

#### Electrical connections

- 201: Cable 4-pole, 0.5 m shielded
- 202: Cable 4-pole, 1 m shielded
- 206: Cable 4-pole, 3 m shielded
- 210: Cable 4-pole, 5 m shielded
- 220: Cable 4-pole, 10 m shielded
- 501: M12 connector 4-pin, with cable, \( L = 0.15 \) m, shielded

Cable versions and assembled connectors on request

#### Measuring range

03: Angle 0° ... 30° min.  
06, 12, 18, 24, 36  
36: Angle 0° ... 360° max.  
Other angles on request

#### Number of channels

- 6: Single output 1 x supply voltage \( U_b \) / 1 x output  
- 7: partly redundant 1 x supply voltage \( U_b \) / 2 x output (only at supply voltage \( U_b = 5 \) V)

#### Series

- 4851: Elongated hole mounting for easy adjustment  
- 4862: Round hole mounting  
- 4854: Round hole mounting, without diagnostic function  
- 4853: Elongated hole mounting, without diagnostic function

Other versions f.e. with internal shielding against magnetic fields on request
## Technical Data - Versions for Mobile Applications

These versions are optimized for the high requirements in mobile applications. Tested to the highest requirements as ISO-pulses and high interferences to ISO 11452.

### Type Designations

- **RFC-48-** - ratiometric
- **RFC-48-** - voltage
- **RFC-48-** - current

### Electrical Data

**Output signal**
- ratiometric to supply voltage $U_b$
- $0.25 \ldots 4.75 \text{ V}$ (5 \ldots 95 %)
- $0.5 \ldots 4.5 \text{ V}$ (10 \ldots 90 %)

<table>
<thead>
<tr>
<th>Type Designations</th>
<th>Voltage Range</th>
<th>Current Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC-48-3</td>
<td>$0.25 \ldots 4.75 \text{ V}$</td>
<td>$4 \ldots 20 \text{ mA}$</td>
</tr>
<tr>
<td>RFC-48-32</td>
<td>$0.5 \ldots 4.5 \text{ V}$ (load $\geq 10 \text{ k}\Omega$)</td>
<td>(burden @ $U_b &gt; 13 \text{ V} \leq 500 \text{ Ohm}$)</td>
</tr>
<tr>
<td>RFC-48-16</td>
<td>$0.25 \ldots 4.75 \text{ V}$ (load $\geq 5 \text{ k}\Omega$)</td>
<td>(burden @ $U_b \leq 13 \text{ V} \leq 250 \text{ Ohm}$)</td>
</tr>
</tbody>
</table>

**Number of channels**
- 1 / 2

**Diagnosis**
- activated (in case of error output signal is outside of the plausible signal range)

**Update rate**
- typical 3.4 kHz

**Resolution**
- 12 bit

**Measuring range**
- 0 \ldots 30 up to 0 \ldots 360, in 10°-steps

**Independent linearity**
- $\leq 0.5 \%$ FS

**Repeatability**
- typical $\leq 0.1 \%$ FS

**Hysteresis at measuring range < 360°**
- typical $\leq 0.1 \%$ FS

**Hysteresis at measuring range 360°**
- typical $\leq 0.25 \%$ (lower hysteresis on request)

**Temperature error at measuring range 30 and 170°**
- typical $\leq 0.7 \%$ FS

**Temperature error at measuring range 180 and 360°**
- typical $\leq 0.35 \%$ FS

**Supply voltage $U_b$**
- 5 [4.5 \ldots 5.5] V
- 12/24 [8 \ldots 34] V

**Current consumption (w/o load)**
- typical 12 per channel mA

**Reverse voltage**
- yes, supply lines and outputs

**Short circuit protection**
- yes (vs. GND and supply voltage)

**Insulation resistance (500 VDC)**
- $> 10 \text{ M}\Omega$

**Cross-section cable / lead wires**
- 0.5 (AWG 20) mm²

### Environmental Data

**Operating temperature**
- $-40 \ldots +105 \text{ °C}$
- $-25 \ldots +85 \text{ °C}$ with M12 connector

**MTTF (DIN EN ISO 13849-1)**
- parts count method, w/o load, wc
- 99 (per channel) years

**Emission and immunity according to ECE - R10 ( E1)**
- ISO 10605 Packaging and Handling + Component Test 8 kV, 15 kV
- ISO 11452-2 Radiated EM-Fields, Absorber Hall 100 V/m
- ISO 11453-5 Radiated EM-Fields, Stripline 200 V/m
- CISPR25 Radiated emission class 5
- ISO 7637-2 Pulses on supply lines (1, 2a, 2b, 3a, 3b, 4, 5) Level 4
- ISO 7637-3 Transient disturbances Level 4

**MTTFd (DIN EN ISO 13849-1)**
- parts count method, w/o load, wc
- 198 (per channel) years

**Connection assignment**

#### One-channel versions

<table>
<thead>
<tr>
<th>Signal</th>
<th>Lead wires code 4</th>
<th>Cable code 2</th>
<th>Connector code 551 / 552</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_b$</td>
<td>RD</td>
<td>GN</td>
<td>pin 1</td>
</tr>
<tr>
<td>Signal</td>
<td>BU/WH</td>
<td>pin 2</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>BK/WH</td>
<td>pin 3</td>
<td></td>
</tr>
</tbody>
</table>

