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 +125 °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
• Agriculture 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><strong>Analog Versions for Industrial Applications</strong></td>
<td></td>
</tr>
<tr>
<td>Technical Data</td>
<td>6</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>7</td>
</tr>
<tr>
<td><strong>Analog Versions for Mobile Applications</strong></td>
<td></td>
</tr>
<tr>
<td>Technical Data</td>
<td>8</td>
</tr>
<tr>
<td>Ordering Specifications</td>
<td>9</td>
</tr>
<tr>
<td><strong>Digital Versions</strong></td>
<td></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><strong>Fieldbus Versions, IO-Link</strong></td>
<td></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><strong>Accessories</strong></td>
<td></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><strong>Customized Versions</strong></td>
<td></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

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>see dimension drawing</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>with 2 lens flange head screws M4 (enclosed in delivery)</td>
<td></td>
</tr>
<tr>
<td>Fastening torque of mounting screws</td>
<td>250</td>
<td>Ncm</td>
</tr>
<tr>
<td>Mechanical travel</td>
<td>360 continuous</td>
<td>°</td>
</tr>
<tr>
<td>Weight (without connection)</td>
<td>approx. 50</td>
<td>g</td>
</tr>
<tr>
<td>Vibration IEC 60664-2-6</td>
<td>5 → 200</td>
<td>Hz</td>
</tr>
<tr>
<td>Amax = 0.75</td>
<td>amax = 20</td>
<td>mm</td>
</tr>
<tr>
<td>Shock IEC 60664-2-27</td>
<td>50 (6 ms)</td>
<td>g</td>
</tr>
<tr>
<td>Life</td>
<td>mechanically unlimited</td>
<td></td>
</tr>
</tbody>
</table>

**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 / 500 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 - Analog 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>Type Designations</th>
<th>RFC-48_ _- _ _ _ - 2 _ _ _</th>
<th>RFC-48_ _- _ _ _ - 1 _ _ _</th>
<th>RFC-48_ _- _ _ _ - 1 2 _ _ _</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>ratiometric to supply voltage</td>
<td>0.1 ... 10 V (load ≤10 kΩ)</td>
<td>4 ... 20 mA (burden ≤500 Ω)</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1 / 2</td>
<td>1</td>
<td>1</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>
</tr>
<tr>
<td>Update rate</td>
<td>typical 3.4 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>bit</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>
</tr>
<tr>
<td>Independent linearity</td>
<td>≤0.5 % FS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>typical ≤0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis at measuring range &lt; 360°</td>
<td>typical ≤0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis at measuring range 360°</td>
<td>typical ≤0.25 (lower hysteresis on request)</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 % 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 % 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 ... 30) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>typical 12 per channel</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, supply lines and outputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥10</td>
<td>MΩ</td>
<td></td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0.5 (AWG 20)</td>
<td>mm²</td>
<td></td>
</tr>
<tr>
<td>Environmental Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-40 ... +125 °C</td>
<td>-40 ... +105 °C</td>
<td>-40 ... +105 °C</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes (vs. GND and supply voltage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)</td>
<td>99 (per channel)</td>
<td>46</td>
<td>40 years</td>
</tr>
<tr>
<td>Functional safety</td>
<td>If you need assistance in using our products in safety-related systems, please contact us</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMC compatibility</td>
<td>EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV</td>
<td>EN 61000-4-3 Electromagnetic fields 10 V/m</td>
<td>EN 61000-4-4 Electrical fast transients (burst) 1 kV</td>
</tr>
<tr>
<td></td>
<td>EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff.</td>
<td>EN 55016-2-3 Radiated disturbances</td>
<td></td>
</tr>
</tbody>
</table>

### Connection assignment

#### One-channel versions

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 2</th>
<th>Connector M12 code 501</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>GN pin 1</td>
<td></td>
</tr>
<tr>
<td>Signal output</td>
<td>WH pin 2</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>BN pin 3</td>
<td></td>
</tr>
<tr>
<td>Not assigned</td>
<td>YE pin 4</td>
<td></td>
</tr>
</tbody>
</table>

Cable shielding connect to GND.

