NOVOHALL
Rotary Sensor
Touchless
RFE-3200
Ratiometric
Mobile Applications

Special Features
- Touchless hall technology
- Electrical range up to 360°
- 2 part design, mechanically decoupled
- High protection class IP67, IP68, IP69K
- Resolution up to 12 bit
- Wear-free
- Temperature range -40 °C to +125 °C
- Single and dual-channel versions
- Optimized for use in mobile applications with highest EMC requirements such as ISO pulses and high interferences to ISO 11452 and ECE-Standard
- Suitable for safety-related applications according to DIN EN ISO 13849
- Other configurations see separate data sheets

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

The 2 part design consisting of sensor and magnetic position marker offers great flexibility when mounting. The absence of shaft and bearing makes the assembly much less sensitive to axial and radial application tolerances - separate couplings are obsolete. Measurements can be made transmissively through any non-ferromagnetic material.

With its completely encapsulated electronics the sensor is perfectly suited for use in harsh environments. Single and dual-channel versions are available and suitable for use in safety-related applications.

Description
<table>
<thead>
<tr>
<th>Material</th>
<th>Housing: high grade, temperature resistant plastic PBT GF30 with SS inserts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>With 2 pan head screws M4x18 (included in delivery)</td>
</tr>
<tr>
<td>Fastening torque of mounting</td>
<td>max. 200 Ncm</td>
</tr>
<tr>
<td>Electrical connection</td>
<td>6-pin MQS-connector, code A, tinned contact according to drawing AMP-114-18063-126, Index A1 (Connector: AMP P/N 1-967616-1)</td>
</tr>
</tbody>
</table>

Mechanical Data
<table>
<thead>
<tr>
<th>Dimensions</th>
<th>See dimension drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical travel</td>
<td>continuous</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 50 g</td>
</tr>
</tbody>
</table>
## Ordering Specifications

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

### Accessories included in delivery
- 2x Pan head screws M4x18

### Supply voltage $U_b$

- $U_b = 5 \text{ VDC}$

### Output signal

1: 5 ... 95% ratiometric to supply voltage $U_b$ (0.25 ... 4.75 VDC)  
2: 10 ... 90% ratiometric to supply voltage $U_b$ (0.5 ... 4.5 VDC)

### Output characteristic

- 1: Rising characteristic cw
- 2: Rising characteristic ccw
- 3: Crossed outputs, channel 1 rising cw (partly redundant)
- 4: Crossed outputs, channel 1 rising cw (fully redundant)
- Other output characteristics on request