#### Redundant versions

<table>
<thead>
<tr>
<th>Signal</th>
<th>Lead wires code 4</th>
<th>Cable code 2</th>
<th>Connector code 551 / 552</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_b$</td>
<td>RD</td>
<td>GN</td>
<td>pin 1</td>
</tr>
<tr>
<td>Signal</td>
<td>BU/WH</td>
<td>pin 2</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>BK/WH</td>
<td>pin 3</td>
<td></td>
</tr>
</tbody>
</table>

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
## Ordering Specifications

### Supply voltage

- **2:** Supply voltage Ub = 5 V (4.5 ... 5.5 V)
- **3:** Supply voltage Ub = 12/24 V (8 ... 34 V)

### Output signal

- **Supply voltage Ub = 5 V**
  - 1: 0.25 ... 4.75 V ratiometric to supply voltage Ub (5 ... 95 %)
  - 2: 0.5 ... 4.5 V ratiometric to supply voltage Ub (10 ... 90 %)

- **Supply voltage Ub = 12/24 V**
  - 2: 4 ... 20 mA
  - 4: 0.5 ... 4.5 V
  - 5: 0.25 ... 4.75 V

### Output characteristics

- **1:** Rising cw
- **2:** Rising ccw
- **3:** Crossed output channel 1 rising cw (partly redundant)
- **4:** Crossed output channel 1 rising cw (fully redundant)

Other output characteristics on request

### Electrical connections

- 251: Cable 4-pole, 0.5 m unshielded, one-channel and partly redundant
- 252: Cable 4-pole, 1 m unshielded, one-channel and partly redundant
- 256: Cable 4-pole, 3 m unshielded, one-channel and partly redundant
- 260: Cable 4-pole, 5 m unshielded, one-channel and partly redundant
- 270: Cable 4-pole, 10 m unshielded, one-channel and partly redundant
- 401: Lead wires 3 x L = 0.5 m, single
- 411: Lead wires 4 x L = 0.5 m, partly redundant
- 421: Lead wires 6 x L = 0.5 m, fully redundant
- 551: M12 connector 4-pin, with cable L = 0.15 m unshielded, one-channel and partly redundant
- 552: Connector AMP Superseal, 4-pin, with cable L = 0.15 m, unshielded, one-channel and partly redundant

Cable versions and assembled connectors on request

### Measuring range

- **03:** Angle 0° ... 30° min.
- **06, 12, 18, 24, 36**
- **36:** Angle 0° ... 360° max.

Other angles on request

### Number of channels

- **6:** one-channel 1 x supply voltage Ub / 1 x output
- **7:** partly redundant 1 x supply voltage Ub / 2 x output
- **8:** fully redundant 2 x supply voltage Ub / 2 x output

### Mechanical version

- **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

Further versions i.e. with internal shielding against magnetic fields on request.
## Technical Data

### SSI Interface

#### Type Designations
- **RFC-48-212-41**
  - Supply voltage 5 VDC
- **RFC-48-212-44**
  - Supply voltage 24 VDC

#### Electrical Data

- **Protocol**
  - SSI 13 bit (12 bit data + 1 stop bit)
- **Inputs**
  - RS422 compatible, CLK lines via optocoupler galvanically isolated
- **Monoflop time (tm)**
  - 16 µs
- **Coding**
  - Gray
- **Update rate (internal)**
  - 2 kHz
- **Resolution across 360°**
  - 12 bit
- **Measuring range**
  - 360°
- **Maximum operational speed position marker**
  - 30 000, higher speeds on request
- **Independent linearity**
  - typical 0,5 ±% FS
- **Repeatability**
  - ± 0.2°
- **Temperature error**
  - ± 0.7°, lower hysteresis on request
- **Supply voltage Ub**
  - 5 VDC (4.5 ... 5.5 VDC)
  - 24 VDC (18 ... 30 VDC)
- **Current consumption (w/o load)**
  - typical 27 mA
  - typical 10 mA
- **Reverse voltage**
  - yes, supply lines
- **Short circuit protection**
  - yes (output vs. supply voltage and GND)
  - yes (output vs. GND)
- **Ohmic load at outputs**
  - > 120 Ω
- **Max. clock rate**
  - 1 MHz
- **Insulation resistance (500 VDC)**
  - > 10 MΩ
- **Cross-section cable**
  - 0.25 (AWG 24) mm²

#### Environmental Data

- **Operating temperature**
  - -40 ... +85 (-25 ... +85 with M12 connector) °C
- **MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)**
  - 141 102 years

### Functional Safety

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

### EMC Compatibility

- **EN 61000-4-2** Electrostatic discharge (ESD) 4 kV, 8 kV
- **EN 61000-4-3** Electromagnetic fields 10 V/m
- **EN 61000-4-4** Electrical fast transients (burst) 1 kV
- **EN 61000-4-6** Conducted disturbances, induced by RF fields 10 V eff.
- **EN 61000-4-8** Power frequency magnetic fields 30 A/m
- **EN 55016-2-3** Noise radiation class B

### Connection Assignment

**SSI Interface**

- **Signal**
  - Supply voltage Ub: WH
  - GND: BN
  - Clock input SSI Clk-: GN
  - Clock input SSI Clk+: YE
  - Signal output SSI Data+: GY
  - Signal output SSI Data-: PK
  - Not assigned: BU
  - Not assigned: RD

**Cable code 4 _ _**

**Connector M12 code 531**

**Connection range**

**data range**

**time**

**SSI protocol**

**Clock**

**Data**

**SSI connection**

- **angle sensor**
  - **shield**
  - **CLJ**
  - **CLK**
  - **TAKT**
  - **DATA**
  - **GND (0V)**