#### Redundant versions

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 2</th>
<th>Connector M12 code 501</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>GN pin 1</td>
<td></td>
</tr>
<tr>
<td>Signal output 1</td>
<td>WH pin 2</td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td>BN pin 3</td>
<td></td>
</tr>
<tr>
<td>Signal output 2</td>
<td>YE pin 4</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.
### Ordering Specifications

#### Analog Versions

<table>
<thead>
<tr>
<th>R</th>
<th>F</th>
<th>C</th>
<th></th>
<th>4</th>
<th>8</th>
<th>5</th>
<th>1</th>
<th></th>
<th>6</th>
<th>3</th>
<th>6</th>
<th>2</th>
<th>1</th>
<th>1</th>
<th>2</th>
<th>0</th>
<th>2</th>
</tr>
</thead>
</table>

**Supply voltage Ub**
1: 24 V
2: 5 V

**Output signal supply voltage Ub = 24 V**
1: 0.1...10 V (only one-channel)
2: 4 ... 20 mA (only one-channel)

**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 %)

**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 Ub / 1 x output
- 7: partly redundant 1 x supply voltage Ub / 2 x output (only at supply voltage Ub = 5 V)

**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

Other versions f.e. with internal shielding against magnetic fields on request

---

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

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-48-1...
  - 2...
  - ...
  - ...
- RFC-48-1...
  - 3...
  - ...
  - ...
- RFC-48-1...
  - 32...
  - ...
  - ...

Electrical Data

Output signal

- Ratiometric to supply voltage Ub
  - 0.25 ... 4.75 V (5 ... 95 %)
  - 0.5 ... 4.5 V (10 ... 90 %)
  - (load ≥ 5 kΩ)

- Voltage
  - 0.25 ... 4.75 V
  - 0.5 ... 4.5 V
  - (load ≥ 10 kΩ)

- Current
  - 4 ... 20 mA
  - (Burden @ Ub > 13 V: ≤ 500 Ω)
  - (Burden @ Ub ≤ 13 V: ≤ 250 Ω)

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 ... 30 up to 0 ... 360, in 10°-steps
- Independent linearity
  - ≤ 0.5 ±% FS
- Repeatability
  - Typical ≤ 0.1 ±% FS
- Hysteresis at measuring range < 360°
  - Typical ≤ 0.1
- Hysteresis at measuring range 360°
  - Typical ≤ 0.25 (lower hysteresis on request)
- Temperature error at measuring range 30 and 170°
  - Typical ±0.7
  - ±0.35
- Temperature error at measuring range 180 and 360°
  - Typical ±1.0
  - ±0.35
- Supply voltage Ub
  - 5 [4.5 ... 5.5]
  - 12/24 [8 ... 34]
  - 12/24 [8 ... 34]
  - VDC
  - (Umb > 13 V: ≤ 500 Ω)
  - (Burden @ Ub ≤ 13 V: ≤ 250 Ω)

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 ... 30 up to 0 ... 360, in 10°-steps
- Independent linearity
  - ≤ 0.5 ±% FS
- Repeatability
  - Typical ≤ 0.1 ±% FS
- Hysteresis at measuring range < 360°
  - Typical ≤ 0.1
- Hysteresis at measuring range 360°
  - Typical ≤ 0.25 (lower hysteresis on request)
- Temperature error at measuring range 30 and 170°
  - Typical ±0.7
  - ±0.35
- Temperature error at measuring range 180 and 360°
  - Typical ±1.0
  - ±0.35
- Supply voltage Ub
  - 5 [4.5 ... 5.5]
  - 12/24 [8 ... 34]
  - 12/24 [8 ... 34]
  - VDC
  - (Umb > 13 V: ≤ 500 Ω)
  - (Burden @ Ub ≤ 13 V: ≤ 250 Ω)

Environmental Data

- Operating temperature
  - -40 ... +125
  - -25 ... +85 with M12 connector
  - -25 ... +85 with M12 connector
  - (The max. operating temperature depends on supply voltage Ub and load resp. burden (see page 4))

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

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


- Functional safety
  - Suitable for safety-relevant applications according to ISO 13849 after customer validation. Further safety data (DCavg...) and support for functional safety are available on request.