### Electrical connection

- 521: Connector AMP M05 6-pin, male

### Measuring range

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

### Number of channels

- 6: One-channel version (1x supply voltage $U_b$, 1x output)  
- 7: Partially redundant version (1x supply voltage $U_b$, 2x output)  
- 8: Fully redundant version (2x supply voltage $U_b$, 2x output)
When the marking of the position marker points towards the connector, the sensor is near the electrical center position.
<table>
<thead>
<tr>
<th>Type</th>
<th>RFE-32-...-2-521</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>Ratiometric to supply voltage Ub</td>
</tr>
<tr>
<td></td>
<td>5 ... 95% (0.25 ... 4.75 V)</td>
</tr>
<tr>
<td></td>
<td>10 ... 90% (0.5 ... 4.5 V)</td>
</tr>
<tr>
<td>Load</td>
<td>≥ 5 kΩ</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1 / 2</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>activated (in case of error, output signal is outside of the plausible signal range)</td>
</tr>
<tr>
<td>Update rate</td>
<td>typ. 3.4 kHz</td>
</tr>
<tr>
<td>Measuring range</td>
<td>0 ... 30° up to 0 ... 360° in 10° steps</td>
</tr>
<tr>
<td>Independent linearity</td>
<td>± 0.5 % FS</td>
</tr>
<tr>
<td>Resolution</td>
<td>12 bits</td>
</tr>
<tr>
<td>Repeatability</td>
<td>typ. ±0.1°</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>typ. &lt; ±0.1°</td>
</tr>
<tr>
<td>(Only measuring range 360°)</td>
<td>Typ. &lt; ±0.25°</td>
</tr>
<tr>
<td>Temperature error</td>
<td>Measuring range 30 ... 170°: typ. ±0.7 % FS, Measuring range ≥ 180°: typ. ±0.35 % FS</td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>5 VDC (4.5 ... 5.5 VDC)</td>
</tr>
<tr>
<td>Current consumption w/o load</td>
<td>typ. 12 mA per channel</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>24 VDC (60 min.)</td>
</tr>
<tr>
<td>Polarity protection</td>
<td>yes (supply lines and outputs)</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes (see supply lines and supply voltage)</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
</tr>
<tr>
<td>Environmental Data</td>
<td></td>
</tr>
<tr>
<td>Max. operational speed</td>
<td>Mechanically unlimited</td>
</tr>
<tr>
<td>Vibration IEC 60068-2-6</td>
<td>20 g, 5 ... 2000 Hz, Akmax = 0.75 mm</td>
</tr>
<tr>
<td>Shock IEC 60068-2-27</td>
<td>50 g, 6 ms</td>
</tr>
<tr>
<td>Protection class ISO 20553</td>
<td>IP67 / IP68 / IP69K</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-40 ... +125°C</td>
</tr>
<tr>
<td>Life</td>
<td>Mechanically unlimited</td>
</tr>
<tr>
<td>Functional safety</td>
<td>Suitable for safety-related applications according to ISO 13849 after customer validation. Further safety data (DCavg.,) and support for functional safety are available on request.</td>
</tr>
<tr>
<td>MTFF (IEC 60065)</td>
<td>1652 years (one-channel), 1642 years (partly redundant, per channel) or 1632 years (fully redundant, per channel)</td>
</tr>
<tr>
<td>MTFFd (EN ISO 13849-1 parts count method, w/o load)</td>
<td>3304 years (one-channel), 1648 years (partly redundant, per channel) or 1653 years (fully redundant, per channel)</td>
</tr>
<tr>
<td>Traceability</td>
<td>Serial number on type labeling, production batch of the sensor assembly and relevant sensor components</td>
</tr>
<tr>
<td>EMC Compatibility</td>
<td>ISO 10665 ESD (Handling/Component) 8 kV / 15 kV</td>
</tr>
<tr>
<td>ISO 11452-2 Radiated HF-Fields</td>
<td>150 V/m</td>
</tr>
<tr>
<td>ISO 11452-5 Radiated HF-Fields, stripline</td>
<td>200 V/m</td>
</tr>
<tr>
<td>EN 13309 25 Radiated emission</td>
<td>Level 5</td>
</tr>
<tr>
<td>EN 13309 Construction machinery</td>
<td>acc. to ECE-R10</td>
</tr>
<tr>
<td>ISO 13766-1/2 Construction machinery</td>
<td>On request</td>
</tr>
</tbody>
</table>

FS = Full scale: Signal span according to electrical measuring range
### Connection Assignment

<table>
<thead>
<tr>
<th></th>
<th>Single-channel</th>
<th>Partly redundant</th>
<th>Fully redundant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage Ub 1</td>
<td>Pin 1</td>
<td>Pin 1 / Pin 6</td>
<td>Pin 1</td>
</tr>
<tr>
<td>SND 1</td>
<td>Pin 2</td>
<td>Pin 2 / Pin 5</td>
<td>Pin 2</td>
</tr>
<tr>
<td>Signal output 1</td>
<td>Pin 4</td>
<td>Pin 4</td>
<td>Pin 4</td>
</tr>
<tr>
<td>Signal output 2</td>
<td>-</td>
<td>Pin 3</td>
<td>Pin 3</td>
</tr>
<tr>
<td>Supply voltage Ub 2</td>
<td>-</td>
<td>-</td>
<td>Pin 6</td>
</tr>
<tr>
<td>SND 2</td>
<td>-</td>
<td>-</td>
<td>Pin 5</td>
</tr>
<tr>
<td>Not assigned</td>
<td>Pin 3, Pin 5,</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Pin 6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Technical Data
Output Characteristics

Output characteristic

One-channel rising cw

Output characteristic

Crossed output characteristics, ch. 1 rising cw

Output characteristic

On request: signal 2 = 0.5 x signal 1

Output characteristic

On request: trapezoid output characteristic

Output characteristic

On request: different gradients

Output characteristic

On request: output characteristics with offset

Output characteristic

On request: parabolic output characteristic
Position Markers

Z-RFC-P23
Position marker for fixation with threaded pin M4 (included in delivery)
Caution: For orientation of the output characteristic please follow the user manual of the position marker!
Material: PA6-GF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056074 | 1
400056085 | 25

Z-RFC-P43
Position marker for fixation with threaded pin M4 (included in delivery)
Caution: For orientation of the output characteristic please follow the user manual of the position marker!
Material: PA6-GF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056086 | 1
400056087 | 25

Z-RFC-P30
Position marker for frontal fixation with 2 cylinder screws M3x8 (included in delivery).
Material: PBT-GF
Max. permitted radial offset: ± 1.5 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056086 | 1
400056087 | 25