**customized control system**

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
### Type Designations

<table>
<thead>
<tr>
<th>Type Designations</th>
<th>Supply voltage 5 VDC</th>
<th>Supply voltage 24 VDC, TTL</th>
<th>Supply voltage 24 VDC, HTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC-48-2-5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC-48-2-530</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC-48-2-534</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Data

#### Outputs
- **A+ / A-**
- **B+ / B-**
- **Z+ / Z-**

#### Level
- RS-422, TTL compatible
- RS-422, TTL-compatible
- HTL-compatible, Push-Pull

#### Supply voltage
- 5 VDC
- 24 VDC, TTL
- 24 VDC, HTL

#### Length Z-pulse
- 90 electrical, between 2 edges A / B

#### Pulses per revolution
- 1024, other resolutions see page 12

#### Counts per revolution (after quadrature)
- 4096

#### Option Low Speed
- **Minimum edge separation**
  - 8 µs

- **Minimum input frequency of counter input**
  - 32 kHz

- **Maximum operational speed**
  - 1 800 min⁻¹

#### Option High Speed
- **Minimum edge separation**
  - 0.5 µs

- **Minimum input frequency of counter input**
  - 500 kHz

- **Maximum operational speed**
  - 29 000, higher speeds on request

#### Measuring range
- 360 °

#### Independent linearity
- typical 0.5 ±% FS

#### Repeatability
- < 0.2 °

#### Hysteresis
- < 0.7 °, lower hysteresis on request

#### Temperature error
- < 0.375 ±% FS

#### Supply voltage Ub
- 5 (4.5 ... 5.5) VDC
- 24 (18 ... 30) VDC
- 24 (18 ... 30) VDC

#### Current consumption (w/o load)
- typical 20 mA
- typical 10 mA

#### Reverse voltage
- yes, supply lines

#### Short circuit protection
- yes, all outputs vs. GND and supply voltage
- yes, all outputs vs. GND and supply voltage
- yes, all outputs vs. GND and supply voltage

#### Ohmic load at output
- > 120 per channel A / B / Z
- > 120 per channel A / B / Z
- > 750 per channel A / B / Z

#### Insulation resistance (500 VDC)
- > 10 MΩ

#### Cross-section cable
- 0.25 (AWG 24)

### Environmental Data

#### Operating temperature
- -40 ... +85 (°C)
- (-25 ... +85 with M12 connector)

#### MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wo)
- 183 years
- 122 years
- 122 years

#### EMC compatibility
- EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV
- EN 61000-4-3 Electromagnetic fields 10 V/m
- EN 61000-4-4 Electrical fast transients (burst) 1 kV
- EN 61000-4-6 Conducted disturbances, induced by RF fields 10 V off.
- EN 61000-4-8 Power frequency magnetic fields 30 A/m
- EN 55016-2-3 Radiated disturbances

### Connection assignment

#### Signal
- Supply voltage Ub
- GND
- A-
- A+
- B-
- B+
- Z+
- Z-

#### Cable code
- 4

#### Connector M12
- pin 1
- pin 2
- pin 3
- pin 4
- pin 5
- pin 6
- pin 7
- pin 8

When the marking of the position marker is pointing away from the cable, the output is in the vicinity of the reference pulse (Z).
Rotational direction CW: A leads before B.
**Technical Data**

**Incremental Interface**

**Electrical Data**

<table>
<thead>
<tr>
<th></th>
<th>1024</th>
<th>512</th>
<th>256</th>
<th>128</th>
<th>ppr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pulses per revolution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Counts per revolution (after quadrature)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Option Low Speed**

- Minimal edge separation: 8 µs
- Minimum input frequency of counter input: 32 kHz
- Maximum operational speed: 1800 3600 7200 11400 min⁻¹

**Option High Speed**

- Minimal edge separation: 0,5 µs
- Minimum input frequency of counter input: 500 500 500 105 kHz
- Maximum operational speed: 29000, higher speeds on request

¹ The requirement for the minimum input frequency of counter input is reduced at lower speed (see below charts).

---

![Incremental Protocol Diagram](image1)

![Incremental Connection Diagram](image2)

**Pulse Rate Option Low Speed**

![Graph](image3)

**Pulse Rate Option High Speed**

![Graph](image4)

¹ max. 130.000 Units, limited by max. operational speed of positional marker
### Technical Data

#### Incremental Interface for Mobile Applications

#### Type Designations

**RFC-48_ _-2 _ _-556- _ _ _**
Supply voltage 12/24 VDC, open collector

#### Electrical Data

<table>
<thead>
<tr>
<th>Outputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Open collector</td>
</tr>
<tr>
<td>Pulses per revolution</td>
<td>1024 512 256 128 ppm</td>
</tr>
<tr>
<td>Counts per revolution (after quadrature)</td>
<td>4096 2048 1024 512</td>
</tr>
<tr>
<td>Minimum edge separation</td>
<td>8 µs</td>
</tr>
<tr>
<td>Minimum input frequency of counter input</td>
<td>32 32 32&quot; 32&quot; kHz</td>
</tr>
<tr>
<td>Maximum operational speed</td>
<td>580 3900 7200 14400 min⁻¹</td>
</tr>
<tr>
<td>Measuring range</td>
<td>360</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>typical 0.5 ±% FS</td>
</tr>
<tr>
<td>Repeatability</td>
<td>&lt; 0.2 °</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>&lt; 0.7, lower hysteresis on request</td>
</tr>
<tr>
<td>Temperature error</td>
<td>0.375 ±% FS</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>12/24 (9 ... 34) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>typical 10 mA</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>60 (temporary / 10 min.) VDC</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, supply lines</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes, all outputs vs. GND and supply voltage Ub</td>
</tr>
<tr>
<td>Load outputs vs. supply voltage Ub</td>
<td>20 per channel mA</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
</tr>
<tr>
<td>Cross-section cable / lead wires</td>
<td>0.5 (AWG 20) mm²</td>
</tr>
</tbody>
</table>