- EMC compatibility
  - 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
  - EN 13309 Construction machinery
  - Emission and immunity according to ECE - R10 (E1)

Connection assignment

One-channel versions

- Signal
  - Supply voltage Ub
  - Signal output
  - Not assigned
- Lead wires code
  - RD
  - BU
  - BK
- Cable code
  - GN
  - WH
  - EN
- Connector code
  - pin 1
  - pin 2
  - pin 3

Redundant versions

- Signal
  - Supply voltage Ub
  - Signal output
  - Not assigned
- Lead wires code
  - RD
  - BU
  - BK
- Cable code
  - GN
  - YE
- Connector code
  - pin 1
  - pin 2
  - pin 3

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.
Supply voltage
2: Supply voltage $U_b = 5\, V$ ($4.5 \ldots 5.5\, V$)
3: Supply voltage $U_b = 12/24\, V$ ($9 \ldots 34\, V$)

Output signal
Supply voltage $U_b = 5\, V$
1: $0.25 \ldots 4.75\, V$ ratiometric to supply voltage $U_b$ ($5 \ldots 95\%$)
2: $0.5 \ldots 4.5\, V$ ratiometric to supply voltage $U_b$ ($10 \ldots 90\%$)

Output signal
Supply voltage $U_b = 12/24\, V$
2: $4 \ldots 20\, mA$
4: $0.5 \ldots 4.5\, V$
5: $0.25 \ldots 4.75\, V$

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 $0^\circ \ldots 30^\circ$ min.
06, 12, 18, 24, 36
36: Angle $0^\circ \ldots 360^\circ$ max.
Other angles on request

Number of channels
6: one-channel 1 x supply voltage $U_b$ / 1 x output
7: partly redundant 1 x supply voltage $U_b$ / 2 x output
8: fully redundant 2 x supply voltage $U_b$ / 2 x output

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

Ordering specifications

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

Ordering
Specifications -
Analog Versions
for Mobile Applications

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
Further versions f.a. with internal shielding against magnetic fields on request.
Type Designations

<table>
<thead>
<tr>
<th>Type Designation</th>
<th>Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC-48...212-41</td>
<td>5 VDC</td>
</tr>
<tr>
<td>RFC-48...212-44</td>
<td>24 VDC</td>
</tr>
</tbody>
</table>

Electrical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RFC-48...212-41</th>
<th>RFC-48...212-44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>SSI 13 bit (12 bit data + 1 stop bit)</td>
<td>SSI 13 bit (12 bit data + 1 stop bit)</td>
</tr>
<tr>
<td>Inputs</td>
<td>RS422 compatible, CLK lines via optocoupler galvanically isolated</td>
<td>RS422 compatible, CLK lines via optocoupler galvanically isolated</td>
</tr>
<tr>
<td>Monoflop time (µs)</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Coding</td>
<td>Gray</td>
<td>-</td>
</tr>
<tr>
<td>Update rate (internal)</td>
<td>2 000 kHz</td>
<td>-</td>
</tr>
<tr>
<td>Resolution across 360°</td>
<td>12 bit</td>
<td>-</td>
</tr>
<tr>
<td>Measuring range</td>
<td>360°</td>
<td>-</td>
</tr>
<tr>
<td>Maximum operational speed position marker</td>
<td>30 000, higher speeds on request</td>
<td>30 000, higher speeds on request</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>typical 0.5 ± % FS</td>
<td>typical 0.5 ± % FS</td>
</tr>
<tr>
<td>Repeatability</td>
<td>&lt; 0.2°</td>
<td>-</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>&lt; 0.7°, lower hysteresis on request</td>
<td>&lt; 0.7°, lower hysteresis on request</td>
</tr>
<tr>
<td>Temperature error</td>
<td>0.375%</td>
<td>-</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>5 (4.5 ... 5.5) VDC</td>
<td>24 (18 ... 30) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>2 000 kHz</td>
<td>-</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, supply lines</td>
<td>yes (output vs. GND)</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes (output vs. supply voltage and GND)</td>
<td>yes (output vs. GND)</td>
</tr>
<tr>
<td>Ohmic load at outputs</td>
<td>≥ 120 mA</td>
<td>-</td>
</tr>
<tr>
<td>Max. clock rate</td>
<td>1 MHz</td>
<td>-</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
<td>-</td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0.25 (AWG 24)</td>
<td>-</td>
</tr>
</tbody>
</table>

Environmental Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-40 ... +85 °C</td>
<td>-</td>
</tr>
<tr>
<td>MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)</td>
<td>141 102 years</td>
<td></td>
</tr>
<tr>
<td>Functional safety</td>
<td>If you need assistance in using our products in safety-related systems, please contact us</td>
<td></td>
</tr>
<tr>
<td>EMC compatibility</td>
<td>EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 61000-4-3 Electromagnetic fields 10 V/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 61000-4-4 Electrical fast transients (burst) 1 kV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 61000-4-6 Conducted disturbances, induced by RF fields 10 V eff.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 61000-4-8 Power frequency magnetic fields 30 A/m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 55016-2-3 Noise radiation class B</td>
<td></td>
</tr>
</tbody>
</table>

