Special Features
• For integration in pneumatic and hydraulic cylinders
• Touchless magnetostrictive measurement technology
• Operating pressure up to 350 bar, peaks up to 450 bar
• Ring-shaped position marker does not contact sensor
• Unlimited mechanical life
• No velocity limit for position marker
• Absolute output
• Outstanding accuracy performance up to 0.04 %
• Wide range of supply voltage
• Optimized for use in mobile applications with highest EMC requirements such as ISO pulses and high interferences to ISO 11452, exceeds E1 requirements
• Other configurations see separate data sheets

Applications
Hydraulic or pneumatic cylinders in
• Agricultural and forestry machinery
• Construction machines
• Vehicles with loading and unloading devices
• Vehicles with extension arms

The absolute position transducer can be used directly in-cylinder and thus enables a compact and cost-effective position measurement. The sensor consists of a stainless steel flange welded to a pressure tight rod and can therefore be used in harsh environments. The magnetostrictive measuring technology offers excellent accuracy for measuring lengths up to 2000 mm. The passive ring-shaped position marker allows a mechanically decoupled measurement.

Description
Material
Flange: SS 1.4307 / AISI 304L
Flange cover: AlSiMgBi
Rod: SS 1.4571 / AISI 316Ti
Sealing: O-ring FKM 80, Supporting ring: PTFE
Mounting
Plugged into cylinders, secured in position with set screw M5 ISO 4026
Electrical connection
Connector M12x1, A-coded / Connector system M12x1, A-coded with lead wires / Cable 3x 0.5 mm² (AWG 20), PUR, unshielded

Mechanical Data
Dimensions
See dimension drawing
### Ordering Specifications

**Preferred types printed in bold**

<table>
<thead>
<tr>
<th>T</th>
<th>M</th>
<th>1</th>
<th>0</th>
<th>5</th>
<th>0</th>
<th>0</th>
<th>3</th>
<th>0</th>
<th>5</th>
<th>8</th>
<th>5</th>
<th>1</th>
<th>4</th>
<th>4</th>
<th>2</th>
</tr>
</thead>
</table>

**Supply voltage** $U_b$:
- $U_b = 12/24$ VDC, 34VDC

**Output signal**
- 0.1 ... 10 VDC
- 0.5 ... 4.5 VDC
- 0.28 ... 4.75 VDC

**Output characteristic**
1: Rising output characteristic, seen from flange
2: Falling output characteristic, seen from flange

**Electrical connection**
- 104: Connector M12x1, 4-pin
- 251: Cable, 3-pole, unshielded, 1 m
- 253: Cable, 3-pole, unshielded, 3 m
- 255: Cable, 3-pole, unshielded, 5 m
- 438: Plug system M12x1, 4-pin, with lead wires 80 mm
- 442: Plug system M12x1, 4-pin, with lead wires 120 mm
- 446: Plug system M12x1, 4-pin, with lead wires 160 mm
- 450: Plug system M12x1, 4-pin, with lead wires 200 mm
- 454: Plug system M12x1, 4-pin, with lead wires 240 mm

**Mechanical version**
- 305: Plug-in flange Ø 48 mm
- 307: Plug-in flange Ø 48 mm with internal thread M4x6 at rod end, additional length 7.5 mm

**Electrical measuring range**
- Standard lengths 0000 up to 2000 mm in 25 mm-steps
- Other lengths on request
Technical Data

Type

<table>
<thead>
<tr>
<th>Type</th>
<th>TM1- _ _ _-305-84 <em>-</em> _ _</th>
<th>TM1- _ _ _-305-85 <em>-</em> _ _</th>
<th>TM1- _ _ <em>-305-81</em>-_ _ _</th>
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</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>0.25 ... 4.75 V</td>
<td>0.1 ... 10 V</td>
<td>0.1 ... 10 V</td>
</tr>
<tr>
<td>Load</td>
<td>≥ 10 kΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling rate / Update rate</td>
<td>0.5 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring range</td>
<td>0 ... 50 mm up to 0 ... 2000 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>≤ ±0.04 %FS (min. 300 µm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolerance of electr. zero point</td>
<td>±1 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>≤ 0.1 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>≤ 0.1 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>≤ 0.1 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature error</td>
<td>typ. 50 ppm/K (min. 0.01 mm/K)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage Ub</td>
<td>12/24 VDC (Il ... 32 VDC)</td>
<td>24 VDC (16 ... 34 VDC)</td>
<td>24 VDC (16 ... 34 VDC)</td>
</tr>
<tr>
<td>Supply voltage ripple</td>
<td>≤ 10% Ub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power drain w/o load</td>
<td>≤ 3 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>36 VDC (permanent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarity protection</td>
<td>yes (-36 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>yes (output vs GND and supply voltage up to 36 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
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</tr>
</tbody>
</table>

Environmental Data

Max. operational speed
Mechanically unlimited

Vibration IEC 60068-2-6
20 g, 10 ... 2000 Hz, Amax = 0.75 mm

Shock IEC 60068-2-27
100 g, 11 ms (single hit)

Protection class DIN EN 60529
IP67 (Connector system M12, fastened, when correctly fitted in cylinder: IP69)

Operating temperature
-40 ... +105°C (connector M12 / Kabel), -40 ... +85°C (connector system M12)

Operating humidity
0 ... 95 % R.H. (no condensation)

Working pressure
≤ 350 bar

Pressure peaks
≤ 450 bar

Burst pressure
> 700 bar

Life
Mechanically unlimited

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

MTTF (IEC 60065)
346 years

EMC Compatibility
ISO 10605: ESD (Handling/Component)
8 kV / 15 kV

ISO 11452-2 Radiated HF-fields
100 V/m

ISO 11452-5 Radiated HF-Fields, stripline
200 V/m

USPR 25 Radiated emission
Level 4

ISO 7037-2 Pulses on supply lines
(1, 2a, 2b, 3a, 3b) Level 4

ISO 15975 Pulses on supply lines
(4, 5) Level 4

ISO 15973-2 Transient emissions
Level 3

ISO 7037-3 Pulses on output lines
Level 4

EN 13309 Construction machinery

ISO 14982 Agriculture/forestry machines

The EMC measurements are conducted in a reference cylinder. The EMC properties can deviate when using different cylinders.