#### Environmental Data

| Operating temperature | -40 ... +85 (-25 ... +85 with M12 connector) °C |
| MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc) | 83 years |
| Functional safety | If you need assistance in using our products in safety-related systems, please contact us |
| EMC compatibility | ISO TR 10605 Packaging and Handling + Component Test 8 kV, 15 kV |
| ISO 11452-2 Radiated EMI fields, absorber half 100 V/m |
| ISO 11452-5 Radiated EM RF fields, stripline 200 V/m |
| ISO 7637-2 Pulses on supply lines (1) Level 3, (2a, 2b, 3a, 3b, 4, 5) Level 4 |
| CISPR 25 Radiated emission class 5 |

*) The requirements for the minimum input frequencies of counter input is reduced at lower speed (see page 12).*

---

#### Connection assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Lead wires code</th>
<th>Cable code</th>
<th>Connector M12 code</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-</td>
<td>BU</td>
<td>GN</td>
<td>pin 1</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>RD</td>
<td>WH</td>
<td>pin 2</td>
</tr>
<tr>
<td>GND</td>
<td>BK</td>
<td>BN</td>
<td>pin 3</td>
</tr>
<tr>
<td>B-</td>
<td>BU/WH</td>
<td>YE</td>
<td>pin 4</td>
</tr>
</tbody>
</table>

---

#### Incremental protocol

- **A**
  - Pulse width
  - Edge separation
- **B**

#### Incremental connection

- Sensor
- R ≤ 20 mA
- U_b
- A
- B
- GND (0V)

#### Rotational direction CW:
A leads before B
**Type Designations**

| RFC-48_ _-2 _ _-_ _ _ 
| Supply voltage 5 VDC |

**Electrical Data**

| Protocol | SPI |
| Coding | Binary code |
| Level SCLK, MOSI, /SS | TTL level (s. application note SPI protocol) |
| Update rate internal | 14 kHz |
| Resolution across 360° | 14 bit |
| Measuring range | 360° |
| Independent linearity | ± 0.5% FS |
| Repeatability | ± 0.1% FS |
| Hysteresis | ± 0.1% FS |
| Temperature error | ± 0.625% FS |
| Supply voltage Ub | 5 (4.5 ... 5.5) VDC |
| Current consumption (w/o load) | typical 15 mA |
| Reverse voltage | yes, supply lines |
| Short circuit protection | yes (vs. GND and supply voltage) |
| Max. clock rate | 400 kHz |
| Insulation resistance (500 VDC) | ≥ 10 MΩ |
| Cross-section cable | 0.14 (AWG 26) mm² |

**Environmental Data**

| Operating temperature | -40 ... +85 °C |
| MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc) | 272 years |
| Functional safety | If you need assistance in using our products in safety-related systems, please contact us |
| EMC compatibility | EN 61000-4-2 electrostatic discharge (ESD) 4 kV, 8 kV |
| | EN 61000-4-3 electromagnetic fields 10 V/m |
| | EN 61000-4-4 electrical fast transients (Burst) 1 kV |
| | EN 61000-4-6 conducted disturbances, induced by RF fields 10 V eff. |
| | EN 61000-4-8 Power frequency magnetic fields 30 A/m |
| | EN 55011/EN 55022/A1 Radiated disturbances class B |

---

**SPI Interface**

**Connection assignment**

| Cable code 302 |
| Supply voltage Ub | GN |
| GND | BN |
| MOSI / MISO | YE |
| SCLK | GY |
| /SS (slave select) | WH |

---

**SPI protocol**

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
## Ordering Specifications -
### Digital Versions
- **SSI**
- **Incremental**
- **SPI**

### Supply Voltage \( U_b / \text{Interface} \)

<table>
<thead>
<tr>
<th>Interface parameters for SSI Interface</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11: 5 V (4.5 ... 5.5 V) supply voltage, output RS422 comp., Gray code, rising cw</td>
<td></td>
</tr>
<tr>
<td>12: 5 V (4.5 ... 5.5 V) supply voltage, output RS422 comp., Gray code rising cw</td>
<td></td>
</tr>
<tr>
<td>41: 5 V (4.5 ... 30 V) supply voltage, output RS422 comp., Gray code, rising cw</td>
<td></td>
</tr>
<tr>
<td>42: 24 V (18 ... 30 V) supply voltage, output RS422 comp., Gray code rising cw</td>
<td></td>
</tr>
</tbody>
</table>

### Interface parameters for Incremental Interface

- **Low Speed Mode** (minimum edge separation 8 µs)
  - 15: 5 V (4.5 ... 5.5 V) supply voltage, output RS422, TTL-compatible
  - 31: 24 V (18 ... 30 V) supply voltage, output RS422, TTL-compatible, Push-Pull
  - 39: 24 V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull
  - 56: 12/24 V (9 ... 34 V) supply voltage, output low side, open collector

- **High Speed Mode** (minimal edge separation 0.5 µs)
  - 10: 5 V (4.5 ... 5.5 V) supply voltage, output RS422, TTL-compatible
  - 30: 24 V (18 ... 30 V) supply voltage, output RS422, TTL-compatible
  - 34: 24 V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull

### UVW signals instead of ABZ signals for motor commutation on request

### Absolute position at Power On (Power on Burst) on request

### Interface parameters for SPI Interface

- 31: 5 V (4.5 ... 5.5 V) Supply voltage, Binary code, rising cw

### Electrical connections

- **SSI / Incremental:**
  - 432: Cable 8-pole, 1.0 m, shielded
  - 436: Cable 8-pole, 3.0 m, shielded
  - 440: Cable 8-pole, 5.0 m, shielded
  - 450: Cable 8-pole, 10.0 m, shielded
  - 531: Connector M12x1 8-pole with cable, L = 0.15 m, shielded

- **Incremental Open Collector:**
  - 252: Cable 4-pole, 1 m, unshielded
  - 256: Cable 4-pole, 3 m, unshielded
  - 260: Cable 4-pole, 5 m, unshielded
  - 270: Cable 4-pole, 10 m, unshielded
  - 411: Lead wires 4 x L = 0.5 m
  - 551: Connector M12x1 4-pin with cable, L = 0.15 m, unshielded

- **SPI:**
  - 302: Cable 5-pole 1.0 m, shielded
  - 412: Lead wires 4 x L = 0.5 m

### Resolution

- **Resolution SSI Interface**
  - 12: 12 bit
  - Other resolutions on request

- **Resolution Incremental Interface**
  - 12: 1024 ppr - 4096 counts (after quadrature)
  - 11: 512 ppr - 2048 counts (after quadrature)
  - 10: 256 ppr - 1024 counts (after quadrature)
  - 09: 128 ppr - 512 counts (after quadrature)
  - Other resolutions on request

- **Resolution SPI Interface**
  - 14: 14 bit

### Mechanical version

- 4801: Elongated hole mounting
- 4802: Round hole mounting
### Type Designations

| Type Designations            | RFC-48 __- 214 - 6 __- __- __-  
|------------------------------|---------------------------------|

#### Electrical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measured variables</strong></td>
<td>Position and speed</td>
</tr>
<tr>
<td><strong>Measuring range</strong></td>
<td>360°</td>
</tr>
<tr>
<td><strong>Measurement range speed</strong></td>
<td>0 ... 1600 min⁻¹</td>
</tr>
<tr>
<td><strong>Number of channels</strong></td>
<td>1 / 2 see ordering specifications</td>
</tr>
<tr>
<td><strong>Output signal / protocol</strong></td>
<td>CANopen protocol to CiA DS-301 V4.2.0, Device profile DS-406 V3.2 Encoder Class C2, LSS services to CiA DS-305 V1.1.2</td>
</tr>
<tr>
<td><strong>Programmable parameter</strong></td>
<td>Position, speed, cams, working areas, rotating direction, scale, offset, node ID, baud rate</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td>activated (in case of error output signal is outside of the plausible signal range)</td>
</tr>
<tr>
<td><strong>Node-ID</strong></td>
<td>1 ... 127 (default 127)</td>
</tr>
<tr>
<td><strong>Baud rate</strong></td>
<td>50 ... 1000 see ordering specifications kBaud</td>
</tr>
<tr>
<td><strong>Resolution across 360° (position)</strong></td>
<td>14 bit</td>
</tr>
<tr>
<td><strong>Update rate</strong></td>
<td>1 kHz</td>
</tr>
<tr>
<td><strong>Independent linearity</strong></td>
<td>± 0.8 ± % FS</td>
</tr>
<tr>
<td><strong>Repeatability</strong></td>
<td>± 0.36 ± % FS</td>
</tr>
<tr>
<td><strong>Hysteresis</strong></td>
<td>± 0.36 ± % FS</td>
</tr>
<tr>
<td><strong>Temperature error</strong></td>
<td>± 0.2 ± % FS</td>
</tr>
<tr>
<td><strong>Supply voltage Ub</strong></td>
<td>12/24 (8 ... 34) VDC</td>
</tr>
<tr>
<td><strong>Current consumption (w/o load)</strong></td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td><strong>Reverse voltage</strong></td>
<td>yes, supply lines</td>
</tr>
<tr>
<td><strong>Short circuit protection</strong></td>
<td>yes, output vs. GND and supply voltage Ub (up to 40 VDC)</td>
</tr>
<tr>
<td><strong>Overvoltage protection</strong></td>
<td>&lt; 45 (permanent) VDC</td>
</tr>
<tr>
<td><strong>Insulation resistance (500 VDC)</strong></td>
<td>≥ 10 MΩ</td>
</tr>
<tr>
<td><strong>Cross-section cable</strong></td>
<td>0.5 (AWG 20) / 4-pole resp. 0.25 (AWG 24) / 8-pole</td>
</tr>
<tr>
<td><strong>Bus termination internal</strong></td>
<td>120, optionally, see ordering specifications</td>
</tr>
<tr>
<td><strong>Environmental Data</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Operation temperature</strong></td>
<td>-40 ... +105 (-25 ... +85 with M12 connector) °C</td>
</tr>
<tr>
<td><strong>MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)</strong></td>
<td>one-channel: 71 / two-channel: 58 years</td>
</tr>
<tr>
<td><strong>EMC compatibility</strong></td>
<td>ISO TR 10805 Packaging and Handling + Component Test 8 kV</td>
</tr>
<tr>
<td></td>
<td>ISO 11452-2 Radiated EM RF fields, Absorberhall 100 V/m</td>
</tr>
<tr>
<td></td>
<td>ISO 11452-5 Radiated EM RF fields, Stripline 200 V/m</td>
</tr>
<tr>
<td></td>
<td>CISPR 25 Radiated emission class 3</td>
</tr>
<tr>
<td></td>
<td>ISO 7637-2 Pulses on supply lines (1, 2a, 2b, 3a, 3b, 4 (24 V systems), 5) Level 5</td>
</tr>
<tr>
<td></td>
<td>ISO 7637-3 Transient emission Level 4</td>
</tr>
</tbody>
</table>