SSI Interface

Connection assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 4</th>
<th>Connector M12 code 531</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>WH</td>
<td>pin 1</td>
</tr>
<tr>
<td>GND</td>
<td>BN</td>
<td>pin 2</td>
</tr>
<tr>
<td>Clock input SSI Clk-</td>
<td>GN</td>
<td>pin 3</td>
</tr>
<tr>
<td>Clock input SSI Clk+</td>
<td>YE</td>
<td>pin 4</td>
</tr>
<tr>
<td>Signal output SSI Data-</td>
<td>GY</td>
<td>pin 5</td>
</tr>
<tr>
<td>Signal output SSI Data+</td>
<td>PK</td>
<td>pin 6</td>
</tr>
<tr>
<td>Not assigned</td>
<td>BU</td>
<td>pin 7</td>
</tr>
<tr>
<td>Not assigned</td>
<td>RD</td>
<td>pin 8</td>
</tr>
</tbody>
</table>

SSI connection

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

**Incremental Interface for Industrial Applications**

#### Type Designations

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>5 VDC</td>
<td>24 VDC, TTL</td>
<td>24 VDC, HTL</td>
</tr>
</tbody>
</table>

#### Electrical Data

<table>
<thead>
<tr>
<th>Outputs</th>
<th>A+ / A-</th>
<th>B+ / B-</th>
<th>Z+ / Z+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>RS-422, TTL compatible</td>
<td>RS-422, TTL compatible</td>
<td>HTL compatible, Push-Pull</td>
</tr>
<tr>
<td>Length Z-pulse</td>
<td>90 electrical, between 2 edges A / B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulses per revolution</td>
<td>1024, other resolutions see page 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per revolution (after quadrature)</td>
<td>4,096</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Option Low Speed</th>
<th>- Minimum edge separation</th>
<th>8 μs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Minimum input frequency of counter input</td>
<td>32 kHz</td>
</tr>
<tr>
<td></td>
<td>- Maximum operational speed</td>
<td>1,800 min⁻¹</td>
</tr>
<tr>
<td>Measure range</td>
<td>360 °</td>
<td></td>
</tr>
<tr>
<td>Independent linearity</td>
<td>typical 0.5</td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 0.2 °</td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>± 0.7 °, lower hysteresis on request</td>
<td></td>
</tr>
<tr>
<td>Temperature error</td>
<td>± 0.375 °/FS</td>
<td></td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>5 (4.5 ... 5.5) VDC</td>
<td>24 (18 ... 30) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>typical 20 mA</td>
<td>typical 10 mA</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, supply lines</td>
<td></td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes, all outputs vs. GND and supply voltage</td>
<td>yes, all outputs vs. GND</td>
</tr>
<tr>
<td>Ohmic load at output</td>
<td>120 per channel A / B / Z</td>
<td>120 per channel A / B / Z</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>&gt; 10 MΩ</td>
<td></td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0.25 (AWG 24)</td>
<td></td>
</tr>
</tbody>
</table>

#### Environmental Data

| Operating temperature | -40 ... +85 (-25 ... +85 with M12 connector) °C |
| MTFP (DIN EN ISO 13849-1 parts count method, w/o load, wc) | 183 122 122 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 eff. |
|                     | EN 61000-4-8 Power frequency magnetic fields 30 A/m |
|                     | EN 55016-2-3 Radiated disturbances |

### Connection assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code 4</th>
<th>Connector M12 code 531</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>WH</td>
<td>pin 1</td>
</tr>
<tr>
<td>GND</td>
<td>BN</td>
<td>pin 2</td>
</tr>
<tr>
<td>A+</td>
<td>GN</td>
<td>pin 3</td>
</tr>
<tr>
<td>A-</td>
<td>YE</td>
<td>pin 4</td>
</tr>
<tr>
<td>B+</td>
<td>GY</td>
<td>pin 5</td>
</tr>
<tr>
<td>B-</td>
<td>PK</td>
<td>pin 6</td>
</tr>
<tr>
<td>Z+</td>
<td>BU</td>
<td>pin 7</td>
</tr>
<tr>
<td>Z-</td>
<td>RD</td>
<td>pin 8</td>
</tr>
</tbody>
</table>