Connection Assignment

<table>
<thead>
<tr>
<th>Signal</th>
<th>Connector code 1 _ _ _</th>
<th>Plug system code 4 _ _ _</th>
<th>Cable code 2 _ _ _</th>
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</thead>
<tbody>
<tr>
<td>Supply voltage Ub</td>
<td>Pin 1</td>
<td>Pin 1</td>
<td>BN</td>
</tr>
<tr>
<td>GND</td>
<td>Pin 3</td>
<td>Pin 3</td>
<td>WH</td>
</tr>
<tr>
<td>Signal output</td>
<td>Pin 2</td>
<td>Pin 2</td>
<td>GN</td>
</tr>
<tr>
<td>Do not connect</td>
<td>Pin 4</td>
<td>Pin 4</td>
<td>-</td>
</tr>
</tbody>
</table>
Position Markers

**Z-TH1-P18**
Ring position marker for fixation with screws M3
- Material: PA6-GF
- Weight: approx. 12 g
- Operating temp.: -40 ... +100°C
- Surface pressure: max. 40 N/mm²
- Fastening torque of mounting: max. 100 Ncm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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</thead>
<tbody>
<tr>
<td>400005697</td>
<td>1</td>
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</tbody>
</table>

**Z-TH1-P19**
Ring position marker for fixation with screws M4
- Material: PA6-GF
- Weight: approx. 14 g
- Operating temp.: -40 ... +100°C
- Surface pressure: max. 40 N/mm²
- Fastening torque of mounting: max. 100 Ncm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400005698</td>
<td>1</td>
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</tbody>
</table>

**Z-TIM-P20**
Ring position marker for mounting via lock washer and retaining ring
- Material: PA-Neonbond Compound
- Weight: approx. 5 g
- Operating temp.: -40 ... +100°C
- Surface pressure: max. 10 N/mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
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<tbody>
<tr>
<td>400005699</td>
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</table>

**Z-TH1-P25**
U-shaped position marker for fixation with M4 screws
Caution: for dimension of electrical zero point please follow the user manual!
- Material: PA6-GF
- Operating temp.: -40 ... +105°C
- Surface pressure: max. 40 N/mm²
- Fastening torque of mounting: max. 100 Ncm

<table>
<thead>
<tr>
<th>P/N</th>
<th>Pack. unit [pcs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>400105076</td>
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</tbody>
</table>
Position Markers

Z-TH1-P22
Ball-type floating position marker
Material: SS 1.4571 / AISI 316Ti
Weight: approx. 42 g
Operating temp.: -40 ... +100°C
Compression strength: ≤ 60 bar
Density: 720 kg/m³
Immersion depth in water: 36.7 mm
P/N: 400056045
Pack. unit [pcs]: 1

Z-TH1-P21
Cylinder floating position marker
Material: SS 1.4404 / AISI 316L
Weight: approx. 20 g
Operating temp.: -40 ... +100°C
Compression strength: ≤ 8 bar
Density: 740 kg/m³
Immersion depth in water: approx. 26.6 mm
P/N: 400056044
Pack. unit [pcs]: 1

Floating Position Marker - Installation Recommendation
When using floating position markers, we recommend to secure the marker against loss with a washer at the rod end.
For this purpose, a sensor version with inner thread at the rod end is required (s. ordering code).
Connector System
M12

EEM-33-35/36/37
M12x1 Mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended
Plug housing: PA
Cable sheath: PUR, Ø = max. 6 mm, -40...+85°C (fixed)
Lead wires: PP, 0.34 mm²

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

EEM-33-38/39/40
M12x1 Mating female connector, 4-pin, angled, A-coded, with molded cable, not shielded, IP67, open ended
Plug housing: PA
Cable sheath: PUR, Ø = max. 6 mm, -40...+85°C (fixed)
Lead wires: PP, 0.34 mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>400056138</td>
<td>EEM-33-38</td>
<td>2 m</td>
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<tr>
<td>400056139</td>
<td>EEM-33-39</td>
<td>5 m</td>
</tr>
<tr>
<td>400056140</td>
<td>EEM-33-40</td>
<td>10 m</td>
</tr>
</tbody>
</table>

EEM-33-89
M12x1 Mating female connector, 4-pin, angled, A-coded, with coupling nut, screw termination, IP67, not shieldable
Included in delivery
Operating temp.: -25...+90°C
Plug housing: PBT
For wire gauge: 6 ... 8 mm, max. 0.75 mm²

<table>
<thead>
<tr>
<th>P/N</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>400056634</td>
<td>EEM-33-89</td>
</tr>
</tbody>
</table>

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IP67: Protection class IP67 DIN EN 60529
IP68: Protection class IP68 DIN EN 60529
Very good Electromagnetic Compatibility (EMC) and shield systems
Very good resistance to oils, coolants and lubricants
Suitable for applications in dragchains
UL - approved
CAN-Bus

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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.