#### Connection assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable Code 2</th>
<th>Connector M12</th>
<th>Connector M12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN_SHLD</td>
<td>Shield</td>
<td>pm 1</td>
<td></td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>WH</td>
<td>pm 2</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>BN</td>
<td>pm 3</td>
<td></td>
</tr>
<tr>
<td>CAN_H</td>
<td>YE</td>
<td>pm 4</td>
<td></td>
</tr>
<tr>
<td>CAN_L</td>
<td>GN</td>
<td>pm 5</td>
<td></td>
</tr>
</tbody>
</table>

Cable shielding connect to GND.

---

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
### Technical Data

#### Type Designations

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC-48 _ _- 214 - A _ _ - _ _ _</td>
<td>IO-Link</td>
</tr>
</tbody>
</table>

#### Electrical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variables</td>
<td>Position (other process data such as speed, revolution counter or cams on request)</td>
</tr>
<tr>
<td>Measuring range</td>
<td>360°</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1</td>
</tr>
<tr>
<td>Output signal / protocol</td>
<td>IO-Link Spec V1.1 to IEC 61131-3, Smart Sensor Profile</td>
</tr>
<tr>
<td>Programmable parameter</td>
<td>Zero point offset, averaging, rotating direction</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>Resolution across 360° (Position)</td>
<td>14 bit</td>
</tr>
<tr>
<td>Update rate</td>
<td>1 kHz</td>
</tr>
<tr>
<td>Transfer rate</td>
<td>COM 3 (230.4 kbps)</td>
</tr>
<tr>
<td>Frame type</td>
<td>2.2</td>
</tr>
<tr>
<td>Minimum cycle time</td>
<td>1 ms</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>±0.5% FS</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.36°</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>±0.36°</td>
</tr>
<tr>
<td>Temperature error</td>
<td>±0.2% FS</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>24 VDC (18 ... 30 VDC)</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td>Reverse voltage protection</td>
<td>yes, supply lines</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes, output vs. GND and Ub (up to 40 VDC)</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>&lt; 35 VDC (permanent)</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>&gt; 10 MΩ</td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0.5 (AWG 20) mm²</td>
</tr>
</tbody>
</table>

#### Environmental Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation temperature</td>
<td>-40 ... +105 °C (-25 ... +85 with M12 connector)</td>
</tr>
<tr>
<td>MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)</td>
<td>single channel: 76 Jahre</td>
</tr>
</tbody>
</table>

#### Connection assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 2 _ _</th>
<th>Connector M12 code 551</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>BN</td>
<td>pin 1</td>
</tr>
<tr>
<td>Do not connect*</td>
<td>GN</td>
<td>pin 2</td>
</tr>
<tr>
<td>GND</td>
<td>WH</td>
<td>pin 3</td>
</tr>
<tr>
<td>C/Q</td>
<td>YE</td>
<td>pin 4</td>
</tr>
</tbody>
</table>

*Alternatively on GND

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
## Ordering specifications

### Interface

<table>
<thead>
<tr>
<th>Interface</th>
<th>CANopen Interface</th>
<th>IO-Link</th>
</tr>
</thead>
</table>

### Interface parameters CANopen

- 1: 1 x position, 1 x speed
- 2: 2 x position, 2 x speed
- 3: Baud rate 800 kBaud
- 4: Baud rate 500 kBaud
- 5: Baud rate 250 kBaud
- 6: Baud rate 125 kBaud
- 7: Baud rate 50 kBaud

### Interface parameters IO-Link

- 11: 1 x position, rising cw

Other process data such as speed, revolution counter or cams on request

### Electrical connections CANopen

- 202: Cable 4-pole, 1.0 m, shielded
- 432: Cable 8-pole, 1.0 m, shielded (CAN IN/OUT)
- 511: Connector M12x1, 5-pin, with cable, L= 0.15 m, shielded

### Electrical connections IO-Link

- 252: Cable 4-pole, 1.0 m, unshielded
- 256: Cable 4-pole, 3.0 m, unshielded
- 260: Cable 4-pole, 5.0 m, unshielded
- 270: Cable 4-pole, 10.0 m, unshielded
- 551: Connector M12x1, 4-pin, with cable, L= 0.15 m, unshielded

Cable versions and assembled connectors on request

### Mechanical version

<table>
<thead>
<tr>
<th>Series</th>
<th>Elongated hole</th>
<th>Round hole mounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>4851</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4852</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Position Markers

**Z-RFC-P02**
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400005661
  - 25 pcs. P/N 400056080

**Z-RFC-P47**
Position marker for fixation with threaded pin M5 (included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400105039
  - 25 pcs. P/N 40005040

**Z-RFC-P08**
Position marker for fixation with threaded pin M5 (included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400056070
  - 25 pcs. P/N 400056084

**Z-RFC-P41**
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400105037
  - 25 pcs. P/N 400105038

**Z-RFC-P47**
Position marker for fixation with threaded pin M5 (included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400105039
  - 25 pcs. P/N 40005040