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

**Incremental Protocol**
- Pulse width
- Edge separation
- Width reference pulse

**Incremental Connection**
- Angle sensor
- Customer application

### Electrical Data

<table>
<thead>
<tr>
<th></th>
<th>1024</th>
<th>512</th>
<th>256</th>
<th>128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulses per revolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counts per revolution</td>
<td>4096</td>
<td>2048</td>
<td>1024</td>
<td>512</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, 14400 min⁻¹

**Option High Speed**
- Minimal edge separation: 0,5 µs
- Minimum input frequency of counter input: 300 MHz
- Maximum operational speed: 29000, higher speeds on request

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

---

**Pulse Rate Option Low Speed**
- Minimal edge separation
- Minimum input frequency of counter input
- Maximum operational speed

**Pulse Rate Option High Speed**
- Minimal edge separation
- Minimum input frequency of counter input
- Maximum operational speed

*max. 100,000 Limits, tested by max. operational speed of position marker*
### Technical Data

**Incremental Interface for Mobile Applications**

#### Type Designations

<table>
<thead>
<tr>
<th>RFC-48</th>
<th>-2</th>
<th>-556</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>12/24 VDC, open collector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Electrical Data

**Outputs**

- **A-**
- **B-**

**Level**

- Open collector

**Pulses per revolution**

- 1024
- 512
- 256
- 128

**Counts per revolution after quadrature**

- 4096
- 2048
- 1024
- 512

**Minimum edge separation**

- 8 µs

**Minimum input frequency of counter input**

- 32 kHz

**Maximum operational speed**

- 580 min⁻¹

**Counts per revolution after quadrature**

- 4096
- 2048
- 1024
- 512

**Independent linearity**

- typical ±0.5

**Repeatability**

- ±0.2 °

**Temperature error**

- 0.375 ±% FS

**Supply voltage Ub**

- 12/24 (9…34) VDC

**Current consumption (w/o load)**

- typical 10 mA

**Overvoltage protection**

- 60 (temporary / 10 min.) VDC

**Short circuit protection**

- yes, supply lines

**Load outputs vs. supply voltage Ub**

- 20 per channel mA

**Insulation resistance (500 VDC)**

- ≥ 10 MΩ

**Cross-section cable / lead wires**

- 0.5 (AWG 20) mm²

#### Environmental Data

**Operating temperature**

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

**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 6 kW, 15 kV
- ISO 11452-2 Radiated EMF fields, absorber half 100 V/m
- ISO 11452-5 Radiated EMF 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

#### Signal

<table>
<thead>
<tr>
<th>Signal</th>
<th>Lead wires code</th>
<th>Cable code 2</th>
<th>Connector M12 code 551</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>

**Rotational direction CW:**

A leads before B

---

**Incremental connection**

- **Sensor**
- **Ub**
- **A**
- **B**
- **GND (0V)**

**CW**

---

**Incremental protocol**

- **A**
- **B**
- **pulse width**
- **edge separation**
- **Position**

---

**Connection assignment**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Lead wires code</th>
<th>Cable code 2</th>
<th>Connector M12 code 551</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>
**Type Designations**

<table>
<thead>
<tr>
<th>RFC-48</th>
<th>-2</th>
<th>-8</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>5 VDC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Electrical Data**

- **Protocol**: SPI
- **Coding**: Binary code
- **Level SCLK, MOSI, /SS**: TTL level (s. application note SPI protocol)
- **Update rate internal**: 5 kHz
- **Resolution across 360°**: 14 bit
- **Measuring range**: 360 °
- **Independent linearity**: ± 0.5 ±% FS
- **Repeatability**: ± 0.1 ±
- **Hysteresis**: ± 0.1 ±
- **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 (v. 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

#### SPI protocol

- **SCLK**: S1
- **MOSI**: D2
- **MISO**: D1
- **/SS (slave select)**: D0

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

#### SPI connection

![SPI connection diagram]

**Connection assignment**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>GN</td>
</tr>
<tr>
<td>GND</td>
<td>BN</td>
</tr>
<tr>
<td>MOSI / MISO</td>
<td>YE</td>
</tr>
<tr>
<td>SCLK</td>
<td>GY</td>
</tr>
<tr>
<td>/SS (slave select)</td>
<td>WH</td>
</tr>
</tbody>
</table>
Ordering Specifications - Digital Versions