Z-RFC-P31
Position marker for frontal fixation with 2 cylinder screws M3x8 (included in delivery).
Material: PBT-GF
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400056088 | 1
400056089 | 25
Position Markers

Z-RFC-P22
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with screw lock, included in delivery).
Attention: Closed side of position marker faces the active side of sensor.
Material: Aluminium, anodized
Max. permitted radial offset: ± 4 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400106735 | 1
400106736 | 25

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

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

Z-RFC-P19
Screw position marker M8 x 25 mm, similar DIN 933/ISO 4017, magnet potted
Material: Aluminium, anodized
Max. permitted radial offset: ± 1.5 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs]
---|---
400104754 | 1
400104755 | 25
Z-RFC-P20
Screw position marker M10 x 25 mm, similar DIN 933
Material: Aluminium, anodized
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs] | 
--- | --- |
400104758 | 1 |
400104759 | 25 |

Z-RFC-P03
Magnet for direct application onto customer’s shaft (see user manual).
We recommend mounting on non-magnetizable materials, otherwise the specified working distances will vary (e.g. reduction of approx. 20% with axial mounting on a magnetizable shaft).
Max. permitted radial offset: ± 1.5 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs] | 
--- | --- |
30005668 | 1 |
400005681 | 50 |

Z-RFC-P04
Magnet for direct application onto customer’s shaft (see user manual).
We recommend mounting on non-magnetizable materials, otherwise the specified working distances will vary (e.g. reduction of approx. 20% with axial mounting on a magnetizable shaft).
Max. permitted radial offset: ± 3 mm
Operating temp.: -40 ... +125°C
P/N | Pack. unit [pcs] | 
--- | --- |
400005669 | 1 |
400056082 | 50 |
### Position Markers

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4 ... 1.9</td>
<td>2 ... 4.7</td>
<td>0 ... 4</td>
<td>0 ... 1.8</td>
<td>2 ... 4.7</td>
<td>4.1 ... 8.9</td>
<td>2 ... 4.7</td>
<td>0.4 ... 1.9</td>
<td>2 ... 4.7</td>
<td>0 ... 2.4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ... 1.5</td>
<td>1.6 ... 4.2</td>
<td>0 ... 3.5</td>
<td>0 ... 1.3</td>
<td>1.6 ... 4.2</td>
<td>3.6 ... 8.4</td>
<td>1.6 ... 4.2</td>
<td>0 ... 1.5</td>
<td>1.6 ... 4.2</td>
<td>0 ... 2</td>
</tr>
</tbody>
</table>

#### Lateral Magnet Offset

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

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

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

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

<table>
<thead>
<tr>
<th>Z-RFC-P02 / P04 / P08</th>
<th>Z-RFC-P41 / P43 / P47</th>
<th>Z-RFC-P03 / P30</th>
<th>Z-RFC-P18 / P28</th>
<th>Z-RFC-P19</th>
<th>Z-RFC-P22</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±0.7°</td>
<td>0.5 mm: ±2.5°</td>
<td>0.5 mm: ±1.1°</td>
<td>0.5 mm: ±2.3°</td>
<td>1.0 mm: ±1.1°</td>
</tr>
<tr>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±1.8°</td>
<td>1.0 mm: ±6.4°</td>
<td>1.0 mm: ±2°</td>
<td>1.0 mm: ±4.5°</td>
<td>2.0 mm: ±2.4°</td>
</tr>
<tr>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ±5.2°</td>
<td>2.0 mm: ± -</td>
<td>2.0 mm: ±4.6°</td>
<td>2.0 mm: ± -</td>
<td>4.0 mm: ±6.7°</td>
</tr>
</tbody>
</table>
Connector System
MQS

EEM-33-34
Connector kit MQS System including
• 1 plug socket (female), PBT GF15, AMP P/N 1-967616-1
• 6 tinned contacts for cable cross-section area 0.25 ... 0.35 mm² (AWG 22), AMP-P/N 963727-1 or 5-962885-1
• 6 single conductor sealings AMP P/N 967067-2
Operating temp. -40 ... +120°C

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>400055666</td>
<td>EEM-33-34</td>
</tr>
</tbody>
</table>

EEM-33-24
Connector MQS AMP P/N 1-967616-1, 6 pin, PBT GF15, with lead wires 0.5 mm², PVC, 1 m, open ended
Operating temp. -40 ... +120°C
Lead wires PVC, 6x0.5 mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>400108029</td>
<td>EEM-33-24</td>
<td>1 m</td>
</tr>
</tbody>
</table>
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.