**Z-RFC-P08**
Position marker for fixation with threaded pin M5 (included in delivery).

- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400056070
  - 25 pcs. P/N 400056084
Position Markers

Z-RFC-P18
Screw position marker
M10 x 25 mm, similar DIN 933, Aluminum anodized, magnet potted
• max. permitted radial offset ±3 mm
• packaging unit:
  1 pc. P/N 400104756
  25 pcs. P/N 400104757

Z-RFC-P19
Screw position marker
M8 x 25 mm, similar DIN 933 / ISO 4017
Aluminum anodized, magnet potted
• max. permitted radial offset ±1.5 mm
• packaging unit:
  1 pc. P/N 400104754
  25 pcs. P/N 400104755

Z-RFC-P20
Screw position marker
M10 x 25 mm, similar DIN 933, Aluminum anodized
• max. permitted radial offset ±3 mm
• packaging unit:
  1 pc. P/N 400104758
  25 pcs. P/N 400104759

Z-RFC-P43
Position marker for fixation with threaded pin M4
(included in delivery)
• max. permitted radial offset ±3 mm
• packaging unit:
  1 pc. P/N 400105041
  25 pcs. P/N 400105042
Position Markers

**Z-RFC-P04**
Magnet for direct application onto customer’s shaft
- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400056659
  - 50 pcs. P/N 400056082

**Z-RFC-P03**
Magnet for direct application onto customer’s shaft
- max. permitted radial offset ±1.5 mm
- packaging unit:
  - 1 pc. P/N 400056658
  - 50 pcs. P/N 400056081

**Z-RFC-P30**
Position marker for frontal fixation with 2 fillister screws M3x8 (included in delivery)
- max. permitted radial offset ±1.5 mm
- packaging unit:
  - 1 pc. P/N 400056086
  - 25 pcs. P/N 400056087

**Z-RFC-P23**
Position marker for fixation with threaded pin M4 (included in delivery)
- max. permitted radial offset ±3 mm
- packaging unit:
  - 1 pc. P/N 400056074
  - 25 pcs. P/N 400056085
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.

### Working distances (mm)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Z-RFC- P02 / P08</th>
<th>P03</th>
<th>P04</th>
<th>P18</th>
<th>P19</th>
<th>P20</th>
<th>P23</th>
<th>P30</th>
<th>P41 / P47</th>
<th>P43</th>
</tr>
</thead>
<tbody>
<tr>
<td>One channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC-4853/4854: Analog / SPI</td>
<td>0.4</td>
<td>0</td>
<td>1.5</td>
<td>0.4</td>
<td>0</td>
<td>4.5</td>
<td>0</td>
<td>2.2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>RFC-4851/4852: Analog / CANopen / IO-Link</td>
<td>2.3</td>
<td>0.7</td>
<td>2.2</td>
<td>2.3</td>
<td>5</td>
<td>0</td>
<td>4.5</td>
<td>0</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Partly / Fully redundant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC-4851/4852: Analog / CANopen</td>
<td>1.9</td>
<td>4.5</td>
<td>0.3</td>
<td>1.8</td>
<td>1.9</td>
<td>4.5</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>RFC-4853/4854: Analog °</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1.5</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

* without diagnostic function

### Mounting instructions Z-RFC-P03 / Z-RFC-P04

- In general, we recommend mounting on non-magnetizable materials, otherwise the stated working distances can change.
- If the shaft is magnetizable please keep sufficient distance.
- When the magnet is mounted in the shaft, the shaft may not be magnetizable.
- If the magnet is axially fixed on a magnetizable shaft the working distances reduces by approximately 20%.

### 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

<table>
<thead>
<tr>
<th>Interface</th>
<th>Z-RFC-P02 / P04 / P08 / P20 / P23</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18</th>
<th>Z-RFC-P19</th>
</tr>
</thead>
<tbody>
<tr>
<td>One channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog / SPI / CANopen / IO-Link</td>
<td>0.4</td>
<td>1.1</td>
<td>3.5</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>SSI / Incremental</td>
<td>0.4</td>
<td>0.7</td>
<td>2.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Partly / Fully redundant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog / CANopen</td>
<td>0.7</td>
<td>1.8</td>
<td>5.2</td>
<td>0.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>
M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

- **Connector housing**: Plastic PA
- **Cable sheath**: PUR; Ø = max. 6 mm, -25 °C...+80 °C (moved), -50 °C...+80 °C (fixed)
- **Wires**: PP, 0.34 mm²

<table>
<thead>
<tr>
<th>Length</th>
<th>Type</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 m</td>
<td>EEM 33-32</td>
<td>400005600</td>
</tr>
<tr>
<td>5 m</td>
<td>EEM 33-62</td>
<td>400005609</td>
</tr>
<tr>
<td>10 m</td>
<td>EEM 33-97</td>
<td>400005650</td>
</tr>
</tbody>
</table>

M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended

- **Connector housing**: Plastic PA
- **Cable sheath**: PUR; Ø = max. 6 mm, -40 °C...+85 °C
- **Wires**: PP, 0.34 mm²

<table>
<thead>
<tr>
<th>Length</th>
<th>Type</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 m</td>
<td>EEM 33-35</td>
<td>400056135</td>
</tr>
<tr>
<td>5 m</td>
<td>EEM 33-36</td>
<td>400056136</td>
</tr>
<tr>
<td>10 m</td>
<td>EEM 33-37</td>
<td>400056137</td>
</tr>
</tbody>
</table>