- SSI
- Incremental
- SPI

Supply voltage Ub / Interface
4: Synchronous-Serial Interface (SSI)
5: Incremental Interface A / B / Z
8: Serial Peripheral Interface (SPI)

Interface parameters for SSI Interface
11: 5 V (4.5 ... 5.5 V) Supply voltage, output RS422 comp., Gray code, rising cw
12: 5 V (4.5 ... 5.5 V) Supply voltage, output RS422 comp., Gray code rising ccw
41: 24 V (18 ... 30 V) Supply voltage, output RS422 comp., Gray code, rising cw
42: 24 V (18 ... 30 V) Supply voltage, output RS422 comp., Gray code rising ccw

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
35: 24 V (18 ... 30 V) supply voltage, output RS422, TTL-compatible
39: 24 V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull
56: 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

Cable versions and assembled connectors on request

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

Interface
2: Digital Interface

Mechanical version
4801: Elongated hole
4802: Round hole mounting
## Technical Data

### Type Designations
- RFC-48 _ _- 214 - 6 _ _-_ 
- CANopen

### Electrical Data

<table>
<thead>
<tr>
<th>Measured variables</th>
<th>Position and speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>360</td>
</tr>
<tr>
<td>Measurement range speed</td>
<td>0 ... 1600 min⁻¹</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1 / 2 see ordering specifications</td>
</tr>
<tr>
<td>Output signal / protocol</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>Programmable parameter</td>
<td>Position, speed, cams, working areas, rotating direction, scale, offset, node ID, baud rate</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>Node-ID</td>
<td>1 ... 127 (default 127)</td>
</tr>
<tr>
<td>Baud rate</td>
<td>50 ... 1000 see ordering specifications kBaud</td>
</tr>
<tr>
<td>Resolution across 360°</td>
<td>360°/2¹⁴ = 0,022 °/ms</td>
</tr>
<tr>
<td>Update rate</td>
<td>1 kHz</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>± 0,8 % / 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>12/24 (8 ... 34) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>yes, supply lines</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>&lt; 45 (permanent) VDC</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
</tr>
<tr>
<td>Cross-section cable</td>
<td>0,5 (AWG 20) (4-pole) resp. 0,25 (AWG 24) (8-pole) mm²</td>
</tr>
<tr>
<td>Bus termination internal</td>
<td>120, optionally, see ordering specifications</td>
</tr>
</tbody>
</table>

### Environmental Data

| Operation temperature  | -40 ... +105 (-25 ... +85 with M12 connector) °C |
| MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc) | one-channel: 71 / two-channel: 58 years |
| Functional safety      | If you need assistance in using our products in safety-related systems, please contact us |

### EMC compatibility
- ISO TR 10805 Packaging and Handling + Component Test 8 kV
- ISO 11452-2 Radiated EM RF fields, Absorberhall 100 V/m
- ISO 11452-5 Radiated EM RF fields, StepLine 200 V/m
- GSFR 25 Radiated emission class 3
- ISO 7637-2 Pulses on supply lines (1, 2a, 2b, 3a, 3b, 4 (24 V systems), 5) Level 5
- ISO 7637-3 Transient emission Level 4

### Connection assignment

#### Signal | Cable Code 2 _ _ | Connector M12 Code 511
--- | --- | ---
CAN_SHLD | Shield | pin 1
Supply voltage Ub | WH | pin 2
GND | BN | pin 3
CAN_H | YE | pin 4
CAN_L | GN | pin 5

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.
### Type Designations

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

### Electrical Data

<table>
<thead>
<tr>
<th>Measured variables</th>
<th>Position (other process data such as speed, revolution counter or cams on request)</th>
</tr>
</thead>
<tbody>
<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 61131-9, 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 kB)</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 (18 ... 30) VDC</td>
</tr>
<tr>
<td>Current consumption (w/o load)</td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td>Reverse voltage</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 (permanent) VDC</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>Operation temperature</th>
<th>-40 ... +105 (-25 ... +85 with M12 connector) °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)</td>
<td>single channel: 76 Jahre</td>
</tr>
<tr>
<td>Functional safety</td>
<td>If you need assistance in using our products in safety-related systems, please contact us</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/O</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**

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

### Interface

6: CANopen Interface
A: IO-Link

#### Interface parameters CANopen

<table>
<thead>
<tr>
<th>Baud rate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: 1000 kBaud</td>
<td>1 x position, 1 x speed</td>
</tr>
<tr>
<td>2: 800 kBaud</td>
<td>2 x position, 2 x speed</td>
</tr>
<tr>
<td>3: 500 kBaud</td>
<td>1 x position, 1 x speed with bus termination 120 Ω</td>
</tr>
<tr>
<td>4: 250 kBaud</td>
<td>2 x position, 2 x speed with bus termination 120 Ω</td>
</tr>
<tr>
<td>5: 125 kBaud</td>
<td>1 x position, 1 x speed with bus termination 120 Ω</td>
</tr>
<tr>
<td>7: 50 kBaud</td>
<td>1 x position, rising cw</td>
</tr>
</tbody>
</table>

#### Interface parameters IO-Link

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:</td>
<td>Other process data such as speed, revolution counter or cams on request</td>
</tr>
</tbody>
</table>

### Electrical connections CANopen

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

### Electrical connections IO-Link

- Cable 4-pole, 1.0 m, unshielded
- Cable 4-pole, 3.0 m, unshielded
- Cable 4-pole, 5.0 m, unshielded
- Cable 4-pole, 10.0 m, unshielded
- Connector M12x1, 4-pin, with cable, L= 0.15 m, unshielded

Cable versions and assembled connectors on request

### Series

- 4851: Elongated hole
- 4852: Round hole mounting
**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 40005037
  25 pcs. P/N 40005038

**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
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 400005659
  - 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 400005658
  - 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.

Additional linearity error (°) at radial displacement

<table>
<thead>
<tr>
<th>Interface</th>
<th>Z-RFC-P02 / P08</th>
<th>Z-RFC-P03</th>
<th>Z-RFC-P04</th>
<th>Z-RFC-P18 / P47</th>
<th>Z-RFC-P30</th>
<th>Z-RFC-P41 / P47</th>
<th>Z-RFC-P19</th>
</tr>
</thead>
<tbody>
<tr>
<td>One channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFC-4852/4854: Analog */ SPI</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
</tr>
<tr>
<td>RFC-4851/4852: Analog / CANopen / IO-Link</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
</tr>
<tr>
<td>Partly / Fully redundant</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>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
<td>0.4 4</td>
</tr>
<tr>
<td>RFC-4852/4854: Analog *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Connector System M12

**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; Ø 0.34 mm²
- **Length** | **Type** | **P/N**
--- | --- | ---
2 m | EEM 33-32 | 400005600
5 m | EEM 33-62 | 400005609
10 m | EEM 33-97 | 400005650

**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; Ø 0.25 mm²
- **Length** | **Type** | **P/N**
--- | --- | ---
2 m | EEM 33-86 | 400005629
5 m | EEM 33-90 | 400005639
10 m | EEM 33-92 | 400005637
## Connector 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>
<th>Type</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>-40 °C...+85 °C</td>
<td>6...8 mm, max. 0.75 mm²</td>
<td>EEM 33-73</td>
<td>400005645</td>
</tr>
</tbody>
</table>

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>
<th>Type</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>-40 °C...+85 °C</td>
<td>6...8 mm, max. 0.75 mm²</td>
<td>EEM 33-75</td>
<td>400005646</td>
</tr>
</tbody>
</table>

### 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>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUR</td>
<td>-25 °C...+85 °C</td>
<td>EEM 33-45</td>
<td>4000056145</td>
</tr>
</tbody>
</table>
**Connector System M12**

**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
- 5 = 120 Ω

**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 + 2 x 0.34 mm²

**Pin assignment**
- 1 = Shield
- 2 = Red (0.34 mm²)
- 3 = Black (0.34 mm²)
- 4 = White (0.25 mm²)
- 5 = Blue (0.25 mm²)

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

**Length**
- Type EEM 33-44
- P/N 400056144
- 5 m

**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.

- **Protection class IP67 DIN EN 60529**
- **Protection class IP68 DIN EN 60529**
- **CAN-bus**
- **Very good Electromagnetic Compatibility (EMC) and shield systems**
- **Very good resistance to oils, coolants and lubricants**
- **UL - approved**

**Suited for applications in dragchains**
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>Adjustable 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>

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 IP67
  - On request

- **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
  - Ordering codes of standard versions see ordering specifications

- **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

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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.