M12x1 mating female connector, 8-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

- **Connector housing**: Plastic PA
- **Cable sheath**: PUR; Ø = max. 8 mm, -25 °C...+80 °C (moved), -50 °C...+80 °C (fixed)
- **Wires**: PP, 0.25 mm²

<table>
<thead>
<tr>
<th>Length</th>
<th>Type</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 m</td>
<td>EEM 33-86</td>
<td>400005629</td>
</tr>
<tr>
<td>5 m</td>
<td>EEM 33-89</td>
<td>400005635</td>
</tr>
<tr>
<td>10 m</td>
<td>EEM 33-92</td>
<td>400005637</td>
</tr>
</tbody>
</table>
Course System

M12

**M12x1 mating female connector, 5-pin, straight, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus**

<table>
<thead>
<tr>
<th>Connector housing</th>
<th>Operating temperature</th>
<th>For wire gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>-40 °C...+85 °C</td>
<td>6.8 mm, max. 0.75 mm²</td>
</tr>
</tbody>
</table>

Type EEM 33-73, P/N 400005645

**It is possible to turn and fix the contact carrier in 90° positions.**

**M12x1 mating female connector, 5-pin, angled, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus**

<table>
<thead>
<tr>
<th>Connector housing</th>
<th>Operating temperature</th>
<th>For wire gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>-40 °C...+85 °C</td>
<td>6.8 mm, max. 0.75 mm²</td>
</tr>
</tbody>
</table>

Type EEM 33-75, P/N 400005646

**M12x1 splitter / T-connector, 5-pin, A-coded, IP68, 1:1 connection, female - male - female, CAN-Bus**

<table>
<thead>
<tr>
<th>Connector housing</th>
<th>Operating temperature</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUR</td>
<td>-25 °C...+85 °C</td>
<td>EEM 33-45, P/N 400056145</td>
</tr>
</tbody>
</table>

**Pin assignment**
M12x1 terminating resistor, 5-pin, A-coded, IP67, 120 Ω resistance, CAN-Bus Connector housing: PUR
Operating temperature: -25 °C...+85 °C
Type: EEM 33-47, P/N 400056147

Pin assignment:
1 = n. c.
2 = n. c.
3 = n. c.
4 = Widerstand 120 Ω
5 = n. c.

M12x1 mating female connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded, open ended, CAN-Bus Connector housing: PUR
Cable sheath: PUR Ø = max. 7.2 mm, -25 °C...+85 °C (moved)
Wires: PP 2x 0.25 mm² + 2x 0.34 mm²

Length | Type | P/N
--- | --- | ---
2 m | EEM 33-41 | 400056141
5 m | EEM 33-42 | 400056142
10 m | EEM 33-43 | 400056143

Note: The protection class is valid only in locked position with its plugs. The application of these products in harsh environments must be checked in particular cases.
Multifunctional Measuring Device with Display
Series MAP4000

Special features
- Supply voltage 10...30 VDC, 80...250 V DC or AC
- high accuracy
- direct connection of potentiometric and standardized signals
- adjustable supply voltage for sensors 5 ... 24 V
- Temperature coefficient 100 ppm/K
- optional RS 232, RS 485, analog output, limited switch
- complete data see separate data sheet MAP-4000

Ordering specifications

<table>
<thead>
<tr>
<th>MAP</th>
<th>4 0 1 0</th>
<th>0 0 0</th>
<th>1 0 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>Supply voltage</td>
<td>Adjustible Excitation voltage (5...24 V/Max. 1.2 W)</td>
<td></td>
</tr>
<tr>
<td>00: 10...30 V AC/DC</td>
<td>1: Excitation present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10: 80...250 V AC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number comparator relays</th>
<th>0: none</th>
<th>2: 2 relays</th>
<th>4: 4 relays</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Analog output</th>
<th>0: no analog output</th>
<th>1: analog output present</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>0: ni interface</th>
<th>1: RS 232</th>
<th>2: RS 485</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Display colour</th>
<th>1: Red</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Data storage (only with interface)</th>
<th>0: not storage</th>
<th>1: RTC storage</th>
<th>2: FAST storage</th>
</tr>
</thead>
</table>

- Number comparator relays
  - 0: none
  - 2: 2 relays
  - 4: 4 relays

- Analog output
  - 0: no analog output
  - 1: analog output present

- Interface
  - 0: ni interface
  - 1: RS 232
  - 2: RS 485

- Display colour
  - 1: Red

- Data storage (only with interface)
  - 0: not storage
  - 1: RTC storage
  - 2: FAST storage
Connecting Options
on request

**ITT Cannon Sure Seal connector**
- Customized lengths
- 3-, 4-, 6- and 8-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

**M12 connector**
- Customized lengths
- 3-, 4-, 6- and 8-pole versions
- Protection class IP68
- on request

**Molex Mini Fit jr.**
- Customized length and lead wires
- 3-, 4- and 6-pole versions
- on request

**Molex Mini Fit**
- Customized length and lead wires
- 3-, 4-, 6- and 8-pole versions
- on request

**Molex Mini Fit jr.**
- Customized length and lead wires
- 3-, 4- and 6-pole versions
- on request

Novotechnik
Messwertaufnehmer OHG
Postfach 4220
73745 Ostfildern (Ruit)
Horbstraße 12
73760 Ostfildern (Ruit)
Telefon +49 711 4489-0
Telefax +49 711 4489-118
info@novotechnik.de
www.novotechnik.de

© 04/2018
Printed in Germany.

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.